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Original articles should be prepared according to the following structure: introduction, aim, material and methods, results, discussion, conclusions, references; case reports: introduction, case description, discussion, summary (conclusions), and references.

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SPIS TREŚCI

Epidemiology of intestinal parasitic infections in Western Belarus

Epidemiologia zarażeń pasożytami jelitowymi w zachodniej Białorusi

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Abstract. The article presents the epidemiology of intestinal parasitic infections in Western Belarus, illustrated with the example of residents of the city, district, and province of Grodno. Epidemiological data was gathered on the number of registered cases and prevalence rates (per 100,000 residents) of ascariasis, enterobiasis, trichuriasis, trichinellosis, and giardiasis among Belarusian residents in the period from 2013 to 2015. The data was obtained from the Ministry of Public Health in Belarus. Parasitological examinations were performed using light microscopy methods. Studies carried out in clinical diagnostic laboratories run by healthcare providers in Western Belarus in 2015 demonstrated an increase in the number of infections with intestinal parasites among the residents of the city, district, and province of Grodno by 13.7%, compared to 2014 (516 vs. 450 cases; 126.2 per 100,000 residents). Of all the reported parasitoses, enterobiasis, ascariasis and giardiasis were the most common. The prevalence of parasitic infections was particularly high among children. High prevalence rates of intestinal parasitic infections in Belarusian residents justify the continuation of epidemiological monitoring in Belarus.
Key words: Belarus, epidemiology, intestinal parasites

Streszczenie. Cel. W pracy przedstawiono epidemiologię zarażeń pasożytami jelitowymi w populacji zachodniej Białorusi na przykładzie mieszkańców Grodna oraz powiatu i obwodu grodnieńskiego. Materiał i metody. Dane Ministerstwa Zdrowia Publicznego Białorusi dotyczące liczby zachorowań oraz wskaźników zachorowalności (na 100 000 ludności) z powodu glistnicy, owsicy, włosogłówczycy, włośnicy i giardiozy w latach 2013–2015. Badania parazytologiczne wykonano metodami mikroskopii świetlnej. Wyniki. Badania przeprowadzone w kliniczno-diagnostycznych laboratoriach placówek medycznych zachodniej Białorusi w 2015 roku wykazały zwiększenie liczby zarażeń pasożytami jelitowymi wśród mieszkańców Grodna oraz powiatu i obwodu grodnieńskiego o 13,7% w stosunku do 2014 roku (516 vs 450 przypadków; 126,2 na 100 000 mieszkańców). Spośród raportowanych parazytoz dominowały owsica, glistnica i giardioza. Wysokie wskaźniki zarażeń pasożytniczych były obserwowane zwłaszcza w środowisku dziecięcym. Wnioski. Obserwowane zwiększenie liczby mieszkańców zarażonych pasożytami jelitowymi w zachodniej Białorusi uzasadnia prowadzenie monitoringu epidemiologicznego na terenie kraju.
Słowa kluczowe: Białoruś, epidemiologia, pasożyty jelitowe

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Introduction

Despite the significant advances in diagnosis and treatment, the issue of intestinal parasitic infections remains a major health problem throughout the world [1]. It is estimated that over 2 billion people are infected with intestinal parasites, and over 5 billion live in areas endemic for pathogenic helminths and protozoa [2]. The spread of parasitic infections is facilitated by poor standards of sanitation and low socioeconomic status, as well as by mass migration and the presence of host species (reservoirs for parasites) in the ecosystem [3, 4]. In European countries, high rates of parasitic infections are observed in the countries of the third and fourth quartile according to gross domestic product per capita (GDP $1 809-$17 630) [5], i.e. Central and Eastern European

countries such as Poland and Belarus. In Poland, the reports issued by the National Institute of Public Health – the National Institute of Hygiene, do not include the majority of intestinal parasitoses.

The Department of Prevention and Control of Infections and Infectious Diseases in Humans at the Chief Sanitary Inspectorate in Poland is unable to estimate current prevalence rates of parasitoses in the general population, and sanitary and epidemiological stations are not required to monitor this type of infection. In 2015, the only notifiable parasitic diseases of the gastrointestinal tract in Poland were giardiasis (1742 cases; 4.53/100,000 residents), cryptosporidiosis (2 cases; 0.01/100,000), echinococcosis (48 cases; 0.12/100,000), cysticercosis (1 case; 0.00/100,000) and trichinellosis (28 cases; 0.07/100,000), whereas the prevalence rates for ascariasis, enterobiasis, trichuriasis or taeniasis are unknown [6]. In 2008, 5817 cases of ascariasis and 5666 cases of enterobiasis were registered in Poland [7]. Since January 2009, the majority of intestinal parasitoses identified in Polish residents are no longer required by law to be registered. At present, the data on the prevalence rates of parasitic infections are mostly obtained from individual scientific publications issued by healthcare providers. The prevalence rates are particularly high in north-eastern Poland, in areas close to the Polish-Belarusian border. The study involving 938 children aged 1-18 years hospitalized in the pediatric ward of the regional hospital in Dąbrowa Białostocka (Podlasie Province) demonstrated that 26.9% of the children were infected with ascariasis [8], while another study conducted in the same region confirmed a parasitic infection in 75% of 120 study subjects, with *Ascaris lumbricoides* infection being the most prevalent [9]. In Belarus, a country sharing a border with Poland, intestinal parasitic infections are diagnosed in clinical diagnostic laboratories run by the national healthcare providers and the tests results are sent to the Chief Sanitary Inspectorate. The Inspectorate issues reports on the number of new cases and the prevalence rates of parasitic infections in each province on a yearly basis.

The aim of the study was to present the epidemiology of intestinal parasitic infections in Western Belarus, illustrated with the example of the residents of the city, district, and province of Grodno.

Material and methods

The article is based on epidemiological monitoring data on the number of registered cases and the prevalence rates (per 100,000 people) of ascariasis, enterobiasis, trichuriasis, trichinellosis, and giardiasis among the residents of the city, district and province of Grodno in the period from 2013 to 2015. The data was obtained from the Department for Hygiene, Epidemiology and Prophylaxis of the Ministry of Public Health in Belarus. The studies were performed using light microscopy methods (Kato-Miura method – detection of helminthic eggs; perianal swab – detection of enterobiasis, and decantation in distilled water – detection of protozoan cysts).

Results

The parasitological tests carried out in clinical diagnostic laboratories run by healthcare providers in Western Belarus in 2015, demonstrated an increase in the number of infections with intestinal parasites among residents of the city, district and province of Grodno by 13.7% compared to 2014 (516 *vs* 450 cases; 126.2 per 100,000 residents). Of all the reported parasitoses, enterobiasis and ascariasis were the most prevalent (87.3% and 11.5%, respectively). The incidence of enterobiasis in Grodno city and district rose by 12.7% in 2015 compared to 2014 (110.3 *vs* 97 per 100,000 residents). In Grodno city, the incidence of ascariasis rose by 61.5% throughout the given period. Other helminthiases were scarcely reported: 1 case of trichuriasis in Grodno city and 2 cases in Grodno district in 2015, 1 case of trichinellosis in Grodno city and 1 case of infection with *Diphyllobothrium latum* in Grodno district (imported from Crimea). The data on the detected cases of helminthiases are shown in Table 1.

In 2015, the observed prevalence of parasitic infections was particularly high among children (0-17 years): 81.8% (321 cases) in Grodno city and 79% (98 cases) in Grodno district, with an especially noticeable increase in the prevalence of ascariasis and enterobiasis (84.3% and 13.8%, respectively). By comparing the ratio of the cases detected and the tests performed, we can conclude that the infection rates for enterobiasis and giardiasis in Grodno city remained at a similar level during the period 2013-2105, whereas the prevalence of ascariasis increased by 60% (0.08% in 2015 *vs* 0.05% in 2014). In contrast, the infection rates of ascariasis and enterobiasis in Grodno district fell from 0.4% to 0.3% and from 2 .6% to 2.4%, respectively. However, there was a threefold increase in the prevalence of giardiasis (from 0.2% to 0.6%) in Grodno district (Tab. 2).

In 2015, the prevalence of trichinellosis fell by 42% in Grodno province (21 cases; 2 per 100,000 residents), although it remained 3.4 times higher than the overall prevalence of trichinellosis in the Belarusian general population for the same period (56 cases; 0.59 per 100,000 residents).

Table 1. Cases of parasitoses reported in Grodno province, Western Belarus in the years 2013-2015
Tabela 1. Przypadki parazytoz raportowane w obwodzie grodnieńskim, zachodnia Białoruś w latach 2013–2015

helminthiasis	year	Grodno city		Grodno district		Grodno province	
		cases	prevalence per 100,000 residents	cases	prevalence per 100,000 residents	cases	prevalence per 100,000 residents
enterobiasis	2013	244	68.6	90	179.9	981	92.7
	2014	296	83.2	101	201.9	949	89.9
	2015	346	96.4	105	210.6	1017	96.5
ascariasis	2013	29	8.2	13	25.8	116	10.9
	2014	27	7. 6	20	40.0	106	10.0
	2015	44	12.3	16	32.9	105	9.9
trichuriasis	2013	4	1.12	1	2.0	12	1.23
	2014	2	0.56	1	2.0	3	0.6
	2015	1	0.28	2	4.0	9	0.9
trichinellosis	2013	1	0.28	–	–	5	0.4
	2014	3	0.84	–	–	36	3.4
	2015	1	0.28	–	–	21	2.0

Table 2. Cases of parasitoses reported in Grodno city and district, Western Belarus in the years 2013-2015
Tabela 2. Przypadki parazytoz raportowane w Grodnie i w powiecie grodnieńskim, zachodnia Białoruś w latach 2013–2015

area	year	number of examinations	detected cases / prevalence rate		
			ascariasis	enterobiasis	giardiasis
Grodno city	2013	47 218	29 / 0.06%	244 / 0.6%	78 / 0.2%
	2014	50 955	27 / 0.05%	296 / 0.7%	84 / 0.2%
	2015	53 366	44 / 0.08%	346 / 0.7%	94 / 0.2%
Grodno district	2013	4748	13 / 0.3%	9 0 / 2.1%	8 / 0.2%
	2014	4833	20 / 0.4%	101 / 2.6%	10 / 0.2%
	2015	4978	16 / 0.3%	105 / 2.4%	26 / 0.6%

Trichinellosis infection resulted from the consumption of home-processed pork that had not been inspected by the veterinary services. In 2015, 15 patients with a diagnosis of intestinal parasitic disease were hospitalized in the Grodno Provincial Clinical Hospital of Infectious Diseases – the largest teaching hospital for the diagnosis and treatment of infectious and parasitic diseases in the Grodno province; 13 of the patients were diagnosed with trichinellosis (average treatment duration was 11 days) and 2 with ascariasis (average treatment duration was 4 days). The vast majority of patients infected with intestinal parasites in Western Belarus were treated on an outpatient basis.

Discussion

The studies on the prevalence of intestinal parasitic infections in Belarusian residents focus mainly on nematodes and protozoa. At the end of the 20th century, attention was drawn to the effects of radioactive contamination caused by the disaster in the Chernobyl nuclear power plant on the increasing prevalence of parasitic infections of the gastrointestinal tract. Between 1986 and 1995, a 4.9 fold increase in the number of infections with helminths (from 3.9 to 19.1%), and a 4.3

fold increase in the number of *Giardia intestinalis* infections (from 2.2 to 9.4%) was observed in Belarusian residents in areas contaminated with radionuclides at 15 qi/km^2 [10]. According to Lysenko et al. [11], children living in Belarusian and Russian towns located in the radiation-contaminated zones were more frequently infected than children from other towns.

The authors tested 1206 children (231 with somatic diseases and 652 with diarrheal syndrome), residents of seven towns in Russia and Belarus, for the presence of cryptosporidiosis in the period 1989-1992. The mean infection rate in children with diarrheal syndrome was 4.8%, among those with somatic diseases was 2.6%, and in children with no symptoms was 1.9%. In 1999 and in 2000, the Department for Hygiene, Epidemiology and Prophylaxis of the Ministry of Health in Belarus reported 24,648 and 24,365 cases of foodborne enteritis respectively; the most common gastrointestinal protozoan infection was giardiasis, which accounted for 15% (3576 cases) and 17% (4093 cases) of the notified cases in the given years [12]. Previously, the number of registered cases of giardiasis in the Belarusian population was 1460 in 2012 and 1293 in 2013 [13].

Conclusions

High prevalence rates of infections with intestinal parasites in Belarusian residents provide justification for continuing epidemiological monitoring in Belarus.

Literature

1. Hotez PJ, Molyneux DH, Fenwick A, et al. Control of neglected tropical diseases. N Engl J Med, 2007; 357 (10): 1018–1027
2. Harp JA. Parasitic infections of the gastrointestinal tract. Curr Opin Gastroenterol, 2003; 19 (1): 31–36
3. Kucik CJ, Martin GL, Sortor BV. Common intestinal parasites. Am Fam Physician, 2004; 69 (5): 1161–1168
4. Korzeniewski K, Augustynowicz A, Smoleń A, Lass A. Epidemiology of intestinal parasitic infections in school children in Ghazni Province, eastern Afghanistan. Pak J Med Sci, 2015: 31 (6): 1421–1425
5. Hotez P.J., Gurwith M. Europe's neglected infections of poverty. Int J Infect Dis, 2011; 15: 611–619
6. Departament Zapobiegania oraz Zwalczania Zakażeń i Chorób Zakaźnych u Ludzi GIS. Zakład Epidemiologii NIZP-PZH. Zachorowania na wybrane choroby zakaźne w Polsce od 1 stycznia do 31 grudnia 2015 r. [Department for Communicable Disease and Infection Prevention and Control. National Institute of Public Health – National Institute of Hygiene (NIPH – NIH). Incidence of selected infectious diseases in Poland from 1 January to 31 December 2015]. Available at: http://www.pzh.gov.pl. Accessed: 08.04.2016
7. Narodowy Instytut Zdrowia Publicznego – Państwowy Zakład Higieny. Zakład Epidemiologii, Pracownia Monitorowania i Analizy Sytuacji Epidemiologicznej. Meldunki o zachorowaniach na choroby zakaźne, zakażeniach i zatruciach w Polsce [National Institute of Public Health – National Institute of Hygiene (NIPH – NIH). Department of Epidemiology, Laboratory of Monitoring and Epidemiological Analysis. Reports on cases of infectious diseases and poisonings in Poland]. Available at: http://www.pzh.gov.pl/ oldpage/epimeld/index_p.html. Accessed: 01.07.2014
8. Wasilewska J, Kaczmarski MG , Sawicka- Żukowska M, e t al. Analysis of clini -cal symptoms and selected hematological indices in hospitalized children with *Ascaris lumbricoides* infection from the northeastern region of Poland. Wiad Parazytol, 2011; 57: 43–51
9. Żukiewicz M, Kaczmarski M, Topczewska M et al. Epidemiological and clinical picture of parasitic infections in the group of children and adolescents from the north-eastern region of Poland. Wiad Parazytol, 2011; 57: 179–187
10. Skripova LV. The effect of the technogenic pollution of the natural environment on the prevalence of parasitic diseases in the Republic of Belarus. Med Parazitol, 1999; 1: 6–8
11. Lysenko A, Lavdovskaia MV, Plotnikov AV, et al. The prevalence of crypto-sporidiosis among the city populations of Russia and Belarus. Med Parazitol, 1993; 3: 54–55
12. World Health Organization. Country Reports: Belarus. WHO Surveillance Programme for Control of Foodborne Infections and Intoxications in Europe. 8th Report 1999–2000
13. GIDEON. Giardiasis in Belarus. GIDEON Informatics, Inc. Available at: www. gideonline.com/web/epidemiology. Accessed: 09 April 2016

Changes in physical fitness of members of the Warsaw Police Department over the period 2007 to 2013

Zmiany sprawności fizycznej policjantów Oddziału Prewencji w Warszawie w latach 2007–2013

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Abstract. Police officers are obliged by the legislature to maintain their physical fitness at levels that allow them to execute their official duties. The objective of this study was to identify the trends and the reliability of the rating system used in evaluating the physical fitness of police officers of the Warsaw Police Department in the period 2007-2013. The study involved 4153 subjects (females=228, males=3925), who were evaluated in three age groups: up to 29, 30-39 and 40-50 years (45 for females). To evaluate physical fitness, a specialized test was used that consisted of 4 trials evaluated according to the standards set by the Chief of Police in Ordinance No. 418 of 15.04.2011. The results of the physical fitness tests were unsatisfactory compared to the tasks assigned to this department, and indicated a downward trend in the years 2007 to 2010 and an upward trend from 2011 to 2013. The evaluation of results does not always correspond to the actual changes in physical fitness, because they are affected by factors of an organizational nature, the scoring methods and low trial reliability.
Key words: physical fitness, the police

Streszczenie. Wstęp. Policjant jest zobligowany przez ustawodawcę do utrzymywania sprawności fizycznej na takim poziomie, by pozwalała na wykonywanie zadań służbowych. Cel. Celem pracy jest wskazanie kierunków zmian i rzetelności ocen poziomu sprawności fizycznej policjantów warszawskiego oddziału prewencji w latach 2007–2013. Materiał i metody. W badaniach wzięły udział 4153 osoby (kobiety n=228, mężczyźni n=3925), które były oceniane w 3 grupach wiekowych: do 29, 39 i 50 lat (kobiety do 45 lat). Do oceny sprawności fizycznej zastosowano test składający się z 4 prób ocenianych według norm ustalonych w Zarządzeniu nr 418 Komendanta Głównego Policji z 15.04.2011. Wyniki. Oceny sprawności fizycznej są niezadowalające w stosunku do zadań stawianych przed tą formacją i wskazują na tendencję spadkową w latach 2007–2010 oraz wzrostową w latach 2011–2013. Wnioski. Ocena wyników testów nie zawsze odpowiada faktycznym zmianom sprawności fizycznej, gdyż mają na nią wpływ czynniki natury organizacyjnej, normy wynikowe i mała wiarygodność prób.
Słowa kluczowe: sprawność fizyczna, policja

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Introduction

The obligation to maintain physical fitness at a level which enables the performing of service tasks is regulated by article 61a, item 2 of the Act on the Police, and Ordinance No. 418 of the Chief of Police from 15 April 2011 [1, 2]. The documents also include recommendations regarding professional improvement, specified in the Regulation of the Ministry of Internal Affairs and Administration of 07 June 2006 [3]. The integral part of professional

improvement is training, ensuring proper preparation for the performance of official tasks and involving: improvement of psychomotor characteristics and preparation for work under conditions which require the highest physical effort and the development of universal physical fitness as part of health prophylaxis [3]. The notion of physical fitness has numerous definitions, formulated by various authors since the beginning of the 20th century [4-9]. It is also associated with an extensive array of tools, such as physical fitness tests, used today not only in education, science, physical education and sports, but also in military and police forces, as a measure of physical condition [10-13]. An obligatory part of professional training and improvement is physical education, intended to form and improve volition, motor features, general effort capacity, as well as specific and general sports skills useful in different types of operational and specialized services [14].

The physical education curriculum is implemented during working hours, with at least 2 mandatory hours a week, although the time can be extended as required by training, or if the level of physical fitness is too low. For the latter the curriculum is implemented in the individual's free time, and does not count as working time [15]. The physical fitness of policemen, including those assigned to a prevention unit, is evaluated on the basis of physical fitness tests, conducted at least once a year, as determined by the relevant training service [1]. However, it seems that despite the clearly and precisely (duty-wise) stated obligations regarding improvement of physical fitness, many officers neglect them, neither perceiving them as the best way to maintain physical and mental health or as a necessary aspect of their work, but instead as an unnecessary duty. This is the question driving study, as it seems relevant to verify whether the ratings are reliable and reflect actual physical fitness in the studied group of police officers over a consecutive 7 year period.

Aim of the study

The aim of this study was to identify trends and evaluate the reliability of ratings in terms of the physical fitness of police officers of the Warsaw Police Department in the years 2007-2013.

Material and methods

Characteristics of the study group. All the officers in the unit were tested, except those officers who were exempted from physical fitness tests. Exemptions are granted to those officers who are past the designated age, delegated, or have completed professional training or a specialist course in tactics and intervention techniques [2]. The study involved 4153 subjects (females=228, males=3925), who were evaluated in three age groups (Table 1) [2].

Table 1. Breakdown according to age group
Tabela 1. Podział badanych ze względu na grupy wiekowe

Year of the test	I - up to 29 years old	II - 30 to 39 years old	III - men 40 to 50 years old, women 40 to 45 years old
2007	486	195	30
2008	389	189	28
2009	301	201	26
2010	265	230	26
2011	309	212	38
2012	307	234	39
2013	328	263	45

Fitness tests were organized by a commission relevant for the place of service, appointed by the head of the cell, or head of the organizational police unit, within a strict timetable, i.e. from 15 April to 31 October.

Tests methods

The test involved four fitness trials performed in one day, in a way described in the relevant regulation (Appendix 1 to Ordinance No. 418 of the Chief of Police from 15/04/2011).

Trial 1 – overhead throw (with both hands) of a 2 kg medicine ball for females, and a 3 kg medicine ball for males, as an indicator of explosive power. Standing with legs apart, facing the throw trajectory (feet placed in parallel before the line), the subject makes an overhead throw using both hands. The subject can stand on tiptoes or jump, but crossing the throw line or touching the area behind the line with the hands for support is not allowed.

Trial 2 – sit-ups, from a supine position, for 30 seconds, as an indicator of abdominal muscle strength. The subject lies on their back on a mattress, with legs bent at right angles and feet hip-wide apart, fully touching the ground, hands on the back of the head. Another person stabilizes the feet. The subject sits up, touching the knees with the elbows, then lies back down and touches the ground with their arms. The hips cannot be lifted. As many sit-ups as can be achieved have to be made in 30 seconds. Incorrect sit-ups (when the elbows do not touch the knees) are not counted.

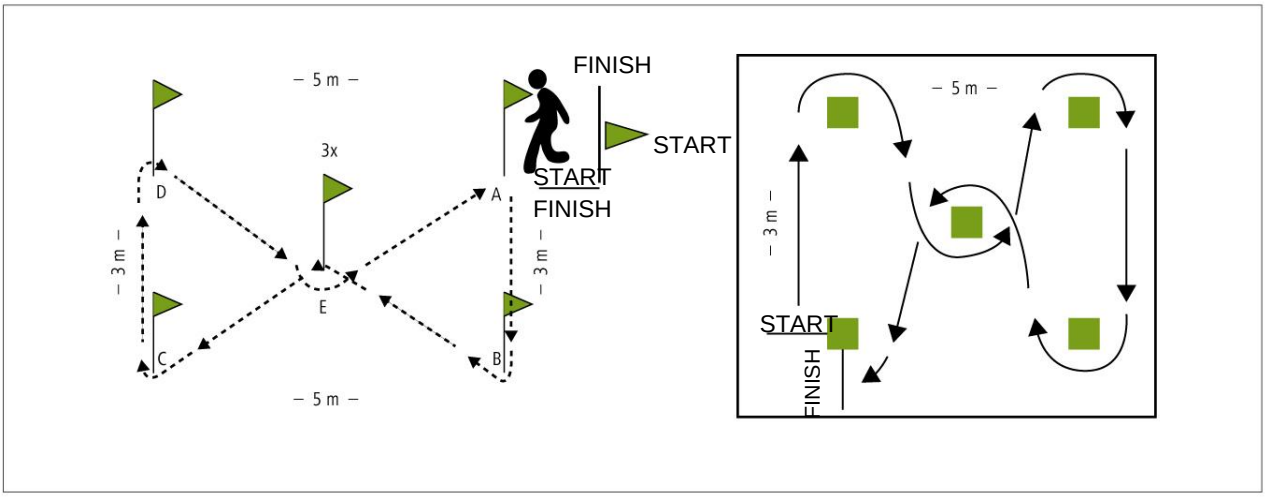

Figure 1. Pole spacing and marking of agility zig zag run track
Rycina 1. Rozstawienie stojaków i oznakowanie trasy biegu po kopercie

Table 2. Scoring standards in physical fitness trials with corresponding evaluation – females
Tabela 2. Normy wynikowe w próbach sprawnościowych i odpowiadające im oceny – kobiety

no.	Type of physical fitness trial	Unit of measurement	Age group	Grade					
				6	5	4	3	2	1
1.	Trial 1	Meter	I (up to 29 years old)	9.5 or more	9.0	8.0	7.0	6.0	*
			II (30-39 years old)	9.0 or more	8.5	7.5	6.5	5.5	*
			III (40-45 years old)	7.5 or more	7, 0	6.0	5.0	4.0	*
2.	Trial 2	No. of repetitions	I (up to 29 years old)	29 or more	27	24	21	18	*
			II (30-39 years old)	27 or more	25	22	19	16	*
			III (40-45 years old)	24 or more	22	19	16	13	*
3.	Trial 3	Second	I (up to 29 years old)	24.9 or less	25.6	27.0	28.4	29.8	*
			II (30-39 years old)	26.4 or less	27.1	28.5	29.9	31.3	*
			III (40-45 years old)	27.9 or less	28.6	30.0	31.4	32.8	*
4.	Trial 4	Minute	I (up to 29 years old)	3" 15' or less	3" 25'	3" 40'	3" 55'	4" 10'	*
			II (30-39 years old)	3" 35' or less	3" 45'	4" 00'	4" 15'	4" 30'	*
			III (40-45 years old)	4" 00' or less	4" 10'	4" 25'	4" 40'	4" 55'	*

* Obtained score below that indicated in the grade "2" column

Trial 3 – zig-zag run, as a trial of speed and motor coordination. Five poles at least 160 cm high are required. The zig-zag area is 3m x 5m. The subject has to run the track three times, as fast as possible, without touching the poles. If the subject overturns a pole, the trial is stopped and can be repeated. The score is established with accuracy of up to 0.1 second (Figure 1).

Trial 4 – 800 m run for women and 1,000 m run for men, as a test of endurance. The route should be flat and without slopes. The time is measured to an accuracy of 1 second.

The final test grade is an arithmetic mean of the four scores obtained in the individual trials: exceptional – 6 (mean score of 5.51-6.00), very good – 5 (range of 4.51-5.50), good – 4 (range of 3.51-4.50), satisfactory – 3 (range of 2.51-3.50), acceptable – 2 (range of 2.00-2.50), unsatisfactory – 1 (range of <2.00).

Table 3. Scoring standards in physical fitness trials with corresponding evaluation – males
Tabela 3. Normy wynikowe w próbach sprawnościowych i odpowiadające im oceny - mężczyźni

No.	Type of physical fitness trial	Unit of measurement	Age group	Grade					
				6	5	4	3	2	1
1.	Trial 1	Meter	I (up to 29 years old)	11.5 or more	11.0	10.0	9.0	8.0	*
			II (30-39 years old)	11.0 or more	10.5	9.5	8.5	7.5	*
			III (40-50 years old)	10.0 or more	9.5	8.5	7.5	6.5	*
2.	Trial 2	No. of repetitions	I (up to 29 years old)	32 or more	30	27	24	21	*
			II (30-39 years old)	29 or more	27	24	21	18	*
			III (40-50 years old)	26 or more	24	21	18	15	*
3.	Trial 3	Second	I (up to 29 years old)	23.5 or less	24.0	25.0	26.0	27.0	*
			II (30-39 years old)	24.0 or less	24.5	25.5	26.5	27.5	*
			III (40-50 years old)	24.7 or less	25.2	26.2	27.2	28.2	*
4.	Trial 4	Minute	I (up to 29 years old)	3" 30' or less	3" 40'	3" 55'	4" 10'	4" 25'	*
			II (30-39 years old)	3" 45' or less	3" 55'	4" 10'	4" 25'	4" 40'	*
			III (40-50 years old)	4" 15' or less	4" 25'	4" 40'	4" 55'	5" 10'	*

* Obtained score below that indicated in the grade "2" column

Scoring standards and corresponding grades in individual physical fitness trials for women are presented in Table 2, and for men in Table 3.

The individual physical fitness charts of the officers of the Warsaw Police Department were analyzed. The results were analyzed using the system of physical fitness assessment for police officers [2] and Appendix no. 2 to the Ordinance.

Arithmetic means and standard deviations were calculated, as well as the coefficient of variation (v), which is the ratio of the standard deviation to the arithmetic mean. Higher (v) means greater variability within the group. The following interpretation of the coefficient was adopted: up to 5% (small), 6-10% (moderate), 11-20% (marked), 21-50% (significant) and >50% (very significant).

The correlation coefficient was calculated, and the strength of correlation was evaluated using Guilford's scale: slight (<0.2), low, definite (0.2-0.4), moderate, substantial (0.4-0.7), high, marked (0.7-0.9), very high, very dependable (0.9-1) [13].

Results

After calculating the mean grades for physical fitness test for the years 2007-2013, a hyperbolic distribution of variation was demonstrated. From 2007, the means tended to decline until 2010, when the lowest values were observed, both among men and women, then they increased significantly until 2013 (Figure 2).

The mean grades for individual trials demonstrate different variation values, from moderate (8%) in trial 3 (speed and motor coordination) to high (27%) in trial 4 (endurance) (Table 4).

Very high correlation can also be found between trials 2 (strength of abdominal muscles) and 3 (speed and motor coordination), and a high correlation between trial 1 (explosive power) and 2 (strength of abdominal muscles), as well as between trial 1 (explosive power) and 3 (speed and motor coordination). An inverse high correlation is found between trial 1 (explosive power) and 4 (endurance) (Table 5).

A similar distribution of mean scores, values of coefficients of variation and correlation coefficients was obtained in all three age groups.

Among women in age group I, numerous examples of significantly lower mean scores in all four trials were found, compared to age group II. High and very high correlations between the group and mean scores were obtained for trials 1, 3 and 4.

It should be noted that anomalies were found also among men, as officers in age group III often obtained significantly higher mean scores than their colleagues in groups I and II. High and very high correlations between the group and mean scores were obtained for trials 1, 2 and 4.

In the years 2007-2011, significantly higher mean scores were achieved by men from age group II. Moderate and high correlations between the group and mean scores were obtained also for trials 1, 2 and 4.

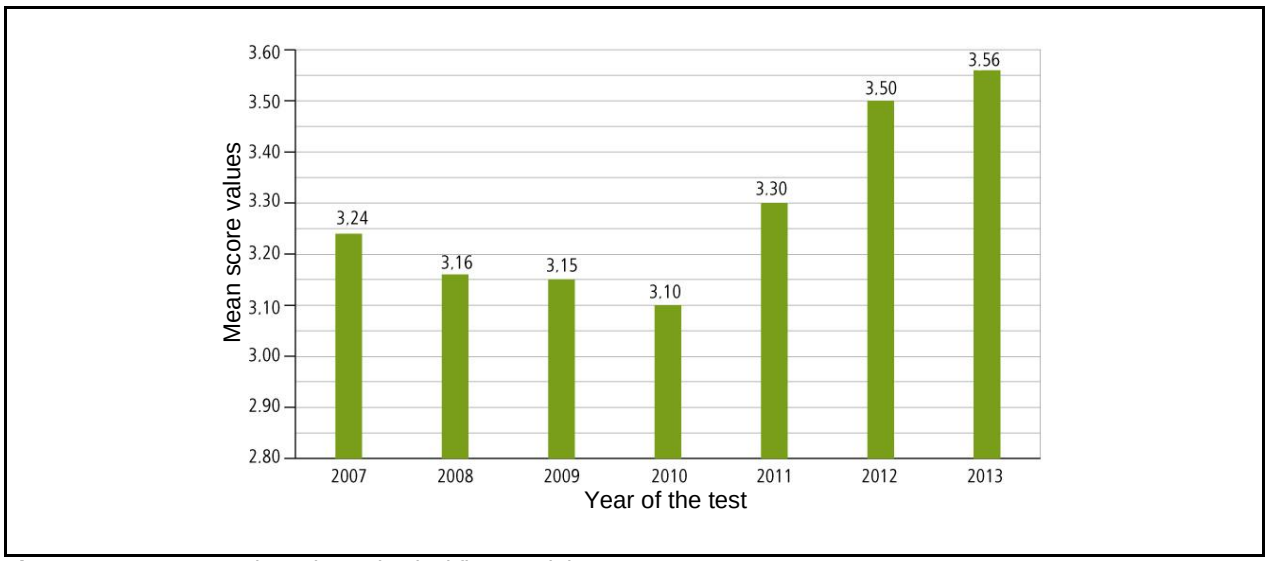

Figure 2. Mean scores in various physical fitness trials
Rycina 2. Średnia ocen testów sprawności fizycznej

Table 5. Correlation coefficients between different trials
Tabela 5. Współczynniki korelacji pomiędzy poszczególnymi próbami

	1.	3.	2.
4.	0.82	0.64	0.67
2.	0.85	0.96	
3.	0.82		

Table 4. Mean scores in physical fitness tests in individual trials
Tabela 4. Średnie ocen testów sprawności fizycznej w poszczególnych próbach

Year of the test	Trial 1	Trial 2	Trial 3	Trial 4
2007	2.98	3.61	3.33	2.85
2008	3.23	3.63	3.14	2.66
2009	3.50	3.54	3.27	2.24
2010	3.72	3.87	3.45	1.34
2011	3.93	3.99	3.46	1.81
2012	4.43	4.19	3.74	1.65
2013	4.13	4.45	3.92	1.74

Discussion

The level of physical fitness of police officers from the Warsaw Police Department in the years 2007-2013 should be considered unsatisfactory in the view of tasks the unit is supposed to complete [1]. The mean scores obtained in the 7 years of the physical fitness tests (3.1-3.56) classify the skills of the officers in the lowest interval of fitness acceptable for the performance of preventive functions. There are probably many reasons for such low physical fitness in police officers, but the main one is the constantly decreasing (since 1990) level of physical fitness in Polish youths [11]. Therefore, already at the selection stage, during admission of candidates for service, we are dealing with young people of relatively poor physical condition. Similar conclusions, supported by detailed statistical analysis, apply to candidates to physical education studies [12]. This observation is confirmed by the results achieved by police officers in age group II (up to 39 years old), and even age group III (up to 45 and 50 years old), whose mean scores were often higher than those of police officers in group I (up to 29 years old). Although the system of training of police officers is not oriented towards improving their physical fitness (except for individual organizational units), instead of 2 hours a week the physical exercises should take place a few times a week, it is noticeable that older officers often obtain higher scores than their younger (sometimes even by 20 years) colleagues. This situation may be due to the effect of "learning" the test exercises, observed in people taking the described trials for many years, or due to inadequate choice of scoring standards; however, the regularity of this phenomenon in all the years covered by this study is striking. Moreover, the reliability of the rating of individual trials is doubtful, as a very high correlation was found

between trials 2 and 3, where correctness and precision of performance is largely dependent on the judgement of the person conducting the test. They can decide that sit-ups were performed properly or not, they can notice or ignore mistakes in the zig-zag run. The doubts as to the reliability of scores in these elements of the test are supported by the highest mean ratings obtained by officers in trials 2 and 3. The reliability of trial 4 (running) is also questionable, which is confirmed by a high degree of variability within this trial (27%), and high inverse correlation with trial 1, which may result primarily from organizational issues. In 2011, Ordinance No. 418 of the Chief of Police entered into force, allowing failing of one of the trials, and calculating the final grade as an arithmetic mean of all the scores. Most people take advantage of this opportunity, and do not try to pass the difficult and demanding running trial, but instead they accept getting one point for the calculation of the mean. Returning to the old evaluation principles, i.e. the requirement to get a positive grade in all the trials, could restore the due importance of this motor function, necessary for the officers of a prevention unit.

The analysis of distribution of variation of scores in individual years indicates that from 2007 to 2010 the physical fitness of the officers from the Warsaw Police Department gradually decreased, until it reached a mean of 3.10. Since 2011 we can observe a significant increase in the mean scores, which reached and exceeded 3.5 in the years 2012-2013. Unfortunately, this must be associated with a significant improvement in the scores of trials of questionable reliability (2 and 3). It appears that, regardless of the usefulness of various trials for the evaluation of physical fitness of police officers, their physical condition is not satisfactory, and changes in the system of training should be introduced, involving increased financing and institutionalization. One example of such a solution is the "Benefit" program, for years successfully used by private companies to improve the physical condition of their employees.

Conclusions

- The physical fitness of police officers from the Department of Prevention in the years 2007-2013 should be considered unsatisfactory, and requires the application of corrective measures.
- The assessment of the physical fitness of police officers appears to have a small diagnostic value and needs fundamental modification, due to the scoring standards used, faulty rating methods and the limited reliability of the trials.

Literature

1. Ustawa o Policji z 6 kwietnia 1990 roku. Dz. U. z 2011 r. nr 287, poz. 1687 [Act on the Police of 6 April 1990. Official Journal of Laws of 2011, no. 287, item 1687]
2. Zarządzenie nr 418 Komendanta Głównego Policji z dnia 15 kwietnia 2011 roku. Dz. Urz. KGP z 2011, nr 3, poz. 17 [Ordinance No. 418 of the Chief of Police of 15 April 2011. Official Journal of the Chief of Police of 2011, no. 3, item 17]
3. Rozporządzenia MSWiA z dnia 7 czerwca 2006 r. w sprawie zadań z zakresu kultury fizycznej realizowanych w Policji, Państwowej Straży Pożarnej, Straży Granicznej i Biurze Ochrony Rządu. Dz. U. 2006.121.841 [Regulation of the Ministry of Internal Affairs and Administration of 07 June 2006 on physical education tasks implemented in the Police, State Fire Department, Border Guard and Government Protection Bureau. Official Journal of Laws 2006.121.841]
4. Grabowski H. Teoria fizycznej edukacji. [Theory of physical education] WSiP, Warsaw 1999
5. Raczek J. Koncepcja strukturalizacji i klasyfikacji motoryczności człowieka. [Structuring and classification of man's motor activity] Wyd. AWF, Poznań 1994
6. Żak S. Somatyczne i rozwojowe uwarunkowania sprawności motorycznej -aspekty teoretyczne i implikacje praktyczne. [Somatic and developmental conditions of motor activity – theoretical aspects and practical implications] Wyd. AWF, Krakow 1996
7. Przewęda R. Rozwój somatyczny i motoryczny. [Somatic and motor development] PSWS, Warsaw 1973
8. Szopa J. Uwarunkowania, przejawy i struktura motoryczności. [Conditions, manifestation and structure of motor activity] PWN, Krakow 1996
9. Osiński W (ed). Motoryczność człowieka -jej struktura, zmienność i uwarunkowania [Human motor activity – its structure, variability and conditions], Poznań 1993
10. Drabik J. Testowanie sprawności fizycznej u dzieci, młodzieży i dorosłych. [Testing physical fitness in children, adolescents and adults] AWF, Gdańsk 1997
11. Przewęda R, Dobosz J. Kondycja fizyczna polskiej młodzieży. [Physical condition of Polish youth] AWF, Warsaw 2007
12. Karpowicz M, Strzelczyk R. Charakterystyka wybranych elementów sprawności fizycznej kandydatów na studia w AWF w Poznaniu. [Characteristics of selected elements of physical fitness in candidates to Physical Education Academy in Poznań] In: Kwieciński J, Tomczak M (eds). Wybrane aspekty kultury fizycznej - stan i perspektywy. [Selected aspects of physical culture – present state and perspectives] PWSZ, Konin 2009: 7
13. Kruszewski M. Changes in maximal strength and body composition after different methods of developing muscle strength and supplementation with creatine, L-carnitine and HMB. Biology of Sport 2011; 2: 145-150
14. Rozporządzenia Ministra Edukacji Narodowej i Sportu z dnia 20 lutego 2002 r. w sprawie wzorcowych programów zajęć wychowania fizycznego dla jednostek organizacyjnych podległych Ministrowi Obrony Narodowej, Ministrowi właściwemu do spraw wewnętrznych. Szefowi Urzędu Ochrony Państwa oraz Szefowi Obrony Cywilnej Kraju. Dz. U. 2002.23.226 [Regulation of the Ministry of National Education and Sports of 20 February 2002 on model physical education programmes for organizational units subordinate to Minister of National Defence, Minister relevant for internal affairs, Chief of the Office for State Protection and Chief of the National Civil Defence of Poland. Official Journal of Laws 2002.23.226]
15. Rozporządzenie Ministra Spraw Wewnętrznych i Administracji z 19 czerwca 2007 roku w sprawie szczegółowych warunków odbywania szkoleń zawodowych oraz doskonalenia zawodowego w Policji. Dz. U. 2007.126.877 [Regulation of the Ministry of Internal Affairs and Administration of 19 June 2007 on detailed conditions for professional trainings and professional improvement in the Police. Official Journal of Laws 2007.126.877]

Bariatric surgery successful in the fight against obesity

Chirurgia bariatryczna skutecznie walczy z otyłością

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Abstract. The aim of this study was to determine the effectiveness of sleeve gastrectomy type bariatric surgery in patients with morbid obesity and to determine whether the surgery resulted in significant change in the level of life satisfaction for patients. This was a longitudinal study. The first stage took place in 2014, immediately before surgery in the Military Institute of Medicine in Warsaw; the second stage 12 months after surgery, in 2015. The study used the SWLS questionnaire (Satisfaction with Live Scale) and interview analysis in which the BMI (Body Mass Index) and the percentage of excess weight loss (%EWL) were used. The study showed a significant decrease in BMI: before surgery the BMI was M = 47.55, SD = 6.82 and after M = 31, SD = 4.56. In the study group the effectiveness of bariatric surgery, defined as %EWL, ranged from 36.27% to 91.96%, with an average of M = 61.97%, SD = 14.43%. The surgery proved to be effective in 80.6% of the patients. The study showed a significant increase in life satisfaction as a result of the surgery across the whole group and in the female group. Bariatric surgery is successful in the fight against morbid obesity. As a result of the surgery, life satisfaction significantly increases.
Keywords: quality of life, life satisfaction, obesity, bariatric surgery, morbid obesity

Streszczenie. Cel badania. Przeprowadzone badanie miało na celu określenie skuteczności operacji bariatrycznejtypu sleeve gastrectomy w walce z otyłością olbrzymią oraz ustalenie, czy w wyniku operacji następuje zmiana satysfakcji zżycia. Procedura. Badanie miato charakter podłużny. Pierwszy etap odbył się w 2014 roku, tuż przed operacją w Wojskowym Instytucie Medycznym w Warszawie, drugi etap-po 12 miesiącach, w 2015 roku. Materiał i metody. W badaniu zastosowano kwestionariusze: SWLS (The Satisfaction with Live Scale) oraz kwestionariusz wywiadu. W analizie wykorzystano wskaźnik masy ciała [body mass index - BMI) oraz wskaźnik %EWL [percent of excess weight loss). Wyniki. Badanie wykazało istotne zmniejszenie BMI. Wskaźnik BMI przed operacją wynosił M=47,55; SD=6,82, a po operacji M=31; SD=4,56. Skuteczność operacji bariatrycznej określona jako %EWL wynosiła w badanej grupie pacjentów 36,27-91,96%, średnio M=61,97%, SD=14,43%. Operacja okazała się skuteczna w przypadku 80,6% badanych. Badanie wykazało istotną poprawę zadowolenia z życia w wyniku operacji w grupie ogólnej oraz w grupie kobiet. Wnioski. Chirurgia bariatryczna skutecznie walczy z otyłością olbrzymią. W wyniku operacji bariatrycznej istotnie poprawia się satysfakcja z życia.
Słowa kluczowe: jakość życia, satysfakcja z życia, otyłość, chirurgia bariatryczna, otyłość olbrzymia

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Introduction

Obesity is one of the major problems of contemporary life. Problems with excessive body weight are referred to as an "epidemic" that is affecting many people, regardless of age. According to the World Health Organization (WHO) [1], in 2014 over 1.9 billion people were overweight, and almost 600 million people were obese. Each year approximately 2.8 million people die due to diseases caused by being overweight or obese. According to WHO,

the problem of excessive body weight is increasing, and it affected almost all the studied countries in the years 2010-2014. According to the data, Polish people hold one of the top positions regarding the prevalence of being overweight or obese, following Andorra, Turkey, Malta, Israel, the Czech Republic and Great Britain. Studies indicate that the problem of obesity affects 61% of the Polish population [2]. Obesity and associated comorbidities are a significant burden to the patient, and contribute to the deterioration of the quality of life.

How to diagnose obesity and morbid obesity

Obesity is a condition in which the amount of fat tissue in the organism is at higher than normal levels, and if it persists for a long time can contribute to the development of concomitant diseases: diabetes, cardiac diseases, arterial hypertension, atherosclerosis, gall bladder diseases, osteoarticular dysfunctions, reproductive disorders and other conditions [3].

A generally available method for diagnosing obesity is the anthropometric method, which determines the patient's body weight (expressed in kg) to height (expressed in m^2) ratio. On the basis of these values, the Quetelet index (body mass index, BMI) is derived.

BMI = body mass (expressed in kg) / height (expressed in m)^2.

Body weight is normal when BMI is in the range of 18.5-24.9 kg/m^2. Overweight occurs for a BMI of 25-29.9 kg/m^2, obesity when BMI exceeds 30 kg/m^2, while morbid obesity is found in patients with BMI ≥ 40 kg/m^2; this latter condition is life-threatening [4, 5]. Table 1 presents the classification of overweight and obesity in adults on the basis of BMI.

Table 1. Classification of overweight and obesity in adults according to BMI
Tabela 1. Klasyfikacja nadwagi i otyłości u osób dorosłych wg BMI

Nutrition status	BMI (kg/m^2)
Very severely underweight	<16
Severely underweight	16-16.99
Underweight	17.0-18.49
Normal value – standard	18.5-24.99
Overweight	25-29.99
Obesity class I	30-34.99
Obesity class II	35.0-39.99
Obesity class III (morbid obesity)	≥40.0

Surgical treatment of obesity

The aim of obesity treatment is the reduction of excessive body weight, which is directly related to improvement of the patient's health status. In the process of morbid obesity therapy it is very important to maintain the obtained effects of reduced body weight. Obesity is usually treated conservatively, but in patients with BMI ≥ 35 and concomitant diseases, or with BMI ≥ 40, the results of conservative therapy are often unsatisfactory and transient. For these patients bariatric surgery is an option. The level of advancement of the performed procedures varies [6]. The surgical techniques can be classified as restrictive, malabsorptive and combined surgeries. Restrictive operations consist of the reduction of stomach volume, which drastically reduces the size of meals. Usually sleeve gastrectomy (SG) is performed, or an adjustable gastric band (ASGB) is placed. Malabsorptive surgeries consist of the reduction of food absorption by shortening of the intestinal passage. Malabsorptive surgeries include biliopancreatic diversion (BPD) and biliopancreatic diversion with duodenal switch (BPD/DS). Combined (restrictive and malabsorptive) surgeries consist of the drastic reduction of the stomach volume and shortening of the small intestinal passage. Such procedures include the Roux-en-Y gastric bypass (RYGB).

Aim of the study

The aim of the study was to verify whether sleeve gastrectomy is effective in reducing body weight in morbidly obese patients, and to determine if their satisfaction with life changes as a result of the procedure.

Assessment of the effectiveness of bariatric treatment

The BMI index was used to assess the effects of the invasive treatment of morbid obesity, demonstrating the number of kilograms per m^2. To determine the effectiveness of the bariatric surgery more precisely, the percent of excess weight loss (%EWL) is calculated [7]. The %EWL index provides more detailed information than the number of kilograms lost, as it takes into account not only the initial body weight and the level of its loss, but also the degree of overweight in a given patient. To determine %EWL, the degree of overweight should be calculated using the following formula [7]:

$$N = Mp - Mi$$

where: N - overweight, Mp - initial body weight (body weight before the surgery). Mi - ideal body weight, derived with the use of the Broca formula.

To calculate the ideal body weight, the Broca formula was used:

ideal body weight for men (kg) = [height (cm) - 100] x 0.9

ideal body weight for women (kg) = [height (cm) - 100] x 0.85

When the overweight is known, %EWL can be calculated with the formula:

%EWL = **[body weight loss in kg (difference between the body weight before and after the surgery) / overweight in kg]** x **100%**

Life satisfaction

Life satisfaction is an ambiguous concept, used interchangeably with the terms "happiness", "contentment with life", "quality of life" and "well-being". In medical science the term refers to health-related quality of life (HQoL). Quality of life perceived in this way refers to present functioning and satisfaction in relation to a situation perceived by a person as ideal [8, 9]. According to WHO experts, the concept of quality of life denotes comprehensive perception by an individual of his/her mental and physical health, functioning in and relations with society, the degree of self-sufficiency and independence [1].

Material and methods

This was a longitudinal study, conducted from January/March 2014 to January/March 2015.

In the first stage 38 patients participated, aged 23-60 years old, diagnosed with morbid obesity or with obesity and concomitant diseases, qualified for stomach reduction (sleeve gastrectomy). The lowest BMI among the patients qualified for surgery was 34, the highest was 69, and mean BMI was M = 47.55: SD = 6.82. The first stage of the study was conducted immediately before the surgery in the Department of General, Oncological, Metabolic and Thoracic Surgery, Military Institute of Medicine, at 128 Szaserów Street in Warsaw.

In the second stage, information was collected through a phone survey. Prior to answering the questions from the questionnaire, patients were read the instructions, and informed about how to respond. The person conducting the survey read each question from the questionnaire, requesting an answer according to the previous instructions and the selection of responses. In the second stage, 31 patients after a bariatric surgery were interviewed, including 14 women and 17 men. The lowest BMI one year after the surgery was 23, and the highest was 45, with a mean of M = 31: SD = 4.56. Seven patients did not consent to participate in the second stage of the study.

The Satisfaction with Live Scale (SWLS) by Diener et al. (adapted by Zygfryd Juczyński [10] was used to determine the level of satisfaction with life of patients undergoing surgery. The questionnaire is intended for interviewing adults, both ill and healthy, and consists of five statements. The studied person decides how much each statement relates to their life so far. The result of the test is a general indicator of contentment with life, composed of 3 elements: satisfaction with life, positive feelings and lack of negative feelings. Assessment of satisfaction with life results from a comparison between the present situation and the standards set by a given person. SWLS contains 5 items, assessed on a 7-degree scale, and refers to subjective satisfaction with life. In the study we also used a tool we developed to complete the information (BMI value, sociodemographic data and contact data for the next stage), as well as a consent form for participation in the longitudinal study and sharing of personal data. Personal data were coded (initials of the first name and parent's surname, and patient's year of birth). The empirical material was analyzed quantitatively with the use of the SPSS 22.0 statistical package.

Results

The analysis revealed a significant difference in the BMI levels after bariatric surgery in patients with morbid obesity. The values from before the surgery were compared with those from after the surgery, using the t-Student test for dependent samples. Separate comparisons were conducted for men and women, and the mean results are presented in Figure 1.

The comparison demonstrated a significant decrease in BMI as a result of bariatric surgery both in women: $t(13) = 15.27$; $p < 0.001$, and in men: $t(16) = 11.80$; $p < 0.001$. The difference in BMI between men and women, verified with the t-Student test for independent samples, was not significant either before the surgery: $t(36)=1.51$; $p = 0.139$, or after the procedure: $t(29) = 0.16$; $p = 0.876$. As a result of the surgery, the body weight in the patients reduced by 17.67-77.20 kg, with a mean of M = 46.63; SD = 16.02. The effectiveness of the surgery, determined by percent of body weight loss, %EWL, in the studied group of patients was 36.27-91.96%, and its distribution was consistent with a normal distribution, with a mean of M = 61.97%, SD = 14.43%. The distribution of the body weight loss index, %EWL, in the studied group of patients is presented in Table 2.

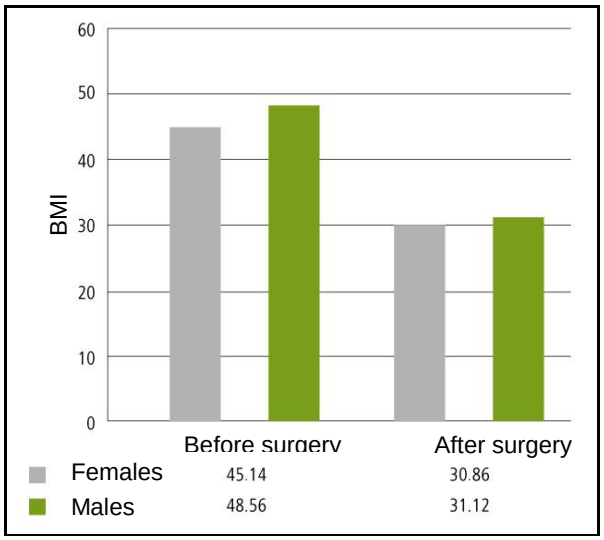

Figure 1. Reduction in body mass index (BMI) as a result of bariatric surgery by gender
Rycina 1. Zmniejszenie wskaźnika masy ciała (BMI) w wyniku operacji bariatrycznej w zależności od płci

According to the criterion of effective surgical procedure, assuming a 50% overweight loss, the surgery was effective in 25 patients (80.6%). Lower than the required %EWL was found in 6 patients (19.4%).

The study did not confirm any correlation between the results of the procedure, gender or age. The same results for the bariatric treatment were observed in men and in women: $t(29) = 1.33$; $p = 0.196$. Also, there was no significant correlation for %EWL and age: $r = -0.225$; $p = 0.232$. A significant difference was found in %EWL depending on education: Chi^2 (2; N = 31) = 6.90; $p = 0.032$. A detailed comparison with the use of the Mann-Whitney test confirmed the significance of differences between patients with primary education and two other groups. The effectiveness of the surgery in patients with primary education was significantly lower ($M_{rang} = 7.83$) than in those with secondary ($M_{rang} = 16.17$) and higher education ($M_{rang} = 19.62$). In these two groups it did not differ significantly. A significant difference in trends of %EWL was found according to marital status: $U = 48.00$; $p = 0.079$. In unmarried women and men the surgery was more effective ($M_{rang} = 19.50$) than in married patients ($M_{rang} = 13.29$).

In order to verify whether bariatric surgery affects quality of life, a comparison between the quality of life before and after the procedure was performed, separately for men and women. In the case of women, due to the significant discrepancies with normal distribution of SWLS quality of life, the non-parametric Wilcoxon's test was used, and in men, where the distribution was consistent with the normal one, the comparison was conducted using the t-Student test for dependent samples. Figure 2 presents the mean quality of life of men and women, before and after the surgery. For women, a median was calculated, as it is more precise in the case of a non-normal distribution.

Table 2. Distribution of overweight loss rate (%EWL) frequency in study group patients
Tabela 2. Rozkład częstości wskaźnika utraty nadwagi %EWL w badanej grupie pacjentów

	Frequency	Percent	Percent of valid	Accumulated percent
<30%	0			
30-49.9%	6	15.8	19.4	19.4
50-69.9%	16	42.1	51.6	71.0
70-89.9%	8	21.1	25.8	96.8
90% or more	1	2.6	3.2	100.0
Valid in total	31	81.6	100.0	
No data	7	18.4		
Total	38	100.0		

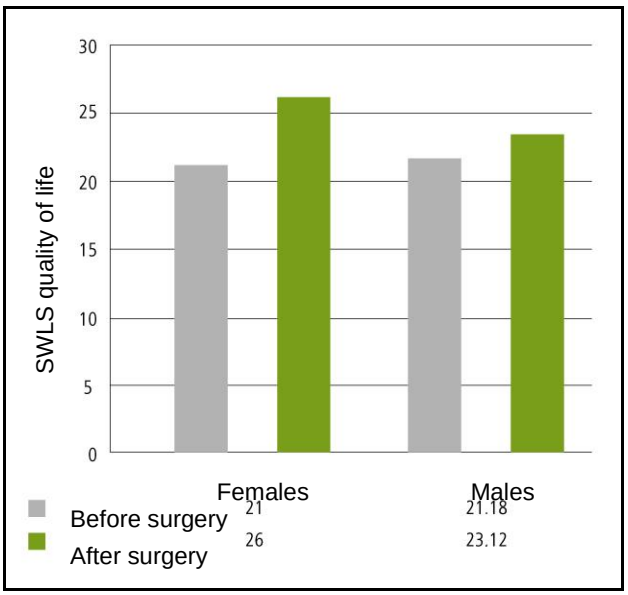

Figure 2. Change in quality of life (SWLS) as a result of bariatric surgery in male and female patients with morbid obesity
Rycina 2. Zmiana jakości życia SWLS w wyniku operacji bariatrycznej u pacjentów i pacjentek z otyłością olbrzymią

The comparison revealed a significant difference in the group of women. The assessed quality of life in women with morbid obesity was significantly higher after the surgery (Me = 26) than before the procedure (Me = 21), which is confirmed by the Wilcoxon test: $Z = 2.20$; $p = 0.028$. In the group of men, the quality of life did not

change significantly as a result of the surgery: t(16) = 1.29; p = 0.215. In general, in the entire study group the analysis confirmed a significant improvement in the quality of life as a result of the surgery: t(30) = 2.63; p = 0.13. The quality of life before the surgery (M = 20.74; SD = 5.42) was significantly lower than after the procedure (M = 23.61; SD = 5.10).

Comparison of the quality of life before and after the surgery using the Mann-Whitney U test did not reveal a significant difference according to gender. Women and men presented the same level of contentment with life, both before the surgery: U = 170.0; p = 0.769, and after: U = 94.5; p = 0.336.

In order to verify whether the quality of life after the surgery is related to the effectiveness of the procedure, i.e. the %EWL index, a correlation analysis was performed. Due to the normal distribution of both variables, r Pearson's coefficient was derived. The correlation was trend-level significant: r = 0.332; p = 0.068. The correlation was positive and moderate. As the effectiveness of the surgery increased, the quality of the patients' lives improved.

Conclusion

The study demonstrated a significant decrease in BMI as a result of bariatric surgery both in men and in women. The results are consistent with the reports of other authors regarding this subject area, and confirm a significant reduction of BMI as a result of bariatric surgery [7, 11, 14]. The body weight loss index, %EWL, in the group was 36.27-91.96%, and its distribution was normal, with a mean of M = 61.97%, SD = 14.43%. According to the criterion of effective surgical procedure, assuming a 50% overweight loss, the surgery was effective in 25 patients (80.6%). Lower than required %EWL was achieved in 6 patients (19.4%). The obtained body weight reduction, expressed in %EWL, was similar to the values achieved by other researchers [7].

In patients in this study the effectiveness of surgery was not associated with gender or age, but it did correlate with the level of education and marital status. The study revealed a significant improvement in the quality of life as a result of bariatric surgery in the general group of patients and in women. This outcome is confirmed by other studies [7, 11, 14]. They demonstrate that after 3 months, 6 months or 1 year following bariatric surgery, the patients' quality of life was rated significantly higher than before the operation.

Conclusions

- The study demonstrated a significant decrease in BMI as a result of bariatric surgery.
- The effectiveness of the bariatric surgery in the studied patients, measured with percent of body weight loss (%EWL), was 80.6%.
- In the operated patients the effectiveness of surgery was not related to gender or age, but it was associated with the level of education and marital status.
- As the effectiveness of the surgery (%EWL) increased, the quality of the operated patients' lives improved.
- The study revealed a significant improvement in the quality of life as a result of bariatric surgery in the entire group of patients. The assessed quality of life in the women increased significantly due to the operation, whereas in the group of men undergoing the same the quality of life did not change significantly.

Literature

1. World Health Organization, http://www.who.int/features/factfiles/obesity/ en/
2. Kossobudzka M. Pani Europa jest chora, ale coraz dłużej żyje. [Ms Europe is sick, but lives longer] http://wybor-cza.pl/1,75 400,18 874 632,pani-europa-jest-chora-ale-co raz-dluzej-zyje.html
3. Tylka J. Psychosomatyka. [Psychosomatics] Wyd. UKSW, Warsaw 2000
4. Jarosz M, Ktosiewicz-Latoszek L. Otyłość. Zapobieganie i leczenie. [Obesity. Prevention and treatment] Wyd. Lekarskie PZWL, Warsaw 2006, 2009
5. Dąbrowiecki S. Zasady kwalifikacji chorych z otyłością olbrzymią do leczenia operacyjnego. [Principles of qualification of morbidly obese patients to surgical treatment] Post Nauk Med, 2009; 22 (7): 502-505
6. Stanowski E, Wyleżol M, Paśnik K. Laparoskopia w chirurgii bariatrycznej w Polsce - stan aktualny. [Laparoscopy in bariatric surgery in Poland – present state] Wideochirurgia i Inne Techniki Małoinwazyjne, t. 2. [Videosurgery and Other Minimally Invasive Techniques, Vol. 2.] 2007:18-23,37
7. Paśnik K. Wpływ chirurgicznych metod restrykcyjnych przewodu pokarmowego na jakość życia i choroby współistniejące u chorych z otyłością olbrzymią. [Effect of gastrointestinal restrictive surgical methods on the quality of life and concomitant diseases in patients with morbid obesity] Habilitation thesis. Department of General, Oncological and Thoracic Surgery, Military Institute of Medicine, Warsaw 2004
8. Oleś P. Jakość życia w zdrowiu i chorobie. [Quality of life in health and in sickness] In: Oleś P, Steuden S, Toczołowski J (eds). Jak świata mniej widzę. Zaburzenia widzenia a jakość życia. [When I see less of the world. Visual disturbance and quality of life] Towarzystwo Naukowe KUL, Lublin 2002
9. Tobiasz-Adamczyk B. Jakość życia w naukach społecznych i medycynie. [Quality of life in social sciences and medicine] Sztuka Leczenia 1996: 2
10. Diener E, Emmons RA, Larsen RJ, Griffin S. The Satisfaction with Life Scale. J Pers Assess, 1985; 49: 71-75
11. Dziurowicz-Kozłowska AH. Jakość życia i funkcjonowania chorych poddanych chirurgicznemu leczeniu otyłości. [Quality of life and functioning of patients undergoing surgical treatment of obesity] Doctoral thesis. Medical University, Lublin 2014
12. Al Harakeh AB, Larson CJ, Mathiason MA, et al. BAR0S results in 700 patients after laparoscopic Roux-en-Y gastric bypass with subset analysis of age, gender, and initial body mass index. Surg Obes Relat Dis, 2011; 7 (1): 94-98
13. Bobowicz M, Lehmann A, Orłowski M, et al. Preliminary outcomes 1 year after laparoscopic sleeve gastrectomy based on Bariatric Analysis and Reporting Outcome System (BAROS). Obes Surg, 2011; 21 (12): 1843-1848
14. Major P. Jakość życia chorych po operacyjnym leczeniu otyłości olbrzymiej. [Quality of life in patients following surgical treatment of morbid obesity] Doctoral thesis. Jagiellonian University, Collegium Medicum, Faculty of Medicine, Krakow 2014

Self-assessment value of a color Doppler study of orbital arteries in patients with primary open angle glaucoma

Ocena własna wartości badania kolorowym doplerem naczyń tętniczych pozagałkowych u chorych na jaskrę pierwotną otwartego kąta

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Abstract. Glaucomatous Optic Neuropathy is a condition with a characteristic structural optic nerve accompanied by characteristic visual field loss. This is a social disease and an age-related condition. Global statistics indicate that 2% of people over 70 suffer from it. It is one of the most frequent causes of blindness. The Doppler test was used to evaluate the extraocular arterial vessels in glaucoma in patients with different severities of the ocular condition, as well as determining the correlation levels in the resulting data with the thickness of the retinal nerve fibers measured with computer optical coherence tomography. Data from the author's own research on the flow in extraocular arteries in the control group and a group of patients from the Glaucoma Clinic Ophthalmology Department in the Central Clinical Hospital of the Ministry of Defense were compared to the results of perimetric tests and optical coherence tomography. A statistical correlation of flows in the extraocular arteries with different degrees of statistical significance was observed. The largest statistical significance was registered for the correlation between the changes in the visual field and the reduction of flows in the central retinal artery and short posterior ciliary arteries. It was observed that the increase in the degeneration of retinal nerve fibers coincided with greater changes in the visual field. The reduction in the thickness of retinal nerve fibers was found to be in positive correlation with a decrease in flows in the short posterior ciliary arteries. A correlation was made between reduced flow in the extraocular arteries and the increase in functional and structural changes in people with glaucoma of different severities.
Key words: primary open-angle glaucoma, Doppler ultrasound

Streszczenie. Wstęp. Neuropatia jaskrowa charakteryzuje się zmianami strukturalnymi tarczy nerwu wzrokowego, którym towarzyszą charakterystyczne ubytki w polu widzenia. Jest to choroba społeczna, o zwiększającej się z wiekiem zapadalności. Statystyki światowe określają częstość jej występowania na 2% u osób po 70. roku życia. Jest jedną z częstszych przyczyn ślepoty. Cel pracy. Określenie badania doplerowskiego naczyń tętniczych pozagałkowych w jaskrze u chorych z różnym stopniem zaawansowania choroby oraz określenie w grupie chorych stopnia korelacji otrzymanych wyników z grubością włókien nerwowych siatkówki zmierzonych w optycznej koherentnej tomografii komputerowej. Materiał i metody. Analiza wyników badań własnych przepływów w tętnicach pozagałkowych w grupie kontrolnej i w grupie pacjentów Poradni Jaskrowej Kliniki Okulistyki CSK MON WIM oraz porównanie z wynikami badań perymetrycznych i optycznej tomografii koherentnej. Wyniki. Uzyskano korelację statystyczną przepływów w tętnicach pozagałkowych o różnym stopniu istotności statystycznej. Największa istotność dotyczyła zależności między zmianami w perymetrii a zmniejszeniem przepływów w tętnicy środkowej siatkówki oraz w tętnicach rzęskowych tylnych krótkich. Stwierdzono, że nasileniu degradacji włókien nerwowych siatkówki towarzyszą większe zmiany w perymetrii. Zmniejszenie grubości włókien nerwowych siatkówki dodatnio koreluje ze zmniejszeniem przepływów w tętnicach rzęskowych tylnych krótkich. Wnioski. Stwierdzono korelację między zmniejszeniem przepływów w tętnicach pozagałkowych a nasileniem zmian czynnościowych oraz strukturalnych u osób w różnym stopniu zaawansowania choroby jaskrowej.
Słowa kluczowe: jaskra pierwotna otwartego kąta, USG doplerowskie

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Introduction

Primary open-angle glaucoma, also known as simple glaucoma, is the most common form of glaucoma, although its etiology is still not fully understood. It is a social disease of age-related incidence. According to global statistics, it affects approx. 0.2% of the population over 55 years old, and 2% of individuals over 70 years old, making it one of the most common causes of blindness in developed countries [1]. The published epidemiological data indicate that about 68 million people around the world suffer from glaucoma, of which 7 million are legally considered blind. It is also estimated that approximately 18-20% of blind people lose their sight due to glaucoma, and that the number of glaucoma patients will increase to over 79 million by 2020 [1]. Polish epidemiological studies on glaucoma conducted among the citizens of Wrocław in the years 1999-2002 demonstrated that 7 in 10 people diagnosed with this disease had not known about it [2]. One of the reasons for late diagnosis is a minimally symptomatic course of the disease, as well as the fact that in about 30% of patients normal-tension glaucoma develops, without increased intraocular pressure. Late diagnosis and inappropriate treatment of glaucoma patients result in health, social and economic problems associated with loss of vision. The social consequences of the disease raise questions and motivates analysis of the pharmacoeconomic aspects [3].

It seems that in the pathogenesis of this disease ischemia and resulting damage to the optic nerve are of primary importance. The success or failure of the treatment depends on early diagnosis, which enables the introduction of therapy, and thus a possibly long preservation of the functional field of vision and visual acuity [4]. Recommended diagnostic tests in glaucoma include: assessment of the appearance of the optic nerve head and retinal nerve fibers using ophthalmoscopy, measurement of the intraocular pressure, assessment of the iridocorneal angle using a gonioscope, examination of the field of vision with standard automated perimetry, measurement of the central corneal thickness, and assessment of the morphology of the optic nerve head, thickness of the retinal nerve fibers and the retinal ganglion cell complex using scanning techniques (optical coherence tomography, confocal laser ophthalmoscopy, and scanning laser polarimetry). Doppler ultrasonography is a convenient, safe and non-invasive method for the quantitative and qualitative evaluation of hemodynamic changes in the extraocular blood vessels, as well as vascularization of pathological focal lesions in the eye wall and extraocular space. Presently, the test is not performed routinely or required in the diagnostic procedure for glaucoma.

Aim of the study

The aim of the study was to determine values of the Doppler test of the extraocular arterial vessels in glaucoma in patients with different severities of the ocular condition, as well as to determine the correlation levels between the resulting data and the thickness of the retinal nerve fibers measured with computer optical coherence tomography.

Material and methods

The study project was accepted by the Bioethical Committee of the Military Institute of Medicine (resolution no. 10/WIM/2011 from 23/02/2011). All patients included in the project expressed an informed consent for the study and use of the results for scientific purposes.

Primary open-angle glaucoma patients included in the analysis presented characteristic changes in the appearance of the optic nerve head, and corresponding deficits in the field of vision. The exclusion criteria included: ocular hypertension, secondary open-angle glaucoma, closed-angle glaucoma, history of eye injury, eye surgery within less than 6 months from the study, diabetic retinopathy and other chronic diseases of the retina, myopia of over -6 D, chronic cardiovascular diseases (unstable coronary disease, cardiac rhythm disorders, ill-managed or malignant arterial hypertension), stenosis of the carotid arteries resulting in changes of the blood flow rate and/or signs of turbulent blood flow at the stenosis and behind it.

The study involved 49 patients from the Glaucoma Clinic of the Department of Ophthalmology, Military Institute of Medicine, including 18 males and 31 females, aged 67 ± 11 years old, with clinical suspicion or diagnosis of primary open-angle glaucoma. The study was conducted between 2009 and 2011. The control group comprised 11 patients: 3 males and 8 females, aged 63 ± 8 years old. There were no statistical differences between the groups in age, concomitant diseases such as arterial hypertension, migraine, Raynaud's disease or family history of glaucoma. 89 eyes in the group of ill patients, and 22 eyes in the control group were analyzed.

With the consent of the Head of the Department of Ophthalmology, the author used the results of the intraocular pressure test, perimetric test, and reports from optical coherence tomography (OCT) examinations. The results of the perimetric tests enabled division of the patients into subgroups (Table 1).

The Doppler test involved morphological and hemodynamic assessment of the common and internal carotid arteries, evaluation of the blood flow parameters in the ocular artery, measured at approximately 35-40 mm behind the eyeball, assessment of the blood flow parameters in the central retinal artery, approximately 2 mm behind the eyeball, evaluation of Doppler parameters in the nasal short posterior ciliary artery, measured 1-5 mm behind the eyeball, and assessment of the Doppler parameters in the temporal short posterior ciliary artery, measured 1-5 mm behind the eyeball.

Table 1. Patients with glaucoma by perimetry test results
Tabela 1. Podział chorych według wyników badania perymetrycznego

Group	Parameter MD	Parameter PSD
IA	0 to -3 dB	0 to -2 dB
IB	3.01 to -6 dB	over -2.01 dB
II	6.01 to -12 dB	
III	12.01 dB and more	

Table 2. Diagnostic criteria for degrees of stenosis according to Robinson
Tabela 2. Kryteria diagnostyczne stopnia zwężenia naczynia wg Robinsona

Narrowing of the diameter (%)	Peak systolic blood flow (m/s)	End diastolic blood flow (m/s)	ICA/CCA systolic blood flow ratio
50	>1.5	>0.5	>2
70	>2.3	>0.75	>3

The analysis involved maximum flow rate in the vessel, end diastolic flow, the Pourcelot index, and the Gosling pulsatility index in each artery.

In the examination of the internal carotid arteries with visible stenoses, the maximum blood flow at the stenosis and in the ipsilateral common carotid artery was determined, and the morphology of the stenosis was assessed by measurement of the diameters and field of the light surface.

To estimate the degree of stenosis in the internal carotid artery, the relevant Robinson's diagnostic criteria for 50% and 70% stenosis were used, as presented in Table 2 [5].

Results

On the basis of the Doppler test, the mean values of blood flow parameters in the created subgroups of arterial vessels were determined. The results are presented in Table 3. Changes in blood flow were determined in individual vessels.

Table 3. Mean arterial Doppler test values for individual subgroups and control group
Tabela 3. Średnie wartości doplerowskie w naczyniach tętniczych dla poszczególnych podgrup badanych i grupy kontrolnej

Name of the vessel	Parameter	Control group (C)	Group IA	Group IB	Group II	Group III
Ocular artery	Vmax. (cm/s)	41.90	40.70	38.70	35.55	32.50
	Vmin. (cm/s)	12.75	10.50	9.30	6.85	7.20
	Rl	0.71	0.71	0.75	0.78	0.77
	PI	1.27	1.32	1.48	1.54	1.51
Central retinal artery	Vmax. (cm/s)	14.4	9.70	9.30	9.65	8.60
	Vmin. (cm/s)	4.15	3.40	2.80	2.95	2.20
	Rl	0.68	0.68	0.70	0.71	0.74
	PI	1.17	1.19	1.21	1.25	1.38
Short posterior ciliary artery (nasal)	Vmax. (cm/s)	12.95	8.60	8.40	8.10	7.80
	Vmin. (cm/s)	5.00	3.50	2.60	2.80	2.80
	Rl	0.61	0.58	0.66	0.71	0.66
	PI	0.99	0.86	1.09	1.33	1.19
Short posterior ciliary artery (temporal)	Vmax. (cm/s)	13.00	8.10	8.30	7.90	8.20
	Vmin. (cm/s)	4.90	3.40	2.80	2.70	2.70
	Rl	0.62	0.59	0.65	0.69	0.68
	PI	0.99	0.92	1.04	1.18	1.19

In the blood flow of the ocular artery, the highest mean maximum blood flow was observed in the control group, and the lowest in patients with the highest degree of clinical advancement of glaucoma, although the correlation was not statistically significant. Similar relations were observed for end diastolic flow; however, this correlation was statistically significant ($p = 0.01$). The blood flow resistivity index and vessel pulsatility index also demonstrated variations, with the lowest values found in the control group, and the highest ones in patients with moderately and highly advanced glaucoma. Similarly to the "maximum flow" parameter, the differences were not statistically significant. In the case of smaller vessels, directly responsible for vascularization of the optic nerve head area, i.e. the central retinal artery and short posterior ciliary arteries, statistically significant correlations were observed between the control group and other patients with advanced deficits in the field of vision ($p < 0.001$). The results of the analysis are presented on the diagrams in Figure 1.

In the further analyses, the results from optical coherence tomography performed by the personnel of the Department of Ophthalmology of the Military Institute of Medicine were retrospectively used. The highest values were observed in patients with the smallest deficits in the field of vision (group IA), and the lowest values were found in patients with advanced glaucoma (group III).

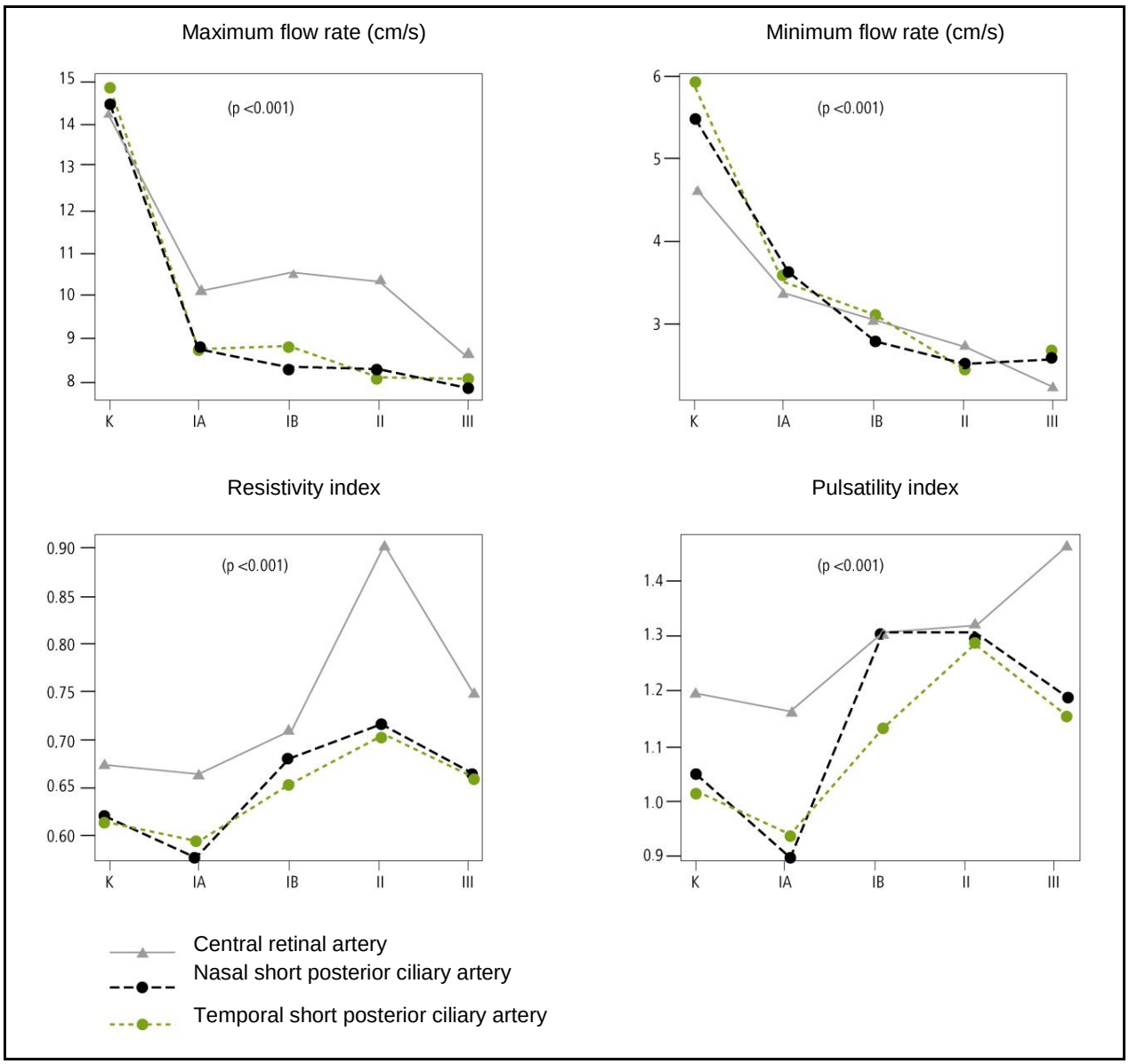

Figure 1. Summary of mean Doppler parameter values of the extraocular arterial vessels by subgroup
Rycina 1. Zbiorcze zestawienie średnich wartości parametrów doplerowskich w naczyniach tętniczych pozagałkowych w podgrupach

Table 4. Mean values of retinal fiber thickness and standard deviations for the study groups (μm)
Tabela 4. Średnie wartości grubości włókien siatkówki oraz odchylenia standardowe dla grup badanych (μm)

Group	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD
IA	51.00	64.00	71.00	73.87	83.50	114.00	15.18
IB	35.00	56.75	66.50	71.75	87.25	120.00	20.17
II	22.00	56.00	64.50	60.58	72.25	86.00	19.14
III	1.00	36.00	46.00	48.20	62.00	85.00	22.73

Table 5. Statistical differences average thickness of retinal nerve fibers in the study groups
Tabela 5. Różnice statystyczne pomiaru średniej grubości włókien nerwowych siatkówki w badanych grupach

ANOVA (analyses of variance)
Result of ANOVA test: p-value: 0.00019; F: 7.4; df: 3

	IA	**IB**	**II**	**III**
IA	"	difference = 2.1 p = 0.65	difference = 13 p = 0.046 significant difference	difference = 26 p = 0.00074 significant difference
IB	difference = -2.1 p = 0.65	-	difference = 11 P = 0.11	difference = 24 p = 0.0024 significant difference
II	difference = -2.1 p = 0.65	difference = -11 P = 0.11	-	difference = 12 p = 0.14
III	difference = -26 p = 0.00074 significant difference	difference = -24 p = 0.0024 significant difference	difference = -22 p = 0.14	-

The mean values and standard deviations of the thickness of the retinal nerve fibers are presented in Table 4.

The obtained values were analyzed using the ANOVA statistical test. No significant differences between patients in groups IA and IB were found. However, in the analysis of paired variables between groups IA-II and IA-III, differences of definite statistical significance were observed ($p < 0.05$). The results are presented in Table 5. Short posterior ciliary arteries are small vessels directly involved in the vascularization of the optic nerve head, and can be selectively identified and examined with the use of advanced Doppler ultrasonography. The results were used to determine the degree of correlation between variations in the Doppler parameters and the thickness of the retinal nerve fibers. In the case of maximum blood flow in the ciliary vessels, lower flow rate values corresponded to lower thickness of the retinal nerve fibers ($p < 0.05$). Similar correlations were observed in the analysis of the relationships between end diastolic flow and mean thickness of the retinal nerve fibers ($p = 0.002$). Simultaneously, increased resistance and pulsatility in vessels was found to clearly correlate inversely with the reduction in the thickness of the retinal nerve fibers ($p = 0.002$). The statistical analysis of the results is presented in Figure 2.

Discussion

Glaucomatous neuropathy is characterized by structural changes in the optic nerve head, accompanied by characteristic deficits in the field of vision, detectable in a perimetric examination. The changes consist of progressive damage to the optic nerve and the formation of specific morphological changes within the head and in the retinal nerve fibers [6]. Optical tomography examination allows the determination of the degree of clinical advancement of the disease. Doppler testing of the extraocular arteries is presently the only non-invasive, highly sensitive method with repeatable measurements. Studies on the usefulness of this diagnostic method clearly accept it as a tool to be used in medical practice [7]. Also in Poland this test has numerous recognized advocates. In a publication from 1997, Tołwiński and Stankiewicz et al. emphasized that "no other imaging technique enables examination of such small vessels" [8]. In glaucoma patients the detection of blood flow disorders in the extraocular arteries responsible indirectly and directly for vascularization of the area near the optic nerve head can be useful in the diagnostics and monitoring of treatment progress, regardless of the cause of the disease or therapeutic method. The author of this article performed a Doppler examination of extraocular arteries, and the results were correlated using statistical analyses with the results of perimetric tests. The resulting values indicate a correlation between reduced blood flow in extraocular arteries, and the advancement of functional deficits. Statistically significant correlations include reduced blood flow in the central retinal artery and in the short posterior ciliary arteries, which are directly responsible for vascularization of the area near the optic nerve head. The results are consistent with the majority of works in this subject area. The correlations are confirmed, for example, by the metaanalysis of test results from the years 1995-2012, involving 1,286 eyeballs of glaucoma patients, and 1,052 eyeballs in the control group, published in 23 research papers. In comparative studies selection of homogenous age groups is important, as it considerably determines the results of the Doppler assessment.

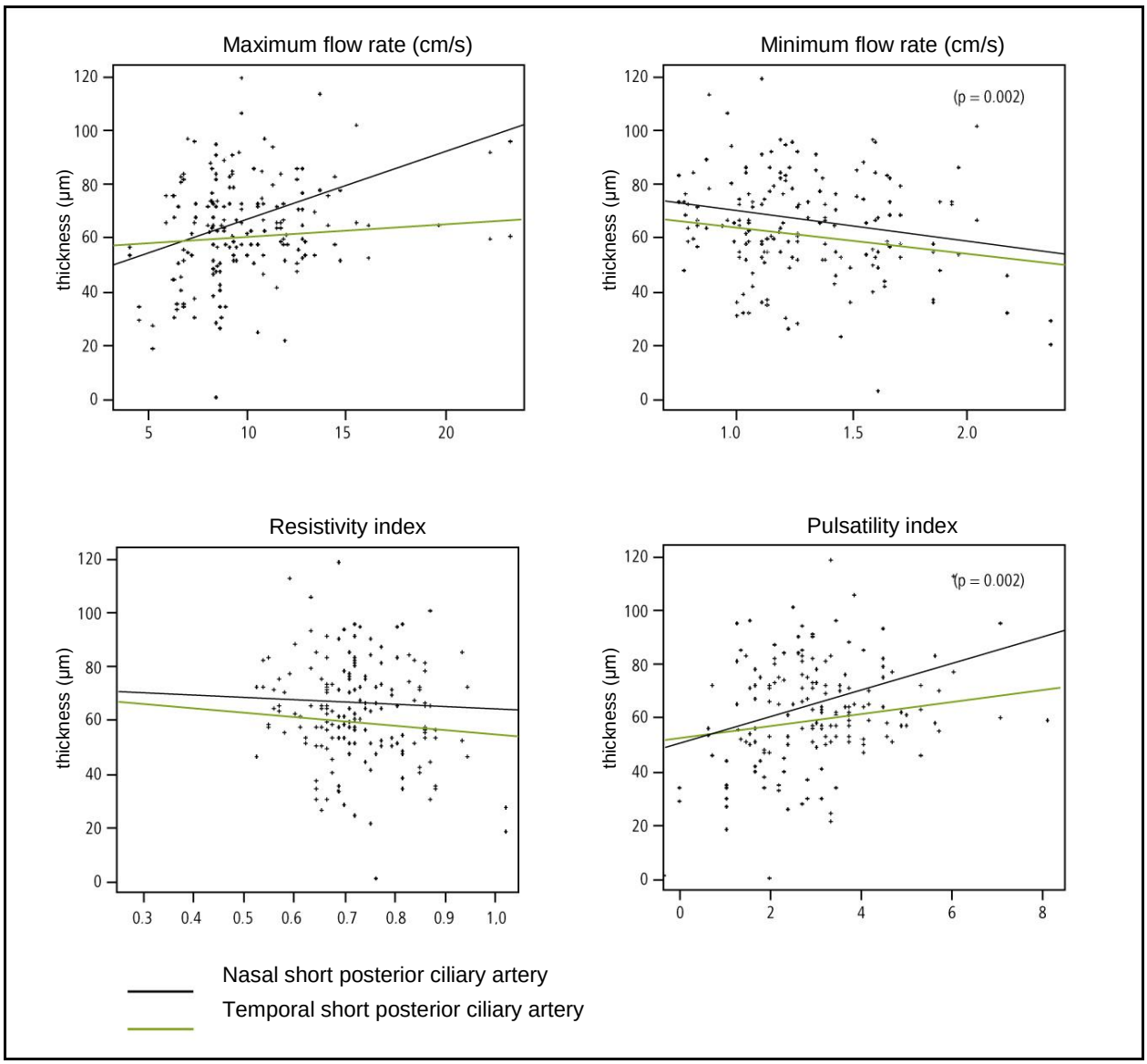

Figure 2. Relationship between flow parameters in nasal and temporal ciliary arteries and thickness of retinal nerve fibers
Rycina 2. Zależności między parametrami przepływów w tętnicach rzęskowych strony nosowej i skroniowej a grubością włókien nerwowych siatkówki

It was also confirmed by studies from the late 1990s [10]. Numerous researchers, including Galassi, Meyer et al., demonstrated hemodynamic changes in elderly patients, resulting in deteriorated eye perfusion in the form of reduced maximum blood flow and end diastolic flow in the ocular artery, as well as reduced end diastolic flow and increased resistivity index in the retinal central artery and in the short posterior ciliary arteries [11]. Similar results were presented in the study by Williamson et al. [12]. The authors found age-related reduction in the blood flow in the ocular artery and short posterior ciliary arteries, although no significant correlations were found between age and blood flow in the retinal central artery.

One of the hypotheses regarding the pathogenesis of glaucoma is the theory of ischemia and apoptosis of the ganglion cells of the optic nerve head, and increased regional involutional changes in the layer of retinal ganglion cells.

A reduction in the layer of retinal nerve fibers, measured by optical coherence tomography, was observed in patients, correlating with perimetric changes. These conclusions correspond to the present common

belief that the loss of axons of the retinal ganglion cells is proportionate to the reduction in the sensitivity of retina, and thus to the occurrence and gradual progression of deficits in the field of vision. Although both methods – perimetry and OCT – are used for the assessment of early glaucomatous lesions, their sensitivity, given the present state of knowledge, is not satisfactory. It is estimated that a deficit in the field of vision in the form of scotoma, measurable in a perimetric test, requires the degeneration of about 25-50% of the ganglion cells [13]. The level of degradation of the retinal nerve fibers correlated with reduced blood flow in the short posterior ciliary arteries. Statistically stronger correlations involved end diastolic blood flow rate, and values of the resistivity index and pulsatility index ($p = 0.002$). The study was limited by the small number of patients in the groups, and the lack of prolonged observation, which affects the effectiveness of the statistical tests. The relationship between changes detected in a Doppler test and morphological lesions found in optical coherence tomography, as well as with the time of observation, was demonstrated in the work by Tobe and Harris from 2015 [14]. The authors monitored 103 patients with primary open-angle glaucoma for 18 months. They found that blood flow reduction in the extraocular and retinal vessels was highly associated with the progression of structural lesions.

Conclusions

The Color Doppler test enables a non-invasive visualization of the sampling sites, and quantitative assessment of blood flow in the ocular, retinal central and short posterior ciliary arteries.

There is a relationship between reduced blood flow in the ocular artery and the degree of clinical advancement of primary open-angle glaucoma. A statistical relationship was demonstrated for the end diastolic blood flow in this vessel.

A strong statistical correlation was found between reduced blood flow in the retinal central arteries and the short posterior ciliary arteries, and the advancement of the deficits in the field of vision in patients with different severities of primary open-angle glaucoma.

The thickness of the retinal nerve fibers, measured in optical coherence tomography, decreases along with the severity of the clinical changes.

A reduction was demonstrated in blood flow in the short posterior ciliary arteries, correlating with reduced thickness of the retinal nerve fibers.

Literature

1. Jaskra. [Glaucoma] In: Niżankowska MH. Podstawy okulistyki. [Basic ophtalmology] Wydawnictwo Volumed, Wroclaw 1992: 194
2. Niżankowska MH, Kaczmarek R, Jakubaszenko J. Detection level of glaucoma and ocular hypertension in Wroclaw population. Wroclaw Epidemiological Study. Adv Clin Exp Med, 2004; 13: 607-613
3. Radwański R, Gerkowicz M. Porównanie kosztów leczenia zachowawczego i operacyjnego jaskry. [Comparison of the costs of conservative and surgical treatment of glaucoma] Okulistyka, 2003; 3: 41
4. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Brit J Ophthalmol, 2006; 90: 262-267
5. Jakubowski W. Standardy Polskiego Towarzystwa Ultrasonograficznego 2003. [Standards of the Polish Ultrasonographic Society 2003] Roztoczańska Szkoła Ultrasonografii Wydawnictwo, Warsaw 2003
6. Flammer J, Mozaffarieh M. What is the present pathogenetic concept of glaucomatous optic neuropathy? Surv Ophthalmol, 2007; 52 (Suppl 2): 162-173
7. Matthiessen ET, Zeitz 0, Richard G, Klemm M. Reproducibility of blood flow velocity measurements using color decoded Doppler imaging. Eye (Lond), 2004; 18 (4): 400-405
8. Tołwiński R, Tarasów E, Szulc S, et al. Zastosowanie kolorowej ultrasonografii dopplerowskiej do oceny przepływów w naczyniach oczodołu. [Color Doppler ultrasonography in the assessment of blood flow in the orbital vessels] Klinika Oczna, 1997; 99:359-362
9. Nana M, Ping Z. Color Doppler imaging analysis of retrobulbar blood flow velocities in primary open-angle glaucomatous eyes: a meta-analysis. PLoS ONE, 2013; V: 1-12
10. Williamson TH, Lowe GD0, Baxter GM. Influence of age, systemic blood pressure, smoking and blood viscosity on orbital blood velocities. Br J Ophthalmol, 1995; 79: 17-22
11. Galassi F, Nuzzaci G, Sodi A, et al. Possible correlations of ocular blood flow parameters with intraocular pressure and visual-field alterations in glaucoma: a study by means of color Doppler imaging. Opthalmologica, 1994; 208: 304-308
12. Williamson TH, Lowe GD0, Baxter GM. Influence of age, systemic blood pressure, smoking and blood viscosity on orbital blood velocities. Br J Ophthalmol, 1995; 79: 17-22
13. Zaleska-Żmijewska A. Diagnostyka i monitorowanie uszkodzenia strukturalnego włókien nerwowych w przebiegu jaskry. [Diagnostics and monitoring of structural damage to the nerve fibers in glaucoma] Okulistyka, 2010; 4 (12): 5-20
14. Tobe LA, Harris A, Hussain RM, et al. The role of retrobulbar and retinal circulation on optic nerve head and retinal nerve fiber layer structure in patients with open-angle glaucoma over an 18-month period. Br J Ophhtalmol, 2015; 99(5):609-612

Experiences with evaluating risk factors connected with wound healing after laparoscopic cholecystectomy

Ocena czynników ryzyka wpływających na gojenie się ran po cholecystektomii laparoskopowej – doświadczenia własne

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Abstract. A laparoscopic cholecystectomy is at the moment a "gold standard" surgical treatment for patients with chronic cholecystitis calculosa. The aim of our study was to determine the factors associated with patients (modifiable and non-modifiable) that significantly affect the process of wound healing after laparoscopic cholecystectomy. Based on the work, the authors conclude that wound healing after cholecystectomy is adversely affected by non-modifiable factors: age over 41 and male gender, as well as modifiable ones: diabetes, being overweight, obesity and smoking.
Keywords: laparoscopic cholecystectomy, wound healing, complications

Streszczenie. Cholecystektomia laparoskopowa jest obecnie „złotym standardem" leczenia operacyjnego chorych z przewlekłym kamiczym zapaleniem pęcherzyka żółciowego. Celem pracy było ustalenie czynników związanych z pacjentem (modyfikowalnych i niemodyfikowalnych), które wpływają w znaczący sposób na proces gojenia się rany pooperacyjnej po cholecystektomii laparoskopowej. Na podstawie naszej pracy wyciągnęliśmy wnioski, że na proces gojenia się ran po cholecystektomii negatywny wpływ mają czynniki niemodyfikowalne, takie jak wiek powyżej 41. roku życia i płeć męska, oraz modyfikowalne, takie jak cukrzyca, nadwaga i otyłość, a także palenie tytoniu.
Słowa kluczowe: cholecystektomia laparoskopowa, gojenie rany, powikłania

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Introduction

Laparoscopic cholecystectomy is presently the gold standard in the surgical treatment of patients with chronic cholecystitis calculosa. The first such procedure was performed in 1987 (Mouret in Lyon), and then four years later in Poland. Laparoscopic surgery began to flourish in the 1990s, associated with the learning curve of surgeons performing laparoscopic procedures as well as with introduction of new, improved instruments. Compared to classic cholecystectomy, laparoscopic cholecystectomy is associated with lower complication rates, faster return to professional activity, better cosmetic effects and reduced pain. Presently, laparoscopic cholecystectomy in most centers is performed as a one-day hospitalization. However, the method is not free of complications, both local and general. The incidence of complications is estimated to oscillate between 8 and 18%, depending on the center performing the procedure [1, 2].

Healing of the post-operative wound is affected by numerous factors: local, general systemic and external. These may have positive effects on the regeneration processes, but also slow them down, or completely prevent proper healing. It should also be noted that the mean age of patients undergoing planned surgeries is increasing, with greater age influencing the process of tissue healing [3].

Apart from non-modifiable factors (age, gender, comorbidities, previous chemotherapy and radiotherapy), the organism is also affected by modifiable factors (smoking, stabilization of glycaemia, and body weight). While qualifying patients for the procedure, it is good to demonstrate how they should consciously prepare for the surgery, and how they can reduce the risk of complications in the form of a difficult to heal, post-operative wound [4].

Aim of the study

The aim was to identify the modifiable and non-modifiable factors associated with patients that significantly affect the wound healing process following laparoscopic cholecystectomy.

Material and methods

The study material was provided by patients undergoing surgery in the Department of Thoracic, General and Oncological Surgery in the years 2014-2015 due to chronic cholecystitis calculosa. After hospitalization, the patients were qualified for further healthcare in the hospital's General Surgery Clinic (for 30 days following the surgery). All patients received perioperative infection prophylaxis in the form of a single dose of 1.0 g intravenous cefazolin before the operation.

The study group consisted of patients who participated in a follow-up visit (post-hospitalization) at our surgical clinic, i.e. a total of 295 patients (212 females and 83 males).

The available medical records from the hospital (regarding hospitalization period) and from the General Surgery Clinic were retrospectively analyzed.

Results

The study group was divided according to age and gender, with factors such as comorbidities, BMI and smoking also being analyzed.

The statistical analysis was performed using Statistica 6, and non-parametric values were used for the calculations: Kolmogorov-Smirnov test and correlation test.

Among the 295 study subjects who underwent a follow-up visit at the General Surgery Clinic, complications in the form of difficult wound healing occurred in 17 patients (5.7%). Disturbed wound healing was defined as the presence of at least one of the following: redness, pain, edema, purulent or periwound oozing, or hematoma in the wound.

In 8 subjects hematoma in the post-operative wound occurred, and was absorbed after administration of heparin gel, 6 patients experienced wound redness and edema (effectively treated locally with metronidazole gel and ketoprofen gel), in 2 cases we observed hematoma in the wound below the navel requiring evacuation and wound healing by granulation, while in 1 case limited periwound oozing occurred after removal of the skin sutures, but disappeared spontaneously after 2 days.

Characteristics according to gender and age

The studied group included 212 female (72%) and 83 male (28%) patients. Disturbed healing was found in 10 (4.8%) females and in 7 (8.4%) males.

The mean age of the patients was 61 years: 63 years in the female group, and 59 years in the male group. Difficult healing was observed in 8.7% of patients over 60 years old, in 8.5% of patients between 51 and 60 years old, and 3.1% of patients between 40 and 50 years old. The correlations between difficult wound healing and age are presented in Figure 1.

Characteristics according to comorbidities

In the study group 74 subjects (25%) suffered from diabetes, and among the patients with disturbed wound healing 7 patients had diabetes (41%) ($r = 0.9$). Moreover, 118 patients (40%) had arterial hypertension, and in the group of subjects with disturbed healing 42% were AH patients ($r = 0.2$).

Characteristics according to BMI

In the study group 3 patients were underweight (BMI 17.0–18.49), 154 had normal weight (BMI 18.5–24.99), 121 were overweight (BMI 25.0–29.99), and 17 were obese (1st degree) (BMI 30.0–34.99). Difficult wound healing occurred in 5 patients with normal body weight, in 11 overweight patients and in 1 patient with 1st degree obesity.

The correlations between BMI of the patients and difficult wound healing are presented in Figure 2.

Characteristics according to BMI

In the study group 124 subjects (42%) were habitual smokers, 80 subjects (27%) formerly smoked (more than 6 months since quitting smoking), and 91 subjects (31%) had never smoked.

In the group of patients with disturbed wound healing, 15 patients (88%) smoked tobacco ($r = 1.0$), while in the group of subjects who never smoked or had not been smoking for at least 6 months only 2 patients experienced wound healing difficulties (1.2%).

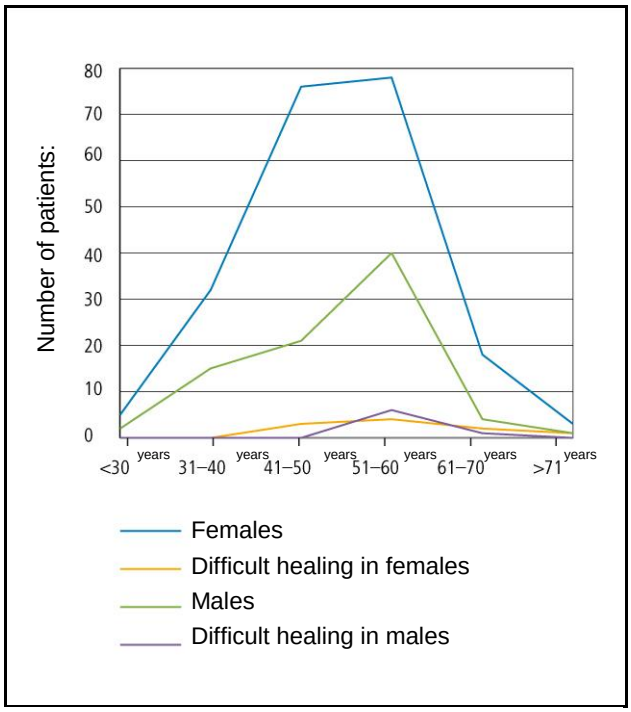

Figure 1. Prevalence of difficult healing depending on gender and age
Rycina 1. Występowanie utrudnionego gojenia w zależności od płci i wieku

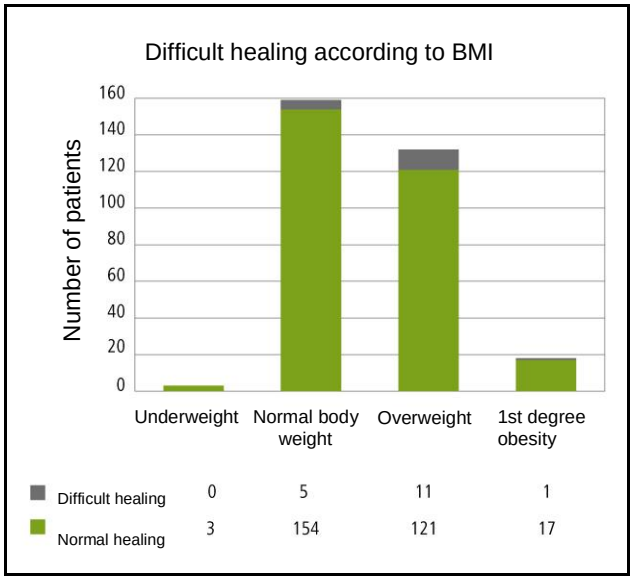

Figure 2. Prevalence of difficult healing depending on BMI
Rycina 2. Występowanie utrudnionego gojenia w zależności od BMI

Discussion

The reconstructive mechanisms associated with post-operative wound healing are intended to restore tissue continuity and full performance of the organism as soon as possible. Any factor that slows down tissue regeneration is an increased risk factor for difficult post-operative wound healing (both regarding modifiable and non-modifiable factors).

The average life expectancy of the general population is increasing, and according to demographic data our society is ageing. Advanced age is not a contradiction for surgical treatment any more, and performing planned operations after proper preparation of the patient and in optimal conditions can reduce the number of complications. We should also bear in mind that between 17 and 65 years of age, each year increases the risk of post-operative wound infection by 1.1%, and after 65 year of age it decreases by 1.2% per year [1, 5]. These observations are based on the knowledge that immune reactions in elderly patients are weaker. As a result of thymic involution in puberty, the lymphocyte T count is reduced in relation to the CD4 and CD8 memory lymphocyte count; as a result, elderly patients have a limited ability to fight infections caused by microorganisms to which they have never been exposed. Moreover, the number of lymphocyte proliferation centers in the lymph nodes continues to decrease [1, 6].

In our study we also observed that the number of patients with disturbed wound healing following cholecystectomy increased with age. In male patients a significant increase was found in the group over 51 years old, and in female patients in the group over 41 years old.

In the literature, there are reports on the predisposition of male patients to operating site infections [1]. In our material we observed a similar tendency: complications in the form of disturbed wound healing were found in 7 males (8.4%) (r = 0.8) and 10 females (4.8%).

Another factor affecting post-operative wound healing is diabetes, particularly the insulin-dependent type. It is very important to maintain proper glycaemia in the perioperative and post-operative periods (preferred values are 100-140 mg/dl). The literature places emphasis on the problem of the impaired bactericidal activity of granulocytes in patients with unstable diabetes and chronic hyperglycemia. Neuropathic and microangiopathic processes are also important, as they adversely affect wound healing [6, 7].

In our material, 25% of the patients had diabetes, while 41% of the group with disturbed healing also had diabetes. This was a significant and statistically strong correlation (r = 0.9).

Arterial hypertension did not have a significant statistical effect on the wound healing process. In the study group the correlation coefficient was only r = 0.2.

Obesity is often associated with diabetes as excessive fat tissue induces the development of insulin resistance.

Both characteristics are related, and are linked to the fact that poorly vascularized abdominal fat tissue is difficult to heal and susceptible to infections. Infections of trocar wounds are smaller than those after classic operations, but in case of obese patients the rate is significantly higher [8, 9].

Our material also demonstrates a statistical correlation between the occurrence of overweight conditions or obesity and difficult wound healing. Difficult wound healing following cholecystectomy occurred in 3.2% of patients with a normal weight, in 9.1% of overweight patients, and in 5.9% of patients with 1st degree obesity. This correlation was confirmed in the study by Bamgbade [8].

Smoking tobacco is one of the modifiable factors affecting the process of post-operative wound healing. In patients who smoke the phagocytic activity of monocytes and granulocytes is impaired; also, increased blood clotting and reduced tissue oxygenation are important. Reduced collagen production in patients who smoke also directly affects the process of wound healing and the formation of post-operative scar [10-12].

Before planned surgeries, it is important to inform patients that giving up smoking for 3 or, preferably, 6 weeks prior to the procedure will significantly reduce the risk of post-operative complications in the form of disturbed wound healing and surgical site infection [13, 14].

This correlation is clearly visible in our material: in the group of patients with disturbed healing 15 patients smoked tobacco, i.e. 88% of the group. In the group of patients who never smoked or had not smoked for at least 6 months it was only 1.2% (2 patients).

Conclusions

The process of wound healing following cholecystectomy is adversely affected by non-modifiable factors, such as age over 41 years and male gender, as well as by modifiable ones, such as unstable diabetes, obesity or being overweight, and smoking tobacco.

Literature

1. Rogoziński P, Bruliński K, Malinowski E, Kucharzewski M. Retrospektywna analiza i ocena czynników ryzyka wystąpienia zakażenia rany operacyjnej u chorych w podeszłym wieku operowanych w latach 2006-2008 w Oddziale Chirurgii Klatki Piersiowej Specjalistycznego Zespołu Chorób Płuc i Gruźlicy w Bystrej. [Retrospective anaysis and assessment of risk factors for surgical wound infection in elderly patients operated in the years 2006-2008 in the Department of Thoracic Surgery, Specialist Team for Pulmonary Diseases and Tuberculosis in Bystra] Lecz Ran, 2012; 9: 43-49
2. Malone D, Genuit T, Tracy J et al. Surgical site infections: reanalysis of risk factors. J Surg Res, 2002; 103: 89-95
3. Kaye K, Schmader K, Sawyer R. Surgical site infection in the elderly population. Clin Infect Dis, 2004; 15: 1835-1841
4. Kopeć B, Marciniak R. Analiza powikłań u pacjentów operowanych z powodu objawowej kamicy pęcherzyka żółciowego w materiale własnym. [Analysis of complications in patients operated due to symptomatic cholelithiasis based on own materials] Now Lek, 2008; 77:183-189
5. Markert R, Januszewski J, Modzelewski B. Cholecystektomia laparoskopowa metoda z wyboru u osób w wieku podeszłym. [Laparoscopic cholecystectomy as a method of choice in elderly patients] Wiad Lek, 2005; 58: 626-629
6. Chuang S, Lee K, Chang W et al. Risk factors for wound infection after cholecystectomy. J Formos Med Assoc, 2004; 103: 607-612
7. Bodmer M, Brauchli Y, Jick S, Meier C. Diabetes mellitus and the risk of cholecystectomy. Dig Liver Dis, 2011; 43: 742-747
8. Bamgbade 0, Rutter T, Nafiu 0, Dorje P. Postoperative complications in obese and non-obese patients. World J Surg, 2007; 31: 556-560
9. Anaya D, Dellinger E. The obese surgical patient: a susceptible host for infection. Surg Infect, 2006; 7: 473-480
10. Paszkiewicz-Mes E. Palenie tytoniu w aspekcie powikłań występujących po zabiegu operacyjnym. [Tobacco smoking in the context of post-operative complications] Probl Hig Epidemiol, 2012; 93: 249-255
11. Dudzińska K, Mayzer-Zawadzka E. Wpływ palenia tytoniu na okres pooperacyjny. [Effects of tobacco smoking on the post-operative period] Anest Inten Terap, 2008; 40: 108-113
12. Pirogowicz I, Gwiazda E, Hoffman K et al. Palenie papierosów a zaburzenia odporności. [Tobacco smoking and impaired immune function] Przegl Lek, 2007; 64: 886-888
13. Warner D. Postoperative smoking cessation: How long enough? Anesthesiology, 2005; 102: 883-884
14. Molier A, Villebro N, Pedersen T et al. Effect of preoperative smoking intervention on postoperative complications: randomized clinical trial. Lancet, 2002; 359: 114-117

Nanosecond lasers in age-related macular degeneration treatment – is there any real chance of inhibiting the disease process?

Zastosowanie lasera nanosekundowego w leczeniu zwyrodnienia plamki związanego z wiekiem - czy istnieje realna szansa na zatrzymanie procesu chorobowego?

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Abstract. The aim of the article is to present a new retinal rejuvenation therapy (2RT). This therapy uses an ultra-low energy nanosecond laser to slow the progression of the early stages of age-related macular degeneration (AMD). It consists of highly selective impacts using very short 3-nanosecond (3ns) laser pulses on the retinal pigment epithelium melanosomes without thermal injury. The 3ns laser is regarded as being able to induce migration of the RPE cells and to release the metalloproteinases matrix, thus improving the hydraulic conductivity of Bruch's membrane. The literature discusses the safety, changes in fundus characteristics and macular function after retinal rejuvenation therapy in patients with bilateral intermediate AMD. A single unilateral retinal rejuvenation therapy may produce bilateral improvement in macula appearance and function. Research is underway to recognize the effects of retinal rejuvenation therapy on the course of age-related macular degeneration. The usefulness of macular perimetry to monitor degeneration after retinal rejuvenation therapy is also being assessed.
Key words: age-related macular degeneration, drusen, macular function, nanosecond laser, retinal rejuvenation therapy

Streszczenie. Celem artykułu jest zaprezentowanie nowej terapii odmładzającej siatkówkę. Wykorzystuje się w niej laser nanosekundowy o ultraniskiej energii do spowolnienia progresji wczesnych stadiów zwyrodnienia plamki związanego z wiekiem. Istotą terapii odmładzającej siatkówkę jest wysoce selektywne oddziaływanie bardzo krótkich - 3-nanosekundowych - impulsów laserowych na melanosomy komórek nabłonka barwnikowego bez ich termicznego uszkodzenia. Uważa się, że laser 3-nanosekundowy indukuje migrację komórek nabłonka barwnikowego i wywołuje uwolnienie metaloproteinaz macierzy, co powoduje poprawę hydraulicznego przewodnictwa błony Brucha. W piśmiennictwie istnieją doniesienia o bezpieczeństwie, zmianach na dnie oka i funkcji plamki u chorych z obustronnym średnio zaawansowanym zwyrodnieniem plamki, którzy zostali poddani terapii odmładzającej siatkówkę. Jednorazowy zabieg odmładzający siatkówkę w jednym oku może powodować obustronną poprawę morfologii i funkcji plamki. Trwają dalsze badania nad wpływem terapii odmładzającej plamkę na przebieg zwyrodnienia plamki związanego z wiekiem. Ocenia się także przydatność badania perymetrycznego plamki do monitorowania zwyrodnienia po terapii odmładzającej siatkówkę.
Słowa kluczowe: zwyrodnienie plamki związane z wiekiem, druzy, laser nanosekundowy, terapia odmładzająca siatkówkę, czynność plamki

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Age-related macular degeneration as a progressive disease

Age-related macular degeneration is the most common pathology of the central retina, and the main cause of blindness in people over 50 years old in developed countries [1-5]. The principal non-modifiable factor of AMD incidence is age. Bird et al. demonstrated that AMD incidence increases from 0.2% in the age group of 55-64 years old to approximately 11% in individuals over 85 years old [2,3]. Other risk factors of AMD development have been identified and described, including female gender, white race, family history, tobacco smoking, cardiovascular diseases and diet [6-9]. One of the major genetic factors of AMD is polymorphism of the *CHF* and *LOC387715* genes [10-12]. In 2015, on the basis of The Blue Mountains Eye Study, data regarding AMD incidence and progression over a period of more than 15 years were published [13]. A strict correlation between age and early or late forms of AMD was demonstrated ($p < 0.0001$). Female gender and the presence of alleles CFH-rs1 061 170 or ARMS2-rs10490924 were independently related to the occurrence of the early stages of AMD. Smoking tobacco and presence of at least one of these alleles was closely correlated with occurrence of late AMD forms. A diet rich in fish significantly protected against late forms of AMD, but it did not prevent the early forms. The advancement of early AMD forms was a strong predictor for progression to late stages. In 2014, Chew et al. published the results of a 5 year prolonged observation of the subjects of the Age-Related Eye Disease Study (AREDS), following randomization to study groups [14]. A significant increase in the risk of degenerative progression to advanced forms related to age, and larger drusen sizes was reported. In females and current tobacco smokers a significantly more frequent occurrence of exudative AMD was observed. In the oldest study subjects, with more advanced baseline degeneration, in 10 years exudative AMD developed in 48.1% of cases, and geographic atrophy including the fovea developed in 26% of cases. The risk of large drusen correlated with their baseline size. In 70.9% of eyes with the initial presence of bilateral moderate drusen, large drusen occurred, and in 13.8% advance forms of AMD developed. Over a 10 year period, in those eyes in which large drusen were initially present, but advanced AMD did not develop, the mean visual acuity was 20/25, and was significantly better compared to 20/200, specific for late AMD stages.

In the pathogenesis of AMD an important role is played by complex, age-related dysfunctions of the anatomical-functional complex comprising photoreceptors, retinal pigment epithelium (RPE), Bruch's membrane (BM) and choriocapillaris [15]. In the space between RPE and BM, accumulations of proteins and lipids with a complement system component (drusen) are formed. The functions and morphology of the RPE cells are disturbed. Similar changes occur in BM, which becomes thicker. As a result, transportation is disturbed of the metabolic products to the choroid, as well as transportation of oxygen and nutrients to the RPE and retina. The described metabolic processes and changes in the morphology of the retina-choroid complex were confirmed in experimental studies using animals [16-17]. In the initial period, the degenerative macular disease may be asymptomatic. As it progresses, visual deterioration and metamorphopsia occur. In advanced process, a central scotoma occurs in the field of vision, and the patient is forced to fixate paracentrally. Reading, performing simple daily activities or even the recognition of familiar faces becomes impossible if AMD develops in both eyes.

Typical macular lesions in AMD are drusen and RPE depigmentations. In late stages geographic atrophy or neovascularisation develop (exudative AMD). In AREDS, on the basis of color photographs of the eye fundus, AMD stage was determined according to the presence of drusen (their size, type, site), RPE abnormalities (increased pigmentation, depigmentation, atrophy), neovascularisation (serous or hemorrhagic RPE detachment, intra- or subretinal hemorrhage, subretinal fibrosis) [18-19]. According to AREDS, advanced AMD forms were defined as the presence of at least one sign of neovascularisation, history of retinal photocoagulation due to AMD, or geographic atrophy including the fovea. Also in the Clinical Age-Related Maculopathy Staging (CARMS) the degeneration stage was determined on the basis of ophthalmoscopic macular examination and color photographs of the eye fundus. The presence of drusen, RPE irregularities, RPE detachments, geographic atrophy and choroidal neovascularisation were taken into account [20]. Ferris et al. developed a clinical classification of degenerative lesions on the basis of macular condition in the area of two heads of the optic nerve, including the fovea, in patients over 55 years old [21]. According to the author, the absence of degenerative changes means a lack of drusen and a lack of RPE depigmentation. Normal, age-related degenerative lesions include the presence of small drusen of < 63 μm, without abnormalities in RPE pigmentation, which equals a lack of increased risk of the development of AMD late stages. The early AMD stage involves medium-sized drusen (>63-<125 μm), without RPE pigmentation disorders. The moderately advanced AMD stage is characterized by the presence of large drusen of >125 μm or/and RPE depigmentation, or medium-sized drusen with RPE depigmentation.

Late AMD is associated with geographic atrophy or macular neovascularisation. In the 5-year observation, Ferris et al. estimated the risk of the development of advanced AMD forms as 0.5% in the case of normal age-related changes, while in the group with moderately advanced AMD the risk was 50%. Klein et al. studied the effect of the size of the area with small and medium-sized drusen on AMD development [22]. The authors analyzed a

group of 3,344 adults, who received ophthalmological tests at 5-year intervals. The area of the macular lesions was determined according to a 4-degree scale, from a minimum of <2,596 μm to a maximum of >9,086 μm. In the 5-year observation period, AMD developed in 3% of eyes without drusen, or with small drusen in a minimum or medium-size area at the baseline. AMD developed in 5% of eyes with an initially large area of small drusen, and in 25% of eyes with initially large area of medium-size drusen. In the eyes with a large baseline area of small drusen, AMD developed significantly more often that in the eyes with an initially medium-size area of small drusen. Similarly, in the eyes with a large baseline area of small drusen, AMD developed significantly more often than in eyes with a medium-size baseline area. In eyes with initially large area of medium-size drusen, AMD developed significantly more often than in eyes with an identical baseline field of small drusen. The results of the analysis conducted by Klein et al. support the hypothesis that the initial presence of a large area of soft drusen in the macula is an important factor in AMD development, followed by the presence of small drusen.

Laser retinal rejuvenation therapy

Considering the chronic and progressive character of AMD, therapies improving the natural defense mechanisms of the macular retina-choroid complex, preventing the progression of degeneration, are being researched. One of them is a laser retinal rejuvenation therapy (2RT). During a 2RT session a 3 nanosecond impulse of Q-switched green laser is used, with a 532 nm wavelength and energy density of 0.2 J/cm^2. It is absorbed selectively by melanin in the melanosomes. Water vapor collects around melanosomes, inducing a selective reaction. The activity of the RPE cells is stimulated, without thermal coagulation of tissues [23]. Conventional laser photocoagulation permanently damages RPE cells and the adjacent external retina [24-25]. A new 2RT therapy using a 3ns laser may injure the RPE cells, but it does not damage the adjacent photoreceptors and their neural connections [26]. As 2RT does not have thermal effects, no significant inflammatory reaction with cell accumulation is observed in the laser focal region [27]. The laser used in the 2RT procedures is thought to induce migration of the RPE cells, and to release the matrix metalloproteinases, which improves the permeability of Bruch's membrane [16, 28]. According to the manufacturer of the laser (Ellex R&D Pty Ltd.), 2RT is recommended for patients with early stage AMD, i.e. with bilateral drusen of >125 μm, with or without RPE depigmentation (hyper- and hypopigmentation) in the macular area with a radius of 3,000 μm, whose center is in the foveola. Contraindications for 2RT include limited access to the eye fundus, other pathologies reducing visual acuity, such as uveitis, advanced glaucoma, presence of macular drusenoid focus of RPE detachment of >1,000 μm, geographic atrophy and chronoidal neovascularisation. Mydriatics are used before the procedure to dilate the pupil to at least 5 mm. Analgesic drops are administered to the conjuctival sac, and a contact lens (Area Centralis Volk Ophthalmic Inc.) is placed in the eyeball to provide 1:1 viewing of the eye fundus. The 2RT laser is combined with a slit lamp. A laser focus of 400 μm in diameter is used during the therapy. The energy of the laser focus ranges from 0.1-0.3 mJ, until retinal whitening outside the vascular arcades is obtained. Next, the laser energy is reduced by 20%, and the final value, used during the procedure, is thus obtained. In AMD therapy 12 laser focuses are used around the macula: 6 in the upper, and 6 in the lower temporal vascular arcade. Drusen sites should not be treated with the laser. The focuses should be spaced at intervals of at least a focus diameter. The laser should not be applied closer than 1 DD (disc diameter - size of the optic nerve head) to the optic nerve and foveola.

A 2RT procedure usually lasts a few to several minutes, and is well-tolerated by patients. The procedure is safe. In case of a too high laser energy of >0.45 mJ, hemorrhages can occur in the laser focal region. In such cases, pressure should be applied on the eyeball through the contact lens. Before the procedure, and during post-2RT follow-up visits, the following should be performed: visual acuity test, fundus autofluorescence (FAF), optical coherence tomography, as well as color photograph of the eye fundus and infrared (IR) photograph of the eye fundus. Laser focuses are not visible directly after the procedure, but three months later they can usually be seen in IR or FAF images. OCT examination occasionally reveals increased signal on the RPE level, corresponding to the laser therapy sites visible in the IR or FAF images. OCT does not demonstrate changes in the photoreceptors or internal retina. As beneficial changes in the macula of the untreated eye are observed, the same tests should be performed simultaneously in the untreated eye as in the 2RT treated one. At an early AMD stage, visual acuity is often normal, therefore more sensitive methods of assessment of the macular retina are used in patients qualified for 2RT or monitored after the procedure. One of the methods is flicker perimetry (FP), which is also important for determining the risk of progression from early to late AMD stages. Luu et al. found a significant reduction in mean retinal sensitivity using FP for eyes with dry AMD, in which geographic atrophy or neovascularisation developed after a few months [29-30].

In 2014, Guymer et al. presented the effects of the 2RT procedures in eyes with baseline moderately advanced AMD [31]. Following the principle of retinal rejuvenation therapy, a nanosecond laser of ultralow energy was used to slow down the progression of early AMD. A prospective, interventional, non-randomized study assessed the safety, macular function and changes in the eye fundus images in 50 patients, aged 50-75 years old, with bilateral, moderately advanced AMD. The 2RT procedure was performed typically. A total of 12 laser focuses of 400 μm diameter, 532 nm wavelength, and energy of 0.15-0.45

mJ, lasting 3 nanoseconds, were applied in the macular area, outside the fovea and the optic nerve head. The Best Corrected Visual Acuity (BCVA), area of the presence of drusen, and sensitivity of the macular retina were examined in FP initially, and 3, 6 and 12 months after the laser therapy. The procedures were not painful and did not leave any clinically detectable changes. Within 12 months, mean visual acuity did not change significantly. Neovascularisation did not occur in any of the patients. Two patients with initially reduced retinal thickness experienced retinal atrophy within 12 months. Drusen were reduced in 44% of eyes treated with 2RT, and in 22% of untreated other eyes. The progression of drusen was observed in 24% of eyes after 2RT, and in 18% of untreated eyes. In cases of drusen reduction, reduced hyperautofluorescence of the same areas was observed in the FAF. No correlation was found between changes regarding drusen and macular function. Improved retinal sensitivity in the central 3° was found 3 months following the procedure, both in the treated eye, and in the other one. In 7 out of 11 eyes with a high risk of AMD progression (baseline deficit in retinal sensitivity demonstrated in FP of >15 dB) a significant improvement in retinal sensitivity was observed. The authors conclude that a single 2RT procedure may result in a bilateral improvement of the macular morphology and function.

In 2015, Jobling et al. published their own results of 2RT procedures [32]. One 2RT procedure was performed on 50 patients, and after 2 years the presence of drusen in the macula was compared with that of untreated patients. The effect of 2RT on the retina of patients and experimental mice was examined with the use of immunohistochemical methods, and compared with untreated eyes. In the mice with thickened BM (ApoEnull) the effect of laser was verified using electron microscopy and quantitative polymerase chain reaction (PCR). After two years from the procedure, drusen reduction was observed in patients undergoing 2RT. The retinal structure following 2RT remained unchanged, both in humans, and in mice. Only small disturbances in the structure of the RPE cells was observed, and a limited response from the mononuclear cells. Three months after the laser surgery, a reduction in BM thickness was reported in mice from the ApoEnull group (BM thickness in ApoEnull mice undergoing the procedure was 683 ±38 nm, in untreated ApoEnull it was 890 ±60 nm). A clear increase in expression of the matrix metalloproteinases -2 and -3 by over 260% was found. On the basis of the results of their own observations, Jobling et al. conclude that 2RT with the use of a nanosecond laser stimulates resolution of drusen without damage to the retina, and improves the BM structure. It appears that 2RT may potentially reduce AMD progression.

Retinologists are also considering the effect of the repeated procedure for the structures of the posterior pole. In 2016, Chidlow et al. published the results of an experimental study on rats undergoing the 2RT procedure [33]. The nanosecond laser was reapplied in the same or overlapping points on the retina, where cellular response and structural integrity were evaluated. The rats were randomized to the following groups: mock procedures, invisible 2RT focuses, 2RT focuses invisible in the second procedure, visible 2RT focuses, and 2RT focuses visible in the second procedure. The procedures were repeated on day 0 and day 21, with a one-time procedure performed on the latter day of the study. On day 28 the rats were euthanized, and the eyeballs were examined in immunohistochemical tests. The final analysis included the assessment of the vascular integrity of the retinal and choroid regions subjected to laser, evaluation of RPE morphology, condition of the photoreceptors and glia. Repeated application of the laser was found to induce an identical response in the retina-RPE-choroid complex as the first-time procedure. On day 7 following the procedure, restoration of the population of RPE cells in the laser therapy sites was observed. No significant histopathological differences were found between the areas subjected to a single or repeated 2RT. No measurable differences were found in the structure of photoreceptors and external retina which could be associated with the number or procedures. There were also no signs of increased microglial activity or neovascularisation in the repeated laser therapy regions. Chidlow et al. conclude that repeated 2RT procedures in humans should not be associated with an increased risk of scotoma formation in the field of vision, neovascularisation or inflammatory reactions. The authors also reported that metabolic and structural disorganization of the retina-RPE complex, induced by 2RT, normalizes so quickly that the changes associated with the second procedure are not significantly different from the initial ones.

Conclusion

Using a nanosecond laser of ultralow energy is justified in the therapy of macular diseases due to its selective effect on melanosomes, without thermal injury, as well as the saving of the external layers of the retina, photoreceptors and their neural connections. In AMD the nanosecond laser demonstrates a beneficial potential due to improvement of the Bruch's membrane function, reduction of drusen, and stimulation of the RPE cells to migrate towards the injured sites. Therefore, the principal indications for nanosecond laser in retinal rejuvenation and regeneration therapy are the early and moderately advanced stages of degeneration, preferably bilateral. There are still few reports assessing the effectiveness of 2RT procedures that emphasize the laser's beneficial effect not only on the treated eye but also on the other one. The effect of the nanosecond laser on the macula in AMD clearly requires further observation and assessment.

Literature

1. Klein R, Klein BE, Jensen SC, Meuer SM. The five-year incidence and progression of age-related maculopathy: the Beaver Dam Eye Study.

Ophthalmology, 1997; 104(1):7-21
2. Bird AC, Bressler NM, Bressler SB, et al. An international classification and grading system for age-related maculopathy and age-related macular degeneration. The international ARM Epidemilogical Study Group. Surv Ophthalmol, 1995; 39 (5): 367-374
3. Bird AC. Age-related macular disease. Br J Ophthalmol, 1996; 80 (1): 2-3
4. Klein R, Peto T, Bird A, Vannekirk MR. The epidemiology of age-related macular disease. Am J Ophthalmol, 2004; 137 (3): 486-495
5. van Leeuwen R, Klaver CC, Vingerling JR, et al. The risk and natural course of age-related maculopathy: follow-up at 6 $^{1}/_{2}$ years in the Rotterdam Study. Arch Ophthalmol, 2003; 121 (4): 519-526
6. Age-Related Diseases Study Research Group. A randomized placebo-controlled clinical trial of high-dose supplementation with vitamins C and E, beta carotene, and zinc for age-related macular degeneration and vision loss: AREDS report no.8. Arch Ophthalmol, 2001; 119 (10): 1417-1436
7. Fraser-Bell S, Wu J, Klein R, et al. Smoking, alcohol intake, estrogen use, and age-related macular degeneration in Latinos: the Los Angeles Latino Eye Study. Am J Ophthalmol, 2006; 141 (1): 79-87
8. Cackett P, Wong TY, Aung T, et al. Smoking, cardiovascular risk factors, and age-related macular degeneration in Asians: the Singapore Malay Eye Study. Am J Ophthalmol, 2008; 146(6): 960-967
9. Tomany SC, Wang J, Van Leeuwen R, et al. Risk factors for incident age-related macular degeneration: pooled findings from 3 continents. Ophthalmology 2004; 111 (7):1280-1287
10. Rivera A, Fisher SA, Fritsche LG, et al. Hypothetical LOC387715 is a second major susceptibility gene for age-related macular degeneration, contributing independently of complement factor H to disease risk. Hum Mol Genet, 2005; 14(21):3227-3236
11. Fritsche LG, Loenhardt T, Janssen A, et al. Age-related macular degeneration is associated with an unstable ARMS2 (LOC387715) mRNA. Nat Genet, 2008, 40(7):892-896
12. Fisher SA, Rivera A, Fritsche LG, et al. Assessment of the contribution of CFH and chromosome 10q26 AMD susceptibility loci in a Russian population isolate. Br J Ophthalmol, 2007; 91 (5): 576-578
13. Joachim N, Mitchell P, Burlutsky G, et al. The Incidence and Progression of Age-Related Macular Degeneration over 15 Years: The Blue Mountains Eye Study. Ophthalmology, 2015; 122 (12): 2482-2489
14. Chew EY, demons TE, Agrón E, et al. Ten-year follow-up of age-related macular degeneration in the age-related eye disease study: AREDS report no. 36. JAMA Ophthalmol, 2014; 132 (3): 272-277
15. Ramrattan RS, Van der Schaft TL, Mooy CM, et al. Morphometric analysis of Bruch's membrane, the choriocapillaris, and choroids in aging. Invest Ophthalmol Vis Sci, 1994; 35 (6): 2857-2864
16. Ahir A, Guo L, Hussain AA, Marshall J. Expression of metalloproteinases from human retinal pigment epithelial cells and their effects on the hydraulic conductivity of Bruch's membrane. Invest Ophthalmol Vis Sci, 2002; 43 (2): 458-465
17. Barathi VA, Yeo SW, Guymer RH, et al. Effects of simvastatin on retinal structure and function of a high-fat atherogenic mouse model of thickened Bruch's membrane. Invest Ophthalmol Vis Sci, 2014; 55 (1): 460-468
18. Davis MD, Gangnon RE, Lee LY, et al. The Age-Related Eye Disease Study severity scale for age-related macular degeneration: AREDS Report No. 17. Arch Ophthalmol, 2005; 123 (11): 1484-1498
19. Ferris FL, Davis MD, demons TE, et al. A simplified severity scale for age-related macular degeneration: AREDS Report No. 18. Arch Ophthalmol, 2005; 123 (11): 1570-1574
20. Seddon JM, Sharma S, Adelman RA. Evaluation of the clinical age-related maculopathy staging system. Ophthalmology, 2006; 113 (2): 260-266
21. Ferris FL 3rd, Wilkinson CP, Bird A, et al. Clinical classification of age-related macular degeneration. Ophthalmology, 2013; 120 (4): 844-851
22. Klein R, Myers CE, Lee KE, et al. Small Drusen and Age-Related Macular Degeneration: The Beaver Dam Eye Study. J Clin Med, 2015; 4 (3): 424-440
23. Wood JP, Plunkett M, Previn V, et al. Nanosecond pulse lasers for retinal applications. Lasers Surg Med, 2011; 43 (6): 499-510
24. Paulus YM, Jain A, Gariano RF, et al. Healing of retinal photocoagulation lesions. Invest Ophthalmol Vis Sci, 2008; 49(12): 5540-5545
25. Jain A, Blumenkranz MS, Paulus Y, et al. Effect of pulse duration on size and character of the lesion in retinal photocoagulation. Arch Ophthalmol, 2008; 126 (1):78-85
26. Wood JP, Shibeeb 0, Plunkett M, et al. Retinal damage profiles and neuronal effects of laser treatment: comparison of a conventional photocoagulator and a novel 3-nanosecond pulse laser. Invest Ophthalmol Vis Sci, 2013; 54 (3): 2305-2318
27. Chidlow G, Shibeeb 0, Plunkett M, et al. Glial cell and inflammatory responses to retinal laser treatment: comparison of a conventional photocoagulator and a novel, 3-nanosecond pulse laser. Invest Ophthalmol Vis Sci, 2013; 54 (3): 2319-2332
28. Zhang JJ, Sun Y, Hussain AA, Marshall J. Laser-mediated activation of human retinal pigment epithelial cells and concomitant release of matrix metalloproteinases. Invest Ophthalmol Vis Sci, 2012; 53 (6): 2928-2937
29. Luu CD, Dimitrov PN, Robman L, et al. Role of flicker perimetry in predicting onset of late-stage age-related macular degeneration. Arch Ophthalmol, 2012; 130 (6): 690-699
30. Luu CD, Dimitrov PN, Wu Z, et al. Static and flicker perimetry in age-related macular degeneration. Invest Ophthalmol Vis Sci, 2013; 54 (5): 3560-3568
31. Guymer RH, Brassington KH, Dimitrov P, et al. Nanosecond-laser application in intermediate AMD: 12-month results of fundus appearance and macular function. Clin Experiment Ophthalmol, 2014; 42 (5): 466-479
32. Jobling Al, Guymer RH, Vessey KA, et al. Nanosecond laser therapy reverses pathologic and molecular changes in age-related macular degeneration without retinal damage. FASEB J, 2015; 29 (2): 696-710
33. Chidlow G, Plunkett M, Casson RJ, Wood JP. Investigations into localized re-treatment of the retina with a 3-nanosecond laser. Lasers Surg Med, 2016. doi: 10.1002/lsm.22 506 [Epub ahead of print]

Severe drug rash with eosinophilia and systemic syndrome (DRESS) induced by carbamazepine

Ciężki zespół nadwrażliwości skórnej indukowanej lekami z towarzyszącą eozynofilią i objawami układowymi (DRESS) indukowany karbamazepiną

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Abstract. DRESS (drug rash with eosinophilia and systemic syndrome) is a drug-induced skin hypersensitivity syndrome with associated eosinophilia and systemic symptoms occurring in adults and children. The most common drugs that trigger the symptoms are anticonvulsants. The study presents the case of an 18-year-old female patient with DRESS syndrome caused by carbamazepine. Apart from persistent skin lesions, swelling, lymphadenopathy, fever and eosinophilia, liver damage was also observed, which did not subside after treatment with high doses of corticosteroids. A favorable effect was obtained only after an immunoglobulin infusion.
Key words: DRESS, drug rush with eosinophilia and systemic syndrome, carbamazepine, corticosteroids, immunoglobulins

Streszczenie. DRESS (*drug rash with eosinophilia and systemic syndrome),* czyli zespół nadwrażliwości skórnej indukowanej lekami z towarzyszącą eozynofilią i objawami układowymi, występuje zarówno u dorosłych, jak i u dzieci. Najczęstszymi lekami wyzwalającymi objawy są leki przeciwdrgawkowe. W pracy przedstawiono przypadek 18-letniej pacjentki z DRESS wywołanym karbamazepiną. Obok utrzymujących się zmian skórnych, obrzęków, limfadenopatii, wysokiej gorączki i eozynofilii obserwowano cechy uszkodzenia wątroby nieustępujące pod wpływem leczenia dużymi dawkami glikokortykosteroidów. Korzystny efekt uzyskano dopiero po zastosowaniu wlewu immunoglobulin.
Słowa kluczowe: DRESS, zespół nadwrażliwości skórnej indukowanej lekami z towarzyszącą eozynofilią i objawami układowymi, karbamazepiną, kortykosteroidy, immunoglobuliny

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Introduction

The term DRESS *(drug rash with eosinophilia and systemic syndrome)* was used for the first time in 1996 by Bocquet et al. [1]. The syndrome is rare, and occurs in 1 in 1,000 to 1 in 10,000 people. The clinical characteristics of DRESS include skin eruptions in the form of papular and erythematous rashes, usually associated with facial edema, fever, generalized lymphadenopathy, damage to one or more organs, primarily the liver but also the kidneys or heart, encephalitis, aseptic meningitis, interstitial pulmonary disease, vasculitis and many other potentially life-threatening disorders [2, 3].

Treatment consists of the prompt identification and withdrawal of the medication causing DRESS, as illustrated by the case described here of a young woman who developed the syndrome a result of using carbamazepine (Tegretol).

Case report

An 18-year-old female patient was transferred from a hospital in Mława with the following diagnosis: "Febrile state of unknown origin. Exanthem, probably in the course of allergy – parasites? Medications? Viruses? – for further diagnostics". The patient had been hospitalized there for 9 days. Small itchy skin lesions (initially on the face, then gradually spreading all over the body) had occurred a few days prior to the hospitalization. Soon the following occurred: fever of up to 40°C, edemas of the entire body and painful enlargement of the peripheral lymph nodes. Treatment involved Cipronex *i.v.,* Corhydron 3 x 100 mg *i.v.,* Zyrtec *p.o.,* Ketonal 100 mg *i.v.* as required, and multielectrolyte fluids (PWE) *i.v.,* without improvement. Due to the suspicion of epilepsy, based on the interview and symptoms, for 6 weeks before the hospitalization the patient had been receiving Tegretol CT 200 (4 tablets / 24 h) *p.o.* On admission to the hospital, the patient's condition was assessed as moderate, the patient complaining about general weakness and severe abdominal pain. Despite the administration of antipyretics, a fever of up to 40°C persisted. The skin of the entire body was swollen and painful on palpation, all covered with papular and erymathous lesions (Figure 1.).

Figure 1A-C. Generalized skin eruptions over the whole body on the first day of admission
Rycina 1A-C. Uogólnione zmiany skórne w dniu przyjęcia

The peripheral lymph nodes were enlarged and very painful. Additional tests revealed: leukocytosis: 28 x 10^9/l (normal range: 4-10 x 10^9/l), eosinophilia: 7.30 x 10^3/µl (normal range: 0.05-0.5 x 10^3/µl), increased aminotranspherases: AST 152 IU/l (normal range: 0-35 IU/l), ALT: 301 IU/l (normal range: 0-35 IU/l), hypoproteinemia with hypoalbuminemia, total protein concentration: 4.7 g/dl (normal range: 6.4-8.3 g/dl), total albumin concentration: 2.9 g/dl (normal range: 3.5-5.2 g/dl), and increased procalcitonin concentration: 0.25 ng/ml (normal range: <0.046 ng/ml). Slightly increased inflammatory markers: CSR 36 mm (normal range: 0-12 mm), and CRP: 1.7 mg/dl (normal range: 0-0.8 mg/dl). Initial diagnostics during hospitalization excluded infectious diseases, such as measles, rubella, toxoplasmosis, cytomegaly, mononucleosis, HIV infection, syphilis, or systemic diseases. Urine and blood cultures without bacterial growth. Cardiac echocardiography and thoracic X-ray without abnormalities.

Preliminary diagnosis of DRESS was established on the basis of the criteria by Kardaun et al. [4]. Tegretol was discontinued as a medication inducing the above symptoms. The administration of glucocorticosteroids (Encorton 60 mg/24 h *p.o.*), antihistamine (Clemastinum WZF 4 mg/24 h *i.v.)* and antipyretics (Perfalgan 2000 mg/24 h *i.v.)* was continued, with a temporary but insufficient improvement.

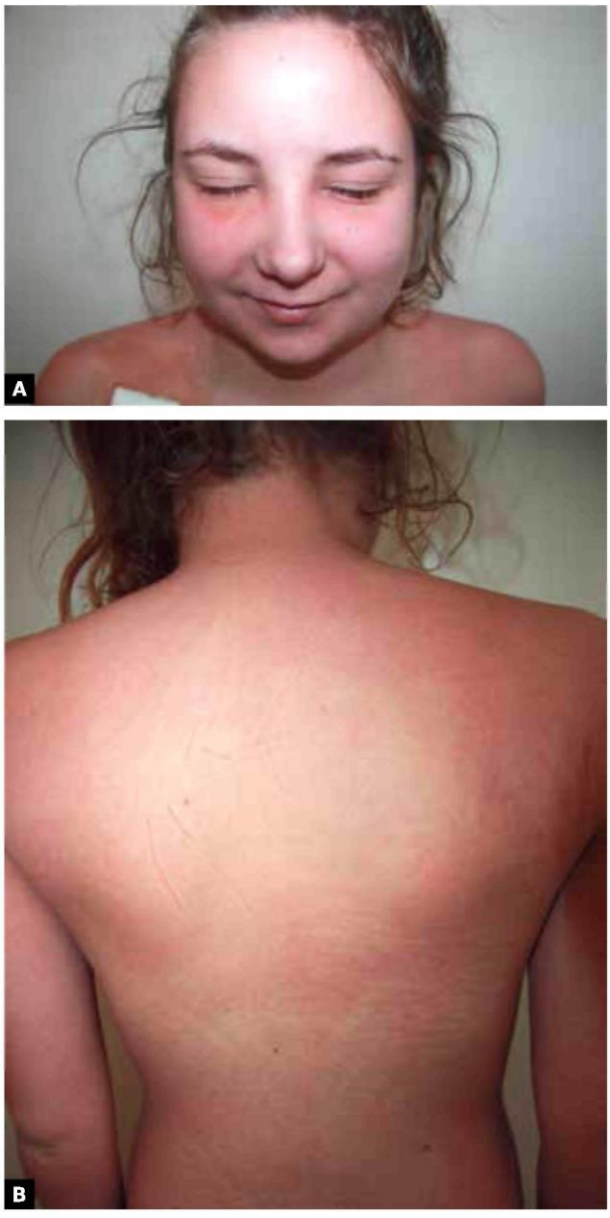

Figure 2A-C. Skin eruption visible over the whole body after the first day administration of intravenous immunoglobulin
Rycina 2A-C. Uogólnione wykwity skórne po pierwszym dniu stosowania immunoglobulin dożylnych

In the following days, as peripheral access was impossible due to severe edema over the entire body, a central venous catheter was placed. The patient was seen by a gynecologist and surgeon due to the abdominal pain. Abdominal and transvaginal ultrasound examinations were performed, but did not reveal any relevant pathologies. Because of the menstrual disorders, pregnancy was excluded on the basis of normal beta-HCG results. The improvement was still insufficient, and indicators of hepatic damage, normocytic anemia and hypoalbuminemia continued to increase, so on day 3 of hospitalization the patient received intravenous immunoglobulins (IgVENA at a dose of 1 g/kg bw, i.e. 60 g/24 h in slow *i.v.* infusion for 2 days). Already on the first day of administering immunoglobulins the body temperature started to decrease (to a subfebrile state). On day 2, the temperature normalized, while the skin lesions in the form of edema and papular and erythematous rashes gradually subsided within 5 days from administration of immunoglobulins (Figure 2). During the hospitalization, the patient was seen by a neurologist, who delayed antiepileptic treatment until the end of the diagnostic tests for the disease (head MRI), and recommended another neurological consultation. After two weeks of hospitalization, the patient was discharged in very good condition. All the symptoms disappeared (i.e. fever, edema, skin lesions – apart from dried skin and slight exfoliation of the epidermis – lymphadenopathy), and previously abnormal test results improved to normal values. Continuation of Encorton 40 mg *p.o.* with gradual dose reduction until complete withdrawal within a month was recommended, as well as administration of antihistamines and a proton pump inhibitor.

Table 1. Criteria for diagnosis of DRESS [4]
Tabela 1. Kryteria diagnostyczne DRESS [4]

Hospitalization
Suspected drug-induced adverse reaction
Acute rash
Fever >38°C*
Enlarged lymph nodes in at least two regions*
Involvement of one internal organ*
Blood count abnormalities*
Lymphocytes above or below the normal range
Eosinophils above the normal range
Blood platelets below the normal range

* To confirm the diagnosis, three out of four criteria must be met.

Discussion

DRESS is a rare condition involving hypersensitivity to drugs, occurring in both children and adults. Early diagnosis and treatment of this syndrome can be difficult due to a latency period of any length from eight weeks up to six months after exposure, with a continuation or worsening of the symptoms despite withdrawal of the drug causing the symptoms. According to various studies, mortality in this area may be as high as 10% [5, 6].

One of the most common causes of DRESS are anticonvulsants (Carbamazepine, phenytoin, phenobarbital), allopurinol, minocycline, sulfasalazine and abacavir [1, 5]. According to Patrice Cacoub et al, there are 44 commonly used medications that can trigger DRESS, the most frequent being carbamazepine at almost 47 cases (27% of all reported cases). Allopurinol was in second position at 19 cases (i.e. 11%) [2]. Medications which rarely induce DRESS include almost all antibiotics, dapsone, isoniazid, telaprevir, PEG-IFN-a2a used concomitantly with ribavirin, nevirapine, nonsteroidal anti-inflammatory drugs, sulfalazine, enoxaparin, nitrofurantoin and montelukast [2, 7-18]. The pathogenesis of DRESS is not completely understood, and different mechanisms play a role. It is believed that Epstein-Barr, HHV-6 and HHV-7 viruses, the immunomodulatory effect of certain medications, metabolic disorders and autoimmune diseases may be important in the etiology of hypersensitivity in this disease. Drug-induced reaction is classified as delayed-type IVb hypersensitivity according to Gell and Coombs [20]. DRESS diagnosis is based on clinical data: history and presence of characteristic disease symptoms. Due to the increasing number of pharmacological substances which could contribute to the development of DRESS, with the associated diagnostic difficulties this causes, criteria for the diagnosis of DRESS have been published (both simplified and extended) based on large studies, e.g. by Regi-SCAR (Tables 1-2) [2, 5, 21, 22]. Another group of Japanese researchers include in their diagnostic criteria the activation of the HHV-6 virus (Table 3) [23].

However, it should be noted that the fundamental principle in the therapy of DRESS is discontinuation of the drug suspected of inducing the abnormal reaction, and introducing glucocorticosteroids. If there is no improvement, administration of immunoglobulins, cyclophosphamide or cyclosporine may be considered [24-27]. Treatment with impulses of methylprednisolone *i.v.* (30 mg/kg bw, max. 1 g/24 h) and methylprednisolone *p.o.* (1 mg/kg bw) was effective in cases described in the study by Celebi Kocaoglu et al [28].

Table 2. Criteria for diagnosis of DRESS [4.25]
Tabela 2. Kryteria diagnostyczne DRESS [4.25]

Factor	1	0	+1	+2	min.	max.
Fever ≥38°C	no	yes			1	0
Generalized lymphadenopathy		no/unknown	yes		0	+1
Eosinophilia					0	+2
Eosinophils			700-1499/µl	>1500/µl		
Eosinophils (%), if WBC <4000			10-19.9%	>20%		
Atypical lymphocytes		no/unknown	yes		0	+1
Skin involvement					2	+2
Skin exanthem (% of involved body area)		no/<50%	>50%			
Exanthem suggestive of DRESS	no	unknown	yes			
Histopathology suggestive of DRESS	no	unknown				
Involvement of internal organs* (liver, kidneys, lungs, muscles/heart, pancreas/other)		no/unknown	1 organ	2 or more	0	+2
Disappears in >15 days	no	yes			1	0
Laboratory tests (HAV, HBV, HCV, EBV, CMV, mycoplasma, chlamydia, ANA); if none of the results is positive and >3 are negative			yes		0	+1
Total score					4	+ 9

* After exclusion of other causes
Total score: <2 - excluded, 2-3 - possible, 4-5 - probable, >5 - confirmed DRESS
unknown – unknown or impossible to assess

Numerous case reports show that systemic or parenteral glucocorticosteroids in patients with internal organ involvement is effective [29, 30]. Still there are no randomized studies evaluating the effectiveness of corticosteroids; therefore, some researchers are against using systemic steroids, which they consider controversial in the treatment of this disease type [2]. In the described case, immunoglobulins were used as glucocorticosteroids did not bring a satisfactory improvement, and this resulted in a spectacular improvement in general condition, including the disappearance of skin lesions.

Conclusion

DRESS may be induced by many different medications, especially carbamazepine, which caused the symptoms in the patient described here. It should be taken into consideration that carbamazepine, phenobarbital or phenytoin are characterized by cross-reactivity, and as a result cannot be used in the future, which makes the treatment and prevention of convulsions difficult.

Table 3. Criteria for diagnosis of DRESS [21]
Tabela 3. Japońskie kryteria diagnostyczne DRESS [21]

Papular rash induced >3 weeks after using the suspected medication
Clinical symptoms persisting 2 weeks after discontinuation of the suspected medication
Fever >38°C
Hepatic function disorders (ALT >100U/l)
Abnormal leukocytes
Leukocytosis (>11 x 10^9/l)
Atypical lymphocytosis (>5%)
Eosinophilia (>1.5 x 10^9/l)
Enlarged lymph nodes
HHV-6 herpes reactivation
7 criteria must be met to confirm the diagnosis

Due to the significant symptom variability and possible health and life-threatening complications, before using the medication patients should be informed about the symptoms which can occur after administration of the drug. This also applies also to physicians examining patients and assessing their condition. Unexplained skin lesions and facial edema with fever and lymphadenopathy may suggest DRESS even a few weeks after using a medication. The prompt discontinuation of the symptom-inducing drug and implementation of proper treatment, immunoglobulins in the reported case, can result in complete remission of the disease symptoms.

Literature

1. Bocquet H, Bagot M, Roujeau JC. Drug-induced pseudolymphoma and drug hypersensitivity syndrome (Drug Rash with Eosinophilia and Systemic Symptoms: DRESS). Semin Cutan Med Surg, 1996; 15 (4): 250-257
2. Cacoub P, Musette P, Descamps V, et al. The DRESS syndrome: a literature review. Am J Med, 2011; 124 (7): 588-597
3. Chan JC, Chan HHL, Yeung CK. Drug reaction with eosinophilia and systemic symptoms (DRESS). Hong Kong J Dermatol Venereol, 2012; 20 (4): 163-170
4. Kardaun SH, Sidoroff A, Valeyrie-Allanore L, et al. Variability in the clinical pattern of cutaneous side-effects of drugs with systemic symptoms: does a DRESS syndrome really exist? Br J Dermatol, 2007; 156 (3): 609-611
5. Chen YC, Chiu HC, Chu CY. Drug reaction with eosinophilia and systemic symptoms: a retrospective study of 60 cases. Arch Dermatol, 2010; 146 (12):1373-1379
6. Pereira de Silva N, Piquioni P, Kochen S, et al. Risk factors associated with DRESS syndrome produced by aromatic and non-aromatic antipiletic drugs. Eur J Clin Pharmacol, 2011; 67 (5): 463-470
7. Lee JY, Seol YJ, Shin DW, et al. Case of the Drug Reaction with Eosinophilia and Systemic Symptom (DRESS) Following Isoniazid Treatment Tuberc Respir Dis (Seoul), 2015; 78 (1): 27-30
8. Cariou ME, Kaabar M, Cailliez P, et al. Dress (Drug reaction with eosinophilia and systemic symptoms) suite f la prise de vancomycine: a propos d'un cas. Ann Biol Clin, 2013; 71 (2):190-195
9. Janocha-Litwin J, Pazgan-Simon M, Simon K. DRESS syndrome as a complication of treatment of hepatitis C virus-associated post-inflammatory liver cirrhosis with peginterferon a2a and ribavirin. Postępy Dermatol Alergol, 2014; 31 (6):401-404
10. Roales-GomezV, Molero Al, Perez-Amarilla I, et al. DRESS syndrome secondary to ibuprofen as a cause of hyperacute liver failure. Rev Esp Enferm Dig, 2014; 106 (7): 482-486
11. Sriratanaviriyakul N, Nguyen LP, Henderson MC, et al. Drug reaction with eosinophilia and systemic symptoms syndrome (DRESS) syndrome associated with azithromycin presenting like septic shock: a case report. J Med Case Rep, 2014; 8 (8): 332
12. Ginory A, Chaney-Catchpole M, Demetree JM, et al. Drug reaction with eosinophilia and systemic symptoms (DRESS) in an adolescent treated with lamotrigine. J Pediatr Pharmacol Ther, 2013; 18 (3): 236-240
13. Ronceray S, Dinulescu M, Le Gall F, et al. Enoxaparin-Induced DRESS Syndrome. Case Rep Dermatol, 2012; 4 (3): 233-237
14. Zhang SN, He QX, Yang NB, et al. Isoniazid-induced drug rash with eosinophilia and systemic symptoms (DRESS) syndrome presenting as acute eosinophilic myocarditis. Intern Med, 2015; 54 (10): 1227-1230
15. Civardi G, Zanlari L, Bassi E, et al. Life threatening, allopurinol-related dress syndrome as a rare cause of fever of unknown origin. Intern Med, 2015; 54 (16):2073-2077
16. Calapai G, Casciaro M, Miroddi M, et al. Montelukast-induced adverse drug reactions: a review of case reports in the literature. Pharmacology, 2014; 94 (1-2): 60-70
17. Chaabane A, Ben Fadhel N, Chadli Z, et al. Phenobarbital-induced DRESS: a lichenoid picture. Iran J Allergy Asthma Immunol, 2014; 13 (6): 453-455
18. Cabańas R, Calderon 0, Ramirez E, et al. Piperacillin-induced DRESS: distinguishing features observed in a clinical and allergy study of 8 patients. J Investig Allergol Clin Immunol, 2014; 24 (6): 425-430
19. Picard D, Janela B, Descamps V, et al. Drug reaction with eosinophilia and systemic symptoms (DRESS): a multiorgan antiviral T cell response. Sci Transl Med, 2010; 2:46-62
20. Pichler WJ. Delayed drug hypersensitivity reactions. Ann Intern Med, 2003; 139 (8): 683-693
21. Walsh SA, Creamer D. Drug reaction with eosinophilia and systemic symptoms (DRESS): a clinical update and review of current thinking. Clin Exp Dermatol, 2011; 36 (1):6-11
22. Kardaun SH, Sekuła P, Valeyrie-Allanore L, et al. Drug reaction with eosinophilia and systemic symptoms (DRESS): an original multisystem adverse drug reaction. Results from the prospective RegiSCAR study. Br J Dermatol, 2013; 169 (5): 1071-1080
23. Shiohara T, Iijima M, Ikezawa Z, et al. The diagnosis of a DRESS syndrome has been sufficiently established on the basis of typical clinical features and viral reactivations. Br J Dermatol, 2007; 156: 1083-1084
24. Bommersbach TJ, Lapid Ml, Leung JG, et al. Management of Psychotropic Drug-Induced DRESS Syndrome: A Systematic Review. Mayo Clin Proc, 2016. pii: S0025-6196(16)30034-9
25. Korbi M, Youssef M, Ben Brahim H, et al. Allopurinol-induced DRESS complicated by hemophagocytic lymphohistiocytosis. Ann Dermatol Venereol, 2015; 142 (12): 767-770
26. Galvao VR, Aun MV, Kalil J, et al. Clinical and laboratory improvement after intravenous immunoglobulin in drug reaction with eosinophilia and systemic symptoms. J Allergy Clin Immunol Pract, 2014; 2 (1): 107-110
27. Laban E, Hainaut-Wierzbicka E, Pourreau F, et al. Cyclophosphamide therapy for corticoresistant drug reaction with eosinophilia and systemic symptoms (DRESS) syndrome in a patient with severe kidney and eye involvement and Epstein-Barr virus reactivation. Am J Kidney Dis, 2010; 55 (3): 11-14
28. Kocaoglu C, Cilasun C, Solak ES, et al. Successful treatment of antiepileptic drug-induced DRESS syndrome with pulse methylprednisolone. Case Rep Pediatr, 2013; 2013: 928 910
29. Omairi NE, Abourazzak S, Chaouki S, et al. Drug reaction with eosinophilia and systemic symptoms (DRESS) induced by carbamazepine: a case report and literature review. Pan Afr Med J, 2014; 2 (18): 9
30. Natkunarajah J, Goolamali S, Craythorne E, et al. Ten cases of drug reaction with eosinophilia and systemic symptoms (DRESS) treated with pulsed intravenous methylprednisolone. Eur J Dermatol, 2011; 21 (3): 385-591

Combined aortic valve replacement and total thyroidectomy

Jednoczasowa operacja wymiany zastawki aortalnej i tyreoidektomia

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Abstract. Approximately 11.2% of the patients qualified for open heart surgery have thyroid dysfunctions. Optimal management for the co-occurrence of indications for cardiac surgery and thyroidectomy has not been explicitly determined. We present a case of a 66-year-old female, who underwent simultaneous retrosternal goiter resection and aortic valve replacement. The post-operative period was uneventful. The patient was discharged 13 days after the surgery. This case report suggests that the above-mentioned procedure is feasible and safe.
Key words: thyroidectomy, aortic valve replacement, combined procedure, cardiopulmonary bypass

Streszczenie. U około 11% pacjentów kwalifikowanych do procedur kardiochirurgicznych występują zaburzenia funkcji tarczycy. Optymalne postępowanie przy współwystępowaniu wskazań do operacji kardiochirurgicznej i tyreoidektomii nie zostało jednoznacznie określone. Prezentujemy przypadek 66-letniej chorej, która została poddana jednoczasowej operacji wymiany zastawki aortalnej i resekcji wola zamostkowego. Przebieg pooperacyjny był niepowikłany. Chora w 13. dobie po operacji została wypisana, co sugeruje, że omawiane postępowanie jest możliwe do wykonania i bezpieczne.
Słowa kluczowe: tyreoidektomia, wymiana zastawki aortalnej, procedura łączona, krążenie pozaustrojowe

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Introduction

The hormonal activity of the thyroid has profound effects on cardiovascular function, as it affects heart rate (HR), cardiac output (CO), peripheral vascular reactivity (peripheral vascular resistance) and positive inotropism [1]. Already by the 1990s Jones et al. observed that patients suitable for cardiac surgery procedures often suffered from thyroid function disorders (11.2% of patients) [2]. The authors suggested that it might be associated with patient age. The negative effect of the extracorporeal circulation used during cardiac surgery procedures on concentration of thyroid hormones and the occurrence of low triiodothyronine (T_3) and thyroxine (T_4) *(euthyroid sick syndrome* - ESS) is well-established [3, 4]. Therefore, cardiac surgery patients with concomitant pathology of the thyroid gland are at increased risk of surgical complications, and require an "individual approach". This group comprises patients with a hyperactive goiter and coronary disease or acquired cardiac valve disease. In some, combined cardiac surgery treatment and thyroidectomy may be considered. The optimal management of such cases has yet to be determined.

Case report

We present the case of a 66-year-old female patient admitted to the Department of Cardiac Surgery for combined aortic valve replacement and total retrostenal goiter resection. Six months before the surgery the patient was admitted to the Department of Internal Diseases and Cardiology at the Military Institute of Medicine due to increased exertional dyspnea and significantly reduced exercise tolerance. A physical examination revealed a significantly enlarged thyroid.

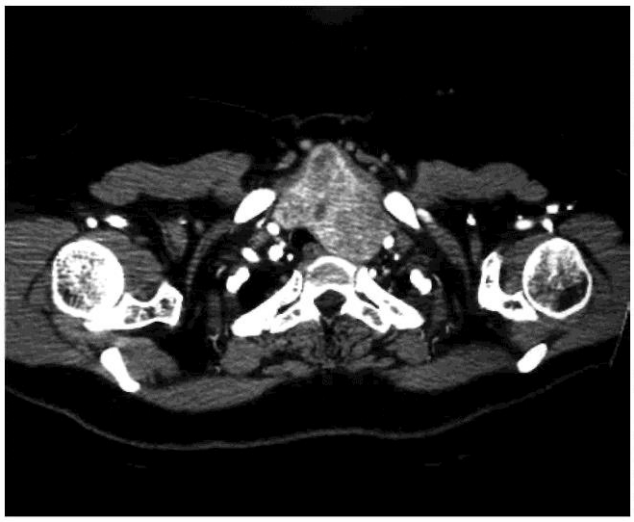

Figure 1. Computed tomography image showing goiter pressing on the trachea and causing its dislocation
Rycina 1. Obraz tomografii komputerowej obrazujący wole uciskające tchawicę i powodujące jej przemieszczenie

Figure 2. Intraoperative photography during strumectomy
Rycina 2. Zdjęcie śródoperacyjne - etap tyreoidektomii

A transthoracic echocardiogram demonstrated severe stenosis of the aortic valve due to degenerative lesions (valvular surface area of 1.0-1.1 cm^2, pressure gradient of 75/41 mm Hg). Computed tomography revealed a nodular goiter reaching the lower poles of the sternoclavicular joints (left lobe of 111 x 59 x 52 mm, right lobe of 111 x x49 x 35 mm) and pressing on the thyroid (Figure 1.). A coronographic examination did not demonstrate significant narrowing of the coronary vessels. The patient was qualified for combined aortic valve replacement and thyroidectomy. To prepare for the surgery, the patient received thiamazole preparations in titrated doses, until euthyreosis was obtained, which enabled a safe procedure with the use of extracorporeal circulation. Before the surgery, the following parameters were determined: thyroid-stimulating hormone concentration (TSH) - 2.19 ulU/ml, fT_3 - 8.79 pmol/l, and fT_4 - 5.93 pmol/l.

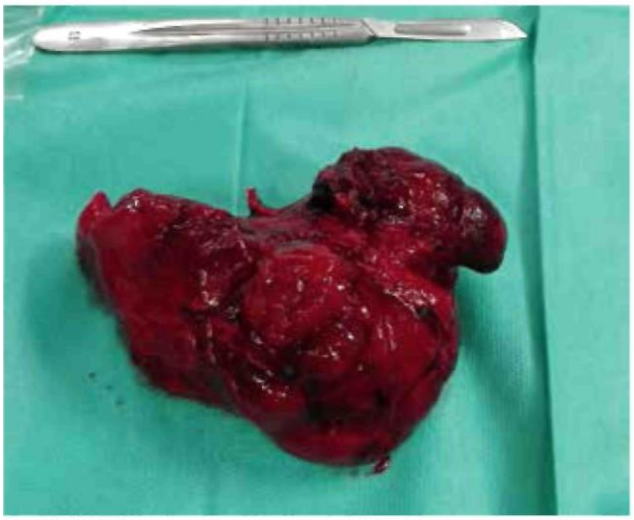

Figure 3. Thyroid - right lobe
Rycina 3. Prawy płat tarczycy

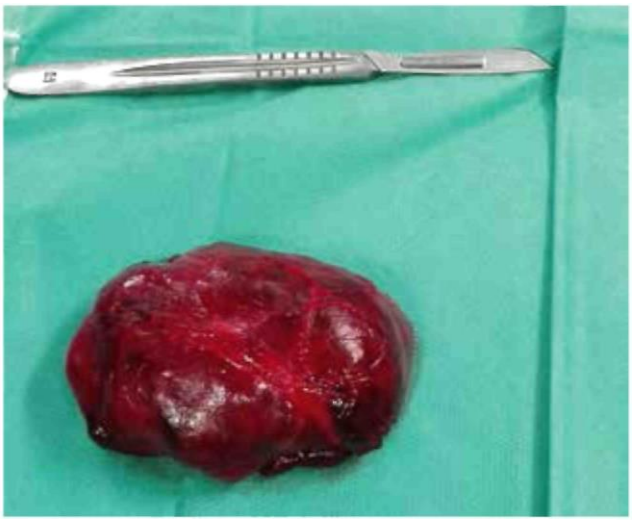

Figure 4. Thyroid - left lobe
Rycina 4. Lewy płat tarczycy

The chest was opened through a median sternotomy incision. The incision was extended to approximately 4 cm towards the head. A thyroidectomy was performed (Figures 2-4). The bed was left open to monitor hemostasis under heparinization during extracorporeal circulation. Next, the anterior mediastinum was dissected, and the pericardial sac opened. A total of 200 mg of heparin was administered to obtain an activated clotting time (ACT) of under 500 seconds.

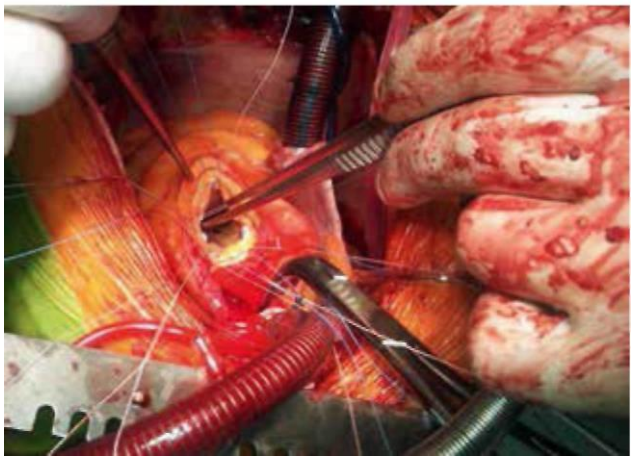

Figure 5. Intraoperative photography during aortic valve implantation
Rycina 5. Zdjęcie śródoperacyjne etapu implantacji zastawki aortalnej

The bed was monitored after the thyroidectomy to exclude hemorrhaging. The heart was cannulated and extracorporeal circulation was implemented. The heart was stopped with a blood cardioplegia solution, the aortic valve replaced, and a biological supra-annular valve implanted (Figure 5.). After finishing the extracorporeal circulation, the heparin effect was reversed with protamine sulfate at a dose of 1 mg per 1 mg of the heparin administered. Hemostasis of the mediastinum and the thyroidectomy bed was performed, and a Redon drain placed in the thyroid bed. The chest was closed typically, with drains left in the left pleural cavity and in the mediastinum. No complications occurred during the surgery.

The calcium metabolism parameters and parathormone concentration in the postoperative period were 9.1 mg/dl and 53.2 pg/ml, respectively. Until day 5 after the surgery no abnormalities in the concentrations of TSH and thyroid hormones were found. On day 5 following the surgery, a significant increase in TSH concentration to 16.29 ulU/ml was observed, as well as reduction in fT_3 (1.53 pmol/L) and fT_4 (9.88 pmol/l) levels, despite supplementation of thyroid hormones since day 1 after the procedure (75 µg levothyroxine/d). The daily dose of levothyroxine was increased to 100 µg, which led to the gradual normalization of the above parameters. In the last test performed at the hospital, TSH concentration was 9.24 ulU/ml, fT_3 - 2.96 pmol/l, and fT_4 - 14.6 pmol/l. Due to the significant improvement, continuation of the treatment and early out-patient follow-up were recommended.

The wound healed properly, no hematoma was found in the thyroidectomy bed (Figure 6.). On day 13 after the surgery, the patient was discharged in a good general and local condition. She was recommended to receive 75 µg of levothyroxine a day. A histopathological examination was performed in the Pathomorphology Department of the Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine, by Marek Kowański MD, PhD, and no suspicious images were found. The dimensions of the right lobe were 85 x 60 x 40 mm, and the left lobe were 100 x 75 x 60 mm.

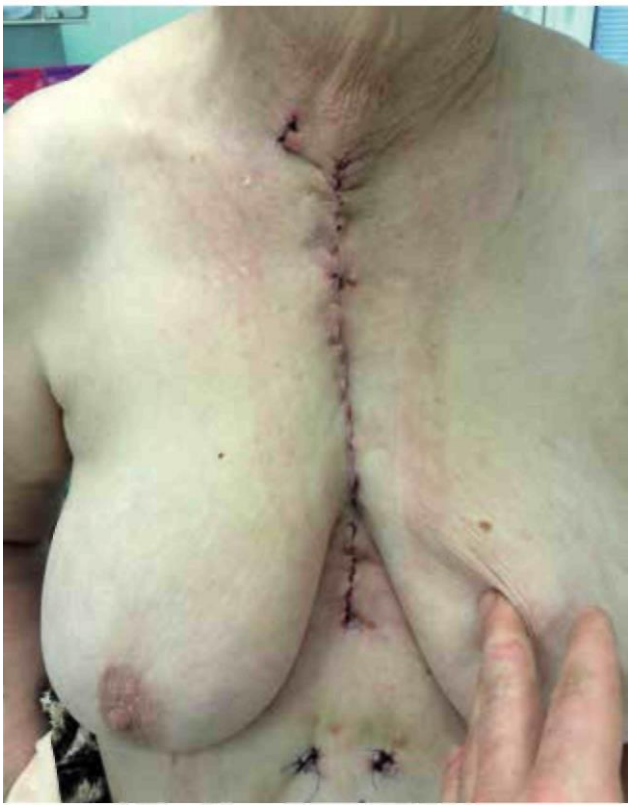

Figure 6. Patient's post-operative wound on the day of discharge
Rycina 6. Rana pooperacyjna u pacjentki w dniu wypisu

Discussion

The analysis of 32 case reports of patients undergoing combined retrosternal goiter resection and cardiac surgery, published in 2015, confirms the safety of this procedure [5]. The authors of the analyzed publications did not observe any increased risk.

Simultaneous performance of procedures is associated with numerous benefits, but also risks requiring different management processes. It is worth noting that patients with ischemic heart disease or valve disorder who require surgical treatment of the goiter, often would not be suitable for isolated thyroidectomy due to the excessive risk related to anesthesia and the procedure itself. On the other hand, primary cardiac surgery treatment followed by thyroidectomy increases the risk of early complications after the cardiac surgery, due to a disturbed thyroid

function. Hyperthyroidism may result in dangerous increases of cardiac oxygen consumption, thus increasing the oxygen deficit, leading to acute postoperative cardiac insufficiency.

A simultaneous approach is beneficial as it reduces surgical intervention to one procedure. In the case of a large retrosternal goiter, median thyroidectomy facilitates access to the gland and performing the thyroidectomy. Goiter resection following sternotomy and recreation of the sternum with metal sutures would be more difficult, partly due to the adhesions formed. Risks related to the simultaneous procedure are associated with potential hemorrhaging to the bed after removal of the goiter during extracorporeal circulation and associated heparinization. The authors closed the bed only after completing the cardiac surgery procedure. The simultaneous approach requires careful monitoring of the thyroid function, parathyroid function and calcium metabolisms in the perioperative period. It is well-established that perioperative thyroid insufficiency significantly increases the risk of low cardiac output syndrome and disturbed peripheral vascular resistance [6].

The occurrence of ESS is possible not only in relation to a procedure using extracorporeal circulation, but also in a patient undergoing procedures without the extracorporeal circulation, e.g. off-pump coronary artery bypass surgery [7]. In these patient groups many authors indicate causes of ESS following cardiac surgery procedures, such as changes in the volume of blood plasma resulting in an altered ability to bind thyroid hormones by proteins, or disturbed central regulation of TSH secretion and metabolism of thyroid hormones. However, the actual cause of reduced total T_3 concentration and its free fraction (fT_3) early after a cardiac surgery remains unclear [8]. The effect of heparin, necessary for a surgery using extracorporeal circulation, on the hormonal metabolism should also be emphasized. Already by the 1970s, Bremner et al. noticed a seven-fold increase in fT_4 concentration 15 minutes following heparin administration [9].

In the discussed procedure the goiter resection was performed with one incision, without the necessity of an additional collar incision reported by other authors [10]. The authors believe that this approach ensures good surgical conditions, and at the same time significantly reduced surgical injury, the risk of disturbed wound healing and the size of the postoperative scar.

To sum up, the possibility of performing a safe combined thyroidectomy and cardiac surgery procedure with the use of extracorporeal circulation has been confirmed. However, careful monitoring of the thyroid hormone concentrations, TSH concentration and calcium metabolism far into the postoperative period is necessary.

Literature

1. Gomberg-Maitland M, Frishman WH. Thyroid hormone and cardiovascular disease. Am Heart J, 1998; 135(1): 187-196
2. Jones TH, Hunter SM, Price A, Angelini GD. Should thyroid function be assessed before cardiopulmonary bypass operations? Ann Thorac Surg, 1994; 58(2):434-436
3. Holland FW 2nd, Brown PS Jr, Weintraub BD, Clark RE. Cardiopulmonary bypass and thyroid function: a "euthyroid sick syndrome". Ann Thorac Surg, 1991; 52 (1):46-50
4. Reinhardt W, Mocker V, Jockenhovel F, et al. Influence of coronary artery bypass surgery on thyroid hormone parameters. HormRes, 1997; 47 (1): 1-8
5. De Silva RP, Dignan RJ. Does a combined procedure for cardiac surgery and thyroidectomy offer acceptable outcomes? Interactive cardiovascular and thoracic surgery, 2015: ivv241
6. Broderick TJ, Wechsler AS. Triiodothyronine in cardiac surgery. Thyroid, 1997; 7(1): 133-137
7. Caluk S, Caluk J, Osmanovic E. Nonthyroidal illness syndrome in off-pump coronary artery bypass surgery. AnatolJ Cardiol, 2015; 15 (10): 836-842
8. Thrush DN, Austin D, Burdash N. Cardiopulmonary bypass temperature does not affect postoperative euthyroid sick syndrome? Chest, 1995; 108 (6): 1541-1545
9. Bremner WF, Taylor KM, Baird S, et al. Hypothalamo-pituitary-thyroid axis function during cardiopulmonary bypass. J Thorac Cardiovasc Surg, 1978; 75(3):392-399
10. Tang GH, Feindel CM, Gullane PJ, Butany J. Combined cardiac surgery and excision of a retrosternal thyroid mass: a case report. J Card Surg, 2006; 21 (3): 281-283

Malignant melanoma metastasizing to cecum - a case report

Czerniak skóry przerzutujący do kątnicy - opis przypadku

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Abstract. The paper presents a patient with melanoma of the back metastasizing to the cecum. The patient has been diagnosed and treated since 2005 for melanoma and numerous metastases to the lymph nodes, salivary glands, facial muscles, brain and colon. The patient's long battle with the disease is described, and a detailed diagnosis of the melanoma is depicted. The paper also indicates the possibility of melanoma metastases to the whole organism. The aim of the study was to analyze the course of the melanoma growth, its diagnosis and possible treatment options, both surgical and combined. A melanoma is a malignant neoplasm that is still difficult to treat effectively. The most important role in the battle against it is played by prevention and early diagnosis of the disease. The disease has a tendency to recur, which often indicates that the recovery was only apparent. Among all known malignant neoplasms, malignant melanomas have an extremely high capacity to spread through the lymphatic and blood vessels, i.e. to metastasize: locally (satellite metastases in close proximity to the tumor, in-transit metastases along the lymphatic vessels and to the lymph nodes located in the immediate vicinity of the tumor), and remotely (in the lungs, liver, bones, brain, or colon).
Key words: melanoma, melanoma metastases, colon

Streszczenie. W publikacji przedstawiono przypadek chorego z przerzutem czerniaka ze skóry pleców do kątnicy, diagnozowanego i leczonego od 2005 roku z powodu czerniaka skóry oraz licznych przerzutów w obrębie węzłów chłonnych, ślinianek, mięśni twarzy, mózgu i jelita grubego. Przedstawiono wieloletnią walkę pacjenta z chorobą oraz zobrazowano szczegółową diagnostykę czerniaka skóry, a także zwrócono uwagę na możliwość przerzutów czerniaka w całym organizmie pacjenta. Celem pracy była analiza przebiegu wzrostu nowotworu, jego diagnostyka oraz możliwe sposoby leczenia zarówno chirurgicznego, jak i skojarzonego. Czerniak to nowotwór, który wciąż trudno poddaje się skutecznemu leczeniu. Najważniejszą rolę w walce z nim odgrywają: profilaktyka i wczesne rozpoznanie choroby. Zdarza się, że choroba powraca, co często świadczy o tym, że „wyleczenie" było pozorne. Czerniak złośliwy ma wyjątkowo dużą zdolność do rozprzestrzeniania się poprzez naczynia chłonne i krwionośne, czyli tworzenia przerzutów zarówno miejscowych (satelitarnych w bliskim otoczeniu guza, tranzytowych na szlakach naczyń chłonnych i do węzłów chłonnych położonych w najbliższym otoczeniu guza), jak i odległych (w płucach, wątrobie, kościach lub w mózgu, a także w okrężnicy).
Słowa kluczowe: czerniak skóry, przerzuty czerniaka, okrężnica

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Introduction

A melanoma (*melanoma malignum*) is a malignant skin neoplasm which originates from transformed melanocytes, i.e. the skin's pigment cells produce melanin that may then mutate, usually due to ultraviolet radiation.

Globally, it is the 16th most common cause of death among all the malignant neoplasms. It is highly malignant due to quick growth, early and numerous

metastases, and limited responsiveness to treatment. There are six **types of skin melanoma**, characterized by different incidence rates and prognoses:

- superficial spreading melanoma (the most common form) – 60-70% of cases, usually on the basis of pigmented lesions, mostly atypical and dysplastic ones,
- lentigo malignant melanoma – 5-20% of cases,
- nodular melanoma – 10-30% of cases,
- melanoma located on limbs, originating in lentigo lesions – approx. 5% of cases,
- melanoma originating from blue lesions – very rare,
- colorless melanoma (amelanotic) – the most severe and rare form of the neoplasm.

Melanoma usually requires multi-stage treatment. The first stage is surgical treatment, consisting of the radical excision of the neoplasm, along with a skin margin of 1 cm for a 2 mm thick melanoma. The biopsy is examined histopathologically. If lymph nodes are enlarged, they are also removed.

When the tumor is small, only the sentinel lymph node is assessed, i.e. the first node on the lymphatic pathway running from the tumor towards the regional lymph system. All the lymph nodes with metastatic deposits should be examined pathomorphologically. In individual cases, after the surgical treatment of high-risk melanomas, adjuvant therapy may be implemented: isolated limb perfusion chemotherapy, radiation therapy, chemotherapy, immunotherapy or targeted therapy.

No standards of treatment have been determined for metastatic melanomas, which demonstrate resistance to conventional chemotherapy, posing a significant challenge for modern oncology and pharmacology.

The prognosis for a melanoma, regarding clinical course and recurrence, may be determined on the basis of histopathological and clinical indicators, the stage of the disease, and the prognosis for the primary tumor, locoregional metastases and distant metastases. Identification of the prognostic features is a key factor in the choice of the most suitable therapy.

In melanomas, similarly to other neoplasms, the primary treatment goal is controlling the disease process, and extending the patient's life.

Case report

A 66-year-old male patient was admitted to the Department of General and Oncological Surgery at the Med-Gastr Hospital in Łódź for a planned right colon resection procedure due to melanoma metastasis to the caecum, confirmed in a histopathological test following a colonoscopy.

The patient had been treated for over 10 years due to skin melanomas with numerous metastases, without other comorbidities.

Case history

- 2005 – resection of a pigmented lesion, existing for several dozen years on the patient's back. In the period directly before the surgery, the lesion began to grow and change its structure. Histopathological results following the resection: *melanoma malignum cutis dorsi.* Post-operative biopsy of lymph nodes from both axillae did not reveal pathological lesions.
- 2007 – the patient felt enlarged lymph nodes in the right axilla. Another biopsy of the lymph nodes of the right axilla was performed. Results of the microscopic examination: melanoma cells in the lymph nodes. In the same year the right auxiliary lymph nodes were resected, and the patient received 6 cycles of CVD chemotherapy – cisplatin, vinblastine and dacarbazine.
- May 2008 – the patient sensed a tumor in the left submandibular area. The lesion was biopsied. Histopathological results: malignant melanoma cells.
- June 2008 – in the Department of Oncological Surgery resection of the neck lymph nodes on the right (neck dissection) was performed.
- January 2009 – a routine follow-up head CT revealed in the left frontal lobe a tumor 10 mm in diameter, possibly metastatic.
- March 2009 – in the Department of Neurosurgery a frontal craniotomy was performed, and the tumor was completely removed. No neurological deficits were observed.
- December 2009 – the patient experienced pain in the area of the left parotid salivary gland. A biopsy revealed a metastatic melanoma in the left parotid salivary gland and adjacent lymph nodes. Resection of the left parotid salivary gland with lymphadectomy was performed.
- 2010 – melanoma metastasis to the left masseter muscle. The muscle was resected. Next, control head CT, thoracic X-ray and abdominal ultrasound were performed; no pathological lesions were found.
- 2011 – the patient was diagnosed with disease recurrence in the frontal process of the left maxilla. The lesion was resected, and radical radiation therapy was implemented, using the most advanced method, IMRT (intensity modulated radiation therapy), which allows

limitation of the radiation field with an accuracy of up to 1 cm.

- November 2012 – a PET-CT (positron emission tomography-computed tomography) test revealed a focus of inflammation in the patient's caecum.
- December 2012 – endoscopic imaging diagnostics (colonoscopy) was performed in the Med-Gastr Medical Centre in Łódź. The entire large intestine was assessed, and due to a suspected neoplastic lesion, biopsies from the tumor were obtained for histopathological examination. The results of the histopathological testing confirmed the suspicion of melanoma metastasis to the caecum.
- January 2013 – the patient was admitted to the Department of General and Oncological Surgery at the Med-Gastr Medical Centre in Łódź. After qualification and preparation for the procedure, he was operated on. Apart from the caecum, no other pathological lesions were found intraoperatively in the peritoneum. Right-sided hemicolectomy was performed with ileo-transverse anastomosis. On day 5 after the surgery, the patient was discharged in a good general condition. Systematic oncological control, and conducting individually planned diagnostic tests were recommended.
- End of 2015 – regular control tests did not reveal any metastatic foci of melanoma in the patient.

Discussion

The incidence of malignant melanomas increases with each passing year. The "tanned body" trend, based on the belief that a tanned body is healthy and beautiful, contributes to the situation. Apart from excessive skin exposure to the sun, use of a solarium can also be very dangerous. The most important factors for increased disease risk include: intensive natural ultraviolet radiation (the sun), artificial UV radiation (solariums), continuous mechanical or chemical irritation, low pigment content in the skin and genetic predisposition, e.g. familial atypical mole syndrome (FAMS).

In women, melanoma occurs usually on the face and lower limbs, in men on the torso. All pigmented lesions which change color, become itchy or grow, should be examined and diagnosed by a dermatologist, surgeon or oncologist. Early identification of the primary focus, possible due to localization (microstaging I – excisional biopsy of the primary lesion) and identification of metastases to regional lymph nodes (microstaging II – lymphoscintigraphy and biopsy of the sentinel nodes) create a unique opportunity to increase the chances of recovery from skin melanomas.

In the clinical assessment of pigmented lesions, the symptoms can be grouped according to the American system, which facilitates the diagnosis by using the ABCD (E) rule:

- **A** (asymmetry) – **asymmetric** lesion suggests pathology; the melanoma is asymmetric relative to every axis, one half significantly differs from the other, the lesion is irregular, composed of protrusions, referred to as "isles", as opposed to benign lesions, which are usually round or oval,
- **B** (borders) – **borders** of the lesion are uneven and suspiciously jagged,
- **C** (color) – **varied** color of the lesion (from white, bluish, red, light brown, brown, through black or steel), with irregular pigmentation, and often with spots of pigment deposits (especially visible in a dermatoscopic examination),
- **D** (diameter) – lesion **diameter** of >5 mm, and every lesion which has grown or is raised above the skin surface, or (dynamics) – **dynamics** of morphological changes in the tumor,
- **E** (elevation) – additional symptom – **elevation** of the lesion surface above the level of the surrounding epidermis.

The most important element that enables early diagnosis of melanoma is examination of the patient's skin. Dermoscopy (epiluminescence microscopy) or videodermoscopy are recommended in the early diagnostics. The diagnosis of skin melanomas is based on the histopathological examination of the entire surgically removed pigmented lesion. After the histopathological diagnosis of skin melanoma, treatment should be implemented according to the macroscopic staging, and an additional basic blood test should be conducted: complete blood count, activity of the liver enzymes, and activity of lactate dehydrogenase (LDH). The most important prognostics in patients with extraregional metastases include: location of the metastases, and LDH activity.

Neoplastic metastases to the intestines are rare, and they are most frequently found in skin melanomas. 19-28% of all melanoma metastases are metastases to the large colon [1]. In patients diseased due to melanoma diffusion, large intestine metastases were found in 43.5% of cases [1-2].

The primary focus of a malignant melanoma located on the skin of the torso, head or neck is thought to predispose to metastases to the lungs and abdominal organs [3-6], whereas tumors located on the limbs predispose to metastases to the soft tissues and distant lymph nodes. There are reports of skin

melanomas metastasizing to the large intestine even 18 years after the diagnosis and resection of the primary focus [7-10].

The discussed case of malignant melanoma demonstrates that local resection of the melanoma may not lead to total recovery. The degree of malignancy and probability of distant metastases are very high in melanomas. Regular monitoring of skin lesions by a specialist is required. In case of the histopathological diagnosis of a skin melanoma, further imaging diagnostic tests are necessary, including conventional thoracic X-ray, and careful ultrasonographic and tomographic examinations of the abdominal cavity, head and lymph nodes. Imaging methods such as multiphoton laser tomography and optical coherence tomography can also be used. Endoscopic diagnostics of the gastrointestinal tract, i.e. gastroscopy and colonoscopy, are also useful.

Periodical imaging diagnostics tests are recommended, individually adapted and planned for each patient.

Continuous monitoring of the progression of the disease is required, in the form of a regular clinical examination of patients, during which special attention is paid to assessment of the entire skin, evaluation of the regional and distant lymph nodes, and liver palpation. As melanomas tend to form metastases even after many years, patients should be monitored their whole lives.

Therapeutic outcomes in patients with disseminated melanomas are not favorable. The treatment for each patient should be considered and planned individually. The treatment methods include: surgery, radiation therapy, chemotherapy, immunotherapy and molecular therapy with the use of tyrosine kinase inhibitors. Progress in the therapy of generalized melanomas are associated with two therapeutic mechanisms: molecularly targeted treatment with the use of tyrosine kinase inhibitors, and non-specific immunotherapy using anti-CTLA4 monoclonal antibodies, which inhibit systemic immunosuppression mechanisms to induce an antineoplastic response. Molecular diagnostic tests of the BRAF and CDKN2A genes allow the assessment of the risk of developing melanoma, predict the course of the disease and treatment effectiveness, as well as detect the neoplasm early (when the surgical procedure is effective), and use the available targeted therapy, if necessary (option for patients with the BRAF gene mutation, responsible for about 50% of all cases).

Currently, researchers focus on the use of non-specific immunotherapy (using anti-PD-1 antibodies: nivolumab or pembrolizumab) and therapies molecularly targeted at the BRAF-MEK pathway.

Non-specific immunotherapy (primarily using anti-CTLA4 monoclonal antibodies – ipilimubab, and anti-PD-1 antibodies – nivolumab and pembrolizumab) lead to a significant improvement in the treatment outcomes of patients with generalized melanomas. Immunotherapy of advanced melanomas have moved towards treatment with anti-PD-1 antibodies (nivolumab or pembrolizumab), which affect the control points of the immune system (such as PD-1 receptor and its ligand, PD-L1), and stimulate the activity of T lymphocytes, or the implementation of a combined treatment with anti-CTLA4 and anti-PD-1 antibodies. These preparations, used in a monotherapy or in combination with ipilimumab, under clinical conditions have demonstrated long-term clinical benefits in some patients with advanced melanomas.

Inhibitors of the PD-1/PD-L1 control point of the immune system are the third type of modern treatment of systemic malignant neoplasms, next to chemotherapy and molecularly targeted therapy. Their mechanism of action is unique: instead of directly inducing the destruction of neoplastic cells, they strengthen the immune system to eliminate the neoplasm.

Presently, the treatment of metastatic melanomas is directed towards therapy with anti-PD-1 antibodies (nivolumab or pembrolizumab) when non-surgical melanoma metastases are found, or implementation of combined therapy with anti-CTLA4 and anti-PD-1 antibodies (upon consideration of the greater toxicity and costs, as well as possible effect of PD-L1 expression). Therapy involving anti-PD-1 antibodies is associated with limited side effects, but requires experience and close following of the management algorithms.

If the BRAF mutation is found in a patient with metastatic melanoma, the molecularly targeted treatment of choice is a combination of BRAF and MEK inhibitors in the first-line or second-line therapy.

To conclude, anti-PD-1 antibodies and combined treatment with BRAF and MEK inhibitors is proposed in Polish, European (ESMO) and American (NCCN) recommendations as a standard therapeutic option of confirmed effectiveness in the treatment of advanced melanomas.

After a period of insufficient progress in treatment, recent years have raised our hopes of finding an effective therapy for advanced melanomas. This is associated with the intense development of immunotherapy and molecularly targeted treatments. However, proper diagnostics and surgical treatment of early lesions are still the basic methods of curing the disease.

Literature

1. Mosimann F, Fontolliet C, Genton A, et al. Resection of metastases to the alimentary tract from malignant melanoma. Int Surg, 1982; 67: 257-260
2. al-Sheneber IF, Meterissian SH, Loutfi A, et al. Small-bowel resection for metastatic melanoma. Can J Surg, 1996; 39: 199-203

3. Jorge E, Harvey HA, Simmonds MA, et al. Symptomatic malignant melanoma of the gastrointestinal tract. Operative treatment and survival. Ann Surg, 1984; 199:328-331
4. Rogers RS, Gibson LE. Mucosal, genital and unusual clinical variants of melanoma. Mayo Clin Proc, 1997; 72: 362-366
5. Jabłońska S, Majewski S. Choroby skóry i choroby przenoszone drogą płciową. [Diseases of the skin and sexually transmitted diseases] PZWL, Warsaw 2005
6. McDermott VG, Low VH, Keogan MT, et al. Malignant melanoma metastatic gastrointestinal tract. Am J Roentgenol, 1996; 166: 809
7. Al-Sheneber IF, Meterissian SH, Loutfi A, et al. Small-bowel resection for metastatic Can J Surg, 1996; 39: 199-203
8. Hao XS, Li Q, Chen H. Small bowel metastases of malignant palliative effect of surgical resection. Jpn J Clin Oncol, 1999; 29 (9):442-444
9. Blecker D, Abraham S, Furth EE, Kochman ML. Melanoma in the gastrointestinal Gastroenterol, 1999; 94: 3427-3433
10. Szawlowski A, Szmidt J (ed). Zasady diagnostyki i chirurgicznego leczenia nowotworów w Polsce. [Principles of diagnostics and surgical treatment of neoplasms in Poland] Fundacja Polski Przegląd Chirurgiczny 2003: 49
11. Kopacz A (ed). Zarys chirurgii onkologicznej. [Outline of oncological surgery] Medical Academy in Gdańsk 2000: 347
12. Breslow A. Thickness, cross-sectional areas and depth of invasion in the prognosis of cutaneous melanoma. Ann Surg, 1970; 172: 902

Surgical and conservative (octreotide) management of iatrogenic retroperitoneal lymphorrhea

Jatrogenny chłonkotok do przestrzeni zaotrzewnowej leczony operacyjnie i z zastosowaniem oktreotydu

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Abstract. This paper presents a case of iatrogenic retroperitoneal lymphorrhea following a lumbar sympathectomy carried out due to atherosclerosis obliterans praecox. The clinical problem, management and results are presented and discussed.
Key words: lumbar sympathectomy, retroperitoneal lymphorrhea, octreotide

Streszczenie. W pracy przedstawiono przypadek jatrogennego chłonkotoku do przestrzeni zaotrzewnowej po klasycznej sympatektomii lędźwiowej wykonanej z powodu atherosclerosis obliterans praecox. Omówiono problem kliniczny i przedstawiono sposób postępowania leczniczego oraz wyniki leczenia.
Słowa kluczowe: sympatektomia lędźwiowa, chłonkotok do przestrzeni zaotrzewnowej, oktreotyd

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Introduction

Lymphorrhea means a leakage of lymph from damaged lymph vessels either to an enclosed space, such as a pleural or peritoneal cavity, or outside in the form of a lymphatic fistula [1]. A damaged lymph outflow pathway is an increasingly common complication, due to the greater number of vascular surgeries [1, 2]. The lymphatic system has good capacity to regenerate after an injury, therefore the majority of such injuries do not result in complications requiring another operation [2].

This article presents a case of iatrogenic retroperitoneal lymphorrhea following a classic lumbar sympathectomy.

Case report

A 36-year-old patient (case history no. 2013-3849 CSK WIM) was admitted to the hospital due to critical ischemia of the right lower limb, with necrosis of the 5th toe and of the 2nd toe stump *(atherosclerosis obliterans praecox).* During previous hospitalizations in another center, the 2nd toe was amputated, and the right foot phlegmon was treated. Two months earlier, in this hospital, balloon angioplasty of the anterior and posterior tibial artery was performed; only the initial part of the sagittal artery, and merely fragments of the foot arch arteries were visible. As all reconstructive treatment options had been exhausted, the patient was qualified to surgical treatment of the sympathetic nervous system.

Classic right lumbar sympathectomy was performed (abdominal, pararectal, retroperitoneal access), and simultaneously the 2nd and 5th toes of the right foot were amputated (necrotic lesions). The surgery was complicated by sub-obstruction of the gastrointestinal tract and abdominal pain persisting for 3 days, mostly on the operated side.

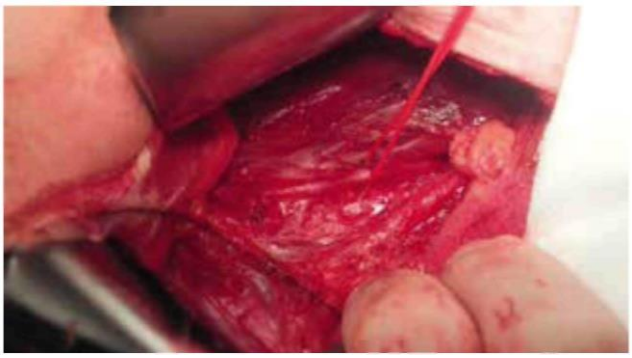

Figure 1. Intraoperative view - sympathetic trunk and lymphatic vessels (near)
Rycina 1. Obraz śródoperacyjny - pień współczulny, obok naczynia limfatyczne.

The ultrasound examination revealed extensive hematoma in the right retroperitoneum. The patient underwent a re-operation on day 8 following the surgery: after opening the right retroperitoneum, the leakage of a white-grayish liquid of consistency resembling lymph (>1,000 ml) occurred under pressure. The liquid was removed, (cultures/antibiogram were obtained), and the retroperitoneal space was rinsed with an aqueous solution of braunoderm. No site of injury of lymphatic or blood vessels was found. A Pezzer's drain was placed. Immediately after the re-operation, blood-tainted serum and lymph were drained, followed by serum and lymph content, and then only lymph. Initially, the patient was treated conservatively (low molecular weight heparin, non-steroid anti-inflammatory drugs, and antibiotics), without success. On day 3 after the re-operation, octreotide (somatostatin) was introduced, and the previously used medications were discontinued. As a result, the lymphatic leakage from the drain wound gradually began to decrease, until it stopped on day 7 after the re-operation (Figure 1).

Discussion

As the lymphatic system demonstrates great regenerative capacity, only a small percentage of lymph outflow pathway injuries require surgical treatment. The most common consequences of injuries include a lymphatic fistula or cyst in the area of the inguinal access [1], while lymphorrhea occurs in 12.2% of cases following surgical treatment of groin pseudoaneurysms [2]. The most characteristic features of lymphorrhea occur a few, sometimes several days after the vascular surgery, and biochemically they present mostly as lymphopenia and anemia [4]. Physical examination reveals the presence of "thickening" in the groin, without pulsation, sometimes with palpable bulking. Diagnostic puncture or testing the drainage content may reveal lymph. The presence of lymph may be confirmed by analyzing the concentrations of fats and protein, pH and specific weight of the collected liquid. The values specific for lymph are: 0.4-4.0 g/dl of fat, up to 3 g.dl of protein, pH>7.5, and specific weight >1.010 g/dl [4, 5].

"Mild" lymphorrhea, with negligible outflow of lymph, may remain unnoticed. Moderate leakage, often in the form of a cyst, requires periodic emptying (puncture in an out-patient setting, usually without ultrasound control). It is important to attempt to delay further punctures (removal of the liquid reduces pressure to the lymphatic pathways; as a result, "covering" of the tissue is impeded, as healing is prolonged). Good effects can be obtained by applying pressure after a puncture, to accelerate covering of the lymph vessels [1, 2]. Severe (>1,000 ml/d) lymphorrhea has a different course. Increasing volume of lymph in the cavities and spaces in the body may cause a local mass effect, as well as metabolic and immunological disorders, the result of accumulation of liquid in an enclosed space. The liquid causes pressure on the surrounding tissue (e.g. vessels), and thus leads to their dysfunction (here – ischemia of the lower limbs). The above mentioned metabolic and immunological disorders result from a significant loss of fats, vitamins, lymphocytes and antibodies in the lymph.

Biochemical analysis should confirm the presence of free fat at concentrations higher than in the blood plasma, stained with Sudan-3. If lymphorrhea is due to an operation, it often contains certain amounts of red blood cells. However, it is the presence of lymphocytes that is pathognomonic. The imaging test of choice is ultrasonographic examination, which should demonstrate a lack of conflict with blood vessels.

In the differential diagnostics of the liquid two basic parameters can be useful: the ratio of cholesterol concentration to triglyceride concentration (<1 in case of lymph) and triglyceride concentration > 110 mg / 100 ml [5, 6].

After the diagnosis has been confirmed, it is necessary to drain the operated area (usually using Redon's method), if it was not performed before, and apply conservative treatment: no oral food consumption (solid or liquid), and parenteral nutrition involving substitution of the compounds being lost. In approx. 50% of patients lymphorrhea stops within 14 days. Surgical intervention is indicated when lymphorrhea persists despite 14 days of conservative treatment.

The intervention consists of re-preparation of the inguinal vessels and puncture or electrocoagulation of any visible lymphatic vessels. If suturing or complete ligation is locally impossible, fibrin or cyanoacrylate adhesive may be used. The drain is usually kept for approx. 3 days and then removed, if the leak from the drain is less than 50 ml/d, and the color of the liquid does not resemble lymph.

If the lymphorrhea from the operated area is

prolonged, additional octreotide therapy is introduced [1, 5-7], apart from applying local pressure, elevation and compression therapy of the limbs [1, 5, 6]. The most common dose is 3.5 μg/kg bw/h of intravenous somatostatin by infusion pump, for at least 3 days [1]. During somatostatin treatment no food or liquids should be consumed orally.

Success of the therapy depends on excellent coordination between all the therapies, without discrediting any of the following: intravenous antibiotics and supplementation of liquids and electrolytes, local wound treatment, compression therapy, local pressure and removal of collected lymph.

Widespread use of intravascular interventions involving access through the femoral artery in the groin (adjacent to the lymphatic system) results in increased rates of lymphorrhea. Suitable conservative treatment (with the use of octreotide) may save the patient an additional surgical procedure.

Literature

1. Obara A, Dziekiewicz M, Maruszyński M, et al. Lymphatic complications after vascular interventions. Videosurgery and Other Miniinvasive Techniques, 2014; 9:420-426
2. Gabriel M, Pawlaczyk K, Mohssen ND, et al. Leczenie operacyjne jatrogennych tętniaków rzekomych w pachwinach - analiza 131 przypadków. [Surgical treatment of groin pseudoaneurysms: analysis of 131 cases] Nowiny Lekarskie, 2007; 76(1): 14-19
3. Rutherford BB. Lymphatic complication of vascular surgery. Saunders Elsevier 2005: 922-930
4. Kaufman HL, Einstein A. Perilymph fistula. eMedicine 2006
5. Guillem P, Papachristos J, Peillon Ch, Triboulet JP. Etilefrine use in the management of post-operative chyle leaks in thoracic surgery. Thorac Cardiovasc Surg, 2004; 3: 156-160
6. Lemaitre J, Segers B, Lebrun E. The use of lantreotide in the management of lymphorrhea after an aortic valve replacement. Interact Cardiovasc Thorac Surg, 2012; 15:762-763
7. Kilic D, Sahin E, Gulcan 0, et al. Octreotide for treating chylothorax after cardiac surgery. Tex Heart Inst J, 2005; 32: 437-439
8. Hoffer EK, Bloch RD, Mulligan MS, et al. Treatment of Chylothorax: Percutaneous Catheterization and Embolization of the Thoracic Duct. Am J Rentgenol, 2001; 176:1040-1042
9. Merigliano S, Molena D, Ruol A, et al. Chylothorax complicating esophagectomy for cancer: a plea for early thoracic duct ligation. J ThoracCardiovasc Surg, 2000; 119:453-457
10. Browse NL, Allen DR, Wilson NM. Management of chylothorax. Br J Surg, 1997; 84:1711-1716
11. Cope C, Salem R, Kaiser LR. Management of chylothorax by percutaneous catheterization and embolization of the thoracic duct: prospective trial. J Vase Interv Radiol, 1999; 10: 1248-1254
12. Kumar S, Kumar A, Pawar DK. Thoracoscopic management of thoracic duct injury: Is there a place for conservatism? J Postgrad Med, 2004; 50: 57-59
13. Wurnig PN, Hollaus PH, Ohtsuka T, et al. Thoracoscopic direct clipping of the thoracic duct for chylopericardium and chylothorax. Ann Thorac Surg, 2000; 70: 1662-1665
14. Hamdan MA, Gaeta ML. Octreotide and low-fat breast milk in postoperative chylothorax. Ann Thorac Surg, 2004; 77: 2215-2217
15. Kelly RF, Shumway SJ. Conservative management of postoperative chylothorax using somatostatin. Ann Thorac Surg, 2000; 69: 1944-1945
16. Gabbieri D, Bavutti L, Zaca F, et al. Conservative treatment of postoperative chylothorax with octreotide. Ital Heart J, 2004; 5: 479-482

Inhalation chlorine poisoning complicated by severe Acute Respiratory Distress Syndrome (ARDS) - a case report

Inhalacyjne zatrucie parami chloru powikłane zespołem ciężkiej niewydolności oddechowej (ARDS) -opis przypadku

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Abstract. The article presents a case of severe accidental inhalation chlorine poisoning. The initially good clinical condition of the patient became aggravated within a few hours after the gas inhalation. The patient was admitted to the anesthesiology and intensive therapy unit. His clinical condition, along with additional clinical tests (incl. imaging), led to the diagnosis of acute respiratory distress syndrome in adults. The patient underwent mechanical ventilation (incl. high frequency oscillation ventilation), was treated with bronchodilatators and antibiotics, and his circulatory system was supported by catecholamine infusion. After several days of hospitalization in intensive therapy units, the patient was transferred to the pulmonary diseases department. Finally, the patient was discharged home in good general condition.
Key words: chlorine intoxication, acute respiratory distress syndrome in adults, high frequency oscillation ventilation, HFOV

Streszczenie. W artykule zaprezentowano przypadek ciężkiego przypadkowego zatrucia parami chloru. Pierwotnie stosunkowo dobry stan kliniczny pacjenta po kilku godzinach od aspiracji gazu uległ szybkiemu pogorszeniu. Chory został przyjęty na oddział anestezjologii i intensywnej terapii. Objawy oraz wyniki badań dodatkowych (m.in. obrazowych) pozwoliły na postawienie rozpoznania zespołu ostrej niewydolności oddechowej dorosłych (ARDS). W leczeniu zastosowano wentylację mechaniczną (w tym wentylację oscylacyjną), leki rozkurczające oskrzela i antybiotykoterapię, a układ krążenia wsparto wlewem amin katecholowych. Po kilkunastu dniach leczenia na oddziałach intensywnej terapii pacjent został przekazany na oddział chorób płuc. Ostatecznie opuścił szpital w stanie ogólnym dobrym.
Słowa kluczowe: zatrucie chlorem, zespół ostrej niewydolności oddechowej dorosłych, wentylacja oscylacyjna, HF0V

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Introduction

Although we associate chlorine poisoning mainly with the atrocities of World War I, the widespread use of this element in industry, workplaces and the home is still associated with a risk of severe inhalation poisoning. This thesis is illustrated by the present case of a young man poisoned with chlorine vapor, and then treated in our center.

Case report

During the evening, a 31-year-old man was brought to the Hospital Emergency Department (HED) with a preliminary diagnosis of chemical burns to the face. As an employee of a water supply and sanitation company, the patient was pouring sodium hypochlorite into a container where previously an herbicide containing glyphosate (commercial name: Roundup) had been stored. As a result of the violent reaction between the residues of the herbicide and the sodium hypochlorite, large amounts of volatile chlorine and heat were released. The patient, who was leaning over the containers, had his face burnt, and aspired chlorine vapors.

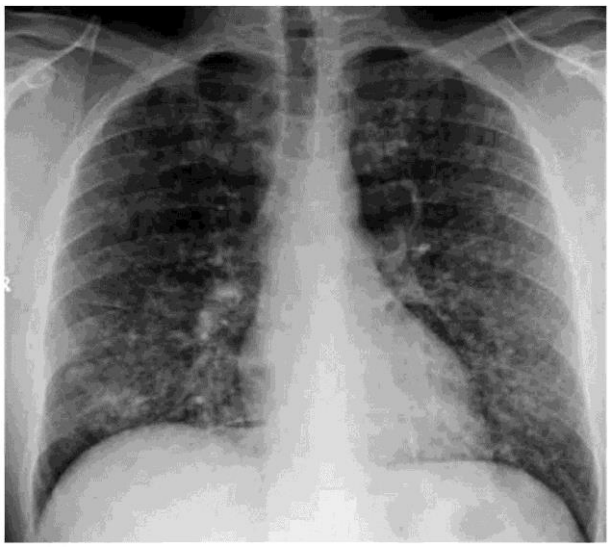

Figure 1. Chest X-ray taken on admission to emergency department. Note the massive bilateral pulmonary infiltrates.
Rycina 1. Zdjęcie RTG klatki piersiowej wykonane przy przyjęciu na SOR. Warto zwrócić uwagę na obustronne masywne nacieki tkanki płucnej.

Upon their arrival, the specialist medical emergency team recognized 1st and 2nd degree burns to the skin of the face, neck, tongue and eyes. In the ambulance the burnt areas were intensively rinsed with 0.9% NaCl solution. At the Hospital Emergency Department the above diagnosis was confirmed; upper and lower respiratory tract burns were also suspected. It was established that the patient was receiving treatment due to bronchial asthma. A consulting ophthalmologist found conjunctival and retinal burns of both eyes, more pronounced on the right side. Due to the good general condition of the patient, absence of dyspnea, blood saturation by indirect measurement (SpO_2) >90% and normal results of laboratory tests, the patient was admitted to the Department of General Surgery. Bronchodilatory and anti-inflammatory treatments were introduced (fenoterol inhalation, dexamethasone intravenously), as well as an antibiotic therapy (amoxicillin with clavulanic acid), the previous asthma treatment was continued (salmeterol inhalation and montelucast orally), intravenous pantoprazole was administered, anticoagulation prophylaxis with low molecular weight heparin was implemented, and fluids were replaced intravenously. Following the recommendations of the ophthalmologist, dexpanthenol, ofloxacin and combined hyaluronic acid with trehalose were administered into the eyes. Intravenous ketoprofen was used for an analgesic effect. A burn treatment center was called for phone consultation.

During the night, the patient's condition worsened, and dyspnea occurred, so passive oxygen therapy with the use of a facial mask was implemented. In the morning the consulting laryngologist noticed redness of the pharyngeal and laryngeal mucosa, without clear edema. Due to continued worsening of the patient's clinical condition, with SpO_2 of approx. 85% and massive bilateral infiltrations visible in the thoracic X-ray (Figure 1), consultation with an anesthesiologist was requested. The clinical picture was consistent with acute respiratory distress syndrome (ARDS). The patient was admitted to the Anaesthesiology and Intensive Care Unit (AICU).

On admission to the AICU the patient was conscious, and fully verbally responsive. He reported dyspnea and the feeling of "congestion of the chest with mucus". The symptoms of increasing respiratory failure were dominant. Over the lung fields diffuse crackling and wheezing sounds were audible. Arterial blood gasometry revealed hypoxemia. The patient was intubated (propofol, succinylcholine, no. 9.0 tube), and BiLevel mechanical ventilation started. The patient received sedation (midazolam and fentanyl in continuous infusion), muscle relaxant (pipecuronium) and 1 g of methylprednisolone and 1 mg of salbutamol intravenously. A central catheter and femoral artery catheter were placed. Hemodynamic monitoring with the use of transpulmonary thermodilution was introduced ($PICCO_2$). The measurement demonstrated low peripheral vascular resistance and an excess of pulmonary extravascular fluid (signs of non-cardiogenic pulmonary edema). Pressor amines and inotropic positive drugs (noradrenaline, dobutamine) were introduced. Diuresis was stimulated with crystalloid infusion, mannitol and furosemide. A bronchofiberoscopy was performed, in which the bronchi were rinsed first with a 0.9% NaCl solution, then with a 20% albumin solution. Tracheostomy was performed percutaneously (Figure 2). Computed tomography of the chest revealed perihilar merging densities in all the pulmonary segments, with a tendency to consolidated inflammatory lesions (Figure 3). Due to the increasing pulmonary edema and deteriorating ventilatory parameters, despite escalation of peak end-respiratory positive pressure (PEEP) and inhalatory oxygen concentrations, the decision was made to transfer the patient to an intensive therapy center, where alternative methods of mechanical ventilation could be provided (Figure 4).

Transportation lasted 30 minutes, and it was uncomplicated (fentanyl and midazolam infusion was continued in the ambulance, ventilation was provided with the use of transport ventilator). After admission of the patient to the department, his condition was assessed at an APACHE II score of 31 points. Sedation was modified (propofol, ketamine, sufentanyl), BIPAP mechanical ventilation was introduced, and empirical wide spectrum antibiotic therapy (ceftriaxone) was implemented. Conventional ventilation was initially effective, as it reduced inhalatory oxygen concentrations, but at night the patient's general condition deteriorated, and the oxygen index reached < 100, which prompted the diagnosis of severe ARDS.

Figure 2. After admission to anesthesiology and intensive therapy unit, the patient was intubated, sedated, and mechanically ventilated. A decision to undertake tracheostomy was made immediately - the procedure involved Griggs technique controlled with bronchofiberoscopy. The patient was mechanically ventilated this way for the next few days. Observe the burns to the face.
Rycina 2. Pacjent po przyjęciu na OAilT został zaintubowany, wdrożono sedację oraz wentylację mechaniczną. Bardzo szybko podjęto decyzję o wytworzeniu tracheostomii - zabieg wykonano metodą Griggsa pod kontrolą bronchofiberoskopii. W ten sposób pacjent byt wentylowany przez kilkanaście kolejnych dni. Uwagę zwracają oparzenia skóry twarzy.

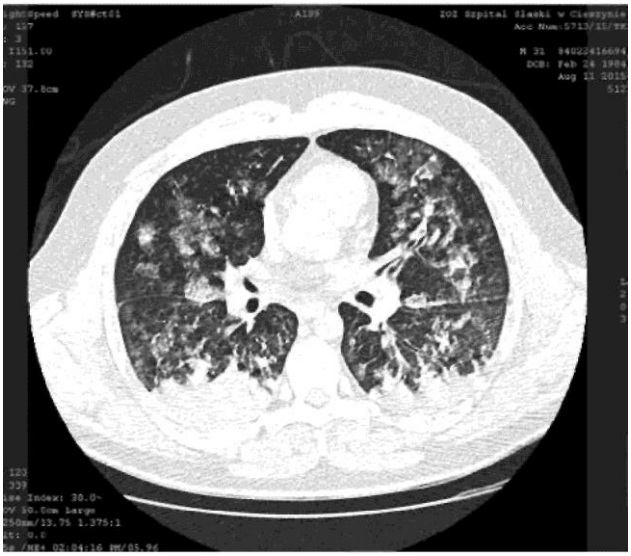

Figure 3. Chest CT-scan taken on the first day of patient hospitalization in anesthesiology and intensive therapy unit
Rycina 3. Tomografia klatki piersiowej wykonana w pierwszej dobie pobytu pacjenta na OAilT

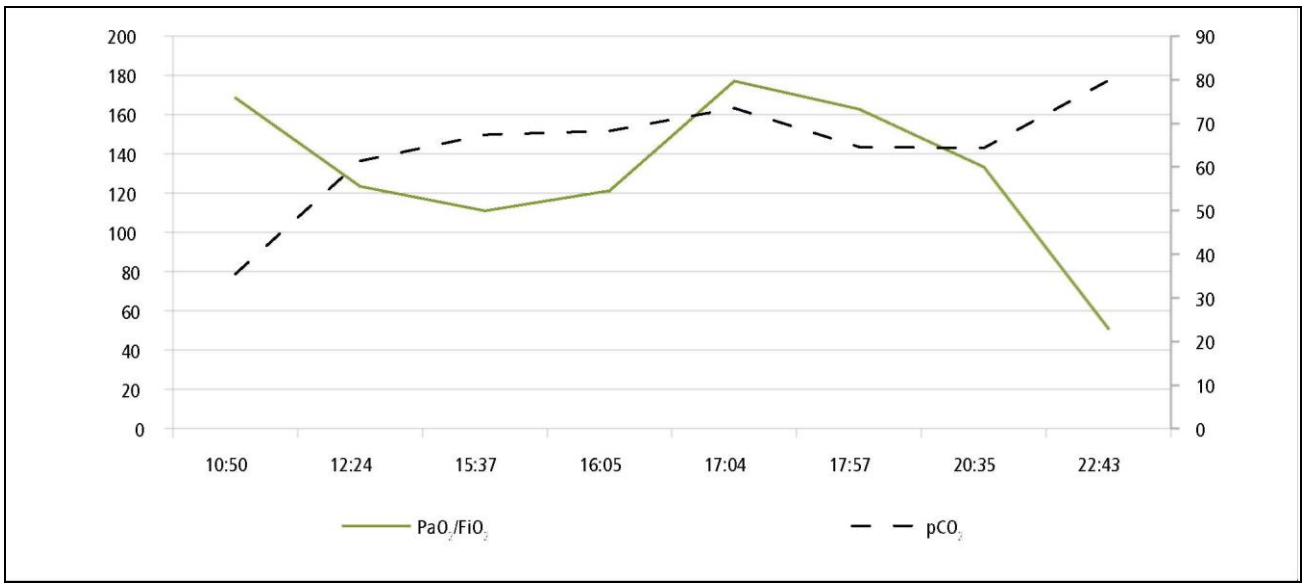

Figure 4. Diagram showing changes in arterial blood carbon dioxide tension and oxygenation index (PaO_2/FiO_2, PaO_2-arterial blood oxygen tension, FiO_2 - inspiratory concentration of oxygen) within the first twelve hours of hospitalization in the anesthesiology and intensive therapy units. Note the rapidly increasing hyperkapnia. At night, oxygenation was 51 and severe ARDS diagnosis could be established according to the Berlin definition.
Rycina 4. Wykres przedstawiający zmiany prężności dwutlenku węgla we krwi tętniczej (pCO_2) oraz wskaźnika tlenowego ($Pa0_2/Fi0_2$, gdzie $Pa0_2$ jest prężnością tlenu we krwi tętniczej, a $Fi0_2$ stężeniem wdechowym tlenu) w pierwszych dwunastu godzinach pobytu na OAilT. Warto zwrócić uwagę na szybko narastającą hiperkapnię. W godzinach nocnych wskaźnik tlenowy wyniósł 51, co według definicji berlińskiej pozwoliło na rozpoznanie ciężkiego ARDS.

Figure 5. During hospitalization in the intensive therapy units, the patient underwent bronchofiberoscopy several times. In the photo, a moment when the bronchofiberscope is over the carina of trachea can be seen. We can see extensive coagulative necrosis of the airway epithelium. This bronchoscopy was undertaken three days after the trauma.
Rycina 5. W trakcie pobytu pacjenta na OIT kilkakrotne wykonywano bronchofiberoskopie. Ujęcie przedstawia moment, gdy narzędzie znajduje się w tchawicy powyżej ostrogi. Widoczne są rozległe skupiska martwicy skrzepowej nabłonka dróg oddechowych. Ten konkretny zabieg wykonano trzy doby od urazu.

Due to hypoxemia, which persisted despite ventilation with 100% oxygen, and high PEEP values, the team on duty decided to use high frequency oscillatory ventilation delivered at a frequency of 5.5 Hz. On the basis of hemodynamic measurements ($PICCO_2$) fluid therapy was administered, and the circulatory system was supported by noradrenaline infusion. Following the change in the type of ventilation, a gradual improvement in gas exchange was obtained, with decreased inhalatory oxygen concentrations. Oscillatory ventilation was maintained for two days, and then the patient was switched back to classic ventilation (BI-PAP). Due to massive densities in the back areas, revealed in a control computed tomography test, the patient was put in a prone position – in four sessions, 10-12 hours each. Several bronchofiberoscopy examinations revealed a massive injury to the tracheal and bronchial epithelium, with areas of thrombotic necrosis (Figure 5). Improvement in the macroscopic picture of the respiratory tract was visible on day 8 after the injury. On the same day the sedatives were discontinued, with the exception of dexmedetomidine.

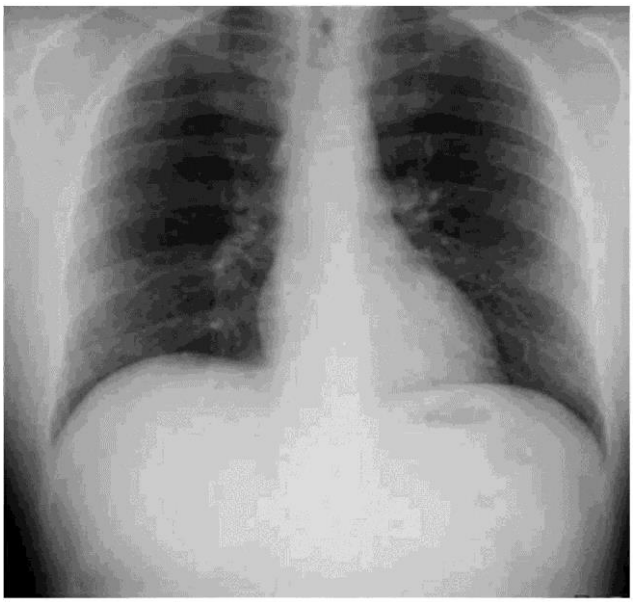

Figure 6. Control chest X-ray taken shortly before discharging the patient
Rycina 6. Kontrolny rentgenogram klatki piersiowej wykonany niedługo przed wypisaniem pacjenta ze szpitala do domu

On the next day the patient regained consciousness. The respiratory support was gradually reduced, the ventilation mode was changed from BIPAP to APRV, followed by a smooth transition to spontaneous breathing with positive pressure in the respiratory tract. Due to stabilization of the circulatory system, dose reduction and discontinuation of noradrenaline was possible. On day 12 after the injury the tracheostomy tube was removed.

After 14 days of hospitalization in the intensive therapy departments, the patient – conscious, fully verbally responsive, cardiovascularly and respiratorily stable, without signs of infection – was transferred to the Department of Pulmonary Diseases for further treatment and rehabilitation. A control bronchofiberoscopy did not reveal post traumatic lesions in the larynx, whereas in the bronchi thickened, partially reddened mucosa with individual necrotic bands was demonstrated, without clear narrowing. The thoracic image performed 17 days after the injury did not show any significant abnormalities (Figure 6). The patient was discharged in a good general condition. Follow-up examinations in an ophthalmology clinic and pulmonology clinic was recommended, as well as continuation of the asthma treatment.

Case discussion

In industry, chlorine is used to produce products like paints, lacquers, solvents, and plastics, as well as a substrate in the pharmaceutical industry. It is estimated that 10 million tons are produced per year in Western

Europe, and 13-14 million tons in the United States [1-3]. Therefore, it is not surprising that accidents in the workplace are among the most common causes of severe poisoning. Chlorine is also used for water disinfection, so poisoning can also take place, as illustrated in the described case, in water and sanitation companies, or in water treatment plants. Once we realize that chlorine is present in many widely available products for the disinfection of surfaces and bathrooms, it will be clear that it is one of the most common and easily accessible irritating agents. In 2011, nearly 4,000 cases of toxic exposure to chlorine vapor and chloramines in households were registered in the USA [3]. Large quantities of chlorine are transported in railway tank cars, so traffic accidents can also be sources of potential poisoning, including on a mass scale. One of the most dramatic poisonings due to a railway accident in recent years happened in January 2005 in Graniteville in America [4, 5]. As a result of a collision between two trains, one of the tank cars, containing several dozen tons of chlorine, leaked. Toxic vapor contaminated an area measuring 1,000 x 600 m. A total of 9 people died due to poisoning, and over 500 were taken to hospital, of whom over 70 were hospitalized. The emergency services evacuated over 5,000 people from the hazard zone. Data regarding the costs induced by the accident complete the picture, estimated at 126 million dollars [4, 5].

Mass chlorine poisonings, although on a smaller scale and with much lesser consequences, have also taken place in Poland. The last incident of this kind, described in the media, happened in 2015 at a swimming pool in Niechorze. Six people were taken to hospital. The fire department established that the required levels of chlorine concentration at the pool were vastly exceeded [6].

In discussing health-related complications associated with exposure to chlorine, it is important to note that there are differences between long-term exposures to small chlorine concentrations (e.g. in pools, at home or workplace) and exposures to high concentration of the gas, even if this is brief. This article focuses only on acute poisonings. The clinical picture of a poisoning depends on the chlorine concentration and the duration of exposure. With a concentration of 3-5% (1-15 ppm), the dominant symptoms are those associated with irritation of the nasal and pharyngeal mucosa, i.e. lacrimation, hypersalivation, sneezing, and sometimes coughing. Patients report "coarseness" or "itching" in the throat, they are anxious, and psychomotor agitation can occur. After exposure to concentrations of >20% (30 ppm) the symptoms are much more pronounced, they can take dramatic forms, and require strong reactions from the medical staff. In such cases, apart from the symptoms listed above, the following may occur: dyspnea, accelerated and shallow breathing, tachycardia, intensive cough, vomiting, chest pain, headache, sensitivity to light and abdominal discomfort or pain. Signs of bronchial obstruction and pulmonary edema may occur over the lung fields on auscultation [3, 5]. With a concentration of 400 ppm a 30-minute exposure results in death, and in case of a concentration of 1,000 ppm death is almost instantaneous [5]. The above thresholds for chlorine concentrations and related clinical symptoms are approximate. It is worth noting that the initially good condition of a patient may quickly deteriorate, as illustrated in the described case. If chlorine aspiration is suspected, it seems reasonable to admit the patient to a hospital for observation, even if the clinical symptoms do not indicate a life-threatening condition.

Due to the complexity of the clinical picture, involving the dysfunction of many organs, effective treatment of chlorine poisoning requires an understanding of its pathophysiology. In case of inhalation of highly concentrated chlorine vapors, pulmonary tissue suffers a massive injury, and in the first phase the "lung" symptoms dominate. The cascade of toxic effects of chlorine starts from reactions with water in the bodily fluids, including mucus in the respiratory tract. The products of this reaction are hypochlorous acid and hydrochloric acid, which damage the respiratory epithelium. When chlorine vapors in a concentration of about 200 ppm are aspired, bronchospasm occurs almost immediately. Oxidative shock (chlorine demonstrates a high oxidative potential) related to the activity of free radicals, the release of inflammatory mediators, migration of inflammatory cells, and activation of the coagulation processes result in impaired surfactant production, inflammation and, secondarily, to ARDS development [3, 5, 7]. Damage to the pulmonary diffusion barrier, penetration of a high-protein fluid into the alveoli, destruction of intervalvular septa and blocking of the small bronchi by plugs of mucus and tissue or blood clots lead to disturbed gas exchange, hypoxemia and carbon dioxide retention in the blood.

It is worth remembering here the "Berlin" definition of ARDS, according to which the following criteria need to be met for the diagnosis:

- the symptoms of respiratory insufficiency occurred within a week from the onset of the disease,
- imaging tests (CT, RTG) demonstrated bilateral opacities which cannot be explained by fluid in the pleural cavities, atelectasis or tumor,
- respiratory failure is not due to cardiac failure or fluid overload,
- oxygenation index, i.e. a quotient of partial pressure of blood oxygen (PaO_2) and fraction of inspired oxygen (FiO_2), is under 300; this indicator is used in classification of ARDS as mild (PaO_2/ FiO_2 <300), moderate (PaO_2/FiO_2 <200) or severe (PaO_2/FiO_2 <100) [8].

However, severe chlorine poisoning cannot be viewed only as a pulmonary pathology. The consequences of ARDS include pulmonary hypertension, which can lead to acute right ventricular heart failure. It has also been demonstrated on animals that chlorine compounds have a

direct toxic effect on the cardiac muscle, which may result in systolic dysfunction and left ventricular failure [9]. Hypotensia observed in the course of poisoning is caused by cardiac pathology and the direct effect of chlorine compounds on endothelium and the walls of the blood vessels [9, 10]. Studies on animals confirm the adverse effect of chlorine on the coagulatory system. It was demonstrated that in chlorine poisoning generalized coagulopathy occurs, and fibrinolysis is activated, with simultaneous intra-alveolar hypercoagulation (coagulation disorders in the pulmonary alveoli are suspected to contribute to the development of ARDS) [10]. The picture of the disease may be completed by chemical burns to the body surface and the eyes.

Before starting any medical emergency procedures on site, the safety of the paramedics must be ensured. It needs to be emphasized that whenever contamination of the area in question is suspected, a hazard assessment, evacuation of the injured from the hazard zone and their decontamination need to be performed prior to any action by the medical services. In Poland, these are mostly the responsibilities of the State Fire Department (SFD). The principles of cooperation between the medical emergency service teams and SFD are discussed in numerous publications, so there is no need to describe them here. It is important that an officer of the fire department is in charge of the rescue process.

The management of a patient with chlorine poisoning in the pre-hospital phase does not differ from the standards for emergency medicine. At this stage, clinical examination should follow the well-known ABCD pattern, and treatment must be oriented towards preservation of the vital functions. Due to the risk of the dynamic progression of disorders affecting the homeostasis of the organism during transportation to hospital, the patient's vital functions must be monitored (cardiomonitor, pulse oximetry), and the person in charge of the medical emergency service team must be in the medical compartment with the patient. Increasing symptoms of respiratory failure may necessitate intubation and mechanical ventilation already in the pre-hospital care stage. The risk of laryngeal spasm and severe bronchial spasm must always be considered. In case of edema of the tongue, pharynx and larynx, intubation may be difficult or impossible. Therefore, the procedure should be considered earlier. Oxygen therapy and bronchodilatory treatment must be also started in the ambulance.

Diagnostics after admission of the patient to the hospital include: repeated clinical examination, ECG, laboratory tests (CBC, arterial blood gasometry, clotting tests, concentrations of CRP, creatinine and urea), and thoracic imaging tests (X-ray, CT). Suspected respiratory burn, and inhalatory chlorine poisoning is a type of chemical respiratory burn, is an indication for bronchoscopy [11]. Apart from its diagnostic aspect, a bronchofiberoscopy can help to unblock the bronchi by removal of blood clots and plugs of the mucus and tissue [11].

There is no specific antidote for chlorine poisoning. The treatment of acute poisoning is mostly symptomatic. In the therapy of bronchospasm inhalatory β-mimetics should be used (intravenous administration may be considered) with anticholinergics (ipratropium) [3, 5]. The effectiveness of theophylline is questionable [3]. Inhalatory and intravenous corticosteroids are also recommended [3, 5, 12]. The effectiveness of inhalatory steroids in the inhibition of inflammatory reaction in the pulmonary tissue after inhalation of chlorine was confirmed in studies on animals [12]. American researchers reported a case of a 45-year-old male poisoned with chlorine, treated in a secondary military center at the Shindad Air Base in Afghanistan. In the therapy of severe bronchospasm they used sevoflurane, an anesthetic gas which demonstrates not only anesthetic, but also bronchodilatory properties [13]. In certain centers heparin nebulization is used in the treatment of respiratory burns [11]. In case of chlorine burns, the method was studied on animals, with promising results [10]. However, sodium bicarbonate solution nebulization is questionable. Theoretically, $NaHCO_3$ is used to neutralize the acids which damage the bronchial epithelium. The release of thermal energy during this reaction may cause concern, as it can hypothetically result in a secondary injury to the respiratory tract [4, 14]. However, numerous works, published since the 1970s, presenting experience with this method, may somewhat justify its use.

Oxygen therapy is necessary in patients with chlorine poisoning, and in case of significant disorders in the gas exchange, ventilatory treatment must be implemented.

In the described case the classical methods of mechanical ventilation were not sufficient. Observation of the dynamic course of the disease within the first few hours at the AICU resulted in a decision to transfer the patient early to a center where high frequency oscillation ventilation (HFOV) was available, before the procedure was necessary. It was a good decision, as the method had to be used the same day. HFOV resulted in an improvement to the oxygenation and in stabilization of the patient's condition.

High frequency oscillatory ventilation was originally used in the treatment of respiratory insufficiency in neonates [15]. Presently, indications for HFOV are extended, and include ARDS with severe hypoxemia resistant to standard ventilatory treatment [16]. HFOV is a type of high frequency ventilation (HFV). According to a general definition of HFV, it is ventilation using a respiratory rate of >60 breaths/minute, and a tidal volume less than or equal to the anatomical dead space [15]. HFOV is not widely accessible in Polish anesthesiology and intensive care units, and it requires special ventilators. Therefore it is worth knowing which centers have such equipment, and their experience in using oscillatory ventilation.

Summary

The toxic effect of chlorine may result in acute respiratory failure, cardiovascular failure, and shock with secondary multiorgan failure.

Out of 71 hospitalized victims of the catastrophe in Graniteville, 25 had to be admitted to an ICU. One of them died. The mean time of hospitalization of the other patients at the ICU was 3 days, with 7 patients requiring intubation, and the median time of mechanical ventilation was 6 days [5]. In the case of our patient, the duration of his stay at the AICU was 14 days, and the duration of mechanical ventilation was 11 days. Comparing the data one can conclude that we observed very severe, fully symptomatic chlorine poisoning, with acute cardiopulmonary failure, pulmonary edema and quickly deteriorating ventilatory parameters. Fortunately, aggressive treatment resulted in stabilization of the patient's condition and its gradual improvement.

Conclusions

- The initially good condition of a patient with chlorine poisoning may quickly deteriorate, even several hours following the injury.
- The treatment of chlorine gas poisoning is primarily symptomatic, and requires multiorgan support.
- In the presented case, use of high frequency oscillatory ventilation appeared to be an effective method of ARDS therapy.

Literature

1. White CW, Martin JG. Chlorine gas inhalation. Human clinical evidence of toxicity and experience in animal models. Proc Am Soc, 2010; 7: 257-263
2. IPPC Polska Internet website: ippc.mos.gov.pl/ippc/custom/BAT-chloro-alkalia.pdf, access on 11/11/2015
3. 0'Malley GF. Chlorine toxixity. Medscape Internet website: emedicine.medscape.com/article/832 336-overview#a6, access on 02/11/2015
4. Branscomb LM, Fagan M, Auerswald P, et al. Rail transportation of toxic inhalation hazards policy responses to the safety and security externality. Harvard Kennedy School Internet website, Harvard University: www.hks.harvard.edu/mrcbg/rpp/Working%20papers/Rail%20Transportation%20 of%20TIH.pdf, access on 02/11/2015
5. Mackie E, Svendsen E, Grant S, et al. Management of chlorine gas-related injuries from the Graniteville, South Carolina, train derailment. Disaster Med Public Health Prep, 2014; 8 (5): 411-416
6. Polish Radio Internet portal: www.polskieradio.pl/13/3/Artykul/ 1 476 907,Kilka-osob-zatrulo-sie-chlorem-w-prywatnym-basenie, accessed on 02/11/2015
7. Vajner JE, Lung D. Acute Chlorine Gas Inhalation and the Utility of Nebulized Sodium Bicarbonate, J Med Toxicol, 2013; 9: 259-265
8. Interna Szczeklika 2015. [Szczeklik's internal medicine 2015] Medycyna Praktyczna, Krakow 2015
9. Zaky A, Bradley WE, Lazark A, et al. Chlorine inhalation-induced myocardial depression and failure. Physiol Rep, 2015; 3 (6): e12 439
10. Zorogiannis SG, Wagner BM, Basappa S, et al. Postexposure aerolised heparin reduces injury in chlorine-exposed mice, Am J Physiol Lung Cell Mol Physiol, 2014; 307 (5): 347-354
11. Wróblewski P, Knefel G, Trzaska M, et al. Oparzenia dróg oddechowych. [Respitarory Tract Burn Injuries] Pneumonol Alergol Pol, 2011; 79 (4): 298-304
12. Cheng J, Mo Y, Schlueter CF, Hoyle GW. Inhibition of chlorine-induced pulmonary inflammation and edema by mometasone and budesonide, Toxicol Appl Pharmacol, 2013; 15: 408-413
13. Bellenger SR, Frizzi JD. Sevoflurane as a therapy for acute chlorine gas exposure in an Austere Healthcare Environment: A case report. ANAA J, 2014; 82(3):223-226
14. Vajner JE, Lung D. Acute chlorine gas inhalation and the utility of nebulized sodium bicarbonate. J Med Toxicol, 2013; 9: 359-265
15. Oczenski W, Werba A, Andel H. Podstawy wentylacji mechanicznej. [Basics of mechanical ventilation] Wydawnictwo a-medica press, Bielsko-Biała 2003: 391-408
16. Kübler A, Jaeschke R, Jankowski M. Intensywna terapia - postępy 2013. [Intensive therapy – improvement in 2013]. MedPrakt, 2014; 5:27-39

Impedance cardiography in the diagnosis of dyspnea – a case series

Kardiografia impedancyjna w diagnostyce duszności – opis serii przypadków

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Abstract. Heart failure is a major epidemiological, social and economic problem. The clinical presentation of heart failure is dominated by dyspnea, which causes problems with differential diagnosis in patients with multiple comorbidities, mainly respiratory disorders. Exacerbation of lung disease can lead to worsening of heart failure, and severe pulmonary congestion may intensify obstruction. There are commonly used laboratory and imaging methods available which can help to determine the cause of the symptoms, but in some cases impedance cardiography, a modern non-invasive method of hemodynamic assessment, may prove to be of significant value. In this work, the usefulness of this method in daily clinical practice is presented by a description of a series of cases.
Key words: heart failure, chronic obstructive pulmonary disease, dyspnea, impedance cardiography

Streszczenie. Niewydolność serca stanowi istotny problem epidemiologiczny, społeczny i ekonomiczny. W obrazie klinicznym niewydolności serca dominuje duszność, co stanowi problem w diagnostyce różnicowej u chorych z licznymi chorobami współistniejącymi, głównie układu oddechowego. Zaostrzenie choroby płuc niejednokrotnie prowadzi do zaostrzenia niewydolności serca, podobnie jak nasilony zastój w krążeniu płucnym może nasilać obturację. Powszechnie stosowane badania obrazowe i laboratoryjne wspomagają ustalenie właściwej przyczyny objawów, jednak w niektórych przypadkach szczególnie przydatna może się okazać kardiografia impedancyjna, nieinwazyjna metoda oceny parametrów hemodynamicznych. W pracy zaprezentowano serię przypadków ilustrującą użyteczność tej metody w codziennej praktyce klinicznej.
Słowa kluczowe: niewydolność serca, przewlekła obturacyjna choroba płuc, duszność, kardiografia impedancyjna

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Introduction

Dyspnea is among the most common causes of patients visiting emergency departments. The differential diagnosis is difficult, both at the preliminary stage and during hospitalization. This is due to complex etiology of dyspnea, which is primarily caused by heart failure (HF) or pulmonary disorders, especially chronic obstructive pulmonary disease (COPD) [1-3]. The diseases often have not been previously diagnosed, and the reported symptoms can result from their synergistic effect [4-6]. In this situation it is not easy to determine which disorder is currently the dominant one, requiring intensive treatment.

Therefore, non-invasive diagnostic methods are sought to enable simple, fast and objective diagnoses. Echocardiography, radiological assessment (RTG) of the thoracic organs, and concentration of the N-terminal pro b-type natriuretic peptide (NT-proBNP) have gained an established position in this respect [7-14]. However, the methods have certain constraints: limited sensitivity and specificity (RTG, NT-proBNP), limited accessibility (echocardiography), and high cost (NT-proBNP) [15-17].

A new method of hemodynamic assessment, which can be used in these cases, is impedance cardiography (ICG), based on the evaluation of thoracic impedance and its changes. Basic resistance indirectly reflects pulmonary hydration, while impedance oscillation associated with the cardiac cycle reflects blood flow in the large arteries [18, 19].

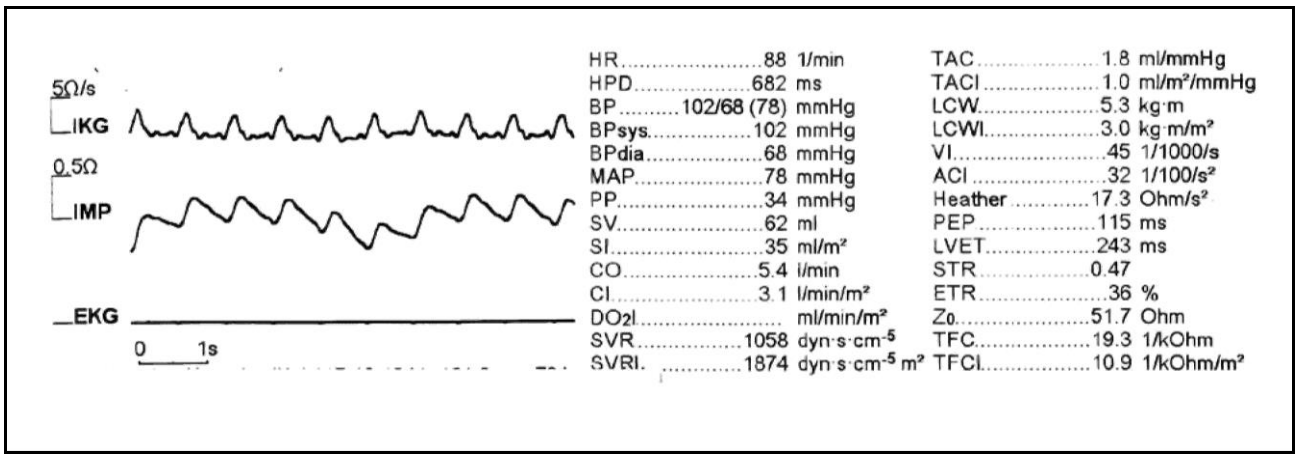


Figure 1. ICG report (case 1). It is noticeable that the TFC value is low, CI and SVR are correct. CI - cardiac index, HR - heart rate, SI - stroke index, SVR - systemic vascular resistance, and TFC - thoracic content of fluid.
Rycina 1. Wynik badania ICG dla przypadku 1. Zwraca uwagę mała wartość TFC, prawidłowy CI i SVR. CI - wskaźnik rzutu serca, HR - częstotliwość rytmu serca, SI - wskaźnik objętości wyrzutowej, SVR - systemowy opór naczyniowy, TFC - zawartość płynu w klatce piersiowej.

The basic parameters evaluated include: total fluid content (TFC), stroke index (SI), cardiac index (CI) and systemic vascular resistance (SVR). The method has proven to be a reliable tool for hemodynamic assessment in preliminary tests [20-24], and is increasingly often used in clinical practice. In this study the clinical value of ICG is presented in four clinical cases in which it appeared to be useful for the differential diagnosis of dyspnea.

Case 1

A 73-year-old female with a history of bronchial asthma, well-controlled arterial hypertension and hypercholerestolemia was admitted to the Department of Cardiology and Internal Diseases of the Military Institute of Medicine due to impaired exercise tolerance, exercise dyspnea and lower leg edema occurring periodically. Before hospitalization, due to suspected ill-controlled bronchial asthma, the patient received intensive pulmonological treatment (including empirical antibiotic therapy), without improvement. On admission to the hospital the patient demonstrated rest dyspnea, lower leg edema, as well as wheezing over the lung fields and a few crackles at the lung base. An echocardiographic examination did not reveal abnormalities (cardiac chambers of normal size, normal systolic and diastolic left ventricular function, no signs of left ventricular overload, and no significant valvular defects). Thoracic X-ray did not reveal stasis or parenchymal densities. Laboratory test results were normal, and NT-proBNP concentration was normal (41.8 pg/ml). ICG revealed normal values of hemodynamic parameters, including thoracic fluid content (TFC), which confirmed the suspicion that the causes of dyspnea were not cardiogenic (Figure 1). The asthma treatment was intensified, which resulted in a rapid improvement in the patient's condition.

Case 2

A 65-year-old female with arterial hypertension, nicotinism and hyporthyroidism treated in replacement therapy was admitted to the hospital due to an effort-induced feeling of chest clogging and dyspnea. A physical examination on admission to the hospital did not reveal significant abnormalities. An echocardiographic examination demonstrated normal left ventricular function. Signs of impaired left ventricular relaxation and moderate insufficiency of the tricuspid valve were found. The symptoms were interpreted as typical for unstable angina, and a coronarography was performed, which did not reveal changes in the coronary arteries. NTproBNP concentration was also normal (65 pg/ml). An impedance cardiographic examination did not reveal any signs of hyperhydration or significant impairment of the cardiac pump function – TFC (26.7 1/kOhm) and CI (3.8 l/m^2) were normal. HF was excluded as the cause of symptoms (Figure 2). Further diagnostics involved spirometry, which revealed signs of moderate obstruction (Figure 3), and eventually the patient was diagnosed with COPD. Suitable treatment was implemented with good clinical results.

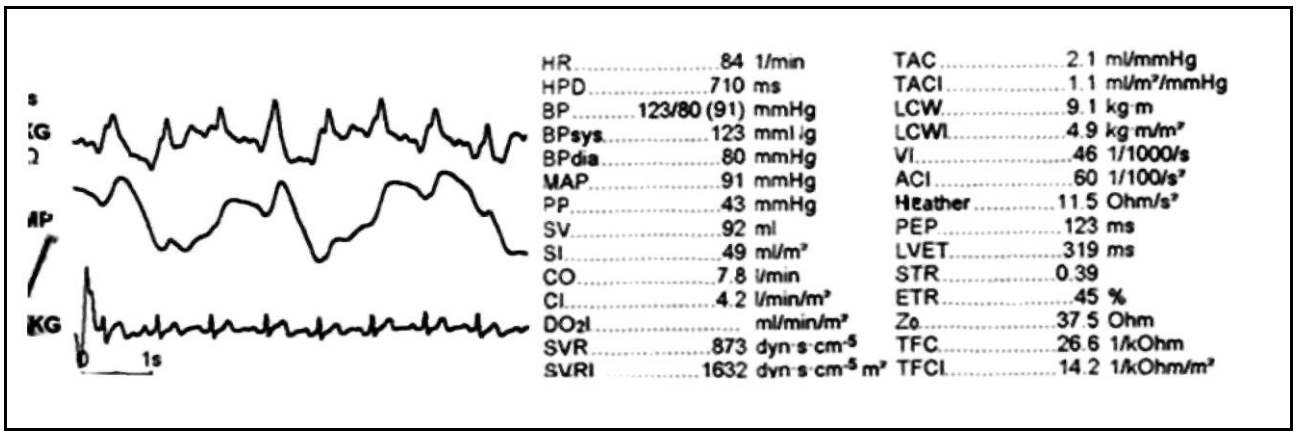


Figure 2. ICG report (case 2). It is noticeable that the TFC value is low, CI and SVR are correct. CI - cardiac index, HR - heart rate, SI - stroke index, SVR - systemic vascular resistance, and TFC - thoracic content of fluid.
Rycina 2. Wynik badania ICG dla przypadku 2. Zwraca uwagę prawidłowa wartość TFC, CI i SVR. CI - wskaźnik rzutu serca, HR - częstotliwość rytmu serca, SI - wskaźnik objętości wyrzutowej, SVR - systemowy opór naczyniowy, TFC - zawartość płynu w klatce piersiowej.

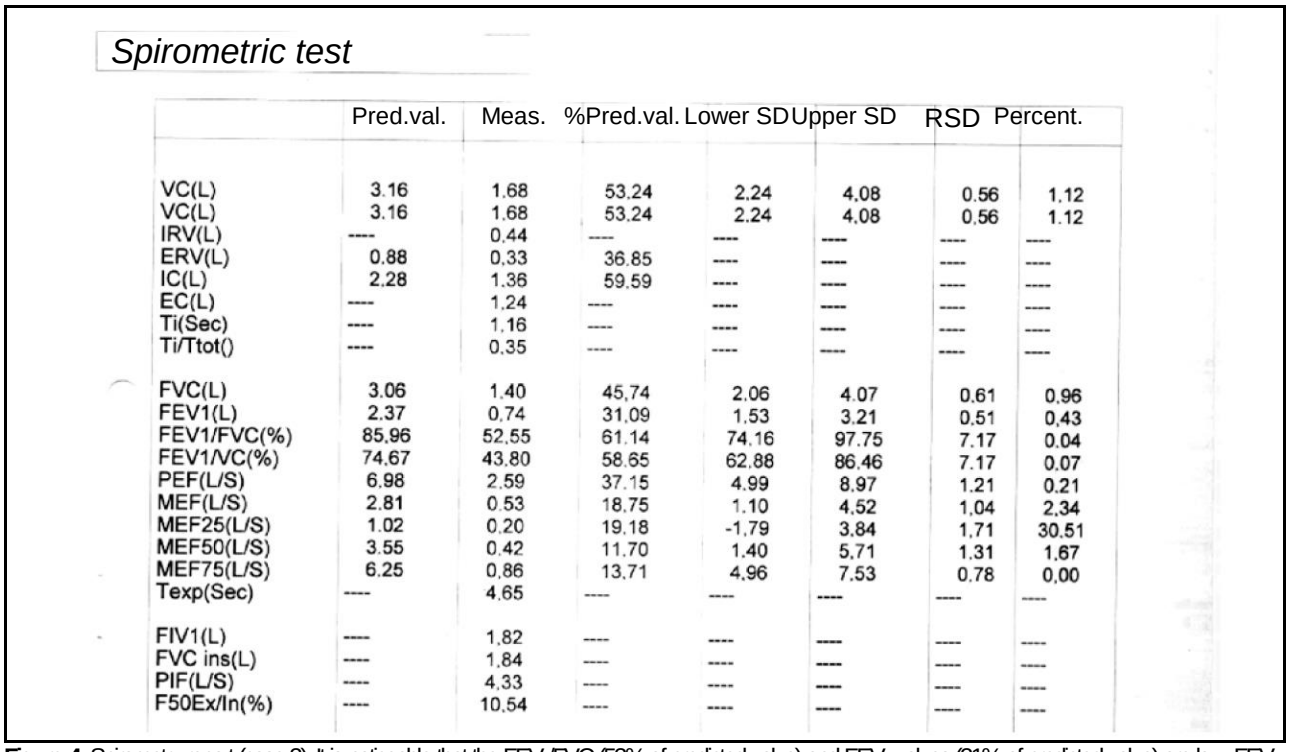
Spirometric test

	Pred.val.	Meas.	%Pred.val	Bottom SD	Upper SD	RSD	Percent.
VC(L)	3.16	2.42	76.71	2.47	3.85	0.42	4.85
VC(L)	3.16	2.42	76.71	2.47	3.85	0.42	4.85
IRV(L)	----	1.20	----	----	----	----	----
ERV(L)	0.76	0.68	89.28	----	----	----	----
IC(L)	2.40	1.74	72.72	----	----	----	----
EC(L)	----	1.22	----	----	----	----	----
Ti(Sec)	----	1.05	----	----	----	----	----
Ti/Ttot()	----	0.49	----	----	----	----	----
FVC(L)	3.15	2.53	80.37	2.44	3.85	0.43	8.01
FEV1(L)	2.66	1.49	56.08	2.04	3.29	0.38	0.53
FEV1/FVC(%)	76.55	59.04	77.12	65.85	87.26	6.51	1.02
FEV1/VC(%)	76.55	61.61	80.48	65.85	87.26	6.51	1.98
PEF(L/S)	6.53	2.68	41.05	5.05	8.01	0.90	0.07
MEF(L/S)	2.86	1.47	51.42	1.46	4.26	0.85	5.83
MEF25(L/S)	1.30	0.32	24.29	-0.92	3.52	1.35	22.51
MEF50(L/S)	3.80	0.94	24.67	1.99	5.61	1.10	1.19
MEF75(L/S)	5.58	2.63	47.07	4.45	6.72	0.69	0.07
Texp(Sec)	----	6.66	----	----	----	----	----
FIV1(L)	----	2.19	----	----	----	----	----
FVC ins(L)	----	2.51	----	----	----	----	----
PIF(L/S)	----	3.66	----	----	----	----	----
F50Ex/In(%)	----	26.87	----	----	----	----	----

Figure 3. Spirometry report (case 2). It is noticeable that the FEV_1/FVC (59% of predicted value) and FEV_1 values (56% of predicted value) are low. FEV_1 - forced expiratory volume in one second, FVC - forced vital capacity, and FEV/FVC - pseudo-Tiffeneau indicator.
Rycina 3. Wynik badania spirometrycznego - przypadek 2. Zwraca uwagę mała wartość FEV^FVC (59% wartości należnej) oraz FEV_1 (56% wartości należnej). FEV_1 - natężona objętość wydechowa pierwszosekundowa, FVC - natężona pojemność życiowa, FEV/FVC -wskaźnik pseudo-Tiffeneau.

Case 3

A 70-year-old male with systolic HF after infarction of the inferior-lateral wall (following aortic coronary bypass surgery) and COPD was admitted to the hospital due to exercise dyspnea exacerbating within the previous 3 months. Because of the above symptoms, the outpatient diuretic treatment was intensified, but without expected improvement. After admission the patient was in a moderate general condition, had rest dyspnea, and cracklings at the base of the lungs over the lung fields were found, as well as multiple wheezing and whirring sounds, and asymmetrical edema of the lower legs.



Spirometric test

	Pred.val.	Meas.	%Pred.val.	Lower SD	Upper SD	RSD	Percent.
VC(L)	3.16	1.68	53.24	2.24	4.08	0.56	1.12
VC(L)	3.16	1.68	53.24	2.24	4.08	0.56	1.12
IRV(L)	----	0.44	----	----	----	----	----
ERV(L)	0.88	0.33	36.85	----	----	----	----
IC(L)	2.28	1.36	59.59	----	----	----	----
EC(L)	----	1.24	----	----	----	----	----
Ti(Sec)	----	1.16	----	----	----	----	----
Ti/Ttot()	----	0.35	----	----	----	----	----
FVC(L)	3.06	1.40	45.74	2.06	4.07	0.61	0.96
FEV1(L)	2.37	0.74	31.09	1.53	3.21	0.51	0.43
FEV1/FVC(%)	85.96	52.55	61.14	74.16	97.75	7.17	0.04
FEV1/VC(%)	74.67	43.80	58.65	62.88	86.46	7.17	0.07
PEF(L/S)	6.98	2.59	37.15	4.99	8.97	1.21	0.21
MEF(L/S)	2.81	0.53	18.75	1.10	4.52	1.04	2.34
MEF25(L/S)	1.02	0.20	19.18	-1.79	3.84	1.71	30.51
MEF50(L/S)	3.55	0.42	11.70	1.40	5.71	1.31	1.67
MEF75(L/S)	6.25	0.86	13.71	4.96	7.53	0.78	0.00
Texp(Sec)	----	4.65	----	----	----	----	----
FIV1(L)	----	1.82	----	----	----	----	----
FVC ins(L)	----	1.84	----	----	----	----	----
PIF(L/S)	----	4.33	----	----	----	----	----
F50Ex/In(%)	----	10.54	----	----	----	----	----

Figure 4. Spirometry report (case 3). It is noticeable that the FEV_1/FVC (53% of predicted value) and FEV_1 values (31% of predicted value) are low. FEV_1 - forced expiratory volume in one second, FVC - forced vital capacity, and FEV_1/FVC - pseudo-Tiffeneau indicator.
Rycina 4. Wynik badania spirometrycznego – przypadek 3. Zwraca uwagę mała wartość FEV/FVC (53% wartości należnej) oraz FEV, (31% wartości należnej). FEV_1 - natężona objętość wydechowa pierwszosekundowa, FVC - natężona pojemność życiowa, FEV_1/FVC - wskaźnik pseudo-Tiffeneau.

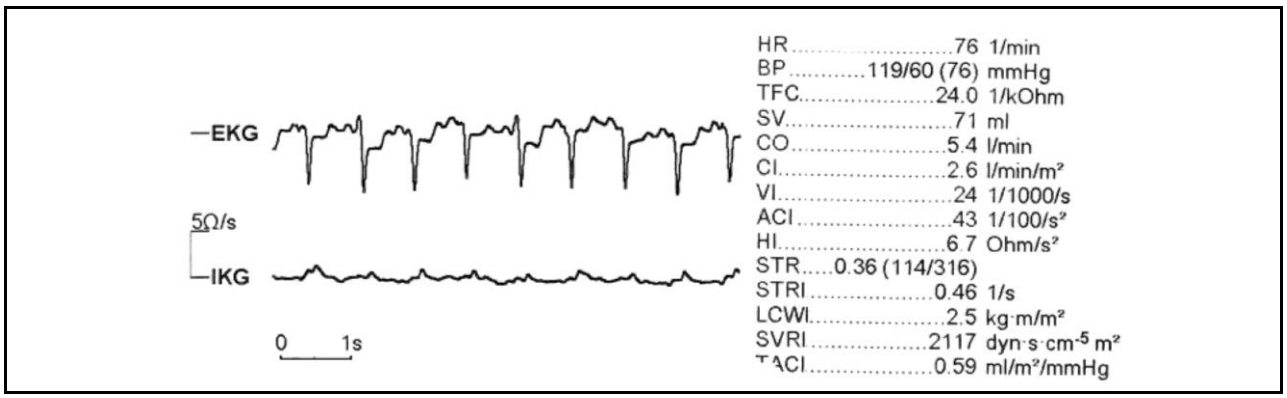


Figure 5. ICG report (case 3). It is noticeable that the TFC value is low, CI and SVRI are correct. CI - cardiac index, HR - heart rate, SI - stroke index, SVRI - systemic vascular resistance index, and TFC - thoracic fluid content.
Rycina 5. Wynik badania ICG dla przypadku 3. Zwraca uwagę mała wartość TFC, prawidłowy CI i SVRI. CI- wskaźnik rzutu serca, HR - częstotliwość rytmu serca, SI - wskaźnik objętości wyrzutowej, SVR - systemowy opór naczyniowy (indeksowany), TFC - zawartość płynu w klatce piersiowej.

Laboratory tests revealed increased inflammatory markers (3.6->9.0 mg/dl) and NT-proNBT concentration (10,221 pg/ml). The echocardiographic examination demonstrated generalized hypokinesis of the left ventricular walls, akinesias of the inferior wall and basal part of the septal wall (EF 20%), and spirometry revealed severe irreversible obstruction (Figure 4). ICG did not reveal significantly increased TFC (Figure 5), which suggested that the primary cause of dyspnea was obstruction and exacerbation of chronic respiratory insufficiency in the course of COPD. Intensive bronchodilatory treatment and intravenous steroid therapy were introduced, resulting in a gradual improvement in the patient's condition.

Case 4

A 73-year-old male, previously not treated for chronic diseases, was admitted to the Department of Cardiology and Internal Diseases of the Military Institute of Medicine due to exercise dyspnea, increasing for 2 weeks, and cough with sputum expectoration. A physical examination revealed wheezing and whirling over the lungs, although bilateral single crackles were also present. A fast heart rate was observed (approx. 150/min), which was reflected in the electrocardiogram as atrial tachycardia with ventricular rhythm of 150/min. Laboratory tests revealed hypercapnia (pH 7.299, pCO_2 46 mm Hg, pO_2 91.2 mm Hg, BE 4.4 mmol/l) and signs of renal failure (creatinine concentration 2.5 mg/dl, urea concentration 150 mg/dl). An echocardiographic examination did not demonstrate contractility disorders, only an impaired left ventricular relaxation was found, as well as right atrium and ventricle enlargement, moderate insufficiency of the tricuspid valve, and borderline size of the pulmonary trunk with normal flow acceleration time. Due to a history of nicotine addiction, persistent obstruction and partial respiratory insufficiency, the patient was diagnosed with exacerbation of previously unrecognized COPD. Supraventricular cardiac rhythm disorders were considered secondary to the pulmonary disease. The patient was referred to the Department of Pneumology, where a spirometric test confirmed severe obstruction (Figure 6.). Unfortunately, intensive COPD therapy did not result in the expected improvement. Due to persistent atrial tachycardia with fast ventricular activity, the patient was transferred back to the Department of Cardiology and Internal Diseases. Because of the ambiguous clinical picture and lack of effectiveness of previous treatment, an ICG examination was performed, revealing significantly increased TFC (Figure 7).

Spirometric test

	Pred.val.	Meas.	%Pred.val.	Bottom SD	Upper SD	RSD	Percent.
VC(L)	4.09	1.63	39.86	3.17	5.01	0.56	0.06
VC(L)	4.09	1.63	39.86	3.17	5.01	0.56	0.06
IRV(L)	----	0.36	----	----	----	----	----
ERV(L)	1.01	0.76	75.01	----	----	----	----
IC(L)	3.08	0.87	28.36	----	----	----	----
EC(L)	----	1.27	----	----	----	----	----
Ti(Sec)	----	1.93	----	----	----	----	----
Ti/Ttot()	----	0.32	----	----	----	----	----
FVC(L)	3.94	1.70	43.07	2.94	4.95	0.61	0.19
FEV1(L)	2.99	0.72	23.93	2.15	3.83	0.51	0.05
FEV1/FVC(%)	85.89	42.12	49.04	74.09	97.68	7.17	0.00
FEV1/VC(%)	73.98	43.90	59.34	62.18	85.77	7.17	0.08
PEF(L/S)	7.86	1.97	25.14	5.87	9.85	1.21	0.03
MEF(L/S)	2.97	0.45	15.05	1.26	4.68	1.04	1.59
MEF25(L/S)	1.37	0.27	19.49	-1.44	4.18	1.71	25.07
MEF50(L/S)	4.08	0.33	8.03	1.92	6.23	1.31	0.76
MEF75(L/S)	7.06	0.63	8.89	5.78	8.35	0.78	0.00
Texp(Sec)	----	5.89	----	----	----	----	----
FIV1(L)	----	0.87	----	----	----	----	----
FVC ins(L)	----	1.40	----	----	----	----	----
PIF(L/S)	----	1.64	----	----	----	----	----
F50Ex/In(%)	----	21.42	----	----	----	----	----

Figure 6. Spirometry report (case 4) before diuretic treatment. It is noticeable that the FEV/FVC (49% of predicted values) and FEV_1 (24% of predicted value) are low. FEV_1 - forced expiratory volume in one second, FVC - forced vital capacity, and FEV_1/FVC - pseudo-Tiffeneau indicator.

Rycina 6. Wynik badania spirometrycznego - przypadek 4. (przed wdrożeniem leczenia diuretycznego). Zwraca uwagę mata wartość FEV/FVC (49%) oraz FEV_1 (24% wartości należnej). FEV_1 - natężona objętość wydechowa pierwszosekundowa, FVC - natężona pojemność życiowa, FEV_1/ FVC - wskaźnik pseudo-Tiffeneau.

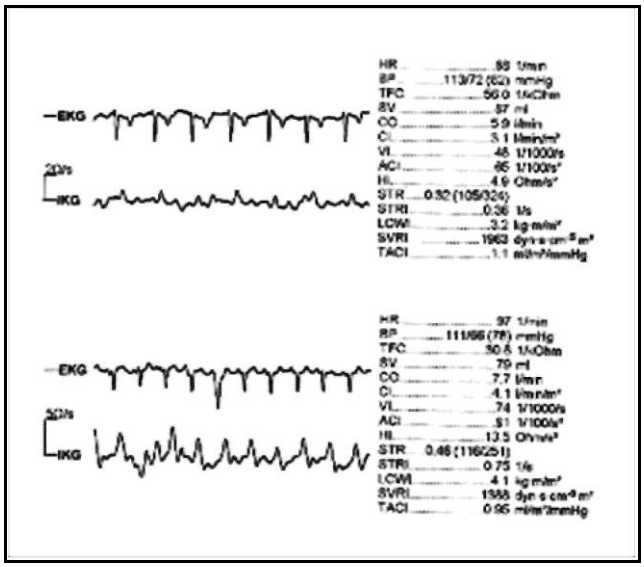


Figure 7. ICG reports (case 4) before (top) and after (bottom) the implementation of diuretic therapy. It is noticeable that the TFC value is significantly decreased. CI - cardiac index, HR - heart rate, SI - stroke index, SVRI - systemic vascular resistance index, and TFC - thoracic fluid content.

Rycina 7. Wynik badania ICG dla przypadku 4.: przed (górny) oraz po (dolny) wdrożeniu leczenia diuretycznego. Zwraca uwagą istotna redukcja TFC. CI - wskaźnik rzutu serca, HR - częstotliwość rytmu serca, SI - wskaźnik objętości wyrzutowej, SVRI - systemowy opór naczyniowy (indeksowany), TFC - zawartość płynu w klatce piersiowej.

The treatment was directed towards the reduction of the stasis in pulmonary circulation, and high doses of loop diuretic were administered. A quick improvement in the patient's general condition was observed over the following days, as well as spontaneous normalization of arrhythmia, reduction of NT-proBNP concentration (from 5556 pg/ml to 3322 pg/ml) and of TFC (Figure 7.). On the basis of a sequential evaluation of volemia, the drug doses were optimized, and the patient's clinical condition was stabilized.

Discussion

The presented cases demonstrate the usefulness of ICG in the assessment of patients with dyspnea. Using this simple method was a valuable addition to the standard diagnostic procedures. The assessment of volemia appeared to be reliable and consistent with the results of other diagnostic tests. It was also important for the determination of the required therapeutic strategy.

The first case demonstrated that ICG is a simple, quick and safe method to exclude stasis in pulmonary circulation as the cause of dyspnea. The low TFC values in this patient were consistent with the X-ray, echocardiography and NT-proBNT results. In our opinion, for such patients ICG could be a key examination to exclude left ventricular HF. It would enable quick diagnosis, and reduce the cost of tests and exposure to X-radiation.

Case 2 illustrates a common clinical situation when a preliminary diagnosis of coronary disease is not confirmed in a coronarographic examination. An echocardiographic examination was performed as part of the further diagnostics, and allowed the exclusion of a significant valvular defect and left ventricular systolic dysfunction. Although the left ventricular diastolic dysfunction could be suggestive of HF with a preserved ejection fraction, the TFC value was not increased in this case. The diagnostics were extended to include spirometry, which revealed the most probable cause of the reported symptoms: COPD. This is an example of an atypical clinical presentation of a pulmonary disease, in which ICG helped to establish an accurate diagnosis.

Cases 3 and 4 illustrate common clinical dilemmas in internal medicine departments. These are examples of interdisciplinary patients who present juxtaposed symptoms of both HF and COPD. In such cases the differential diagnosis of the cause of dyspnea on the basis of medical interview and physical assessment can be very difficult, and an echocardiographic examination and NT-proBNP inconclusive. Using ICG in these patients significantly supported the clinical decision. In case 3 a normal TFC value enabled exclusion of a significant aggravation of HF, directing the treatment towards exacerbation of COPD. In case 4 the HG exacerbation was masked by obstruction, and only the ICG examination revealed a significant stasis in the pulmonary circulation, with one of the most visible clinical effects of the diuretic treatment being the disappearance of obstruction symptoms.

Using ICG in patients with dyspnea is supported by scientific studies. Springfield et al. [24] demonstrated that the test presents higher sensitivity and specificity in the differential diagnosis of dyspnea in patients admitted to emergency rooms than standard clinical assessment supported by auxiliary tests. Peacock et al. [25] observed that hemodynamic assessment using ICG resulted in a change in preliminary diagnosis in 13% of patients with dyspnea, and in treatment modification in 39% of them (primarily regarding diuretic therapy). The test demonstrated greater importance in the therapeutic process than determination of NT-proBNP [26]. Our own research [27] revealed that the hemodynamic profile of patients admitted due to exacerbation of HF is varied, and TFC is a valuable indicator of treatment effectiveness, correlated with changes in NT-proBNP. Volemic evaluation also appeared to play an important role in estimating the risk of aggravation of the condition in HF patients. The PREDICT study (Prospective Evaluation and Identification of Cardiac Decompensation in Patients with Heart Failure by Impedance Cardiography Test), which involved 212 patients with class II-IV (NYHA) chronic heart

failure [28], TFC appeared to be one of six factors affecting the risk of HF exacerbation within 14 days. ICG assessment of two basic parameters (TFC and SI) helped to classify patients into four risk groups, in which patients with increased TFC and reduced SI were at a nearly 7-fold higher risk of clinical destabilization than when the parameters were in the opposite relation [28, 29]. Assessment of intrathoracic impedance (ITI) is also gaining appreciation in patients with implantable devices (stimulators, cardioverter defibrillators). It appears that a lower ITI value (corresponding to higher TFC value) is associated with higher distant mortality, and its changes can reflect increasing stasis in the pulmonary circulation (also at the asymptomatic stage), and correlates with the natriuretic peptide concentrations [30, 31].

Conclusion

An understanding of the hemodynamic profile in patients with dyspnea is of great clinical importance, and may be very useful in taking therapeutic decisions, especially when the symptoms exacerbate. These patients often require quick and effective intervention, suffer from comorbidities and are at high risk of therapy-induced complications. In such cases, impedance cardiography can be a useful tool in the assessment at a patient's bedside: inexpensive, simple and readily available. Tracking trends in selected parameters in response to the applied treatment may be particularly beneficial. We encourage frequent use of this method in everyday clinical practice, especially in the diagnostics and treatment of HF patients.

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Literature

1. McMurray JJV, Adamopoulos S, Anker SD, et al. ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012. The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2012 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association (HFA) of the ESC. Eur Heart J, 2012; 33: 1787-1847
2. Hawkins NM, Petrie MC, Jhund PS, et al. Heart failure and chronic obstructive pulmonary disease: diagnostic pitfalls and epidemiology. Eur J Heart Fail, 2009; 11 (2):130-139
3. Gupta D, Agarwal R, Aggarwal AN, et al. for the C0PD Guidelines Working Group; Guidelines for diagnosis and management of chronic obstructive pulmonary disease: Joint ICS/NCCP (I) recommendations Lung India, 2013; 30 (3): 228-267
4. Hillas G, Perlikos F, Tsiligianni I, et al. Managing comorbidities in COPD. Int J Chron Obstruct Pulmon Dis, 2015; 10: 95-109
5. Smith MC, Wróbel JP. Epidemiology and clinical impact of major comorbidities in patients with COPD. Int J Chron Obstruct Pulmon Dis, 2014; 9: 871-888
6. McCraig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2001 Emergency Department Summary. Report from Centres for disease Control and Prevention. Hyattsville, MD: National Center for Health Statistic; 2003. Advance data from Vital and Health Statistic. No. 335: 18
7. Marwick TH. The role of echocardiography in heart failure. J Nucl Med, 2015; 56 (Suppl4): 31S-38S
8. Hunt SA. American College of Cardiology; American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure). ACC/AHA 2005 guideline update for the diagnosis and management of chronic heart failure in the adult: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure). J Am Coll Cardiol, 2005; 46 (6): e1-e82
9. Swedberg K, Cleland J, Dargie H, et al. Task Force for the Diagnosis and Treatment of Chronic Heart Failure of the European Society of Cardiology. Guidelines for the diagnosis and treatment of chronic heart failure: executive summary (update 2005): The Task Force for the Diagnosis and Treatment of Chronic Heart Failure of the European Society of Cardiology. Eur Heart J, 2005; 26 (11): 1115-1140
10. Prastaro M, D'Amore C, Paolillo S, et al. Prognostic role of transthoracic echocardiography in patients affected by heart failure and reduced ejection fraction. Heart Fail Rev, 2015; 20 (3): 305-316
11. Ciampi Q, Villari B. Role of echocardiography in diagnosis and risk stratification in heart failure with left ventricular systolic dysfunction. Cardiovasc Ultrasound, 2007; 5: 34
12. Omar HR, Guglin M. A single BNP measurement in acute heart failure does not reflect the degree of congestion. J Crit Care, 2016; 33: 262-265
13. Palazzuoli A, Beltrami M, Ruocco G, et al. Diagnostic utility of contemporary echo and BNP assessment in patients with acute heart failure during early hospitalization. Eur J Intern Med, 2015; 30: 43-48
14. Santaguida PL, Don-Wauchope AC, Oremus M, et al. BNP and NT-proBNP as prognostic markers in persons with acute decompensated heart failure: a systematic review. Heart Fail Rev, 2014; 19 (4): 453-470
15. Hill SA, Booth RA, Santaguida PL, et al. Use of BNP and NT-proBNP for the diagnosis of heart failure in the emergency department: a systematic review of the evidence. Heart Fail Rev, 2014; 19 (4): 421-438
16. Tait L, Roalfe AK, Mant J, et al. The REFER (REFer for EchocaRdiogram) protocol: a prospective validation of a clinical decision rule, NT-proBNP, or their combination, in the diagnosis of heart failure in primary care. Rationale and design. BMC Cardiovasc Disord, 2012; 12: 97
17. Mason JM, Hancock HC, Close H, et al. Utility of biomarkers in the differential diagnosis of heart failure in older people: findings from the heart failure in care homes (HFinCH) diagnostic accuracy study. PLoS ONE, 2013; 8 (1): e53 560
18. Siebert J. Kardiografia impedancyjna. [Impendance cardiography] Via Medica, Gdańsk 2006
19. Krzesiński P, Gielerak G, Kowal J. Kardiografia impedancyjna -nowoczesne narzędzie terapii monitorowanej chorób układu krążenia. [Impedance cardiography – a modern tool for monitoring therapy of cardiovascular diseases] Kardiol Pol, 2009; 67:1
20. Yung GL, Fletcher CC, Fedullo PF, et al. Noninvasive cardiac index using bioimpedance in comparison to direct Fick and thermodilution methods in patients with pulmonary hypertension. Chest, 1999; 116 (suppl. 2): 281S
21. Verhoeve PE, Caldwell CA, Tsadok S. Reproducibility of noninvasive bioimpedance measurement of cardiac function. Second Annual Meeting of the Heart Failure Society of America Boca Raton, FL, 1998
22. Yancy C, Abraham WT. Noninvasive hemodynamic monitoring in heart failure: utilization of impedance cardiography. Congest Heart Fail, 2003; 9: 241-250
23. Van De Water JM, Miller TW, et al. Impedance cardiography: the next vital sign technology? Chest, 2003; 123: 2028-2033
24. Springfield CL, Sebat F, Johnson D, et al. Utility of impedance cardiography to determine cardiac vs noncardiac cause of dyspnea in the emergency department. Congest Heart Fail, 2004; 10 (suppl. 2): 14–16
25. Peacock F, Summers R, Emerman C. Emergent dyspnea impedance cardiography- aided assessment changes therapy: The ED IMPACT trial. Ann Emerg Med, 2003; 42 (4): S82
26. Kosowski JM, Weiner C, Morrissey JH. Impact of B- type natriuretic peptide testing on medical decision making for older patients with dyspnea. Ann Emerg Med, 2003; 42 (4): S11
27. Galas A, Ryczek R, Krzesiński P, et al. The usefulness of repeated

hemodynamic monitoring in patients with decompensated heart failure preliminary report. Acute Cardiovascular Care 2015; 4th Annual Congress of the Acute Cardiovascular Care Association “Innovating to improve acute cardiovascular care”, 17–19.10.2015, Vienna
28. Packer M, Abraham WT, Mehra MR, et al. Prospective Evaluation and Identification of Cardiac Decompensation by ICG Test (PREDICT) Study Investigators and Coordinators. Utility of impedance cardiography for the identification of short‐term risk of clinical decompensation in stable patients with chronic heart failure. J Am Coll Cardiol, 2006; 47: 2245–2252
29. Strobeck J, Silver M. Beyond the four quandrants: the critical and emerging role of impedance cadiography in heart failure. Congest Heart Fail, 2004; 10 (Suppl. 2): 1–6
30. Zile MR, Sharma V, Johnson JW, et al. Prediction of all‐cause mortality based on the direct measurement of intrathoracic impedance. Circ Heart Fail, 2016; 9 (1): e002 543. Doi: 10.1161/CIRCHEARTFAILURE.115.002543
31. Nishii N, Kubo M, Okamoto Y, et al. MOMOTARO Investigators. Decreased Intrathoracic Impedance Associated With OptiVol Alert Can Diagnose Increased B‐Type Natriuretic Peptide – MOMOTARO (Monitoring and Management of OptiVol Alert to Reduce Heart Failure Hospitalization). Study, 2015; 79 (6): 1315–1322

How to write a good scientific article

Jak napisać dobry artykuł naukowy?

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Abstract. This article combines the experience of acknowledged research centers that promote good writing and have more than 50 years of experience in writing and preparing various types of articles for publication.
Key words: scientific article, professional writing, own experience.

Streszczenie. Przedstawione w pracy doświadczenia uznanych ośrodków naukowych promujących good writing zilustrowano własnym ponad 50-letnim doświadczeniem w przygotowaniu do publikacji różnego typu artykułów naukowych.
Słowa kluczowe: artykuł naukowy, opracowanie profesjonalne, doświadczenia własne

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Without publication, science is dead
Gerard Piel, editor of "Scientific American"

Introduction

Melchior Wańkowicz[1] in his work "La Fontaine's Carafe" published in 1974 in the chapter "Delving into the Subject (absorptivity)" addresses the issue of creative inspiration. To quote W. Somerset Maugham: "I almost never happen to spend an hour with anyone and not get enough material to write a story worth reading," and "This absorptivity - it is one of the imponderables of writing. And as any imponderable, it is not possible to weigh or measure it!" This absorptivity also concerns us, physicians, when we set to writing about our scientific work on our clinical observations or the results of scientific research. Sometimes it is sufficient to focus on a single patient to find appropriate material sufficient for a case study, while at other times it is necessary to "delve into the subject" for a longer period to achieve an original scientific work or doctoral thesis.

Finally, the quintessence of our activities may be a great review article based on the many years' experience of the research center.

The beginnings of my "delving into the subject" date back to 1964, with my appointment to the Military Institute of Medicine (WIM, which was then CSK WAM - Central Clinical Hospital of the Military Medical Academy). My superior and scientific guide at the first Polish Centre of Intensive Internal Therapy, Wanda Wysznacka-Aleksandrow, indicated peritoneal dialysis as the necessary direction for my further professional and scientific development. During this period the "delving into the subject" itself was not difficult, as I happened upon very rare clinical cases on a daily basis, while the metabolic complications related to peritoneal dialysis served as a basis for my doctoral thesis, the viva examinations for which took place in 1968. Another and highly important factor was that my mentor, with her incredible clinical inquisitiveness and what is now called a clear mind, forced me to gain the skills of logical thinking and clear writing. I will quote the words she often repeated when she shattered entire pages of my arduously written

[1] Melchior Wańkowicz (1892-1974), writer and publicist; 1939-1958 in exile; a master of reportage stories; a famous document on the Polish nature of Masurian land "Na tropach Smętka" ["On the Trail of Smętek"], relations on the military participation of Poles in the Second World war ("Bitwa o Monte Cassino" ["The Battle of Monte Cassino"]), novels, memoirs ("Szczenięce lata" ["The Puppy Years"], "Ziele na kraterze" ["A grass shoot on the edge of a crater"]), and drafts on the theory of non-fiction ("Karafka La Fontaine'a" ["La Fontaine's Carafe"]). Encyklopedia PWN, Vol. 3. PWN, Warsaw 1999.

work: "Zosia, you have to write so that everyone can understand you." This is how it started [2].
I would like to share with the readers of Military Physician both the current standards on how to write a scientific article and my own experience in this field.

The scientific article - what is it?

According to the definition of the Ministry of Science and Higher Education a scientific article is one presenting the results of original studies of an empirical, theoretical, technical or analytical nature, containing the titles of publications, first and last names of the authors including their affiliations, presenting the current state of knowledge, research methodology, course of the research process, its results and conclusions, and citations of appropriate literature (bibliography). Scientific articles also include monographic, polemic and review articles, as well as clinical opinions and comments [3].

Someone planning to undertake doctoral studies and seeking an original and interesting subject for publication should first consider from what source they will gather the data they will need. For example, a physician employed in a clinical department would be advised to choose a subject that lies within the main stream of thought at the clinic, one employed at a non-clinical department should consider a subject related to the experiences of the department, while one employed at a military unit should take a subject related to the specificity of the work of that particular military unit.

Every author, especially a novice, should prior to writing a scientific article attempt to answer the following questions: why publish, what do the readers and publishers expect, and has the work "matured" enough for publication?
In accordance with the assumptions given above, a good scientific article should meet the following requirements:

- innovative subject matter of the studies and/or diagnostic methods,
- strong theoretical justification for the discussed problem, and
- solution[s] for the same problem in accordance with the current state of knowledge.

In recent years publishers have been giving particular attention to the interdisciplinary nature of the studies they publish.

The most popular form of publication, not requiring long "delving into the subject", is a case study. An original article on the other hand requires specific scientific and/or clinical skills. A review article summarizes the current state of knowledge on a given topic, but also requires the author to analyze that which they have gained through their own professional experience.

Case studies in the opinion and experience of others

The preparation and description of a particular case report (case study) requires a response to particular questions. First of all - what is the justification for the case study, second - what is the actual problem (e.g. an unprecedented clinical course, rarely identified biochemical irregularities or originality of a medical procedure), third - what tool or tools does the author wish to use to conduct the analysis of this case, fourth - have similar issues or clinical situations been discussed in the literature, and finally - what message is conveyed by the case for the clinic and/or basic research?

Also, the potential reader of the case study is important: who it is and what their preferences and potential reservations are in regard to the case.

The literature contains many sources of information on how to write and edit suitable case reports. Monash University presents two approaches to case reports. Type 1 is the analytical approach, in which the authors of a case report attempt to understand what happened and why. In this situation it is not necessary to identify issues nor suggest solutions. Type 2 is a study oriented not only at analysis, but also the solution to a particular problem. Here the authors attempt to identify the main issue of the case and indicate a potential solution [4].

On the other hand, Ashford University recommends that authors focus particular attention on the thorough preparation of a draft prior to having their work edited. Once all the necessary data have been gathered, a draft case report should contain the following sections:

- introduction, identification of the main issue in one or two sentences,
- basic information related to the essence of the presented case,
- alternative solutions, their description and explanation whether and why the authors accept or reject them or why these solutions cannot be implemented currently,
- a proposed solution to the problem and the reasons why it was selected based on appropriate literature for the subject, and
- recommendations - what should be done and who should do it in order to solve the problem.

Once the draft is prepared the final preparation of the case study can be undertaken. Here one should pay attention to any errors and inaccuracies in the content and the structure of the text, with particular regard to the elements that may have been omitted or treated superficially in the previous version. Ashford University recommends reviewing the text many times, and then subjecting it to assessment by associates and even by outsiders - all of which is intended to verify the legibility of the text [5].

New South Wales University in Australia emphasizes the necessity of specifying the potential readership of the

case study. In doing so, the following questions are formulated: who is going to read this article and why, what are the potential goals and needs of the potential reader, and how should the article be prepared for the message it contains to reach those responsible for shaping appropriate medical procedures (e.g. a person managing a hospital or a clinic should gain clear information in regard to the necessity of introduction of the suggested drug) [6]?

A case study in the light of one's own experience

In my experience, writing a perfect text involves creating several drafts before an acceptable result is achieved.

I would like to illustrate the concepts described by the above-mentioned English-language sources with three cases selected from among several dozen cases presented by me and my team in the years 1966-2010 [7-9]. The first two cases are Type 2 descriptions oriented at problem solution, in which a detailed investigation of a particular clinical situation was conducted.

The first case involved a young woman with paroxysmal hypertension and a circular shadow in the posterior mediastinum, visible on a chest X-ray [7]. At that time, the 1st Department of Internal Diseases at our hospital and the 2nd Department of Internal Diseases at the Medical Academy in Warsaw established a health program whose aim was to mark catecholamine levels in the plasma and urine in patients suspected of endocrine hypertension. Although the patient was considered beyond suspicion by the head of the department, I ordered this test to be conducted for her as well. The positive test result indicated the presence of a phaeochromocytoma; however, the radiography imaging did not confirm the presence of a tumor in the area of the adrenal glands. At that moment Franciszek Smolarek intervened with the surgical intuition typical of him, making the decision to remove the lumpy tissue from the posterior mediastinum, which in the histopathologic examination was found to be the sought chromaffin tissue. Soon after the procedure the blood pressure in the patient normalized. This case illustrates the necessity of performing extensive laboratory tests, considering all the signs and symptoms, which in our case was the presence of tissue of unknown origin in the posterior mediastinum with paroxysmal hypertension.

Another example illustrating a Type 2 case study was published in 2001 [8]. Here there was a necessity to make a dramatic decision initially concerning only a right-sided (1995), and then also a left-sided (1998), nephrectomy. This case illustrates the superiority of investigation based on clinical experience over investigation based solely on the analysis of laboratory tests and imaging methods. In our case, the first type of investigation took place after the first episode of bacteremic shock in 1995, when, after the patient was brought out of shock, a series of diagnostic tests was conducted, which indicated bilateral reflux nephropathy, especially in the area of the right kidney without significant pockets of infection observable in a radioisotope scan with technet-marked leukocytes ($HMV^{99}cTC$). On the other hand, the second type of investigation, based on clinical experience, was initiated after the second bacteremic shock with a very difficult clinical course. In the course of this investigation, conducted together with a consulting urologist, the most probable diagnostic option was the presence of microabscesses in the area of the right kidney, which was confirmed by histopathologic examination of the removed kidney. The option of clinical investigation also prevailed when, after two years of intensive antibacterial treatment and the application of thymosin in order to compensate for the compromised phagocytic capability of the peripheral blood granulocytes, another directly life-threatening bacteremic shock occurred, complicated by disseminated intravascular coagulation and respiratory failure requiring long-term mechanical ventilation. Clinical suspicion of microabcesses in the left kidney as a cause of bacteremic shock underlay the decision made together with the patient and her family concerning the left-sided nephrectomy and transfer of the patient to the peritoneal dialysis program, including the entry on an urgent kidney transplant list. Similarly as in the case of right-sided nephrectomy, our clinical investigation was confirmed by a histopathologic examination.

The third case illustrates a Type 1 case study, in this case an analytic one.

Here we were among the first in Poland to describe the application of peritoneal dialysis in a patient with congestive heart failure resistant to standard pharmacotherapy, who was prepared for a heart transplant with the use of this method.

Table 1. Irreplaceable components of an original article
Tabela 1. Niezbędne składowe artykułu oryginalnego

Chapter	Irreplaceable components
Introduction	The current state of knowledge, justification for conducting the studies. What do we know? What do we not know?
Aim of the study/publication	Stemming from the introduction What do we present and why?
Elaboration/proper text of the article	Material; methods; results; discussion of results. What do we present and how?
Discussion	Comparison of our results with the results of other researchers. What did we present and what stems from it?
Conclusion	Conclusion to the work, containing the discussion of potential benefits from the work. What are the benefits for the reader stemming from what we presented?

Based on 10 items of literature of the subject (own modification)

I would like to emphasize that in the first and the third case the first authors were young adepts of medical art engaged in conducting a clinical investigation. This procedure follows the good practice commonly adopted in English literature on the subject. In the second case I placed my name as the first author, for as the head of the department I took direct responsibility for the incredibly difficult decision, not only for medical reasons but also for ethical reasons, in order to save the patient's life at any cost. The second important message is the interdisciplinarity visible in the composition of the teams responsible for leading particular cases - from nephrologists, to surgeons, urologists and clinical immunologists representing the departments cooperating with us.

Original article - what it should be and what it too often is

Most physicians, especially directly after completing their studies, have none or few of the skills required to prepare a scientific article for a good journal. This is nothing to be ashamed of, for the ability to write scientific works is not a gift of nature. This ability is gained by way of continued practice, regardless of the first, inevitable, failures in this regard.
Table 1 presents the necessary components of an original article.

Bearing in mind the relative young age of the researchers, Kakoli Majumder developed recommendations concerning the correct construction of a test for an original article according to the IMRaD acronym [11]. This acronym covers:

- **Introduction**: provides general information on which the study is based and defines its scope and aims.
- **Methods:** describes in detail the process of conducting the study and the materials used in it; this section is necessary for other researchers to repeat our study, if needed.
- **Results:** contains the detailed results.
- **Discussion:** interprets the results and discusses their influence on a particular field.

It is important for young researchers and their supervisors to remember the importance of taking an ethical approach to scientific publications.

- The first author should be the researcher responsible for the study, whereas the mentor / work advisor should appear as the corresponding author.
- The obtained results should be published in their entirety.
- Even if the result of the study was negative, if it was properly documented by the authors then an attempt to publish the article in a good journal should be made anyway.

Researchers at Columbia University refer in their recommendations to the construction of a text required for an original work [12].

- The title should correspond to the content of the publication and should be understandable for the target reader. The title usually describes the subject of the study, and should be used to increase its appeal.
- The authors of the study, similar to Kakoli Mayumder, take note of the order of the authors of a publication, emphasizing that in the case of other people co-participating in the project the first author should gain the consent of the mentor to include their names in the list of authors or in the form of recognition in the Acknowledgements section.

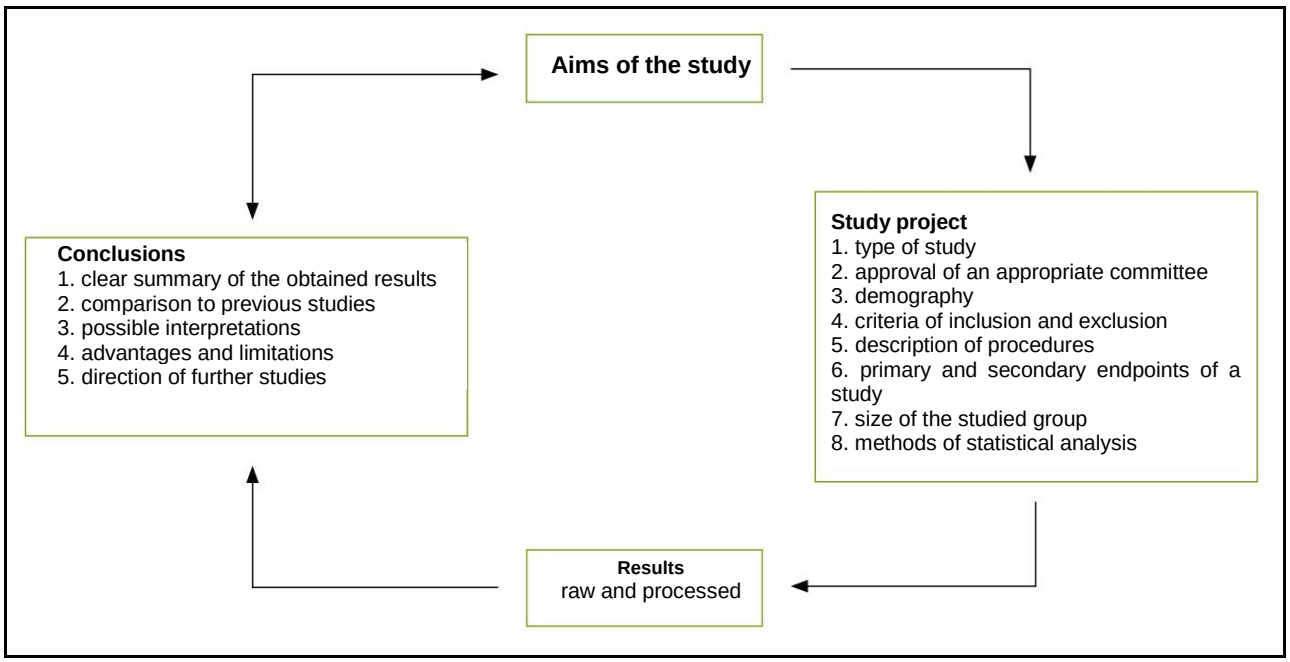

Figure 1. The strategy used to prepare an article for publication according to Anthony Vintzileos and Cande V. Ananth
Rycina 1. Strategia przygotowania artykułu do publikacji wg Anthony'ego Vintzileosa i Cande V. Anantha

- The introduction to a publication should describe the addressed issue and why it is so interesting.
- In the "Material and Methods" section, use an appropriate graphic form to present the complex research protocol. However, the initial results should not be given here.
- The "Results" section constitutes a basic element of an original article. Results in the form of figures or basic tables should be presented in order to document the problem. If information can be contained in one or two sentences, then neither tables nor figures should be used for this purpose. In this section, "what if" speculation is unacceptable.
- "Discussion" is a very important element of an original article. One should sum up the meaning of the most important results, rather than repeat them. The fundamental role of a well-conducted discussion is to prove that the results of the work justify the research hypothesis adopted in the introduction, and how much they are in accordance with similar research conducted by other authors. In the case of results unforeseen by the aim of the work, an attempt should be made to explain the reason for this inconsistency and answer the questions on whether and what research would be necessary to document the negative result of the work.

The recommendation of these authors in regard to the editing of the scientific text also appears to be very practical: **write accurately, write clearly, write succinctly, using active voice in the first person and avoiding participles.**

How to prepare an original article for publication

Anthony Vintzileos and Cande V. Ananth presented a strategy for preparing an article for publication, which is presented in Figure 1 [13].

It should be emphasized that the conclusions and aims correspond with each other, which means they should be compatible with each other, and even directly stem from each other.

In reference to the particular elements of an original article, these authors recommend the following.

- First check the requirements of the journal to which the work is to be sent.
- Keep the title short, but at the same time succinct. Some journals prefer the conclusions to be presented in the title, others do not honor it, nor do they accept titles in the form of questions (sic!).

- A synopsis is usually a single sentence containing no more than 25 words, summing up the results. This synopsis should also meet the needs of those who use it to decide whether to read the article.
- The summary should reflect the entire article and contain four main elements, i.e. aim of the study, subject of the study, results and conclusions, and it should not be too long.
- Introduction - the most vulnerable part of the article - contains two basic elements. In the first the authors justify the initiation of their research, and in the second they explain what new information their publication is intended to present. This part of the publication should give the impression that the work is based on reliable research.
- Material and Methods - referred to by some as "Patients and methods", should contain the following elements: research protocol, approval of an appropriate bioethical committee, study group, criteria of inclusion and exclusion, clear description of the implemented procedures, primary and secondary endpoints of the study, size of the study group and the methods of statistical analysis including the adopted level of statistical significance for the results. In the age of computerized medicine, publishing houses attach great importance to using statistical methods corresponding to the nature of the study. One of the most often used statistical methods is the assessment of the sensitivity, specificity and predictive value of the results - positive and negative. The author should bear in mind that the reader of the article may possess sufficient knowledge to question any statistical methods used incorrectly.
- Results - this part should only give the results of the work presented earlier in the "Material and methods" section. It is important for the tables and figures to present both processed and raw data, as well as their statistical analysis. The text should also contain a short analysis of the results presented in a descriptive form, including a specification of the statistically significant ones.
- It is recommended that the following elements are included in the discussion:

- summary of our research, accentuating its original character,
- advantages and limitations of our research,
- reference to the results of our previous research,
- discussion of the results with those of other authors, including an attempt to explain the potential differences,
- conclusions formed, written in a clear and transparent manner,
- suggestions for further research.

- The list of literature on the subject is a very important element of an article, increasing the chances for its publication in a good journal. At this point it should be borne in mind that many publishers appoint the authors quoted by the researcher as the reviewers, which may mean that an improperly quoted author may turn out to be a negative evaluator of our publication.

Original article - personal experience

Practical answers to the issues presented above can be provided by the analysis of selected original articles from the output of the Nephrology Clinic at the Military Institute of Medicine. The first article is from the early, pioneering period of the activity of the "Hospital on Szaserów Street", and dates back to 1960s.

In this article we were the first in the literature on the subject to indicate the possibility of replacing a classical method for the determination of renal plasma flow with the use of paraaminohippurate - a method that is very burdensome to the patient and labor-intensive for the laboratory - with the J-125-hippurate radioisotope method. This method was applied by clinical departments using radioisotope methods for the assessment of kidney function in patients with comorbidities, such as hypertension. This article was selected by the editorial board of the "Polish Archives of Internal Medicine" to be published in the "Polish Medical Journal" published in English with the title "A simplified method for the determination of renal blood flow with radioactive hippurate", and was quoted in Medline [15].

The first author of the work was Janusz Przedlacki, the project initiator, and pioneer of nuclear medicine in Poland with regard to the radioisotope assessment of kidney functioning [16]. It should be mentioned here that one of the authors of this report was Barbara Bogdańska-Czarnyszewicz MD, who represented the Diagnostic Clinic Laboratory processing the calculations required by our studies.

The second example is a work on the assessment of the peritoneal transport of particles and water in peritoneal dialysis, performed with the use of new biocompatible dialysis fluids [17].

The work was a result of international cooperation initiated by our center at the end of the 20th century with the Institute of Biocybernetics and Biomedical Engineering of the Polish Academy of Sciences in Warsaw and the Karolinska Institutet in Stockholm. The research report was one of the most often cited and read articles of 2008. Particular attention should be paid to the summary prepared according to a readable outline, in accordance

with the principles of text construction discussed above.

Why a review article is important

The progress of medical sciences in recent decades has caused a significant increase in the number of original works. This has also resulted in an increased need for review articles. As a result, many publishers introduced in their guidelines a limitation for review papers, and only allow the citing of current sources, i.e. those published within the 5 year period prior to the publication of a given article. The side effect of this situation is common disregard for original publications that are crucial for a particular issue, tenderly referred to as sleeping beauties [18]. The final result is a cluttering of the publishing market with review articles of little cognitive value.

According to Ingo Schubert, the signs of a good review article are on the one hand an exhaustive and ordered review of the literature on the subject, and on the other a multidimensional approach to the subject of the article that casts new light on the issues tackled in the original article. This same author also believes that the potential authors of review articles should not succumb to the temptation of writing another widely-cited work if it gives little value, especially if a work of a similar nature was published recently. Such an approach should stop the flood recently visible on the publishing market of redundant carbon copies of articles [19].

In 2013 Marco Pautasso published 10 simple rules for writing a review article (Tab. 2) [20].

The choice of an appropriate type of review article contained in Rule 4 is very important. The distinguished review articles include the following types: mini-review vs. major-review/full-review, descriptive review vs. integrative review and narrative review vs. systemic review.

Due to the increased interest of publishers in short review articles with limited references it is good to focus attention on the mini-review form, which - although short - does not have to be superficial. The additional advantage of this form is its popularity among readers. The adoption of the major-review form grants the author greater freedom to go deep into the details and history of the issue, but it may result in an article not enjoying as much interest from readers as other, shorter forms.

The difference between descriptive and integrative reviews is in the alternative nature of a review article concerning its approach to the subject. A descriptive article requires the author to focus on the methodology, results and interpretation of each of the described original works. An integrative review article on the other hand aims to find shared ideas in the literature review. A similar division appears in the dichotomy between narrative and systemic review articles. Narrative articles assess the quality of the described original works, whereas the systemic articles follow the protocol constructed by the author in order to conduct a meta-analysis of the gathered results.

Table 2. Principles of developing a review article
Tabela 2. Zasady opracowania artykułu poglądowego

Rule 1. Define a topic for the article and its potential audience
Rule 2. Research the literature and repeat this activity a number of times
Rule 3. Take notes while researching the literature in accordance with a key you have designed
Rule 4. Choose the type of review corresponding to your scientific goals
Rule 5. Specify the subject of the review, but allow for the possibility of reaching a broader circle of readers
Rule 6. Be critical in relation to the subject of the review
Rule 7. Choose the structure of the review that corresponds to the subject of the article
Rule 8. When preparing the publication, cooperate with the editorial board and potential readers
Rule 9. Include the results of your own research, but remain objective in the assessment of their usefulness for the prepared subject
Rule 10. Present the current achievements in the particular field, but do not forget the classics - sleeping beauties in science [18]
Based on 20 items of literature on the subject

The choice of the type of review depends on many factors, such as time, scope of material for analysis, engagement of co-authors, number of pages intended for the article and predicted interest of the readers in the particular subject.

Review article - personal experience

I have written many review articles during my scientific career; however, the one I value most is the article published in 2013 in "Medical Science Monitor" on the role of technological progress, incidental discoveries and clinical experience in the evolution of dialysis worldwide [21].

This article was a significant success, gaining 2913 views on the website as of the end of June 2016. The measurable result of this publication was my appointment as a reviewer for significant international medical journals. The success of this article was also based on the fact that it became a part of the celebration of the 50th anniversary of international dialysis, objectively presenting the technological progress of the method on a par with a lack of significant clinical achievements. My taking an attitude to the described issue in the light of my own 50 years of experience granted it an original, authentic character.

Conclusions

Regardless of the planned form of publication, the preparation of an article for publication should follow the algorithm presented below.

Stage 1 is "delving into the subject", in accordance with the definition adopted in the introduction to the work and in a time period dependent upon the planned form of publication, ranging from several weeks for case reports up to several months in the case of original papers or reviews. Remaining in this period for too long carries the threat of "exhaustion". The title and subject is on a general basis imposed by the scientific supervisor of the project or the head of the department, but this should not prevent a young scientist suggesting a subject to their supervisor. It should be noted that the choice of a particular research subject should take into account the environment in which the research is to be conducted.

Stage 2 is the most important stage of the implementation of a project, where the author should take into account the diagnostic, technical and laboratory capabilities of the native institution. One should not "throw the baby out with the bath water" by means of copying data redundant for documenting the adopted aim of the project. This is often the case with scientific articles prepared on the basis of a doctoral thesis. Here we need to "cut the coat according to the cloth", which means determining the study group or the scope of the panel of tests possible to implement and interpret by a single researcher. A doctoral thesis is the result of the individual work of a researcher, not that of the activities of an entire team.

Stage 3 is the preparation of a draft. It should be kept in mind that the text of the draft should be clear, logical and understandable even to a reader who is not a specialist in the particular field. Repeated writing and rewriting at this stage is highly desirable, as well a review of the draft by someone who can offer a fresh look on the subject.

Stage 4 is the final version of the article before it is sent to the publisher. At this stage, the following elements are important. First of all, the order of authors - the first author should always be the person managing a given project, whereas the work advisor should keep the last position. Second, the first author of the article can co-opt co-authors from other clinics or centers with the approval of the advisor. They will hold positions between the first author and the advisor. Third, if the author benefits from the assistance of other centers, by publishing their results in the work, the author can either co-opt these people as co-authors or include the appropriate acknowledgement in an appendix to the work. A well-structured list of authors is a sign of good manners and is therefore highly valued. For example, the formula "we organized the test/determination" is unacceptable if the test was conducted by a researcher from another center. Fourthly, the choice of the type and nature of the journal to which we are sending a publication should be considered as well. Publishers, especially of journals published in English, often select reviewers from among the researchers cited by the author of the article. Therefore, if the references of a given author are neither clear nor correct, the work can fail in the course of the editorial work.

Stage 5 is awaiting the response of the publisher. In this case there are 4 options. The first option is acceptance without revisions, which happens very rarely. The second option is minor revision, acceptance of which makes publication of the work certain. The third option is major revision, after which publication is possible, but subject to essential, substantive revision. And finally there is the fourth option, one that I do not wish to anyone, an unconditional rejection of a publication.

Therefore, by delivering this evaluation to the readers of "Military Physician", containing both the recommendations of worldwide authorities and my own experiences, I hope that my advice will be useful for authors and help them to prepare good reports, so that science can continue to thrive.

Literature

1. Wańkowicz M. Karafka La Fontaine'a [La Fontaine's Carafe]. Wydawnictwo Literackie, Kraków 1974:507-508
2. Wańkowicz Z. Pożegnanie z kliniką [A farewell to the clinic]. Mil. Phys., 2010; 88 (2): 204
3. Komunikat Ministra Nauki i Szkolnictwa Wyższego z dnia 29 maja 2013 r. w sprawie kryteriów i trybu oceny czasopism naukowych [Announcement of the Minister of Science and Higher Education of 29 May 2013 on the criteria and procedure of assessment of scientific journals]
4. Monash University Library. How to write the case study. July 2007. http:// www.monash.edu.au/lls/llonline/
5. Ashford University Writing Center. Guidelines for writing a case study. 2015. https://awc.ashford.edu/tocw-guidelines-for-writing-a-case-study.html
6. UNSW Current Students. Writing the Case Study. October 2014. https:// student.unsw.edu.au/writing-case-study
7. Górko Z, Smolarek F. Guz tkanki chromochłonnej umiejscowiony poza nadnerczem [Extra-adrenal pheochromocytoma]. Pol Tyg Lek, 1996; 21 (30): 1157-1159
8. Wańkowicz Z, Olszowska A, Stawarz B, et al. Obustronna nefrektomia jako zabieg ratujący życie u młodej kobiety z nawracającym wstrząsem bakteriemicznym [Bilateral nephrectomy as a life-saving procedure in a young woman with recurrent bacteremic shock]. Pol Arch Med Wewn, 2106; 5: 1059-1063
9. Próchnicka A, Olszowska A, Baczyński D, et al. Peritoneal dialysis as a therapeutic approach in congestive heart failure resistant to pharmacological treatment. Pol Arch Int Med, 2009; 119 (12): 815-818
10. Cetin S, Hackam DJ. An approach to the writing of a scientific manuscript. J Surg Res, 2005; 128: 165-167
11. Mayumder K. A young researcher's guide to writing an original research article. March 2015. http://www.editage.com/insights/a-young-researchers-guide-to-writing-an-original-research-article
12. Columbia University. Writing a scientific research article, http://www.columbia.edu/cu/biology/ug/research/paper.html
13. Vintzileos AM, Ananth CV. How to write and publish an original research article. AJ0G, 2010; 202 (4): 344
14. Przedlacki J, Wańkowicz Z, Bogdańska-Czarnyszewicz B. Uproszczona metoda oznaczania przepływu nerkowego za pomocą radiohipuranu [A simplified method for the determination of renal blood flow with radioactive hippurate]. Pol Arch Med Wewn, 1967; 39 (3): 335-341
15. Przedlacki J, Wańkowicz Z, Bogdańska-Czarnyszewicz B. A simplified method for the determination of renal blood flow with radioactive hippurate. Pol Med J, 1968; 7 (3): 555-561
16. Dziuk E. Ośrodek Medycyny Nuklearnej i Klinika Terapii Izotopowej z Poradnią Chorób Tarczycy [Nuclear Medicine Centre and Isotope Therapy Clinic with a Thyroid Disease Clinic]. Mil. Phys., 1995; Sup. III
17. Olszowska A, Waniewski J, Werynski A, et al. Peritoneal transport in peritoneal dialysis patients using glucose-based and amino acid-based solutions. Perit Dial Int, 2007; 27 (5): 544-553
18. Van Raan AFJ. Sleeping beauties in science. Scientometrics, 2014; 59: 467-472
19. Schubert I. We have an inflation of review papers - for what are reviews

good? Front Plant Sci, 2016. http://journal.frontiersin.org/article/10.3389/ fpls.2016.00088/full
20. Pautasso M. Ten simple rules for writing a literature review. PLOS Computational Biology, 2013; 9: 7
21. Wańkowicz Z. The role of technological progress *vs* accidental discoveries and clinical experience in the evolution of dialysis. Med Sci Mon, 2013; 19: 984-992

Activities of the Department for the Organization of Military Healthcare and Public Health at the Military Medical Institute in Warsaw

Działalność Zakładu Organizacji Ochrony Zdrowia Wojsk i Zdrowia Publicznego w strukturach Wojskowego Instytutu Medycznego w Warszawie

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Abstract. The organization of military medical support is a unique field of knowledge, and the only research facility dealing with this subject in Poland is the Department for the Organization of Military Healthcare and Public Health at the Military Institute of Medicine in Warsaw. The article presents the scope of activities of the department and the academic achievements and papers published by its employees. The essential role of the department is to serve as a teaching facility, where approx. 500 military healthcare professionals with the rank of officer attended training courses to be promoted to lieutenant colonel or colonel.
Keywords: military health service, medical support

Streszczenie. Organizacja zabezpieczenia medycznego wojsk jest unikatową dziedziną wiedzy. Jedyną placówką naukową w Polsce zajmującą się tą tematyką jest Zakład Organizacji Ochrony Zdrowia Wojsk i Zdrowia Publicznego Wojskowego Instytutu Medycznego w Warszawie. W artykule przedstawiono tematykę, którą zajmuje się zakład, jak również dorobek edytorski i naukowy jego pracowników. Istotnym zakresem działania zakładu jest dydaktyka, w ramach której około 500 oficerów wojskowej służby zdrowia podnosiło kwalifikacje na kursach doskonalących na stopień podpułkownika i pułkownika.
Słowa kluczowe: wojskowa służba zdrowia, zabezpieczenie medyczne

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Introduction

The Military Health Service is an integral part of the Armed Forces and it is an important element of ensuring the combat readiness of the same. Its task is to assure the high mental-physical capabilities of the human resources during times of peace and in those of crisis. A significant role in the provision of medical support is its planning, forecasting of medical losses, as well as directing and commanding the health service during times of crisis and war. In order to prepare military physicians properly in this respect, at the time of the foundation of the Military Medical Academy (WAM) in 1958 the Department for the Organization of the Military Healthcare (OOZW) was also founded, which currently functions within the structures of the Military Institute of Medicine (WIM) in Warsaw as the only research and education facility of its type in Poland.

History

For hundreds of years, the aim of the health organizations of the fighting forces was to provide aid to the wounded, later also to include hygiene and counter-epidemic activities, as well as broadly understood medical logistics. Starting with the 18th century, due to the creation of standing armies and the specificity of the activities of military medics, there began a trend to educate the staff of the military health services at separate military and medical universities. This included, for example, the Austrian, Prussian, Russian and French armies.

After Poland regained its independence, a Military Sanitary School was founded in 1922 for the needs of educating the medical staff of the Polish Army. It was transformed into the Medical Officer Cadet School, and in 1930 it was renamed the Sanitary Training Centre. It is worth noting that the division of civil and military medical training was introduced in connection with the appearance of differences in terms of the possession of particular military skills as well as the military and medical skills of the uniformed physicians, which were not a subject of education for non-military physicians.

After the Second World War, this separate military medical education was continued in Poland. The year 1947 saw the foundation of the Military and Medical Feldsher School and the Military Academy of Medical Instructors, followed in 1949-1950 by the Sanitary Training Centre, in 1950 the first year of operation for the Military Medical Training Centre, and in 1958 the founding of the Bolesław Szarecki Military Medical Academy. With these different stages of transformation in military and medical education, the scope of interest of military medics in support of combat operations extended from the initial aid provided to the wounded and their evacuation to comprehensive medical assistance provided from the moment of the wounding to full recovery and rehabilitation, combining the organizational elements and the principles of their functioning, and creating the treatment and evacuation support systems for contemporary combat operations. With the extension of the scope of responsibility, the name of the department also evolved, from the initial Healthcare Organisation and Tactics (OTSZ) to Organisation of Military Healthcare (OOZW). The Department of the Organisation of Military Healthcare was the only research, development and training center in the country where Polish military and medical thought in respect of the organization and functioning of medical support for the army during times of war and peace was developed. The result of the research by the staff of the department were numerous works in the form of instructions, articles in domestic and foreign literature, as well as papers presented at scientific conferences [1]. From 1997 the department was the first and the only organizer of annual conferences, the subject matter of which was directed to the physicians working in military units, as well as the management of the military healthcare system, which constituted a vital element for increasing the qualifications of military physicians.

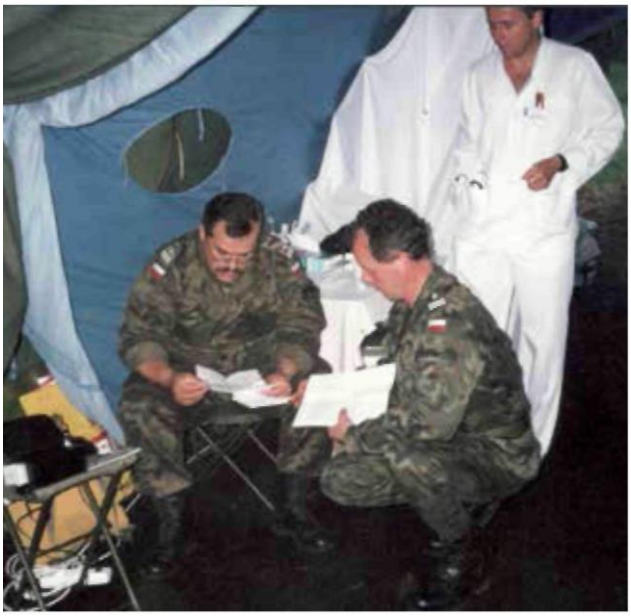
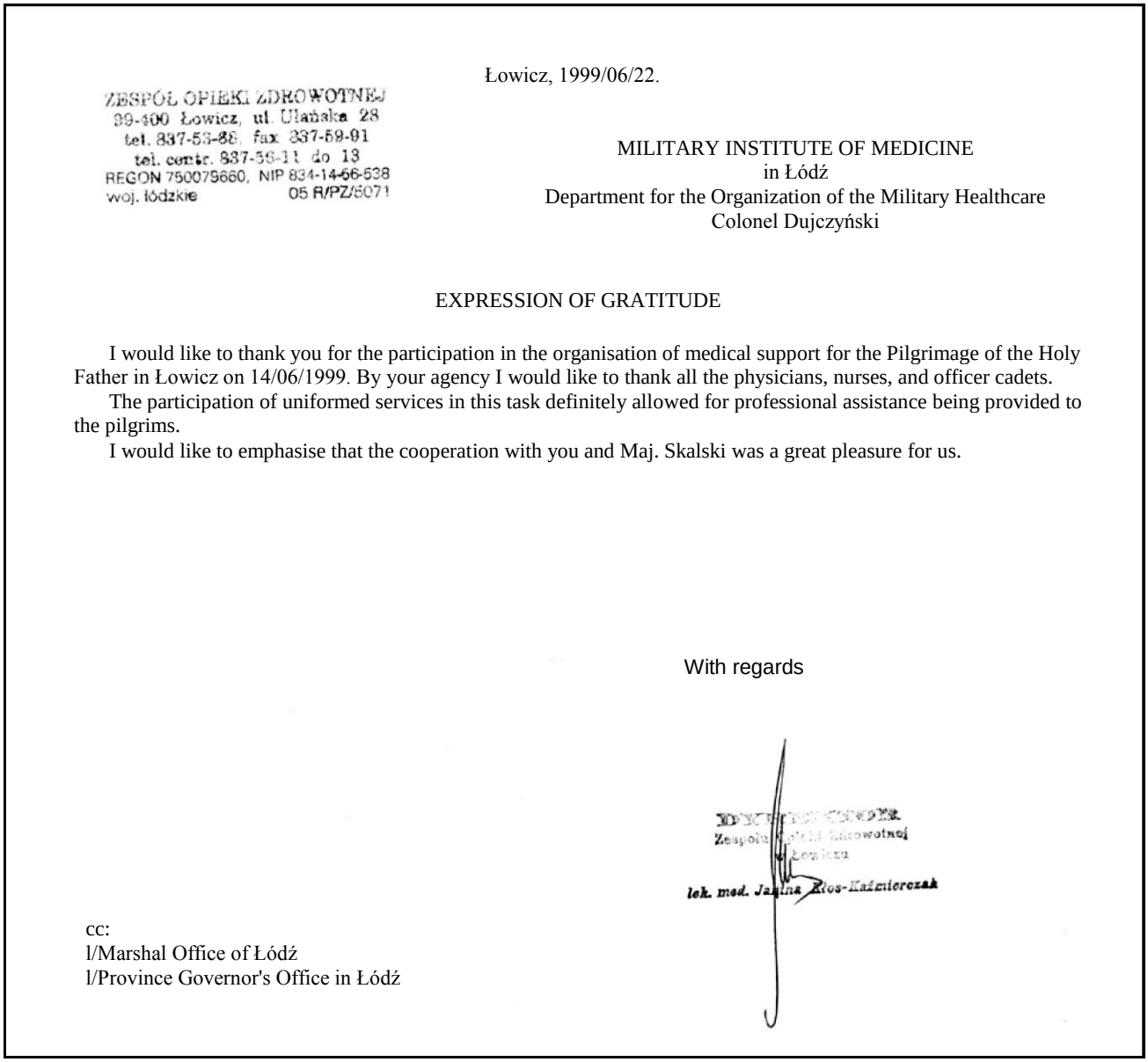


Figure 1. Officers of the Department at a field dressing point
Rycina 1. Oficerowie zakładu w polowym punkcie opatrunkowym

The conferences organized by the department until 2008 presented the only opportunity to exchange the experiences of medical management and organizers of military healthcare systems, often with the participation of general military personnel, within the scope of improving the functioning of the military healthcare service during times of war and peace. An important element of the conferences was the practical development and presentation of battlefield medical equipment. Experience in the organization of medical support was used by the staff of the department in practice, when they coordinated the medical support for the visit of Pope John Paul II in June 1999 in Łowicz (Fig. 1-2).

Modern times

After the dissolution of the Military Medical Academy in Łódź in 2002 and the foundation of the Military Institute of Medicine in Warsaw, a year later the department was included in its structure under the current name: 'Department for the Organization of the Military Healthcare and Public Health' (ZOOZWiZP). ZOOZWiZP continues the research and development traditions of OOZW of the Military Institute of Medicine. Regardless of the changes, the scope of activities of the organizational unit has not changed, and it continues its educational, scientific and editorial activities.



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Łowicz, 1999/06/22.

MILITARY INSTITUTE OF MEDICINE
in Łódź
Department for the Organization of the Military Healthcare
Colonel Dujczyński

EXPRESSION OF GRATITUDE

I would like to thank you for the participation in the organisation of medical support for the Pilgrimage of the Holy Father in Łowicz on 14/06/1999. By your agency I would like to thank all the physicians, nurses, and officer cadets.

The participation of uniformed services in this task definitely allowed for professional assistance being provided to the pilgrims.

I would like to emphasise that the cooperation with you and Maj. Skalski was a great pleasure for us.

With regards

Zespołu Opieki Zdrowotnej
Łowicz
lek. med. Janina Rios-Kaźmierczak

cc:
l/Marshal Office of Łódź
l/Province Governor's Office in Łódź

Figure 2. Thanks from the Director of the Health Care Department in Łowicz
Rycina 2. Podziękowanie od Dyrektora Zespołu Opieki Zdrowotnej w Łowiczu

During the initial period the employees participated in the educational process of the students at the Faculty of Military Medicine of the Medical University of Łódź; however, with time these activities have been ceased for organizational reasons. Currently, the main effort in educational activities is directed at the training of the officer cadre during the regular monthly training courses for promotion in officer ranks (lieutenant colonel and colonel). In the years 2005-2015, a total of 29 courses were organized and 386 officers were trained to be promoted to the rank of lieutenant colonel and respectively 21 courses and 125 officers to the rank of colonel. The department also organizes classes within the scope of public health for physicians specializing in different fields of medicine.

The beginning of the 21st century is a period of dynamic changes in the Armed Forces of the Republic of Poland (SZ RP), and therefore also military healthcare. Organizational structures and views in regard to the use of SZ RP have continued to change.

In the years 2003-2007, the department implemented a

research project under the following name: "Optimization of the treatment and evacuation support system of combat operations on the modern battlefield". The implementation of the project included numerous analyses of essential issues in regard to the threats to the area of the country, the functioning of the medical support system of the SZ RP and the improvement of the organizational structures for healthcare during the times of war and peace. Based on the analysis of the organization and functioning of military healthcare, an organizational model for the functioning of military healthcare in a garrison was developed [2]. It has been shown that the creation of garrison military healthcare centers, remaining in the structure of the prevention and treatment district, allows more effective improvement of the professional qualifications of the medical staff. The in-depth analysis covered the so-called zonal system of medical support for combat operations at the divisional and brigade levels, and its resulting advantages for military healthcare and medical support during combat operations. There was also a positive evaluation for the need of taking military healthcare out of the subdistricts and districts and focusing it on military support groups (GZM), which were, however, intended to form an integral part of the brigades or divisions. What has to be recognized as the greatest misrepresentation of the presented proposals and the defeat of the proposed system is the isolation of GZM outside the military units and their subordination to Military Field Hospitals, which were in fact inoperative. All the conclusions from the conducted studies were included in the programs of the VIII, IX, X, XI, and XII Scientific and Training Conferences organized by the department and they were published in military medical journals [3].

Within the last decade the department has conducted studies on the use of telemedicine on the modern battlefield, creating the concept of a national Medical Information Management System (MIMS) [4, 5]. The works, initiated in the 1990s on the individual soldier's electronic health card under the objectives of the Armed Forces, were continued and a new evacuation card specimen was designed. A draft of the national doctrinal document for medical support (SZ-AD 4.10) was developed in the department in the same period. Two versions of the document were developed, one of them compact, containing only information significant to the medical support of the AF, the other one extended by descriptive elements, which in the opinion of the Military Health Service Board, and later the Military Health Service Inspectorate, should be included in the created document. The project has not been accepted with a positive response and has not been implemented in the AF of the RoP; however, unofficial copies of the same have served military unit physicians in conducting their daily tasks, as they were the first document supporting physicians in conducting their duties to appear in a very long time.

Responding to the needs of the AF in regard to modernization of medical support districts, in 2008 the department implemented a research project under the following name: "Tasks and organization of a central level medical support unit". The need to initiate works within this scope was a result of the necessity to implement organizational structures in the mobile medical structures, such as the medical support battalions (bwmed). This medical structure was outdated, it did not cohere with the realities of the modern battlefield, and was a typical example of paper structures, the effectiveness in operation of which has not been verified in a very long time. In the course of the pursuit of the subject, a series of analyses on the functioning of field health services were performed, evaluating the potential of particular medical elements on the levels of medical support for military combat operations.

The AF engaged in stabilization and peace missions as well as organizational changes leading to full professionalization of the army, confirming the need for possession of a mobile, centrally subordinated medical unit with a modular structure, capable of performing tasks on all levels of medical support. It should be staffed with officers - physicians serving in military hospitals, who will provide the unit modules created on their basis with proper equipment, in accordance with the purpose. Such a unit construction system was intended to ensure quick organization of the entire structure or any functional part, depending on the required task. It has been indicated that the need for possession of a unit bears influence on the quality of medical support for the armed forces as a part of the medical support for defensive domestic operation and military contingents operating outside the state. The organizational structure of a unit include the subdivisions and divisions forming it, located by the military hospitals. On the occasion of the analysis of the medical equipment, qualitative and quantitative assessments of the newly formed Zlek-1, Zlek-2 and Zlek-3 drug sets were performed [6, 7]. The study of this issue has been subjected to official use.

In the years 2011-2012, in relation to organizational changes concerning the GZM structures in the OOZWiZP, a project was undertaken: "Assessment of the capabilities of the military health service of a Mechanised Brigade (Armoured Brigade) within the scope of medical support for combat operations in new organizational structures". The purpose of the research project was to evaluate the capability of medical support for combat operations conducted under Article 5 of the Washington Treaty by the military health service at the tactical level, operating in the new organizational structures. Based on the conducted analyses, the following conclusions have been drawn:

Activities of the Department for the Organization of the Military Healthcare and Public Health at the Military Medical Institute in Warsaw

- newly formed medical elements do not have a sufficient number of operational teams, which can result in the appearance of a "bottleneck" during operations and a decrease in the general efficiency of a dressing point,
- medical staffing should be increased by at least 2 surgeons; this should result in unblocking of the

dressing point as far as support for damage from conventional weapons,

- in the case of the massive inflow of wounded from all kinds of weapons it is necessary to reinforce the health service with personnel from a superior level; therefore the possession of medical reserves compatible with GZM should be pursued, grouped in a new, centrally subordinated medical support unit [8, 9].

Based on the conclusions presented above, a document was prepared: "Assessment of the capabilities of the military health service of a Mechanised Brigade (Armoured Brigade) within the scope of medical support for combat operations in new organizational structures".

Summary

The OOZWiZP has been functioning as a department in the structure of the Military Institute of Medicine for 13 years. The presented outline of activities of the department can hardly be called "an uninterrupted series of successes", but the educational activities, the publication of 51 articles on specific subject matters, the presentation of 47 papers on domestic and foreign conferences and the implementation of the discussed research projects concerning the current issues of the military health service should not remain unnoticed [10, 11]. The Armed Forces of the Republic of Poland are currently undergoing dynamic transformations, which also applies to the structures of the military health service and the medical support system. In order to implement these changes, knowledge and ability is required related to the identification of needs, capabilities and the creation of organizational structures for the military health service under the conditions of modern threats, with respect to International Humanitarian Law. The Military Institute in Warsaw, the organizational structure of which includes the Department for the Organization of the Military Healthcare and Public Health and the Department of Bioethics and Medical Law, supported by the experience of the participants of operations outside the state, has the potential for active participation in the process of improving the system of medical support for the Armed Forces of the Republic of Poland.

Literature

1. Słowiński A. Historia Katedry (Zakładu) Organizacji Ochrony Zdrowia Wojsk Wojskowej Akademii Medycznej (krótki zarys) [History of the Department for the Organization of the Military Healthcare and Public Health at the Military Medical Academy (a short outline)]. Łódź 2001
2. Dójczyński M, Wiśniewski A, Wojsa J, et al. Optymalizacja struktur organizacyjnych wojskowej służby zdrowia w procesie zabezpieczenia medycznego czasu „P" [Optimization of organizational structures of military health service in the process of medical support at the time of "P"]. Skalpel, 2006; 15 (1): 27-29
3. Skalski M, Wojsa J„ Jankowski A, et al. Zabezpieczenie strefowe działań bojowych - potencjalne korzyści [Zonal support for combat operations - the potential advantages]. Valetudinaria Post Med Klin Wojsk, 2006; 11 (1 supl.): 56-60
4. Wojsa J, Skalski M, Jankowski A, et al. System zarządzania informacją medyczną-MIMS (Medical Information Management System) [Medical Information Management System-MIMS]. Valetudinaria Post Med Klin Wojsk, 2006; 11 (1 supl.): 61-64
5. Wojsa J, Jankowski A, Skalski M, Soszyński M. System Zarządzania Informacją Medyczną (MIMS) jako narodowa część systemu NATO MEDICS [Medical Information Management System (MIMS) as a national part of the NATO MEDICS system]. Mil. Phys., 2010; 88 (2): 176-179
6. Skalski M, Jankowski A, Wojsa J, et al. Potrzeby i możliwości wojskowej służby zdrowia w zakresie zabezpieczenia medycznego strat sanitarnych od broni masowego rażenia (NBC) na 2 poziomie pomocy medycznej [The needs and capabilities of military health service within the scope of medical support for sanitary losses from the weapons of mass destruction (NBC) at the 2nd level of medical assistance]. Valetudinaria Post Med Klin Wojsk, 2006; 11 (1 supl.): 51-55
7. Skalski M, Jankowski A, Wojsa J, Dójczyński M. Zestawy lekowe ZLek-1, ZLek-2, ZLek-3 - metodologia oceny ilościowej i jakościowej leków w zestawach medycznych [Drug sets ZLek-1, ZLek-2, ZLek-3 - the methodology of qualitative and quantitative assessment of drugs in the medical sets]. Mil. Phys., 2010; 88 (2): 180-186
8. Skalski M, Jankowski A, Abramowicz J. Drugi poziom pomocy medycznej -ocena potrzeb w zakresie zabezpieczenia medycznego działań bojowych [The 2nd level of military assistance – an assessment of needs associated with medical support in military operations]. Mil. Phys., 2011; 89 (1):56-59
9. Skalski M, Dójczyński M, Wojsa J, et al. Zabezpieczenie 2. poziomu pomocy medycznej - ocena możliwości służby zdrowia szczebla taktycznego [The second level of medical assistance - the evaluation of the capabilities of health service at the tactical level]. Mil. Phys., 2012; 90 (4): 396-402
10. Military Institute of Medicine, Intranet https://remote.wim.mil.pl/+CSC0+00756767633A2F2F6A6A6A2E6F612E6A767A2E7A76792E6379++/bib/ expertus.cgi [accessed on 15/05/2016]
11. Military Institute of Medicine, Intranet https://remote.wim.mil.pl/+CSC0+00756767633A2F2F6A6A6A2E6F612E6A767A2E7A76792E6379++/b/ expertus3e2.cgi [accessed on 15/05/2016]

Post-trauma Reintegration System For Special Forces Commando Units

System reintegracji pourazowej Jednostki Wojskowej Komandosów

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Abstract. The Special Forces Commando (JWK) conducts a full spectrum of special operations. While conducting operations and training, soldiers of the JWK suffer from health impairment issues. In order to help them to recover, the Post-Trauma Reintegration System (PTRS) has been developed to fill the gap within the National Health Service (NFZ). The three-stage system offers help in specialized health care, dental care, psychological and maintenance counseling, physiotherapy and individual physical training. Introduction of this program has reduced the time spent on rehabilitation and boosts the soldiers' morale.
Key words: rehabilitation, convalescence, prophylaxis, dentistry, military psychology

Streszczenie. Jednostka Wojskowa Komandosów prowadzi pełne spektrum operacji specjalnych. Żołnierze jednostki podczas prowadzenia działań i szkoleń ponoszą uszczerbek na zdrowiu. Aby pomóc im w powrocie do pełni sprawności, zorganizowano System Reintegracji Pourazowej, wypełniający lukę w systemie świadczeń zdrowotnych NFZ.
System trójetapowo oferuje pomoc w: leczeniu specjalistycznym i stomatologicznym, poradnictwie psychologicznym i dietetycznym oraz zabiegach fizjoterapeutycznych i prowadzeniu indywidualnego treningu fizycznego. Prowadzenie programu realnie skraca czas rehabilitacji i wpływa na podniesienie morale żołnierzy.
Słowa kluczowe: rehabilitacja, rekonwalescencja, profilaktyka zdrowotna, stomatologia, psychologia wojskowa

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Introduction

The Special Forces Commando (JWK) is the oldest and the largest unit of the Special Forces in the Polish Army. It inherits the traditions of battalions of the Polish Home Army: "Zośka", "Parasol" and "Miotła", as well as of No. 6 Troop (Polish) of No. 10 (Inter-Allied) Commando. This unit is intended to undertake a full range of special missions, particularly direct actions, special reconnaissance and military support. In recent years it has proven its value in the course of combat missions outside the state. This is confirmed by praise and distinctions honoring the unit and its members. Not all of the activities are known to the wider public, in accordance with the motto: "Silent and Effective".

The successes in which the JWK have had its share were preceded by many years of training conducted in Poland and elsewhere. This mainly covers general military training, parachuting, mountain training, diver training, as well as activities in urban areas.

The intensive program of specialist training and activities in training areas prepares the soldiers to undertake tasks at an acceptable level of risk. However, it is not possible to eliminate the incidence of traumas entirely. Three soldiers have been killed and several of them have been wounded during combat missions. Injuries also occur while duties are being performed in Poland.

Issues with receiving proper medical assistance

Several to over a dozen soldiers currently remain in the process of recovery, under the constant supervision of the

Healthcare Chief of the JWK. Apart from the wounded, this group includes those soldiers whose lack of health is related to the performed tasks and age. From the years of supervision over the treatment process, a range of issues which soldiers have to deal with in the process of convalescence has been observed. They appear at every level of healthcare, from Primary Health Care (POZ), specialist treatment, to rehabilitation.

Wounded and ill soldiers receive healthcare provided by the National Health Fund (NFZ), which does not distinguish the soldiers from the general population of patients. Some of them choose private treatment, financed by their own means. The patients treated at the cost of the NFZ have more difficulty in gaining access to the Primary Care Physician, as registration requires appearance in person, involving many hours of waiting in a queue. Furthermore, some of the soldiers are registered with the physician in their place of residence, which is often in a different province. Even minor advice or referral for treatment requires sick leave covering the time spent on activities related to administration and registration (queueing). Upon registration with a specialist physician it may then require several weeks or months before the actual appointment. Not even Military Hospitals treat soldiers as their most important (departmental/privileged) patients, as the act guaranteeing equal access to treatment to all patients does not allow it [1]. The Veteran Status and the Injured Veteran Status is of some help [2], but due to the complicated and long-lasting formal procedures and limited scope of rights, it is only applicable to a small percentage of soldiers.

Medical care provided in the unit

Due to the issues mentioned above, with which soldiers struggle during the process of full recovery, as well as in order to fill in the gap in the healthcare system, an individual health recovery aid program was designed and launched at the JWK with the support of its unit commander.

Post-Trauma Reintegration System (PTRS) is a multi-directional program of diagnostics, rehabilitation and treatment implemented at the JWK. The general aim of the designation and implementation of the system is to:

- Improve the health condition of soldiers by means of preventative measures and the elimination of potential health risks,
- indicate the untapped physical potential of the soldiers,
- accelerate the recovery process and restoration to full capability in order to perform duties within the period of rehabilitation.

The system was created with the use of human resources and equipment at the disposal of the JWK. The primary and fundamental element, on which the program was based, is occupational medicine. This includes: examination and consultation in the field of internal medicine, cardiology, neurology, ophthalmology, laryngology, gynecology, body analyzer tests, laboratory and radiological tests.

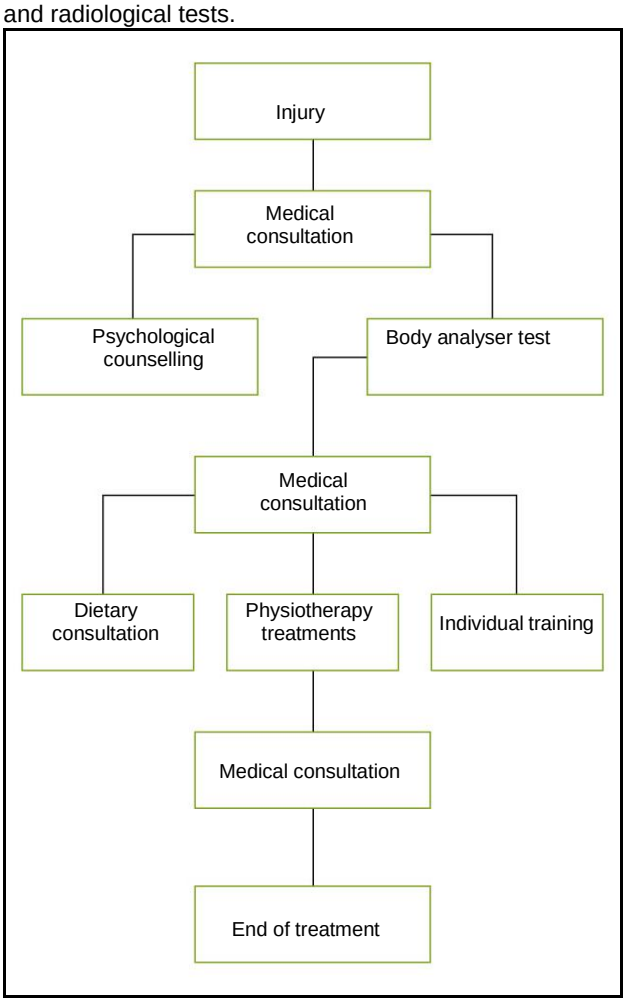

Figure. Scheme of the Post Trauma Reintegration System (PTRS)
Rycina. Schemat funkcjonowania Systemu Reintegracji Pourazowej (SRP)

Based on the regulation of the Minister of National Defence [3], soldiers of the Special Forces are entitled to additional dental care services exceeding the standard provided by NFZ. They can also receive counselling from military psychologists. The outpatient clinic has at its disposal a rehabilitation office equipped with modern physiotherapy equipment, allowing the performing of a wide range of rehabilitation treatments. These elements have been combined into a coherent mechanism, directed and supervised by the healthcare chief of the unit. With time they have been supplemented with general development and fitness improvement classes run by physical education instructors based on the sports infrastructure. The system has also been extended by a

specialist dietitian.

The soldiers referred to participate in the Post-Trauma Reintegration System are those:

- after trauma (supervisor of the injured person submits a report on the injury to the unit commander),
- on long-term sick leave of more than 30 days (obligatorily subject to follow-up examination once the treatment is finished),
- recognized as individuals with special health care needs (occupational medicine) [4],
- whose tests performed as a part of occupational medicine indicate a health issue (e.g. chronic conditions, abnormal laboratory findings, metabolic age, high BMI),
- who were evaluated poorly during the annual physical education exam (information from the chief instructor),
- who manifest the symptoms of psychological disorders, including PTSD,
- who voluntarily ask for help.

The system is organized into three stages.

The first stage, the aim of which is to identify the problem, is implemented by the occupational medicine physicians of the unit. This is achieved through preliminary examinations, including taking a history, physical examination, analysis of laboratory and radiological tests, as well as the body analyzer test. If needed, the diagnostics are extended by means of specialist consultations available as subcontracted occupational medicine tests.

Patients with an identified issue are directed to the second, fundamental stage, in which they are subjected to therapeutic treatments. This includes several variants, the most basic of which is specialist treatment - in an outpatient clinic or in a hospital. This requires a referral issued by a primary care physician. JWK physicians indicate appropriate medical facilities, actively participating in determining the time of the appointment. The unit's dental office is where specialist dental treatment is conducted. Carious cavities are prepared and filled, and the endodontic treatment also includes root canal fillings, non-carious cavities are treated, root tips are removed with reverse filling procedures, open curettage procedures are performed, and periodontal dressings are applied.

The unit's psychologist tests the candidates for service in Special Forces, making sure only those meeting the high psychological requirements make it to the units. The psychologist participates in searching for appropriate candidates for sappers, divers, snipers and dog handlers. The psychologist also interviews soldiers qualified for service outside the state and after they return from a mission. During these interviews it is possible to determine those soldiers who require psychological assistance. The effectiveness of the tests is proved by the fact that no case of PTSD has been identified so far in JWK soldiers. Post-Trauma Reintegration System also includes preventative measures and cycles of therapeutic meetings intended for soldiers and their families. Referrals to more advanced therapy are also issued.

The rehabilitation office offers a range of medical treatments, such as classic, medical, functional and isometric massage, peripheral and vertebral joint mobilization and manipulation, cupping therapy, kinesiology taping, Cyriax, PNF techniques, spinal traction, Träbert currents, cryotherapy, sollux lamp, laser therapy, magnetotherapy, ultrasound treatment, TENS currents, iontophoresis, galvanic baths, electrical stimulation, interferential and Kotz currents. Soldiers after long-term treatment often require assistance in returning to good physical fitness. They are aided by instructors, who develop an individual set of exercises, taking into account the medical history of the soldier. The instructor systematically evaluates the progress of the patient under care, correcting the exercise program if needed. They have at their disposal a swimming pool and a gym fitted with specialized equipment, such as treadmills, stationary bicycles and kayak training machines, as well as a sauna. Dietary assistance is an element of the therapeutic stage of no less importance. Medical and exercise (sports) dietetics are offered, the dietitian developing individual algorithms of sports supplementation, taking into account the training program. The ALIANT program is used when designing the diet. An objective tool that allows the assessing of the therapeutic effects is the body analyzer test.

The third stage is re-examination. The patient is subjected to the examinations undertaken during the first stage. The unit's physicians evaluate the effectiveness of treatment and decide whether the patient can be allowed to perform the duties or whether they need to repeat the treatments. If there are no satisfactory effects, the soldier is referred by the unit commander to the Military Medical Committee in order to determine the fitness for service in the Airborne Forces.

Experiences of other NATO member states

The medical services of the Special Forces of other member states of the North Atlantic Treaty Organization have also noticed the need for a systemic solution to the issue of care for the injured. The armed forces of the USA and Canada have the highest-ranked of all the human performance programs. The currently implemented project is called Tactical Human Optimization, Rapid Rehabilitation and Reconditioning (THOR3). The idea behind this project is concurrent with that of the Post-Trauma Reintegration System of JWK. It assumes preparation of the operators for performing tasks in terms of physical training, nutrition and medical screening, as well as post-trauma medical care, rehabilitation and return to service.

Military hospitals provide treatment to both soldiers and civil patients. However, a soldier, in keeping with the priorities related to health condition, is always a patient that is received outside any lines.

Summary

Almost 1000 patients were examined under the Post-Trauma Reintegration System in 2015. The physiotherapist performed almost 2000 treatments, the dentist operated on similar scale in terms of treatments, the psychologists performed several hundred examinations, and the physical education instructors implemented training programs for 25 soldiers. According to the analysis of expenditures incurred, the cost of a single dental treatment is approximately PLN 60, and a cycle of 10 physiotherapy treatments costs less than PLN 20.

Several hundred soldiers have benefited from the Post-Trauma Reintegration System in the three years of its functioning. The time to recovery and restoration to full capability to perform duties has been decreased in real terms, with soldiers not wasting time on the bureaucratic procedures of the healthcare system. The performance of most treatments in the primary unit during work time allows time to be saved, time usually wasted on making appointments at specialist clinics and hospital departments. As a result, soldiers do not have to go on sick leave for the sake of rehabilitation. The existence of the system is beneficial to the morale of the mission participants, who see that when suffering from a contusion they are not left to themselves, without support, with a serious health issue.

The beneficiaries of the system also include the families of soldiers on missions. In the case of illness in children, spouses or parents, the unit physicians provide medical assistance and aid in reaching proper specialist or hospital treatment. Subject to the approval of the unit commander, it is also possible to use the sanitary transport at the disposal of the Medical Support Team. The psychologists talk with those who need their help, including aiding families to cope with difficult life situations or those caused by separation.

All these activities result in an increase in trust and respect for the medical staff of the unit. A certain obstacle and impediment in the operation of the Post-Trauma Reintegration System is the lack of its own medical facility providing assistance to soldiers at the level of POZ. Cooperation between the physicians and the psychologists would also have the potential to increase efficiency if they acted within a single subdepartment.

Conclusion

The Post-Trauma Reintegration System is an individual, innovative program of the JWK. It takes into account the specificity of the unit and the needs of the soldiers. It can be adapted to the needs of other military units.

Literature

1. The Act on Publicly Funded Health Care Services of 27 August 2004, 1(1)(3), 2(6). Official Journal of Laws of 2004, No. 210, Item 2135
2. The Act on veterans of activities outside the state of 19 August 2011. Journal of Laws of 2011, No. 205, Item 1203
3. Regulation of the Minister of National Defence of 8 September 2011 on additional healthcare benefits for professional soldiers in the form of dental practitioners and dental materials. Journal of Laws of 2011, No. 210, Item 1252
4. Regulation of the Minister of National Defence of 23 December 2010 on certain healthcare benefits for professional soldiers. Journal of Laws of 2011, No. 8, Item 36

The role of effective and empathic communication in improving patients' quality of life

Rola skutecznej i empatycznej komunikacji w podnoszeniu jakości życia pacjenta

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Abstract. The understanding of a disease phenomenon requires one to focus on its complexity. Each disease has its biomedical aspect, describing it as a system of diagnosed pathological changes, but it also has a psychological dimension. It is for this reason that caring for the quality of a patients' life has now become a therapeutic target. Quality of life is a sensitive tool measuring the effects of the therapy and the expectations of the patients in this respect. Meeting this challenge certainly requires achieving good doctor-patient relationships. Quality of life and effective communication seem to be inseparable. Effective and emphatic doctor-patient communication based on cooperation, understanding and trust has a high potential for solving the health problems of the patients. Nowadays, it is an integral part of clinical practice and plays a central role in medicine, benefitting doctors, patients and their families. Communication and interpersonal relationship-building skills are crucial tools of the trade for medical staff. It is becoming increasingly recognized that more attention needs to be paid to the acquisition of the ability to communicate with the patient.
Key words: health related quality of life, effective communication, patient-doctor relationship

Streszczenie. Współczesne zrozumienie zjawiska choroby wymaga skupienia uwagi na jej złożonym charakterze. Każda choroba oprócz aspektu biomedycznego, w którym chorobę można sprowadzić do zdiagnozowanych zmian patologicznych, ma jeszcze wymiar psychologiczny. Z tego powodu celem terapeutycznym jest obecnie również troska o jakość życia pacjenta. Jakość życia jest czułym miernikiem oczekiwań chorych w tym względzie i efektów stosowanej terapii. Sprostanie tym wyzwaniom zdecydowanie ułatwia prawidłowe porozumiewanie się między pacjentem i personelem medycznym. Jakość życia i komunikacja interpersonalna wydają się nierozerwalne. Skuteczna i empatyczna komunikacja lekarz – pacjent, oparta na współpracy, zrozumieniu i zaufaniu, pozwala w pełni rozwiązać problemy zdrowotne chorego. Obecnie stała się nieodłączną częścią praktyki klinicznej i pełni główną rolę w medycynie. Niesie korzyści zarówno dla lekarza, jak i dla pacjenta oraz jego rodziny. Kompetencje komunikacyjne i kwalifikacje z zakresu budowania relacji międzyludzkich są istotnym narzędziem pracy personelu medycznego. Obecnie coraz częściej uznaje się konieczność zwrócenia większej uwagi na zdobywanie w procesie kształcenia umiejętności porozumiewania się z pacjentem.
Słowa kluczowe: jakość życia zależna od zdrowia, efektywna komunikacja, relacja pacjent – lekarz

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Introduction

Until quite recently, the main objective of medicine was to relieve discomfort and the symptoms of disease. When curing was impossible, the purpose was to keep the patient alive regardless of their disappointment and at the

expense of their long-term passive existence [1]. The contemporary approach to illness focuses on its complex nature, so in addition to its biomedical aspect, where the disease can be reduced to diagnosed pathological changes, each disease has psychological, social and cultural aspects that determine the position of the patient within the family and society [2].

For this reason, therapeutic objectives now address the patients' quality of life, which introduces a humanitarian element into healthcare and forms an accurate measure of patients' expectations in this respect and the effects of the provided treatment [3]. When these new challenges are met, that is when the patients' health problems are comprehensively resolved, communication between patients and medical staff is facilitated [4]. The quality of life and interpersonal communication seem inseparable. In order to care for the quality of other people's lives it is important to develop good interpersonal relationships, as well as effective and empathic communication to create ideal interactions that satisfy the primary need for contact with other people, hence leading automatically to increased satisfaction with one's life. Effective and empathic communication has become an essential element of successful treatment and medical care, a mutual relationship based on cooperation, understanding and trust. It serves informational and motivational functions while regulating the patient's feelings and emotions [5]. It benefits doctors, patients and their families, making it possible to share one's ideas, make decisions and solve the patients' problems together. Today it is becoming increasingly recognized that more attention needs to be paid to acquiring the ability to communicate with patients, with communication and interpersonal relationship-building skills being crucial tools of the trade for medical staff [2].

Quality of life in the medical sciences

Since its beginnings, medicine has been linked with a concern for the patients' health and quality of life. However, throughout the ages, those concepts have been understood in a variety of ways, and the corresponding approaches have changed a number of times. Over the last few centuries, the technological advancements made in the fields of medicine have given rise to many medical specializations, and doctors often make decisions about patients without having any direct contact with them. This has naturally led to a gradual decrease in human interactions and caused a departure from the holistic approach to patients [6]. Amazingly, at a certain point, the development of medical care has brought medicine back to its initial approach, considering the individual as a whole and re-introducing the concept of quality of life. In a way, history has come full circle, returning to the times of Hippocratic philosophy and medicine in terms of the approach to patients and illnesses [7].

The term "quality of life" is intuitively understandable by everyone and associated with the essential existential values of the individual, family and society as a whole [8]. In medical terms, quality of life largely focuses on health and illness (health-related quality of life), but it is a multifaceted notion. A common definition of the quality of life has yet to be developed, but the available definitions take basic areas of patients' functioning into account. These areas include objective aspects, such as their physical and mental condition, economic standing and social status [9]. They also include the subjective assessment of factors that affect the perception of one's current health, ability to achieve and maintain a level of performance that corresponds to the overall sense of well-being and happiness, and facilitates the accomplishment of the important goals in life. In addition, they refer to the assessment of perceived satisfaction in relation to the situation viewed as ideal [10]. In respect of the patients' quality of life, it might be useful to consider the fact that the assessment of health and illness solely in medical terms often differs from the subjective assessment given by patients. Generally, the care for patients is justified by the significant extension of the average life expectation and, at the same time, the ageing of societies and the development of chronic diseases that create many limitations and often lead to disability [3]. Moreover, concern for the patients' quality of life makes it possible to evaluate the support provided to the ill, and might prove useful in making decisions concerning treatment. It calls into question the validity of various, often very expensive and invasive, diagnostic and therapeutic approaches, and conversely brings to light the needs of patients associated with the provision of professional care, something that often goes unnoticed by the health services [10].

Interpersonal communication and its role

Interpersonal communication is a dynamic verbal and non-verbal process that involves at least two people, commonly referred to as the sender and the receiver. The sender sends a message intentionally to elicit a response from the receiver [11]. The verbal form of communication is a vehicle of linguistic communication that is human-specific. The individual manner of speaking combined with a wide or narrow vocabulary make it possible to convey one's personality, thoughts or current mood. Contrary to all appearances, articulated speech is responsible for only a small (7%) proportion of the development of interpersonal relationships [5]. A significantly more important role is played by other elements of communication that, even though older and more primitive than speech, were identified and acknowledged only as late as in the 1960s.

Previously, people did not realize how important they were. It is common knowledge, however, that the words we use while constructing our message are inseparably linked to non-verbal cues and body language. Non-verbal

messages, often conveyed unconsciously, are more difficult to control, compared to linguistic communication, and are more likely to engender confidence than those expressed with words [4]. Non-verbal aspects of speech account for 38% of communication, and include intonation, pitch, rate, articulation and accent. The most crucial aspect, accounting for as much as 55% of communication, is body language, i.e. eye contact, body posture, gestures, facial expressions, touch, and the use of space. What also matters in the development of interpersonal relationships is physical appearance, first impression, and the setting in which communication occurs [5]. There are several forms of communication, and their division is based on various criteria. The primary forms of communication are oral and written, while based on the direction in which the message is conveyed, the communication can be unilateral, in which the message is conveyed from the sender to the receiver without any feedback; bilateral or mass. Group communication can further be divided into horizontal communication, between people who have equal positions in the organizational hierarchy, and vertical, usually corresponding to the reporting line [5]. Communication has many important functions. Firstly, it improves the chances of achieving a better understanding of ourselves, other people and the world around us. As a result, it supports self-improvement and boosts self-esteem. The exchange of information with other people can influence their behavior and win their approval. It disseminates and enforces certain values and standards of behavior within a group or society [11]. However, above all, interpersonal relationships fulfil the primary need for interaction with others, supporting the establishment of satisfying social bonds based on mutual respect, understanding and trust [12].

Characteristics of effective and empathic communication

Effective communication is based on clear and comprehensible messages that transfer the sender's intentions, thus facilitating successful communication with another person, both at the level of personal relationships and at the professional and social levels [12]. Communication is by no means an easy task, even though we communicate throughout our lives and practice it from birth, first using non-verbal channels and body language, and later through words. While the establishment of effective relationships is certainly supported by certain natural aptitudes and character traits, interpersonal skills developed throughout one's life are crucial. In order to master successful and effective interpersonal communication, one needs to follow some fundamental rules. One of the prerequisites for the achievement of this goal is the skilled use of verbal communication [4]. The sender should convey a clear and simple message, using language that is comprehensible to the recipient, and corresponding to their ability to understand the facts. The message should be clear, concise and accurate. There are words which raise no doubts about the intentions of the interlocutor. However, articulated speech is so rich and diverse that not all of the uttered words have clear and unambiguous meanings [12]. Another rule for successful interpersonal communication is to maintain consistency between verbal messages, which constitute explicit communication, and non-verbal expressions, which convey implicit messages. When both those types of messages are inconsistent, the non-verbal expressions will be considered true, since body language nearly always reveals the authentic intentions of the interlocutor [4]. In addition, effective dialogue requires the active involvement of the communicator and their readiness to receive feedback and continuous following of the receiver's line of reasoning. Techniques that make it possible to observe this rule are based on active listening and asking questions about the discussed issue [12]. This helps reduce the gap between the messages uttered by the sender and those received by the recipient. It makes it easier to see the other person's point of view and to communicate our way of understanding it [4]. For the receiver, it is important that the message be acknowledged, which is the simplest technique of active listening. Another way is to disambiguate the expressions used by the interlocutor to clarify and discover the specific meaning that the topic has for the sender. Paraphrasing, i.e. describing what the other person has said in one's own words, is a technique that directly expresses in words what the receiver believes the other party thinks or feels. This technique by no means reveals one's own position on the matter, and acknowledges the right to have one's own way of thinking. Active listening techniques also include a technique based on reflecting on the feelings of one's interlocutor. This method is an attempt to accurately describe how the sender feels in order to make it easier to deal with them and acknowledge the meaning of those feelings. Accurately describing the positive or negative emotions of one's interlocutor to recognize their needs makes it possible for them to realize their already satisfied needs or see what stops them from having their needs met [13].

In addition to interpersonal skills, the establishment of effective relationships also rests on such traits as naturalness, warmth, maturity, emotional intelligence, and empathy [13]. Emotional intelligence is the ability to recognize one's own and other people's emotions, to understand, express, and control emotions, and to use them to guide one's thoughts and actions. This intellectual processing of emotions helps to better understand the received information and prevent the harmful effects of emotions, which can distort one's perception and disorganize one's actions [14]. Emotional intelligence usually manifests itself in greater openness to other people, while also increasing the chances of developing effective and empathic relationships with others. Empathy is the ability to accurately recognize the unique and

subjective world of one's interlocutor. It allows the individual to retain their own personality and ways of thinking and experiencing, and does not mean literal identification with other people's feelings [15]. It is a multifaceted ability, characteristic for the human species that allows us to recognize the emotions and feelings experienced by other people at a particular time. Empathy is often referred to as sympathy, but never as pity. It is not so easy to respond empathically as mature empathy requires mental effort to discern the thoughts, feelings or needs of one's interlocutor, and demands overcoming the egocentric habit of seeing the situation mainly from one's own point of view [13]. It should not mean excessive or unlimited emotional involvement with one's interlocutor's affairs, as this might cause mental overload, limited control over the situation and crossing of some psychological lines. Healthy empathy facilitates human interaction, but in the face of the risks posed by excessive sympathy that can distort normal communication, it is important to have another skill, namely assertiveness. This is a friendly and gentle firmness, without any signs of aggression or submissiveness, intended to sustain empathic balance. Assertive behavior is not compliant, because it emphasizes self-respect; is not aggressive, as it includes respect for others; and is not manipulative, because it is based on honesty and openness [4].

Communication barriers during human interactions

Barriers to communication with others are nothing uncommon, they are obstacles we put up ourselves. We encounter them every day and they constitute an inseparable part of communication. Barriers to communication can be grouped according to various criteria. They can be the fault of the sender, the receiver, or the environment [5]. The first area where communication can be distorted involves obstacles to information sending, i.e. the sender conveys an inaccurate or incomprehensible message. In addition, communication might break down when the provided information is contradictory, where verbal and non-verbal messages are inconsistent. On the part of the receiver, barriers to communication can be created as a result of their lack of focus, or unwillingness to discuss a particular topic or to continue the conversation. Other things that contribute to communication barriers are prejudice against the sender, and physiological indisposition, such as a hearing impairment [11]. Problems with effective communication are also caused by linguistic or cultural differences, or different ways of interpreting reality. The majority of disagreements in interpersonal relationships are due to the fact that the interaction participants wrongly assume that their way of thinking and acting is the only and right way. Effective communication is hardly possible when interlocutors perpetuate stereotypes, make judgements and conclusions based on their own needs and perspectives, decide for other people, and belittle the discussed problem or avoid it because they are afraid of it [12]. Efforts to improve the process of communication should focus on realizing the factors that can distort communication, understanding their nature, and avoiding them in the future [11].

The importance of effective communication in relationships between patients and medical staff

A unique example of interpersonal communication that differs from a number of others is therapeutic communication, which is the art of conversation between a member of medical staff and a patient. The specific nature of this relationship is based on the character of the values that are the focus of medicine. Meetings between doctors and patients constitute interactions between opposite ends, with different roles and expectations, where problems are seen from different perspectives and use different parlance [16]. This relationship is characterized by asymmetry and complementarity, but also shared goals. Another specific feature of this relationship comes from the fact that medical professions are associated with high prestige and social status, which can further widen the gap between the staff and the patient. Moreover, the relationship is emotionally charged, as medical staff have access to the most intimate information about the patient's body and about their private life [17]. In ancient times, when the greatest philosophers such as Plato or Aristotle lived, the doctor-patient relationship was described as medical friendship.

During the period in which Hippocrates worked, the approach to the patient was holistic. Over the time, the doctor-patient relationship has undergone numerous transformations that in modern times has become a biomedical paradigm, ignoring the impact of mental factors on health and disease. The return to the holistic, biopsychosocial approach to the patient was marked by the new definition of health introduced in 1946 by WHO [7]. Today, care is provided to the patient not only by doctors, but by the medical staff as a whole, including many specializations and responsibilities towards the patient. Consequently, the contemporary model of holistic medicine was developed not only with doctors in mind, but also nurses, health instructors, nutritionists, physiotherapists, music therapists, and all the other support providers. In their work, doctors and nurses do not deal with clinical cases but living people with their complex and diverse structures. Therefore, they need to focus on the individual, who expects their fears, emotions, views and desires to be taken into consideration, regardless of their stage in life, health situation, and living and work environments, as well as across all healthcare institutions [18]. It is now believed that effective communication on this level is not just the background to the treatment process, but rather its basis, ensuring professional care [5]. In

respect of the professional healthcare system, it is important to consider not only the validity of the provided treatment, but also great care for the patients' quality of life. Interactions with patients are very complex. Medical staff are required not only to have the appropriate knowledge and skills, which are the essence of their instrumental function, but also expression-related skills, i.e. the ability to establish effective therapeutic contact [19]. Good communication skills help to avoid mistakes and misunderstandings between medical staff and patients. In this case, suitable interpersonal communication benefits both parties of the interaction [16]. For medical staff, effective therapeutic communication reduces the emotional pressure patients are under, and facilitates further information exchange that helps to obtain more detailed data and reach a more accurate diagnosis. With open communication, based on dialogue, doctors can explain to patients the consequences of introducing new therapeutic solutions. It helps to hear the patient out and get to know them better, and, as a result, assess their need for information about the disease [4]. It makes it easier to induce patients to agree to specific treatment methods, and to take care of their well-being through active participation in the proposed treatment. Patients' trust in doctors and their satisfaction levels increase, thus reducing the number of complaints about the healthcare service. Ultimately, effective and empathic communication contributes to improved self-esteem and professional satisfaction among doctors [2]. Patients who have successfully established good contact feel that their needs, safety and dignity are respected and taken care of. They feel in control of their own health, and as a result of the knowledge obtained in such an open relationship, they are able to make decisions about their therapy. When patients are willing to cooperate, the administered treatment is more likely to succeed [15]. Effective and empathic therapeutic communication helps patients to assuage such negative emotions as anxiety, depression, anger, guilt, sense of injustice, or helplessness [13]. When those negative emotions and feelings are banished, at least to some extent, quality of life improves considerably.

Conclusions

Considering the above-mentioned information, it seems that effective and empathic communication between patients and medical staff is now more desirable than ever. Accurate assessment of patients' quality of life helps provide better care, which is based mainly on the establishment of good contact. None of the technology-based communication techniques can replace interpersonal communication involving face-to-face conversation and interaction. The responsibility for the success of the interaction does not lie solely with medical staff, since patients should also contribute to the development of appropriate relationships. However, it seems reasonable to claim that it is the responsibility of doctors to steer the conversation in such a way as to produce as many therapeutic benefits as possible (patients cooperate in the treatment process, and after treatment they adopt a more health-conscious attitude). Even though the issue of communication in medical sciences has already been reflected in the curriculum, every-day professional practice continues to show a number of aspects that can be improved. It can be concluded that there is a reasonable need for educating healthcare providers in respect of appropriate communication with patients, interpersonal skills and psychological professional assessment, and that these should be given special attention.

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Literature

1. Wnuk M, Marcinkowski JT. Jakość życia jako pojęcie pluralistyczne o charakterze interdyscyplinarnym [Quality of life as a pluralistic, interdisciplinary notion]. Probl Hig Epidemiol, 2012; 93: 21-26
2. Wtoszczak-Szubzda A, Jarosz MJ. Rola i znaczenie komunikacji w relacji lekarz - pacjent - rodzina [The role and importance of communication within the doctor-patient-family relationship]. Medycyna Ogólna i Nauki o Zdrowiu, 2012; 18: 206-211
3. Wnuk M, Marcinkowski JT. Jakość życia w chorobach przewlekłych [Quality of life in chronic diseases]. Hygeia Public Health, 2013; 48:274-278
4. Stangierska I, Horst-Sikorska W. Ogólne zasady komunikacji między pacjentem a lekarzem [General principles of communication between patients and doctors]. Family Medicine Forum 2007; 1: 58-68
5. Czerw A, Religioni U, Matuszna A, et al. Zasady skutecznej komunikacji w placówkach medycznych [Principles of effective communication in medical institutions]. Hygeia Public Health, 2012; 47: 247-253
6. Letkiewicz S. Holistyczne podejście lekarza do pacjenta [Doctors' holistic approach to patients]. Przegląd Urologiczny, 2012; 2:39-41
7. Krajewska-Kulak E, Chatzopulu A, Łukaszuk C, et al. Postrzeganie pacjenta na przestrzeni wieków [Perception of patients throughout the centuries]. In: Krajewska-Kulak E (ed). Pacjent podmiotem troski zespołu terapeutycznego [Patients as the recipients of care provided by therapeutic teams]. Białystok, Wydawnictwo Akademia Medycznej w Białymstoku 2005: 13-30
8. Trojanowska A. Znaczenie badań nad jakością życia w medycynie [Importance of research into the quality of life in medicine]. Zdrowie Publiczne, 2011; 121:99-103
9. Trzebiatowski J. Jakość życia w perspektywie nauk społecznych i medycznych - systematyzacja ujęć definicyjnych [Quality of life from the perspective of social and medical sciences – systematisation of definitions]. Hygeia Public Health, 2011; 46: 25-31
10. Miniszewska J, Chodkiewicz J, Zalewska-Janowska A. Jakość życia w zdrowiu i chorobie - czym jest, jak i po co ją oceniać [Quality of life in good and bad health – what is it, how to assess it, and for what]. Przegl Lek, 2012; 69: 253-259
11. Makara-Studzińska M. Komunikacja z pacjentem [Communication with patients]. Wydawnictwo PZWL, Lublin 2012: 9-11
12. Kosowicz M. Poprawna komunikacja drogą do porozumienia [Proper communication as a way to connect]. Przegl Uroi, 2012; 2:24-30
13. Motyka M. Rola aktywnego słuchania w komunikacji terapeutycznej z pacjentem [The role of active listening in therapeutic communication with patients]. Problemy Pielęgniarstwa, 2011; 19: 259-265
14. Matczak A, Knopp KA. Znaczenie inteligencji emocjonalnej w funkcjonowaniu człowieka [The importance of emotional intelligence for human functioning]. Wydawnictwo Liberi Libri, Warszawa 2013:

1-211
15. Spiridonow K. Empatia w komunikacji międzyludzkiej - czy to łatwe? [Empathy in interpersonal communication – is it easy?] Medinfo, 2012; 4:35-36
16. Gawor A, Gerber-Leszczyszyn H, Nawrat M, Nowak R. Wybrane psychologiczne aspekty komunikowania się między lekarzem a pacjentem [Selected psychological aspects of communication between doctors and patients]. Adv Clin Exp Med, 2006; 15:157-161
17. Meller D, Milik A. Komunikacja interpersonalna w zakładach opieki zdrowotnej [Interpersonal communication in healthcare institutions]. Zarządzanie i Finanse, 2014; 12: 133-144
18. Krajewska-Kulak E. Komunikowanie się w pielęgniarstwie - zasady ogólne [Communication in nursing – general principles]. In: Kwiatkowska A (ed). Komunikowanie interpersonalne w pielęgniarstwie [Interpersonal communication in nursing]. Wydawnictwo PZWL, Warszawa 2012: 77-85
19. Bargiel-Matusiewicz K, Hofman G. Psychologiczne aspekty kontaktu z pacjentem chorym somatycznie [Psychological aspects of interactions with patients with somatic illnesses]. In: Krajewska-Kutak E (ed). Pacjent podmiotem troski zespołu terapeutycznego [Patients as the recipients of care provided by therapeutic teams]. Wydawnictwo Akademia Medycznej w Białymstoku, 2005: 48-52

Spinal stenosis in the lumbar spine - pathomechanism, symptoms, diagnosis and treatment

Stenoza kanału kręgowego w odcinku lędźwiowym kręgosłupa - patomechanizm, objawy, diagnostyka, leczenie

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Abstract. Spinal stenosis in the lumbar spine is a growing therapeutic problem. If conservative treatment is ineffective, surgical decompression of the neural structures of the spinal canal is performed using direct (traditional) and indirect (alternative) techniques. The effectiveness of both methods of surgical treatment is comparable and amounts to approx. 70%. Each treatment method has its pros and cons, and choosing an appropriate treatment method remains a serious dilemma with no "happy medium" as a standard course of treatment. In line with the current trends towards reducing the invasiveness of treatment, less traumatic surgical methods are still more frequently used. Dynamic stabilization retains the anatomical and biomechanical functions of the lumbar spine, constituting a useful surgical alternative to traditional methods. The success of treatment significantly depends on the correct classification of patients. This article presents information on the pathomechanism, symptoms, diagnosis and treatment of spinal stenosis in the lumbar spine.
Key words: spinal stenosis, degenerative spine disease, spinal arthrodesis, dynamic interspinous stabilization

Streszczenie. Stenoza w odcinku lędźwiowym kanatu kręgowego stanowi narastający problem terapeutyczny. W przypadku nieskuteczności leczenia zachowawczego stosuje się operacyjne odbarczenia struktur nerwowych kanatu kręgowego za pomocą technik: bezpośrednich (tradycyjnych) i pośrednich (alternatywnych). Skuteczność leczenia operacyjnego obu metod jest porównywalna i wynosi około 70%. Każda z metod leczenia ma swoje wady i zalety. Wybór odpowiedniego leczenia pozostaje poważnym dylematem. Nie wypracowano jak dotąd „złotego" standardu postępowania. Zgodnie z obecnymi tendencjami do ograniczania inwazyjności zabiegów coraz częściej stosuje się mniej traumatyczne metody leczenia operacyjnego. Stabilizacja dynamiczna umożliwia zachowanie funkcji anatomicznych i biomechanicznych kręgosłupa lędźwiowego. Stanowi użyteczną i alternatywną opcję leczenia operacyjnego dla metod klasycznych. Powodzenie leczenia w istotny sposób zależy od właściwej kwalifikacji chorych. W niniejszym artykule przedstawiono informacje na temat patomechanizmu, objawów, diagnostyki i leczenia stenozy odcinka lędźwiowego kanału kręgowego.
Słowa kluczowe: stenoza kanału kręgowego, choroba zwyrodnieniowa kręgosłupa, artrodeza kręgosłupa, stabilizacja dynamiczna międzywyrostkowa

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Introduction

Spinal stenosis (spinal canal tightness) is a state of disproportion between the volume of the spinal canal and its content, caused by the narrowing of the spinal canal, lateral recesses or interventricular foramina, such as occurs in the context of degenerative spinal lesions. This narrowing can be caused by bone tissue or soft tissues: ligament elements or the meninx. Degenerative lesions leading to the emergence of spinal narrowing include intervertebral disc lesions, disc height loss, osteophytes (bony excrescences) on the vertebral body margins,

degenerative spondylolisthesis, degenerative lesions in facet joints and ligamentum flavum or posterior longitudinal ligament hypertrophy. These lesions result in the compression of the thecal sac, nerve roots and blood vessels located in the area. The resulting ischemia of the nerve roots causes chronic pain, sensory loss and muscle weakening in lower limbs.

Epidemiology

Spinal stenosis in the lumbar spine can now be diagnosed more frequently owing to the introduction of high-resolution, non-invasive radiological techniques to diagnostic imaging. These techniques include Magnetic Resonance Imaging and Computed Tomography, both of which also enjoy increasing availability. Spinal stenosis in the lumbar spine is usually diagnosed in the L4/L5 segment, more rarely in the L3/L4, L2/L3, and L5/S1, while cases of stenosis in the L1/L2 segment are the rarest. Procedures due to spinal stenosis are among the most often performed by neurosurgeons; however, determining the best treatment algorithm can be problematic [1].

Biomechanics of the lumbar spine

According to the Denis concept, a functional unit can be divided into three columns: anterior, middle and posterior. The anterior column consists of: the anterior longitudinal ligament and the anterior half of the vertebral body and the annulus fibrosus. The middle column comprises: the posterior half of the vertebral body and the annulus fibrosus, and the posterior longitudinal ligament. The posterior column includes: vertebral arches, spinous processes, superior and inferior articular processes, synovial membranes, the ligamenta flava, and the interspinous and supraspinous ligaments [4]. Excessive mechanical loads are transmitted from the anterior column to the posterior one, causing the hypertrophy of joint elements, resulting in strain symptoms. The way in which the biomechanical load is distributed in the spine defines its function. Under normal conditions, the distribution of compressive forces is as follows: 80-90% of the axial load falls on the anterior and middle columns, and 10-20% on the posterior column. Thanks to cooperation between the elements of the anterior and posterior columns, spinal mobility is controlled. Any functional disorder in one of these elements causes the development of an instability [5]. Spinal stenosis by <10 mm in the median plane proves the absolute stenosis of the spinal canal. The nerve roots, after leaving the thecal sac, pass through lateral recesses in the spinal canal, and next through the interventricular foramina. A value of 5 mm in terms of the lateral recess in the sagittal plane is deemed normal, intermediate values (between 3 and 4 mm) suggest lateral recess stenosis, while any value of 2 mm or lower is a sign of abnormality. The size of interventricular foramina in the vertical plane is within the range of 20-23 mm. In 80% of patients with a diameter of an interventricular foramen of <15 mm and intervertebral disc space narrowing of <4, mm we can observe the symptoms of nerve root compression [6].

Spinal stenosis classification

Depending on etiology, one can differentiate between primary and secondary stenosis. Primary stenosis refers to a congenitally narrow spinal canal or to such birth defects as dysraphism and achondroplasia. Among the causes of secondary stenosis we can include: degenerative lesions associated with the hypertrophy and calcification of the ligamentum flavum, spondylolisthesis, postoperative lesions at the stabilized level or the level adjacent to the stabilized one, nucleus pulposus removal, laminectomy, trauma, metabolic diseases (e.g. Paget's disease), endocrine diseases (e.g. acromegaly) and neoplasms. The course of spinal stenosis can involve no instability, being associated with a degenerative disc disease, or with instability caused by spondylolisthesis or scoliosis in the context of degenerative lesions. Spinal stenosis can affect the central part of the spinal canal (central stenosis) of the lateral part – in the area of interventricular foramina, through which the nerve roots pass (foraminal stenosis) [8].

Spinal stenosis symptoms

The variety of clinical symptoms relates to the possible anatomical conditions, which are different in every person. Symptomatology is conditioned by the size of the spinal canal, the transverse surface of the thecal sac and the nerve roots. The main factor responsible for the symptoms of stenosis is thecal sac compression. Radicular symptoms in the form of motor and sensory dysfunctions can be often observed when the transverse surface of the thecal sac is decreased by 50% in the lumbar section. In clinical terms, spinal stenosis in the lumbar spine manifests itself through pain in the lumbosacral area and neurogenic claudication. The latter is characterized by radicular, often bilateral, pain with symptom intensity depending on the body position assumed by the patient.

One characteristic is pain during physical activity, while standing and in other positions requiring a straight lumbar spine. Sitting and bending the spine increase the dimensions of the spinal canal and interventricular foramina. Shifting the center of gravity from the posterior column to the anterior column relieves or eliminates the pain. On the other hand, straightening the spine and shifting the center of gravity to the posterior column exacerbates the pain. Neurogenic claudication should be differentiated from intermittent claudiction in the context of lower limb artery obstruction, in which the ailments subside when the patient is resting, irrespective of body position. Spinal stenosis in the lumbar spine, with predominant instability above thecal sac compression, causes pain in the lumbosacral area, which usually does not radiate to the lower limbs. Stenosis is usually found in the L4/L5 segment, causing exteroceptive sensation disorders in respect of L5 radicular innervation and weakening of the extensor hallucis muscles and the anterior compartment of the leg [9].

Pathogenesis of the pain syndrome in patients with spinal stenosis

A spinal canal of a given size can be stenotic in one patient and normal in another. Spinal stenosis is a clinical condition, and not a radiological one. The incorrect distribution of spinal load is the source of the pain syndrome in the lumbosacral area [10]. Rather than by the volume of load, pain is triggered by the manner of distribution of the axial loads. Anatomical differences, and, consequently, the distribution of axial loads vary from case to case [10]. It is worth noting the venous hypertension hypothesis, explaining the causes of the pain syndrome in patients with spinal stenosis. Circulatory disorders result from increased blood flow through the internal vertebral venous plexus during walking. The observed phenomena are vascular system dilation and congestion, which cause increased pressure on a nerve root. Simultaneously, the inflow of arterial blood becomes hindered, which causes radicular symptoms to transpire as a result of ischemia. Significant spinal stenosis leads to increased cerebrospinal fluid pressure in the system, causing venous collapse in the cauda equina, and, as a result, strain-related oxygen deficiency in the nerve-root area. There are, however, several doubts related to the venous hypertension hypothesis. Venous stasis can be prevented by numerous anastomoses in the venous system and the lack of valves. The sudden subsidence of pain resulting from a change in one's body position suggests that venous stasis is not the main pain-causing factor, as in such circumstances the ailment should subside slowly [11].

Pain mechanisms caused by nerve root compression

There are two pain mechanisms caused by nerve root compression that are worth highlighting. They differ in their clinical picture. The first mechanism is connected with degenerative lesions in the spinal canal in older patients. These lesions take the form of disc space narrowing, facet joint hypertrophy, the presence of osteophytes on the vertebral body margins or ligementum flavum bulging into the spinal canal. Tension signs are negative, the nerve root is not stretched over the collapsed disc space. The other one can be observed mainly in young people, without nerve root pressing on the posterior wall of the spinal canal. Hofmann's ligaments have an important role in this mechanism, as they connect to the nerve root in the part that enters the interventricular foramen, thus preventing the posterior shift of the nerve root. Their activity results in nerve root stretching. Tension signs are predominant, and increase in intensity while the individual is sitting, and decrease in the standing position and during walking [12].

Diagnostics

Diagnostic techniques are used for the radiological assessment of stenosis and the correlation between clinical symptoms and stenosis location, making it possible to plan the procedure correctly. The diagnostic method of choice is nuclear magnetic resonance. It allows the visualization of the anatomical details of the spinal canal and neural structures, providing direct information on the pathological process. A decreased signal of epidural fat, decreased signal of cerebrospinal fluid in T_2-weighted time, and decreased volume of the thecal sac in the stenosed segments, and the lack of signal of the cerebrospinal fluid surrounding the cauda equina roots in the thecal sac, make it possible to determine the degree of stenosis. It is currently not recommended to measure the spinal canal using Computed Tomography or x-ray images. The thecal sac is compressed the most in the upright position. This proves the purposefulness of diagnostic imaging being performed in the upright position, which causes the most painful symptoms.

Nowadays, MRI examination in the upright position is not commonly available. In some centers, before a decision to pursue surgical treatment is made, axial loads are employed to

simulate the vertical position, and evaluate the degree of spinal stenosis using images created in that way [13]. Computed Tomography can also be of use, as it makes it possible to better present the bone elements of the spine, significantly contributing to the development of spinal stenosis. Electrophysiological methods, such as electromyography and nerve conduction studies, can also be helpful. They facilitate the detection of nerve fiber function disorders caused by compression in the stenosed section of the spinal canal. In the case of nerve damage we can observe a 'neurogenic pattern', characterized by the occurrence of denervation potentials at rest, with a simple pattern during maximum strain and extended amplitude and duration of potentials. These days, in the MRI era, radiographic examinations, due to their limited usability in the assessment of the degenerative lesions of the spine, are of historical importance, and they merely complement the aforementioned types of study. Based on x-ray imaging one can identify the features of intervertebral disc degeneration, degenerative lesions of the vertebral bodies and spine shape irregularities, such as scoliosis, kyphotic lumbar spine and degenerative spondylolisthesis. Functional x-ray imaging can reveal the characteristics of an instability of a specific functional spinal unit. Spinal stenosis and the location of nerve element compression can be demonstrated directly using contrast examination of the thecal sac, i.e. radiculography and myelography.

Conservative treatment

Many cases of spinal stenosis can be successfully treated by employing conservative treatment, especially in the initial, early stage of the disease. Conservative treatment is the most effective in the group of patients who experience minor to moderate pain. The methods of conservative treatment include pharmacotherapy and physiotherapy. Pharmacological treatment can entail analgesics, nonsteroidal anti-inflammatory drugs, and muscle relaxants. When it comes to physiotherapy methods in spinal stenosis, the most frequently used include kinesiotherapy, physiotherapy and medical massage. As part of physiotherapy, one can employ thermotherapy, cryotherapy, transcutaneous electrical nerve stimulation (TENS) and magnetic field therapy. Kinesiotherapy is a form of treatment that uses physical activity which decreases excessive strain on the spine. It facilitates the strengthening of the muscular corset and postural stability. The purpose of medical massage is to decrease muscle tone in the paraspinal area. Most recently published works concentrate mainly on surgical treatment [14].

Comparison of the results of conservative and operative treatments

The results of published analyses indicate the superiority of neurosurgical spinal canal decompression over conservative treatment. Spinal stenosis management should start with conservative treatment, while operative treatment is advisable only after all options of conservative treatments have been depleted. Progressing neurological symptoms, including cauda equina syndrome, which manifests itself in micturition and defecation control disorders and sexual function disorders, as well as in decreased muscle strength and impaired feeling in lower limbs, constitute an absolute indication for surgical treatment [14].

Methods of operative treatment

When it comes to the manner of the decompression of the neural structures of the spinal canal one can differentiate between two main treatments: direct decompression using traditional methods (conventional, classic) or indirect, using cutting-edge, minimally invasive techniques (alternative) [14].

The direct decompression of the neural structures of a stenosed spinal canal using convention methods involves extensive decompression of the spinal canal by removing structures impinging on the vascular and nervous elements (laminectomy, facetectomy and foraminectomy). To restore the height of the disc spaces and interventricular foramina, following the extraction of a degenerate nucleus pulposus, it is necessary to supplement the operation with internal stabilization (spinal fusion, arthrodesis), consisting in the fusion of adjacent vertebral bodies with implants. After the dilation and the restoring of the normal disc space using a distraction device, an interbody cage is implanted. This is a “rigid” disc prosthesis, which should align itself in the anterior part of the disc space, which transfers the greatest loads in the spine. The “cage” is made of polyether ether ketone (PEEK) which has the hardness and elasticity of bone. Stabilization with spinal fusion reduces the pain associated with intervertebral joint degeneration at the cost of limited mobility of the spine.

Figure 1. X-ray spine examination in AP projection - condition after L4-S1 transpedicular stabilization with nerve root decompression and L5-S1 discectomy with TLIF stabilization
Rycina 1. Badanie RTG kręgosłupa w projekcji AP-stan po stabilizacji transpedikularnej L4-S1 zodbarczeniem korzeni nerwowych, discekto-mii L5-S1 ze stabilizacją TLIF

One complication with an extensive operation can be a kyphosis-type spine deformity, spondylolisthesis or retrospondylolisthesis with a pain relapse. In this case it is necessary to limit the mobility of the spine using an internal stabilizer screwed to the vertebral arch floors [14].

The aim of spine stabilization

In addition to the elimination of instability in a functional unit, it is also important to prevent future degenerative lesions in the form of spondylolisthesis or scoliosis. The procedures creates appropriate conditions for natural bone remodeling processes, leading to the fusion of adjacent vertebral bodies (spinal fusion). Incomplete decompression of spinal canal structures can lead to symptoms persisting and ineffectiveness of the treatment. On the other hand, excessive decompression without spinal fusion results in secondary spinal instability. Judging from data presented in the literature, stabilization is justified in the event of x-ray-confirmed instability, or when instability occurs after multisegment decompression, e.g. in patients with scoliosis. In the group of patients with abnormal mobility of a functional unit confirmed by dynamic examination, especially with associated spondylolisthesis, arthrodesis appears to be an effective form of treatment. One drawback of the arthrodesis of a functional unit is the risk of overloading in adjacent segments. There is no gold-standard procedure, which is why treatment should be individualized [15].

Indications for arthrodesis using conventional methods

The main indications include preoperative spinal instability in the course of degenerative disc disease or iatrogenic spinal instability following excessive spinal canal decompression, and the correction of an abnormal shape of the spine (spondylolisthesis, lateral spondylolisthesis, and scoliosis). For the last two decades, the performance of arthrodesis has been justified by the elimination of pain in the case of diagnosed excessive mobility in a functional unit. Spinal stability can be distorted during a decompression procedure after the bilateral removal of more than 50% of the intervertebral processes, or after the unilateral removal of an entire intervertebral joint, or after the removal of the posterior longitudinal ligament and intervertebral disc [16].

Stabilization techniques

This procedure consists of the removal of an intervertebral disc, cleaning the space of the removed disc, and inserting an interbody implant (cage) into this space. Various surgical techniques of arthrodesis can be used: posterior lumbar interbody fusion (PLIF), transforaminal lumbar interbody fusion (TLIF) [figs. 1-2], anterior lumbar interbody fusion (ALIF), and transpedicular stabilization [16] [figs.1-2].

Figure 2. X-ray spine examination in lateral projection - condition after L4-S1 transpedicular stabilization with nerve root decompression and L5-S1 discectomy with TLIF stabilization
Rycina 2. Badanie RTG kręgosłupa w projekcji bocznej - stan po stabilizacji transpedikularnej L4-S1 z odbarczeniem korzeni nerwowych, dyscektomii L5-S1 ze stabilizacją TLIF

Indirect (alternative) methods of decompressing the neural structure of the spinal canal using minimally invasive techniques

Two aspects contributed to the search for novel, minimally invasive surgical techniques, which facilitate the retaining of a significant part of the ligaments and bone structures. These are:

- the necessity of a broad surgical approach and significant traumatization of the paraspinal muscles in the classic methods of decompressing the neural structures of the spinal canal causing patients to experience pain in the operated segment of the spine for many weeks,
- anatomical and biomechanical conditions – in most cases spinal stenosis refers only to a disc and interventricular joints ('motion segment'), and rarely concerns the vertebral body and arch ('immovable segment') [16].

Contemporary systems of dynamic stabilization of the spine – an alternative to conventional treatment

Procedures that fall within the scope of minimally invasive surgery can restore the normal distribution of spinal loads, prevent potential problems with pseudarthrosis and retain elastic connections within a functional unit [16].

Dynamic stabilization is defined as a system that beneficially decreases the axial distribution of loads of a functional spinal unit. It neutralizes excessive segmental mobility in the pain-triggering plane, retaining the full movement range. Interspinous implants, through the distraction of spinous processes, indirectly decompress the neural structures by increasing the size of the spinal canal and interventricular foramina in the upright position, without impacting on the measurements of the spinal canal in adjacent segments, irrespective of the position. Dynamic stabilization makes it possible to decompress the cauda equina roots in the central section of the spinal canal. It restores the biomechanical conditions present in the posterior column, as well as the correct alignment of the articular processes and prevents excessive mobility within functional units during flexion and extension. Furthermore, it increases, in segmental terms, lordosis through decreasing pressure in the posterior part of the annulus fibrosus and nucleus pulposus in the implanted segment, without changing the pressure in the adjacent segments [17]. It facilitates pain abatement and functional improvement to a much greater degree than in patients receiving conservative treatment. In contrast to conventional operative treatment, it does not put stress on the sacroiliac joints during rotation. It makes it possible to change the mobility of a functional spinal unit depending on the alignment of the spine. It is a much shorter, simple procedure that is much less traumatic to the patient and entails only minimal postoperative complications. It is associated with smaller blood loss, lower risk of pain syndrome of the lumbosacral area and quicker recuperation. During a dynamic stabilization procedure, there is no direct contact between the instruments or the implant and the neural structures, which makes the risk of failure connected with additional neurological impairment minimal. The ligament-muscle anatomy of the posterior

column is also retained [15].

Indications for dynamic stabilization

The implementation of a dynamic interspinous stabilization device can be used as a single type of treatment in moderate spinal stenosis causing lower back pain. It can also complement spinal decompression surgeries to eliminate the necessity of using long, multisegmental interspinous stabilization [17]. It can be also employed in conventional interbody stabilization, using autogenous implants, increasing, in line with Wolff's law, the probability of arthrodesis through increased compressive load on the autogenous implant during spinal flexion [15]. It can be used in any segment of the lumbar spine having well-developed spinous processes. The L5/S1 segment is a crucial area, as in 20-30% of patients it is impossible to implant an interspinous distraction device in this segment [7]. The procedures are among the minimally invasive, with an interspinous distraction device being implanted between spinous processes. It reduces extension movement and facilitates flexion, without limiting axial rotation or lateral flexion. The implantation procedure can be carried out under local or general anesthesia, and usually takes no more than 30 minutes [18].

Contraindications for dynamic stabilization as a monotherapy

The main contraindications include advanced stenosis of the spinal canal, chronic neurological impairment, cauda equina syndrome, peripheral neuropathy, significant instability, spondylolisthesis above grade 1, past spinal fracture, scoliosis (Cobb angle >25), cancer, and active inflammation [18].

Types of dynamic stabilization

There are several available systems for the dynamic stabilization of the lumbar spine, based on spinous process distraction devices implanted using the posterior approach. These systems facilitate some degree of movement, at the same time stabilizing the functional unit in one or several planes. The following types of dynamic stabilization can be distinguished:

- systems based on transpedicular screws connected using an elastic link: Dynesys system (Zimmer Spine), and FASS system (AO International),
- interspinous distraction devices (implants, stabilizers, cantilevers): X-Stop (St. Francis Medical Technologies), Wallis system (Spine Next), DIAM - Device for Intervertebral Assisted Motion (Medtronic), Coflex (Paradigmspine) (figs. 3-4), BacJac (RTI Surgical), BacFuse (Pioneer Surgical), InSWing (Ortho-fix Spine - Blackstone Medical), StenoFix (Synthes), and In-Space (Synthes) [18].

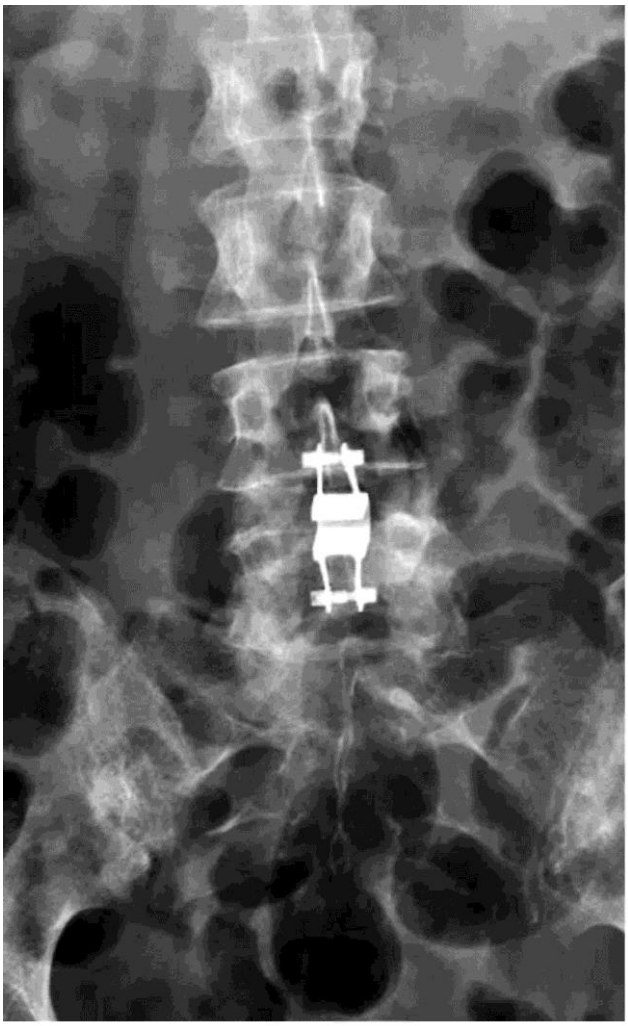

Figure 3. X-ray spine examination in AP projection - condition after decompression of roots and spinal canal at L4-L5 level along with Coflex F 10 mm stabilization
Rycina 3. Badanie RTG kręgosłupa w projekcji AP- stan po odbarczeniu korzeni i kanatu kręgowego na poziomie L4-L5 ze stabilizacją Coflex F 10mm

Comparison of the efficiency of surgical treatment utilizing traditional and alternative methods

Using an ODI (Oswestry Disability Index) questionnaire, the degree of clinical improvement was assessed following decompression facilitated using a dynamic interspinous stabilization device or laminectomy. Both these methods yielded a result of approx. 70%. The effectiveness of spinal canal decompression using a dynamic interspinous stabilization device and decompression with PLIF stabilization was at the same level [19].

Figure 4. X-ray spine examination in lateral projection - condition after decompression of roots and spinal canal at the L4-L5 level along with Coflex F 10 mm stabilization
Rycina 4. Badanie RTG kręgosłupa w projekcji bocznej - stan po od-barczeniu korzeni i kanału kręgowego na poziomie L4-L5 ze stabilizacją Coflex F 10 mm

Factors impacting on the effect of the surgical treatment of stenosis utilizing traditional and alternative methods

Advanced age and long duration of symptoms are among the factors associated with the poor clinical effect of spinal stenosis treatment. Other negative prognostic factors include: comorbidities, laminectomy spanning more than one segment, female sex and no improvement after the previous procedure [19, 20].

Summary

- Spinal canal stenosis treatment should start with conservative methods, except in cases of significant neurological impairment.
- Symptoms of cauda equina syndrome and lower limb paresis should be regarded as absolute indications for operation.
- The intensification of the symptoms of spinal canal stenosis, despite the employment of non-operative treatment methods, is an indication for a surgical procedure.
- The efficiency of spinal canal decompression using classic and alternative methods is comparable.
- After the use of direct spinal canal decompression methods, patients can experience pain in the operated spinal segment for many weeks.
- Dynamic stabilization constitutes an alternative to traditional treatment, indicating the possibility of a good result of treatment carried out in a less traumatic way, without the need for opening the spinal canal, and, at the same time, postponing the necessity of arthrodesis.
- Due to its restrictions, dynamic stabilization cannot be used in every patient.
- The success of surgical treatment employing dynamic stabilization depends on the correct classification for the procedure.
- In classic and alternatives methods alike, the percentage of positive treatment results decreases with age and disease duration.
- The choice of a specific method of surgical treatment must be preceded by a detailed risk-benefit analysis.
- To date no gold-standard procedure has been established for patients with spinal stenosis.
- Choosing the best treatment method is still under discussion.

Literature

1. Genevay S, Atlas SJ. Lumbar spinal stenosis. Best Pract Res Clin Rheumatol, 2010; 24 (2): 253-265
2. Khalil J, Mokbel K. The tract of history in the treatment of lumbar degenerative disc disease. Neurosurg Focus, 2003; 16: 1-4
3. Kości, stawy i więzadła kręgosłupa i klatki piersiowej [Bones, joints, and ligaments of the spine and the chest]. In: Bochenek A, Reicher M. Anatomia człowieka [Human anatomy] Vol. I. PZWL, Warsaw 2010: 219-272
4. Denis F. The three column spine and its significance in classification of acute thoracolumbar spinal injuries. Spine, 1983; 8 (8): 817-831
5. Resnick DK, Choudhri TF, Dailey AT, et al. Guidelines for the

performance of fusion procedures for degenerative disease of the lumbar spine. J Neurosurg Spine, 2005; 2 (6): 686-691
6. Shiu-Bii L, Nien-Hsien L, Shing-Sheng W, et al. Analysis of anatomie morphometry of the pedicles and the safe zone for through-pedicle procedures in the thoracic and lumbar spine. Eur Spine J, 2007; 16 (8): 1215-1222
7. Simpson EK, Parkinson IH, Mathey B, et al. Intervertebral disc disorganization related to trabecular bones architecture in the lumbar spine. J Bone Miner Res, 2001; 16:681-687
8. Kunkel ME, Schmidt H, Wilke HJ, et al. Prediction equations for human thoracic and lumbar vertebral morphometry. J Anat, 2010; 216 (3): 320-328
9. Conway J, Tomkins C, Haig AJ, et al. Walking assessment in people with lumbar spinal stenosis: capacity, performance, and self-report measures. Spine J, 2011; 11 (9):816-823
10. Fórsth P, Ólafsson G, Carlsson T et al. A Randomized, Controlled Trial of Fusion Surgery for Lumbar Spinal Stenosis. N Engl J Med. 2016; 374(15): 1413-23
11. Abbas J, Hamoud H, May O, et al. Degenerative lumbar spinal stenosis and lumbar spine configuration. Eur Spine J, 2010; 19(11): 1865-1873
12. Gunzburg R, Szpalski M. Spondylolysis, spondylolisthesis, and degenerative spondylolisthesis. Lippincott Williams & Wilkins, Philadelphia 2006: 29
13. Thornes E, Ikonomou N, Grotle M, et al. Prognosis of Surgical Treatment for Degenerative Lumbar Spinal Stenosis: A Prospective Cohort Study of Clinical Outcomes and Health-Related Quality of Life Across Gender and Age Groups. Open Orthop J, 2011; 5:372-378
14. Atlas SJ, Keller RB, Wu YA, et al. Long-term outcomes of surgical and nonsurgical management of lumbar spinal stenosis: 8 to 10 year results from the maine lumbar spine study. Spine, 2005; 30: 936-943
15. Russ P. Dynamic stabilization in the surgical management of painful lumbar spinal disorder. Spine, 2005; 30: 68-72
16. Kwon BK, Vaccaro AR, Grauer JN, et al. Indication, techniques, and outcomes of posterior surgery for chronic low back pain. Orthop Clin North Am, 2003; 34: 297-308
17. Landi A. Interspinous posterior devices: What is the real surgical indication? World J Clin Cases, 2014; 2 (9): 402-408
18. Postacchini R, Ferrari E, Cinotti G, et al. Aperius interspinous implant versus open surgical decompression in lumbar spinal stenosis. Spine J, 2011; 11 (10):933-939
19. Davis RJ, Errico TJ, Bae H, et al. Decompression and Coflex interlaminar stabilization compared with decompression and instrumented spinal fusion for spinal stenosis and low-grade degenerative spondylolisthesis: two-year results from the prospective, randomized, multicenter, Food and Drug Administration Investigational Device Exemption trial. Spine, 2013; 38 (18): 1529-1539
20. Hong P, Liu Y, Li H, et al. Comparison of the efficacy and safety between interspinous process distraction device and open decompression surgery in treating lumbar spinal stenosis: a meta analysis. J Invest Surg, 2015; 28 (1):40-49

Urine sample manipulation – a serious problem in laboratory toxicology?

Próby fałszowania moczu na obecność narkotyków - realny problem diagnostyki toksykologicznej?

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Abstract. The urine drug test is a cheap, fast and widely available drug testing method. However, the possibility of false positive or false negative results should be taken into account. The pre-analytical phase, including manipulation of a urine sample, can have a major impact on the final results of the test. Adding adulterants to the urine sample, which can effectively distort the presence of drugs, leads to disturbed chemical reactions or changes in the structure of these drugs. The most common chemical adulterants in use are: pyridinium chlorochromate, glutaraldehyde, papain and sodium chlorate. The initial review and pre-analytical assessment of the physiochemical properties of the provided urine sample can become a key phase of the entire process and could lead to more reliable testing results.
Key words: urine drug test, urine manipulation, screening test, adulterants

Streszczenie. Badania przesiewowe na obecność substancji niedozwolonych w moczu są tanim, szybkim i szeroko wykorzystywanym sposobem detekcji tych związków. Należy jednak pamiętać o możliwości uzyskania wyników fałszywie dodatnich lub fałszywie ujemnych. Faza przedanalityczna, w tym próby manipulacji próbką moczu, może w znaczący sposób wpłynąć na ostateczny wynik testu. Dodatek do moczu adulterantów, czyli związków mających na celu zafałszowanie obecności narkotyków w moczu, zaburza prawidłowy przebieg reakcji lub zmienia strukturę oznaczanego związku. W tym celu wykorzystywane są między innymi chlorochromian pirydyny, aldehyd glutarowy, papaina czy chloran (1) sodu. Wstępna ocena dostarczonego do laboratorium materiału i przedanalityczna kontrola właściwości fizykochemicznych moczu może okazać się kluczowym etapem procesu analitycznego, a co za tym idzie, wiarygodnej interpretacji wyniku.
Słowa kluczowe: narkotesty, fałszowanie moczu, badanie przesiewowe, adulteranty

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Introduction

Screening methods for drug detection in biological materials are used by the police services, penitentiary services, ER departments and military medical boards in laboratory tests for recruits. Cassette drug tests are often used, i.e. drug screens which use immunochromatographic methods to detect the most popular narcotics and their metabolites in urine. The wide commercial range, high availability and easy use of such tests encourages laboratory diagnosticians and doctors to "identify" addictive substances quickly and cheaply. However, in using drug tests one should be aware of the risk of false positive results, primarily due to what are known as cross-reactions. Therefore, when interpreting the test result, laboratory diagnosticians and doctors should consider any effects of the pre-analytical phase, and possible interference of other

substances in the test sample on the reliability of the assay. It is important to confirm, using reference methods, each positive result obtained by this type of test [1].

Attempts at sample adulteration

Interpretation of drug screens is problematic due to attempts at deliberate falsification of the biological material in order to achieve a negative test result. Internet websites and forums are filled with information about the metabolism of addictive substances, principles of narcotic tests, and ways to falsify the results. Forum users share their knowledge and experience regarding adulteration of the biologic material, both *in vivo,* and *in vitro.* Such practices may apply to as much as 50% of the urine samples received in laboratories for drug testing [2].

Based on a survey conducted in 2007 among recruits of the Lubelski Garrison Military Unit, the phenomenon of drug taking is present in the Polish Army. As many as 43% of the surveyed soldiers had contact with addictive substances [3], therefore it can be concluded that attempts at adulteration of urine submitted to the laboratory by recruits referred to the Military Medical Board will become increasingly frequent. Evidence for that tendency is provided by the fact that users of the Polish Army Forum suggest to internet users the easiest methods of falsifying the biological material, i.e. substitution of the urine sample [4].

Synthetic "biological" materials

Another method of urine adulteration for drug screens is using synthetic urine whose composition imitates the biochemical parameters of a healthy individual's urine. Currently there are numerous foreign Internet auctions offering such products. Synthetic urine can be warmed up in a microwave oven to reach the temperature close to body temperature, and its characteristics correspond to physiological pH, creatinine concentration and specific weight. It is used primarily in situations when the patient is not closely supervised during urine sample collection [5].

Sample dilution

Deliberate adulteration of the urine for drug testing may consist in dilution of the test material by adding water or other fluids directly into the sample. The dilution may also result from increased fluid supply or administration of diuretics which increase diuresis, accelerating elimination of the narcotic and its metabolites from the organism. As a result, their concentration in the urine sample decreases below the cut-off value, i.e. the level of substance concentration for which the test result is interpreted as negative. This means that the concentration of illicit substances in the tested material is too low to be detected by the test used. However, this does not mean that the compound is not present in the biological material [1, 6].

Due to the high motivation of consumers of addictive substances to obtain a negative result in drug tests, numerous products facilitating "washout" and fast elimination of illicit substances from the organism have appeared on the market. Examples of such products include herbal teas (Rapid Drug Detox Tea - Naturally Klean), diuretics (e.g. hydrochlorothiazide, furosemide) and a wide range of "cleansing" drinks (e.g. m.in. QCARBO Fast Cleansing Formula, Ready Clean), available mostly from foreign Internet auctions [2]. Awareness among doctors and diagnosticians of such practices enables elimination of those urine samples that demonstrate clearly non-physiological biochemical parameters or suspicious color. A highly diluted sample has a very low specific urine weight of <1.003 and low creatinine concentration of <20 mg/dl. A simple physicochemical test on a primary urine sample, before toxicological analysis, may eliminate any biological material which shows signs of sample manipulation by dilution. Literature reports indicate that this method of sample adulteration applies to approx. 11% of all the urine samples received by laboratories [6].

Addition of adulterants, i.e. falsifying substances

There are also numerous reports in the literature about the use of adulterants, i.e. chemical compounds added to the urine samples in order to obtain a negative test result. Adulterants interfere mostly with immunoenzymatic reaction, or change the chemical structure of the sought substances, preventing their bonding with the antibody used in the test [7].

Bleach, which contains sodium chlorate (I) (sodium hypochlorite), is one of the most common and easily available adulterants. Its strong oxidant effect disturbs not only the reaction involved in the immunoenzymatic method, but also determination of the tested substance by gas chromatography combined with mass spectrometry (GC/MS) [8, 9]. However, it is relatively easy to detect the presence of sodium chlorate (I) in urine, as the tested urine sample will have a different, non-specific odor and non-physiological (alkaline) pH. Suspicious

foaming of the urine can also occur [1]. The diagnostic market offers control tests using 'dry chemistry' methods. These contain reactive fields which enable detection of oxidants, including bleach. It allows the quick assessment of the usefulness of the material for further toxicological testing.

The addition of other, commonly available, adulterants such as liquid soap, lemon juice, common salt, vinegar or isopropanol can also lead to falsification of the test results for drugs and their metabolites. However, these adulterants can be detected during the preliminary assessment of the material received by the laboratory, and in pre-analytical control of the physicochemical properties of urine. Conducting such preliminary control tests in the pre-analytical phase has been regulated by the U.S. Department of Health and Human Services. The guidelines oblige laboratories to determine creatinine concentration, specific weight and pH in each tested sample, as well as to use at least one test for the presence of oxidative adulterants. Further tests are also recommended if non-physiological physical features are observed, or if non-specific reactions occur during drug testing [10-20].

However, it is worth emphasizing that the use of adulterants difficult to identify has also been reported. Benzalkonium chloride, an ingredient in eye drops, is one such substance. This compound significantly disturbs the immunoenzymatic reaction, reducing the possibility of detecting tetrahydrocannabinol (THC) in the tested material. It is probably related to the formation of the micelle which trap lipophilic tetrahydrocannabinols in their hydrophobic structures [13].

"Urine Luck", a preparation available for several years on the Internet market, is intended to mask effectively the presence of narcotics and their metabolites, without affecting the physicochemical properties of urine, and contains pyridinium chloromate (PCC, Corey's reagent). PCC interferes primarily with the results of all the tests for tetrahydrocanabinols (underestimating the concentration of THC in the tested sample by up to 58-100%), as well as for opiates. Chromium compounds in +6 oxidation states present in "Urine Luck" are strong oxidants which block the normal course of the immunoenzymatic reaction, but can also cause false-negative results in reference analyses (GC/MS). To detect chromate (VI) ions in a urine sample, the reaction with 1,5-diphenylocarbazide (DPC) can be conducted. The reaction has also been used in special control strip tests [14, 15].

Other adulterants include substances containing NO_2 ions, masking primarily the presence of 11-Nor-Δ9-tetrahydrocannabinol carboxylic acid (THC-COOH) in urine. Similarly to chrome compounds, their effectiveness is a result of the oxidative effect on the analyte. The products available on the Internet contain potassium or sodium nitrate (III), they are easily soluble in a urine sample, and do not affect the physical properties of the tested material. Literature reports indicate that in approx. 10% of urine samples tested for the cannabinoid concentrations of nitrates (III) were high. It is worth noting that in daily laboratory work general urinalysis involves the semi-quantitative assessment of nitrate (III) concentration in urine for preliminary diagnostics of urinary infection. Positive test results may be indicative of the presence of bacteria in the urine, which can reduce nitrates (V) to nitrates (III). Strip tests using dry chemistry technology enable their quick preliminary identification. Studies clearly indicate that an increase in concentration of these compounds as a result of bacterial denitrification does not exceed 36 µg/ml, whereas the concentration of nitrates (III), used as adulterants, in a manipulated urine sample was within the range 1.910-12.200 µg/ml. Therefore, the concentration of nitrates (III) >500 µg/ml in the urine is considered to be suggestive of the deliberate addition of these compounds *in vitro* [16, 17].

There are also reports of using papain as a compound effectively reducing THC-COOH concentration in a urine sample. Papain is a proteolytic enzyme, active in a wide range of pH: 3-12. Its mechanism of action has not been fully ascertained, but it is likely that the papain binds non-specifically with THC-COOH, preventing detection of this metabolite with both screening and reference methods [18].

There are also ready products available on the Internet containing peroxidase and peroxides which, when combined and added to a urine sample, increase the oxidative potential of the biological material. It disturbs the basic reactions of the immunoenzymatic methods in the tested material, which enables negative test results to be obtained due to the destruction of the drug's chemical structure. This applies mostly to THC-COOH, but also to LSD and opiates [19].

Another interesting compound is glutaraldehyde, normally used as a disinfectant. As an adulterant it appears to be the inhibitor of the enzyme involved in the immunoenzymatic reaction, and at the same time it does not visibly change the physicochemical properties of urine. Achieving the proper concentration of gluteraldehyde in the urine may lead to

false-negative results of the screening tests for cannabinoids, and in higher concentrations also for amphetamine, benzodiazepine derivatives, cocaine, opiates and methadone. One of the first commercially available products intended to mask narcotics and their metabolites in urine contained glutaraldehyde [6].

New methods of preventing falsification of test material

New methods enabling the detection of falsified urine samples are still being researched. Use of polyethylene glycol (PEG) is an interesting solution, as PEG is to be used as a marker for a properly collected urine sample. One of the key problems associated with obtaining this type of test material is the limited ability to supervise the tested person during the urine sample collection without violation of their intimacy. There is a risk of substitution of the material with a previously prepared sample, free from illicit substances. Administration of a capsule with PEG before the test could be a simple solution. Due to the unique combination of molecules of different molecular weights, administered polyethylene glycol can be detected in a urine sample already after about 30 minutes from oral ingestion of the capsule. Therefore, the patient can take the capsule in the laboratory, before the planned urine sample collection. It eliminates the need to observe the patient during urination, and minimizes the risk of sample substitution. Preliminary results of tests using PEG are satisfactory, but this method requires additional cost, time and equipment [20].

Recently, oral fluid (OF) appeared to be an alternative material for drug screening tests, with the main advantages of this biological material including easy, non-invasive collection, and good correlation between concentration of substances in the oral fluid and their blood concentrations. Importantly, direct control is possible during collection of the test sample, which minimizes the risk of deliberate manipulation with biological material. The introduction to the diagnostic market quick immunochromatographic tests for analysis of addictive substances in oral fluid has significantly facilitated the screening of drivers during traffic controls, or of criminals [21].

Conclusion

So far in Poland no tests have been conducted on the extent of manipulation with biological material samples used in drug screening tests. Preliminary assessment of the color or increased, non-physiological foaming of urine, as well as suspiciously low temperature of the urine sample submitted to the laboratory directly after leaving the bathroom will enable quick selection of the tested material and minimize the number of false-negative results. However, attempts to detect adulterants, especially those which do not visibly change the physicochemical properties of the tested urine samples, significantly increase the cost of testing, and prolong the procedure [17].

Literature

1. Gomółka E, Morawska A. Advantages and disadvantages of rapid tests, how to determine drugs of abuse in medical laboratory? Journal of Laboratory Diagnostics, 2011; 47 (2): 197-203
2. Scholer A. The effect of urine manipulation on substance abuse testing. T + K, 2004:71 (3):127-137
3. Dudek M. Narkomania w wojsku – wybrane uwarunkowania. [Drug addiction in army – selected apects] Annales. Etyka w życiu gospodarczym [Ethics in economic life], 2009; 12(2): 187-194
4. http://www.wojsko-polskie.pl/pl/forum/posty/22874 [access: 18-05-2015]
5. Dasgupta A. Urinary adulterants and drugs of abuse testing. In: Dasgupta A. Handbook of drug monitoring methods, therapeutics and drugs of abuse. Humana Press Inc., New Jersey 2008: 317-335
6. Dasgupta A. The effects of adulterants and selected ingested compounds on drugs-of-abuse testing in urine. Am J Clin Pathol, 2007; 128 (3): 491-503
7. Wu A, Bristol B, Sexton K, et al. Adulteration of urine by "Urine Luck". Clin Chem, 1999; 45 (7): 1051-1057
8. Jaffee W, Trucco E, Levy S, et al. Is this urine really negative? A systematic review of tampering methods in urine drug screening and testing. J Substance Abuse Treat, 2007; 33 (1):33-42
9. PhamA, Kelly T, FuS. Urine adulteration: can bleach be used to mask MDMA use? Anal Methods, 2013; 5: 3948-3955
10. Uebel R, Wium C. Toxicological screening for drugs of abuse in samples adulterated with household chemicals. S Afr Med J, 2002; 92: 547-549
11. Chou SL, Giang YS. Elucidation of the US urine specimen validity testing (SVT) policies and performance evaluation of five clinical parameters for pre-screening adulterants in Taiwan's opiates urinalysis. Forensic Sci J, 2007; 6 (2): 45-58
12. Bush DM. The U.S. Mandatory Guidelines for Federal Workplace Drug Testing Programs: current status and future considerations. Forensic Sci Int, 2008; 174(2-3):111-119
13. Pearson SD, Ash K0, Urry FM. Mechanism of false-negative urine cannabinoid immunoassay screens by Visine eyedrops. Clin Chem, 1989; 35 (4): 636-638
14. Paul BD, Martin KK, Maguilo J. Effects of pyridinium chlorochromate adulterant (Urine Luck) on testing for drugs of abuse and a method for quantitative detection of chromium (VI) in urine. J Anal Toxicol, 2000; 24 (4): 233-237
15. Ferslew KE, Nicolaides AN, Robert TA. Determination of chromate adulteration of human urine by automated colorimetric and capillary ion electropho-retic analyses. J Anal Toxicol, 2003; 27 (1): 36-39
16. Dasgupta A, Wahed A, Wells A. Rapid spot tests for detecting the presence of adulterants in urine specimens submitted for drug testing. Am J Clin Pathol, 2002; 117 (2): 325-329
17. Moeller KE, Lee KC, Kissack JC. Urine drug screening: practical guide for clinicians. Mayo Clin Proc, 2008; 83

(1): 66-76
18. Larson SJ, Holler JM, Magluilo J. Papain adulteration in 11-nor-Delta9-tet-rahydrocannabinol-9-carboxylic acid-positive urine samples. J Anal Toxicol, 2008; 32 (6): 438-443
19. Cody JT, Valtier S. Effects of stealth adulterant on immunoassay testing for drugs of abuse. J Anal Toxicol, 2001; 25 (6): 466-470
20. Jones J, Atchison J, Madera G, et a l. Need and utility of a polyethylene glycol marker to ensure against urine falsification among heroin users. Drug Alcohol Depend, 2015; 153:201-206
21. Lee D, Huestis M. Current knowledge on cannabinoids in oral fluid. Drug Test Anal, 2014;6:88-111

Plasma PAF acetylhydrolase - a promising atherosclerosis biomarker?

Osoczowa acetylohydrolaza PAF -obiecujący biomarker miażdżycy?

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Abstract. Arterial atherosclerosis is an important medical and social issue. This disorder presents a complex pathogenesis, which is probably based on oxidative stress and consequent chronic inflammation. Although many risk markers of those processes have been discovered, more are still being established and could potentially be used during cardiovascular risk stratification. One of the new risk markers is plasma platelet activating factor acetylhydrolase (PAF-AH). Its role in the pathogenesis of atherosclerosis still remains controversial, but we already have convincing data about the usability of this enzyme as a marker of the disease process. However, it has yet to be determined whether and when it can be used for early detection of subclinical atherosclerosis and the prognosis of its course. The purpose of the following review is to systematize the actual state of research regarding the importance of plasma PAF acetylhydrolase in the pathophysiology and diagnostics of atherosclerosis.
Key words: PAF acetylhydrolase (PAF-AH), cardiovascular diseases, platelet activating factor, myocardial infarction, atherosclerosis

Streszczenie. Miażdżyca naczyń krwionośnych stanowi istotny problem medyczny i społeczny. Jest to jednostka chorobowa o złożonej patogenezie, u której podstaw leży - jak się wydaje - stres oksydacyjny, a także będące jego efektem przewlekłe zapalenie. Mimo że odkryto już wiele czynników ryzyka tych procesów, kolejne są wciąż badane i być może będą użyteczne w stratyfikacji ryzyka sercowo-naczyniowego. Jednym z takich nowych czynników ryzyka jest osoczowa acetylohydrolaza czynnika aktywującego płytki (PAF-AH). Choć jej rola w patofizjologii miażdżycy wciąż pozostaje kontrowersyjna, to dysponujemy już przekonującymi danymi na temat potencjalnej wartości tego enzymu jako markera procesu miażdżycowego. W dalszym ciągu nie ustalono jednak, czy i kiedy może być on wykorzystywany do wczesnego diagnozowania subklinicznych postaci miażdżycy oraz do oceny jej dalszego przebiegu. Poniższy przegląd piśmiennictwa ma na celu uporządkowanie bieżącego stanu badań nad znaczeniem osoczowej acetylohydrolazy PAF w patofizjologii i diagnostyce miażdżycy.
Słowa kluczowe: acetylohydrolaza PAF (PAF-AH), choroby sercowo-naczyniowe, czynnik aktywujący płytki, zawał serca, miażdżyca

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Introduction

Atherosclerosis is a disease entity with a diverse clinical picture and vast social significance. The recognition of hypercholesterolemia as the leading risk factor and the development of statins constituted a breakthrough, allowing the implementation of hypolipemic therapy on a massive scale. However, the current view on the pathogenesis of atherosclerosis is definitely broader. This is partly a result of the observation that cardiovascular diseases also appear in people with normocholesterolemia, while pharmacotherapy reducing the concentration of cholesterol in this group of patients does not produce significant benefits [1]. Therefore, atherosclerosis is currently recognized as a chronic inflammatory disease, the main cause of which is oxidative stress. It is the common denominator of the numerous known atherosclerosis process risk factors, such as nicotinism and diabetes [2]. From the chemical point of view, particularly prone to oxidation are the polyunsaturated fats (PUFA) due to the presence of numerous double bonds in the area of the alkene chain.

Phospholipids containing PUFA in their structure are widely represented in the area of low density lipoproteins (LDL), which is why this fraction is the primary target for attacks by reactive oxygen species (ROS) appearing as a result of oxidative stress. The oxidized LDL constitute an alien molecular pattern for the body cells, which is why they are actively consumed by monocytes and macrophages. The

effect of this process is the intensification of the chronic inflammatory condition and the formation of foam cells, which is the morphological foundation for atherosclerotic lesions [3].

As oxidative stress and chronic inflammatory conditions seem to be the basis of atherogenesis, the subject of research work are the numerous modulators influencing these processes. One of them is the platelet activating factor acetylohydrolase (PAF-AH), also known as lipoprotein-associated phospholipase A2 (Lp-PLA_2, EC 3.1.1.47) [4]. In the light of reports from the last decade, this enzyme can be recognized as an important anti-inflammatory factor. The purpose of the following review is to systematize the current state of knowledge on the meaning of plasma PAF acetylohydrolase in the pathogenesis of atherosclerosis and to present the potential directions of research in this area.

Methodology

The MEDLINE bibliographic database was researched with the use of the EndNote X7 software. The search criteria entered into the search engine in English included the following any-field type phrases*:* "atherosclerosis acetylhydrolase", "phospholipase A2 intima media", "PAF acetylhydrolase IMT", "acetylhydrolase intima media", "lipoprotein associated phoshpholipase a(2) coronary disease", "acetylhydrolase coronary heart disease" and "lipoprotein associated phospholipase A2 atherosclerosis" – in the latter case for articles published after 2007. As a result, 123, 55, 5, 10, 38, 29, and 217 search results were returned respectively – a total of 477. Next, the duplicate entries were reduced, and then the remaining ones were subjected to critical analysis and then those were the publications best corresponding to its subject matter in terms of content included in the review.

Mechanism of action

Plasma PAF acetylhydrolase is one of the four representatives of the family of human PAF acetylhydrolases [5]. This protein is coded by the *PLA2G7* gene, its weight is 43.4 kDa, and its single polypeptide chain consists of 441 amino acids. In circulation this enzyme appears in two fractions: L-PAF-AH (LDL-associated PAF-AH) and H-PAF-AH (HDL-associated PAF-AH). This is imposed by the presence of two hydrophobic areas in its structure and a region composed of neighboring 3 alkaline residues and 10 acidic residues. These protein motifs are responsible for the strong bond between PAF-AH and lipoproteins [6, 7]. The residues important for the bond with apolipoprotein B100 are W115, L116 and Y205, whereas in the case of HDL it is respectively the area of H367-K370 - highly specific to human PAF-AH [2].

The action of plasma PAF acetylohydrolase is independent of the presence of calcium ions and is based on ester linkage hydrolysis in the *sn-2* position*.* The substrate specificity of this enzyme is an interesting issue – it primarily hydrolyses phospholipids with a short-chain acyl group, consisting of 5-6 carbon atoms. In the case of PAF the products of this reaction are lysophosphatidylcholines (LPC) and the acetyl residue. Due to the very quick turnover of PAF, its endovascular distribution is a key process regulating the influence of this mediator and indirectly preventing the uncontrolled escalation of the inflammatory response. This is why PAF-AH is referred to in the literature as a 'signal terminator' [1]. This action is interesting in the context of data referring to significantly higher plasma PAF concentrations in patients with coronary heart disease (49.7 pg/ml *vs.* 23.8 pg/ml in the control group, $p < 0.001$) [8], as well as in the people consuming low amounts of food rich in antioxidants and presenting other adverse dietary habits [9].

Degradation of the platelet activating factor does not, however, fully exhaust the biological role of plasma PAF acetylohydrolase. Notably, the substrate limitations mentioned earlier, concerning the length of the acyl residue that loosens if its composition includes oxidized groups, such as carboxylic, aldehyde or hydroxyl groups – then the enzyme is able to separate chains containing up to 18 carbon atoms. As a result, the target of plasma PAF-AH can also be the esterified isoprostanes, long-chain phospholipid hydroperoxides and other oxidized phospholipids (oxPL) [5]. Such chemical compounds are commonly present within oxidized low-density lipoproteins (oxLDL). This fraction is rich in PUFA, which under the influence of oxidative stress undergo numerous non-enzymatic modifications and generate an entire palette of diverse products of oxidation. Many of them are referred to as PAF mimetics, and their adverse effect on homeostasis is pleiotropic (Fig. 1) [1]. In the light of these facts plasma PAF-AH presents itself as a significant antioxidative enzyme. Importantly, with TNF-α – tumor necrosis factor α, and PAF-R – platelet activating factor receptor, it seems that it applies to the entire family of PAF acetylohydrolases – for example the type 2b cytoplasmic homologue is translocated to the cell membrane in order to prevent the formation of PAF and similar compounds [1].

On the other hand, plasma PAF acetylohydrolase was for a long time treated as a cause, not as a result of the atherosclerotic process. It was stated that under the influence of PAF-AH free oxidized phospholipids can intensify the immunogenicity of oxLDL particles [10]. Furthermore, it was proved that LPC, as one of the products of the reaction catalyzed by PAF-AH, induces the synthesis of cytokines and intensifies the migration of smooth muscle cells and monocytes. The result of these is an intensification of the inflammatory processes and atherogenesis. Moreover, the main site of production for plasma PAF acetylohydrolase are the macrophages, essential cells in the process of atherosclerotic plaque development. As monocytes they do not exhibit significant mRNA expression of this enzyme, but after undergoing the maturation process they become active [11].

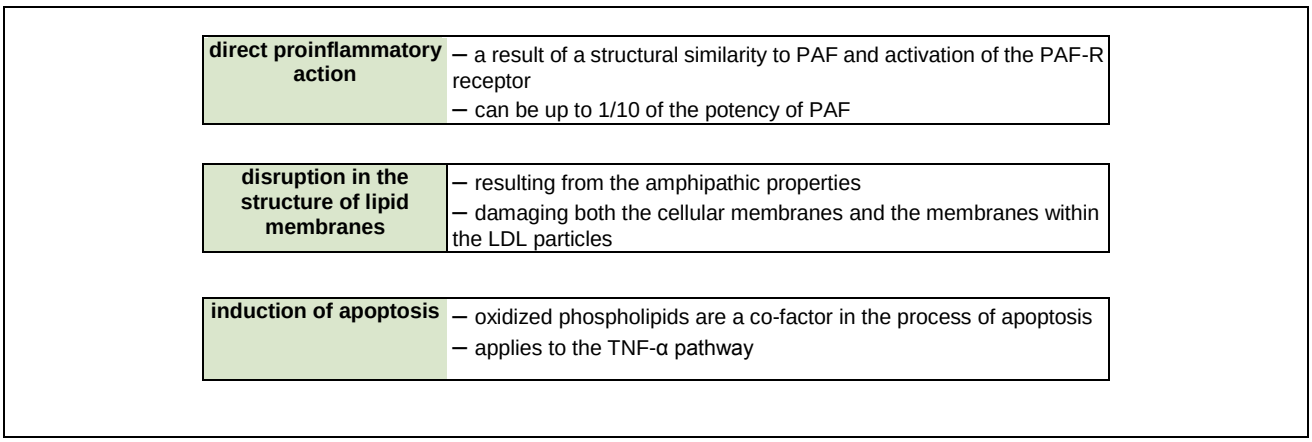

Figure 1. Pleiotropic effects of oxidized phospholipids in homeostasis (figure by author acc. to [1])
Rycina 1. Wielokierunkowe oddziaływanie utlenionych fosfolipidów na homeostazę (rycina autora wg [1])

The suspected relationship between the instability of atherosclerotic plaque and the presence of PAF-AH within it, although this enzyme is mainly present in the areas of intensified migration of macrophages and accumulation of oxLDL, has not been confirmed in clinical studies [12]. It is currently considered that the force of impact of LPC is much lower than that of PAF and has been exaggerated in the past. This was most probably a result of contamination of the tested lysophosphatidylcholine extracts. In addition in LPC circulation it is mostly bound by lipoproteins and albumins, therefore the concentration of the biologically active free fraction is subject to small changes even in the case of significantly increased PAF-AH activity [1, 13, 14].

Participation of PAF-AF in the pathogenesis of cardiovascular diseases

The relationship between PAF-AH plasma, atherosclerosis and cardiovascular diseases has been a subject of many studies, therefore there is good quality data available on the subject. Undoubtedly key to this topic is the metaanalysis prepared within the framework of The Lp-PLA2 Studies Collaboration in 2010. This included 32 prospective studies, covering 79,036 participants in total. Both the PAF-AH concentration and activity were assessed in them, which in accordance with the predictions were correlated with each other. However, the most important conclusion, reached as a result of the application of log-linear models, was the statement that both parameters correlate with the risk of the incidence of coronary heart disease, ischemic stroke and vascular death (Tab. 1). Relative risk (RR) in each of the listed cases was not significantly different in the groups of healthy people and patients with stable vascular disease. The exception was vascular death dependent upon the concentration of PAF-AH. Interestingly, the metaanalysis proved that the plasma PAF acetylohydrolase is a predictive factor for cardiovascular incidents comparable in terms of its value to systolic blood pressure and the concentration of non-HDL cholesterol. Furthermore, connections between PAF-AH and different clinical parameters were documented (Tab. 2). It was observed that the activity of the enzyme correlates better than concentration with the parameters of the lipidogram, concentrations of lipoproteins and gender [15].

Regardless of the promising results listed above, the recommendations of the AHA (American Heart Association) of 2010 took PAF-AH into account in risk stratification solely in patients with initially average or major cardiovascular risk. This was an effect of the earlier results of the Women's Health Study and Atherosclerosis Risk in Communities Study, which showed that the addition of PAF-AH to traditional risk factors improves the predictive power to a small extent in comparison to cardiovascular incidents in healthy people [12, 16].

Table 1. Risk ratios connected with plasma PAF acetylhydrolase mass and activity adjusted for conventional cardiovascular risk factors [15]
Tabela 1. Ryzyko związane ze stężeniem i aktywnością osoczowej acetylohydrolazy PAF skorygowane o konwencjonalne czynniki ryzyka sercowo-naczniowego [15]

Risk	Concentration		Activity	
	RR	CI	RR	CI
coronary heart disease	1.11	1.07-1.16	1.10	1.05-1.16
ischemic stroke	1.14	1.02-1.27	1.08	0.97-1.20
hemorrhagic stroke	ND	ND	0.97	0.79-1.19
unspecified stroke	ND	ND	1.02	0.93-1.12
vascular death	1.13	1.05-1.22	1.16	1.09-1.24
non-vascular death	1.10	1.03-1.18	1.10	1.04-1.17
cancer death	1.08	0.98-11.8	1.05	0.97-1.14
non-vascular and non-cancer death	1.13	1.04-1.23	1.18	1.07-1.30

CI - confidence interval, RR - relative risk, ND - no data

Table 2. Correlations between plasma PAF acetylhydrolase mass or activity and different clinical factors [15]
Tabela 2. Korelacje pomiędzy stężeniem i aktywnością osoczowej acetylohydrolazy PAF a poszczególnymi parametrami klinicznymi [15]

Parameter	Concentration		Activity	
	r	CI	r	CI
PAF-AH activity	0.51	0.47-0.56	1.00	X
age	0.06	0.04-0.08	0.02	0.00-0.05
female	0.10	013-0.07	0.21	0.25-0.17
non-Caucasian race	0.08	0.12-0.03	0.07	0.11-0.03
tobacco smoking	0.08	0.06-0.11	0.03	0.01-0.05
diabetes in interviews	0.03	0.05-0.02	0.00	0.02-0.02
body mass indices	0.01	0.03-0.01	0.04	0.02-0.05
systolic blood pressure	0.02	0.01-0.04	0.02	0.00-0.03
total cholesterol	0.28	0.25-0.31	0.41	0.37-0.45
non-HDL cholesterol	0.30	0.27-0.34	0.49	0.45-0.52
HDL	0.07	0.12-0.02	0.24	0.29-0.19
LDL	0.28	0.22-0.34	0.48	0.41-0.55
triglicerides (loge)	0.07	0.04-0.11	0.22	0.19-0.26
apolipoprotein B	0.24	0.13-0.30	0.45	0.38-0.51
apolipoprotein AI	0.07	0.13-0.00	0.15	0.23-0.05
C-reactive protein (loge)	0.08	0.04-0.11	0.03	0.01-0.05
fibrinogen	0.05	0.03-0.07	0.00	0.02-0.02
leukocytes (loge)	0.07	0.04-0.10	0.03	0.01-0.05

r - Pearson linear correlation coefficient

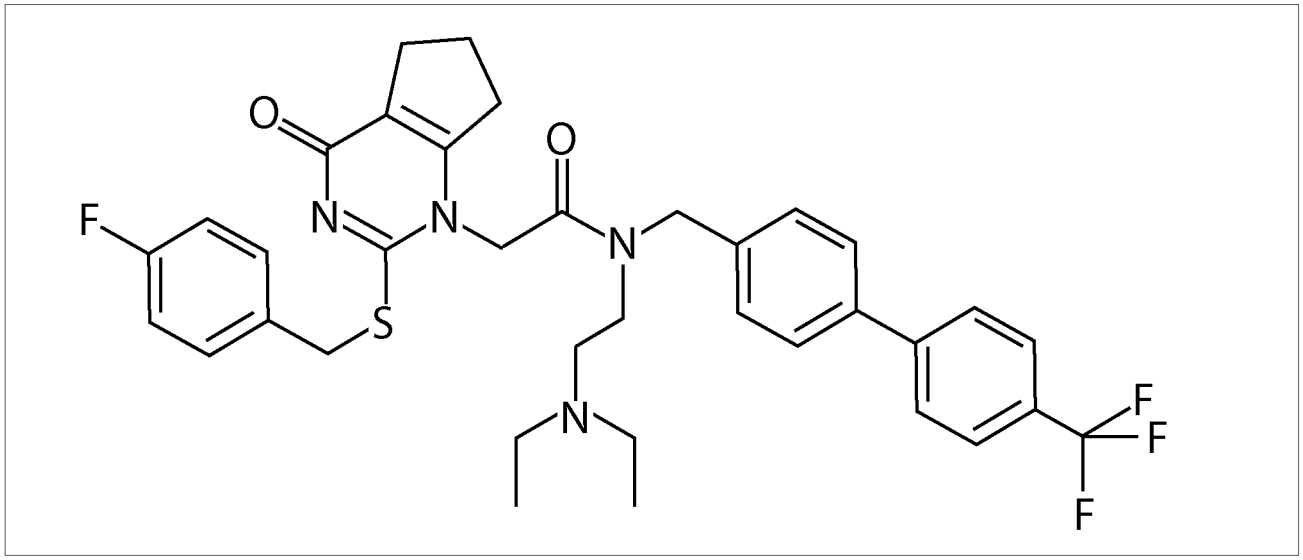

Figure 2. Darapladib - molecular structure (figure by author ace. to https://pubchem.ncbi.nlm.nih.gov)
Rycina 2. Darapladib - struktura chemiczna (rycina autora wg https://pubchem.ncbi.nlm.nih.gov)

Studies from the following years, including those conducted on non-Caucasian populations, confirmed the impact of plasma PAF acetylohydrolasis on cardiovascular risk. For instance in the course of the Iranian case-control study it was established that patients with unstable coronary heart disease were characterized by significantly higher plasma PAF-AH activity than patients with stable disease and healthy people (respectively 40 nmol/min/ml, 32 nmol/min/ml and 26 nmol/min/ml, $p < 0.01$ – there were 50 people in each of the groups) [17]. Another example is a Chinese study conducted on a group of 570 people, which proved a similar relationship between PAF-AH and coronary atherosclerosis. In addition, a correlation was made between the R92H and I198T polymorphisms of the *PLA2G7* gene and coronary heart disease. Interestingly, I198T polymorphism, regardless of the lack of influence on enzyme concentration, significantly increased the risk of the development of a coronary heart disease from a blood stasis syndrome [18].

The hypothesis concerning the participation of plasma PAF-AH in the pathogenesis of atherosclerosis was an indication to recognize this enzyme as an independent cardiovascular disease risk factor and its potential in the development of a pharmacoterapeutic strategy based on the blocking of its activity. Therefore, selective, oral PAF-AH inhibitors have been developed, such as darapladib (Fig. 2). However, in a Phase III multi-center clinical trial, STABILITY (Stabilization of Atherosclerotic Plaque by Initiation of Darapladib Therapy), involving 16,000 participants with chronic coronary heart disease, this drug did not decrease the risk of myocardial infarction, stroke, or cardiovascular death. Also in the next trial, SOLID-TIMI (Stabilization Of pLaques using Darapladib - Thrombolysis In Myocardial Infarction), conducted on a group of 13,000 patients following acute coronary syndrome, no improvement was achieved at the primary endpoints [19, 20]. Another fiasco involved studies on the sister preparation - varespladib methyl (Fig. 3) [21]. These results significantly undermined the hopes placed in PAF-AH blockers, although they have not caused a total loss of interest in this group of drugs. Darapladib is currently tested on animals with regard to their cardioprotective action, which might depend on simultaneous plasma PAF-AH inhibition and Rho kinase [22].

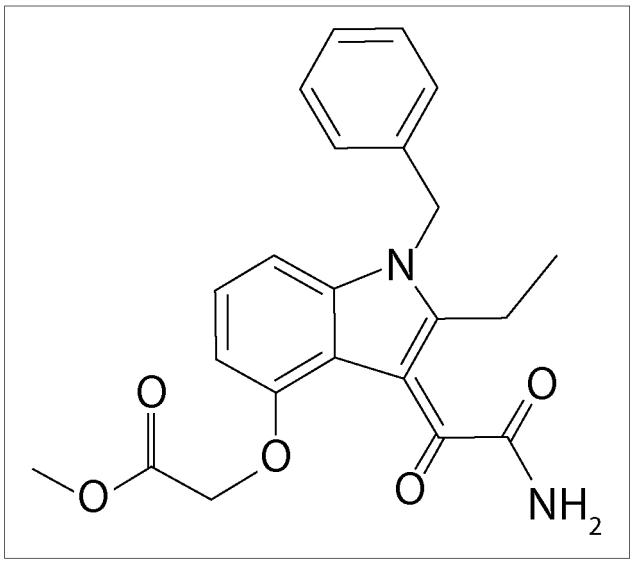

Figure 3. Varespladib methyl - molecular structure (figure by author acc. to https://pubchem.ncbi.nlm.nih.gov)
Rycina 3. Metylowarespladib - struktura chemiczna (rycina autora wg https://pubchem.ncbi.nlm.nih.gov)

Cardiovascular risk biomarker

One result of the unsuccessful clinical trials with darapladib was a change in perception of the role of plasma PAF acetylohydrolase. It has been noted that in animal trials this enzyme showed a protective effect in relation to blood vessels, blocking the uncontrolled proliferation of neointimal cells, reducing the accumulation of oxLDL, as well as acting with an anti-inflammatory and anticoagulant effect [23, 24]. And although the latter mentioned effect has not been confirmed in human trials [25], there is an increasing number of advocates of the view that PAF-AH does not participate in the development of atherosclerosis, but constitutes an element of the adaptive reaction and biomarker of the atherosclerotic process, related to the metabolism of lipoproteins and the inflammation process [26]. In this context, this enzyme is often compared to hs-CRP (high sensitive C-reactive protein), the measurement of which in certain clinical situations has already been granted IIb-B class recommendation by ACC/AHA (American College of Cardiology/American Heart Association). It seems that in this comparison PAF-AH is a more specific marker of vascular inflammation process than CRP. Furthermore, it may also be beneficial to determine both markers together [12].

In recent years, attention has focused on the possibility of using plasma PAF acetylohydrolase as a predictive marker of early forms of atherosclerosis. This is why correlations are made between PAF-AH and such indices of subclinical atherosclerotic processes as initma-media thickness (IMT) in the carotid artery measured with the use of ultrasound. However, studies conducted so far have provided highly ambiguous results. In the case of early works with the participation of European patients with dyslipidemia and metabolic syndrome, no significant relation was identified between IMT and the activity or concentration of PAF-AH, including the HDL-PAF-AH fraction [27-29]. On the other hand, Japanese studies, comparing older patients manifesting V279F missense mutation with those people without this mutation, showed significantly lower average IMT in the latter group (0.98 ±0.22 mm *vs.* 0.87 ±0.20 mm, p = 0.0292) [23]. In a later period, in a Dutch center, a correlation was determined between the PAF-AH concentration and IMT in the case of patients without diabetes (r = 0.325, p <0.009), whereas this relationship was not identified in patients with diabetes (r = 0.021, p = 0.86). The authors explain this with the phenomenon of plasma redistribution of PAF acetylohydrolase within the particle fractions of lipoproteins in diabetes [30]. On the other hand, in the case of people with low cardiovascular risk, it has been proven that the PAF-AH concentration constitutes an independent significant predictive risk factor for large IMT and vice-versa [31]. Analogous results were obtained in the case of HIV-positive people and patients with β-thalassemia, rheumatoid arthritis or chronic ischemic heart disease [32-35]. In the case of the latter group it has also been noted that the combined determination of IMT and PAF-AH may be beneficial in risk stratification for the presence of narrowing of the coronary arteries [36]. A study by a center in Beijing established that PAF-AH concentration is related to the progression of IMT in men, but not in women (OR 1.28, p = 0.043 for men and 0.92, p = 0.273 for women) [37]. In the Japanese population the relationship between PAF-AH and IMT was in turn identified for the population of men aged 50-70 [38]. In another study with the participation of healthy tobacco smokers, a correlation was shown between IMT and the LPC concentration [39]. On the other hand, other studies, including the Multi-Ethnic Study of Atherosclerosis and studies with the participation of children with familial hypercholesterolemia, have not confirmed the relationship between PAF-AH and IMT [40-42].

Summary

The presented findings reveal the complex image of the role that plasma PAF acetylohydrolase plays in the pathogenesis of atherosclerosis. It would be an error to attribute an unequivocal protective or negative impact to this enzyme. However, it should be acknowledged that the potential value of plasma PAF-AH as a marker of the atherosclerotic process has been confirmed. It is as yet unknown what usability PAF-AH determinations may have in specific clinical situations. In particular, it has not been determined whether and when it can be used for the early detection of subclinical forms of atherosclerosis and the prognosis of its further course. This subject matter will undoubtedly be an absorbing and interesting direction of research in the future.

Literature

1. Marathe GK, Pandit C, Lakshmikanth CL, et al. To hydrolyze or not to hydrolyze: the dilemma of platelet-activating factor acetylhydrolase. J Lipid Res, 2014; 55 (9): 1847-1854
2. Rosenson RS, Stafforini DM. Modulation of oxidative stress, inflammation, and atherosclerosis by lipoprotein-associated phospholipase A2. J Lipid Res, 2012; 53 (9): 1767-1782
3. Choudhury RP, Lee JM, Greaves DR. Mechanisms of disease: macrophage-derived foam cells emerging as therapeutic targets in atherosclerosis. Nat Clin Pract Cardiovasc Med, 2005; 2 (6): 309-315
4. TGCSP-Team. GeneCards: The Human Gene Database 2016 [Available from: www.genecards.org.]
5. Gęgotek A, Skrzydlewska E. Metabolizm i biologiczna rola czynnika aktywującego ptytki krwi (PAF) [Metabolism and the biological role of the blood platelet activating factor (PAF)]. Alergia Astma Immunologia, 2015; 20: 79-84
6. Fan P, Liu HW, Wang XS, et al. Identification of the G994T polymorphism in exon 9 of plasma platelet-activating factor acetylhydrolase gene as a risk factor for polycystic ovary syndrome. HumReprod, 2010; 25 (5): 1288-1294
7. Tellis CC, Tselepis AD. Pathophysiological role and clinical

significance of lipoprotein-associated phospholipase A(2) (Lp-PLA(2)) bound to LDL and HDL. Curr Pharm Des, 2014; 20 (40): 6256-6269
8. Zheng GH,XiongSQ, Mei LJ, etal. Elevated plasma platelet activating factor, platelet activating factor acetylhydrolase levels and risk of coronary heart disease or blood stasis syndrome of coronary heart disease in Chinese: a case control study: a case-control study. Inflammation, 2012; 35 (4): 1419-1428
9. Detopoulou P, Fragopoulou E, Nomikos T, et al. The relation of diet with PAF and its metabolic enzymes in healthy volunteers. Eur J Nutr, 2015; 54 (1): 25-34
10. Papathanasiou AI, Lourida ES, Tsironis LD, et al. Short-and long-term elevation of autoantibody titers against oxidized LDL in patients with acute coronary syndromes. Role of the lipoprotein-associated phospholipase A2 and the effect of atorvastatin treatment. Atherosclerosis, 2008; 196(1): 289-297
11. Stafforini DM. Biology of platelet-activating factor acetylhydrolase (PAF-AH, lipoprotein associated phospholipase A2). Cardiovasc Drugs Ther, 2009; 23 (1):73-83
12. Tehrani DM, Wong ND. Cardiovascular Disease Risk Assessment: Review of Established and Newer Modalities. Curr Treat Options Cardiovasc Med, 2015; 17 (12): 57
13. Detopoulou P, Nomikos T, Fragopoulou E, et al. Lipoprotein-associated phospholipase A2 (Lp-PLA2) activity, platelet-activating factor acetylhydrolase (PAF-AH) in leukocytes and body composition in healthy adults. Lipids Health Dis, 2009; 8: 19
14. Mclntyre TM, Prescott SM, Stafforini DM. The emerging roles of PAF acetyl-hydrolase. J Lipid Res, 2009; 50 (Suppl): S255-259
15. Lp PLASC, Thompson A, Gao P, et al. Lipoprotein-associated phospholipase A(2) and risk of coronary disease, stroke, and mortality: collaborative analysis of 32 prospective studies. Lancet, 2010; 375 (9725): 1536-1544
16. Greenland P, Alpert JS, Beller GA, et al. 2010 ACCF/AHA guideline for assessment of cardiovascular risk in asymptomatic adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol, 2010; 56 (25): e50-103
17. Samsamshariat S, Basati G, Movahedian A, et al. Elevated plasma platelet-activating factor acetylhydrolase activity and its relationship to the presence of coronary artery disease. J Res MedSci, 2011; 16 (5): 674-679
18. Zheng GH, Xiong SQ, Chen HY, et al. Associations of platelet-activating factor acetylhydrolase (PAF-AH) gene polymorphisms with circulating PAF-AH levels and risk of coronary heart disease or blood stasis syndrome in the Chinese Han population. Mol Biol Rep, 2014; 41 (11): 7141-7151
19. GlaxoSmithKline. GSK announces phase III study with darapladib did not meet primary endpoint in patients following an acute coronary syndrome 2014 [Availablefrom: https://us.gsk.com/en-us/media/press-releases/2014/ gsk-announces-phase-iii-study-with-darapladib-did-not-meet-primary-end-point-in-patients-following-an-acute-coronary-syndrome/
20. Investigators S, White HD, Held C, et al. Darapladib for preventing ischemic events in stable coronary heart disease. N Engl J Med, 2014; 370 (18): 1702-1711
21. ClinicalTrials.gov. VISTA-16 Trial: Evaluation of Safety and Efficacy of Short-term A-002 Treatment in Subjects With Acute Coronary Syndrome (VISTA-16) 2012 [Available from: https://clinicaltrials.gov/ct2/show/ NCT01 130246]
22. Zhang J, Xu DL, Liu XB, et al. Darapladib, a Lipoprotein-Associated Phospholipase A2 Inhibitor, Reduces Rho Kinase Activity in Atherosclerosis. Yonsei Med J, 2016; 57 (2): 321-327
23. Yamamoto I, Fujitsu J, Nohnen S, et al. Association of plasma PAF acetylhydrolase gene polymorphism with IMT of carotid arteries in Japanese type 2 diabetic patients. Diabetes Res Clin Pract, 2003; 59 (3): 219-224
24. Arakawa H, Qian JY, Baatar D, et al. Local expression of platelet-activating factor-acetylhydrolase reduces accumulation of oxidized lipoproteins and inhibits inflammation, shear stress-induced thrombosis, and neointima formation in balloon-injured carotid arteries in nonhyperlipidemic rabbits. Circulation, 2005; 111 (24): 3302-3309
25. Olson N, O'Meara ES, Jenny NS, et al. Lipoprotein-associated phospholipase A2 and risk of venous thrombosis in older adults. Am J Hematol, 2008; 83 (7): 524-527
26. Munzel T, Gori T. Lipoprotein-associated phospholipase A(2), a marker of vascular inflammation and systemic vulnerability. Eur Heart J, 2009; 30 (23): 2829-2831
27. Campo S, Sardo MA, Bitto A, et al. Platelet-activating factor acetylhydrolase is not associated with carotid intima-media thickness in hypercholesterol-emic Sicilian individuals. Clin Chem, 2004; 50 (11): 2077-2082
28. Kiortsis DN, Tsouli S, Lourida ES, et al. Lack of association between carotid intima-media thickness and PAF-acetylhydrolase mass and activity in patients with primary hyperlipidemia. Angiology, 2005; 56 (4): 451-458
29. Mattsson N, Magnussen CG, Ronnemaa T, et al. Metabolic syndrome and carotid intima-media thickness in young adults: roles of apolipoprotein B, apolipoprotein A-I, C-reactive protein, and secretory phospholipase A2: the cardiovascular risk in young Finns study. Arterioscler Thromb Vase Biol, 2010; 30 (9): 1861-1866
30. Constantinides A, van Pelt LJ, van Leeuwen JJ, et al. Carotid intima media thickness is associated with plasma lipoprotein-associated phospholipase A2 mass in nondiabetic subjects but not in patients with type 2 diabetes. Eur J Clin Invest, 2011; 41 (8):820-827
31. Hargens TA, Rhodes PG, VanReenen J, Kaminsky LA. Lipoprotein-associated phospholipase A2 and carotid intima-media thickness in individuals classified as low-risk according to Framingham. Cardiovasc Diagn Ther, 2014; 4 (6): 487-494
32. Ikonomidis I, Kadoglou NN, Tritakis V, et al. Association of Lp-PLA2 with digital reactive hyperemia, coronary flow reserve, carotid atherosclerosis and arterial stiffness in coronary artery disease. Atherosclerosis, 2014; 234 (1):34-41
33. Mangili A, Ahmad R, Wolfert RL, et al. Lipoprotein-associated phospholipase A2, a novel cardiovascular inflammatory marker, in HIV-infected patients. Clin Infect Dis, 2014; 58 (6): 893-900
34. Ragab SM, Safan MA, Obeid 0M, Sherief AS. Lipoprotein-associated phospholipase A2 (Lp-PLA2) and tumor necrosis factor-alpha (TNF-alpha) and their relation to premature atherosclerosis in beta-thalassemia children. Hematology, 2015; 20 (4): 228-238
35. Sodergren A, Karp K, Bengtsson C, et al. Is Lipoprotein-Associated Phospholipase A2 a Link between Inflammation and Subclinical Atherosclerosis in Rheumatoid Arthritis? Biomed Res Int, 2015; 2015: 673 018
36. Li Y. Analysis of intima-media thickness of carotid artery and lipoprotein-associated phospholipase A2 in coronary heart diseases of different types. Technol Health Care, 2015; 23 (Suppl 1): S147-150
37. Liu J, Wang W, Qi Y, Yong Q, et al. Association between the lipoprotein-associated phospholipase A2 activity and the progression of subclinical atherosclerosis. J Atheroscler Thromb, 2014; 21 (6): 532-542
38. Ueshima H, Kadowaki T, Hisamatsu T, et al. Lipoprotein-associated phospholipase A2 is related to risk of subclinical atherosclerosis but is not supported by Mendelian randomization analysis in a general Japanese population. Atherosclerosis, 2016; 246: 141-147
39. Fratta Pasini A, Stranieri C, Pasini A, et al. Lysophosphatidylcholine and carotid intima-media thickness in young smokers: a role for oxidized LDL-induced expression of PBMC lipoprotein-associated phospholipase A2? PLoS One, 2013; 8(12): e83092
40. Garg PK, McClelland RL, Jenny NS, et al. Association of lipoprotein-associated phospholipase A(2) and endothelial function in the Multi-Ethnic Study of Atherosclerosis (MESA). Vase Med, 2011; 16 (4): 247-252
41. Urazalina S, Titov VN, Vlasik TN, et al. Relationship between concentration of lipoprotein-associated secretory phospholipase A2 and markers of subclinical atherosclerotic lesion of the arterial wall in patients with low and moderate risk by SCORE scale. Ter Arkh, 2011; 83 (9): 29-35
42. BraamskampMJ, TsimikasS, Wiegman A, etal. Statin therapy and secretory phospholipase A(2) in children with heterozygous familial hypercholesterolemia. Atherosclerosis, 2013; 229 (2): 404-407

Chlorine on the Great War frontlines - military medical service experiences

Chlor na frontach Wielkiej Wojny - doświadczenia wojskowej służby zdrowia

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Abstract. Chlorine gas saw its first use in combat at Ypres on April 22, 1915. That day went down in the history of warfare as the moment of introduction of deadly war gasses and thereby changed the nature of World War I. The article presents the World War I experiences of military medical services related to the care of chlorine-intoxicated soldiers. The first anatomic pathology research and first treatment attempts are discussed. An important component of the article is the eyewitness accounts of those tragic events. The paper also includes Polish chlorine intoxication analyses from the interwar period.
Key words: chlorine intoxication, World War I, history of military medicine

Streszczenie. Pierwsze bojowe zastosowanie choru miało miejsce pod Ypres 22 kwietnia 1915 roku. Dzień ten przeszedł do historii wojen jako moment wprowadzenia do walki śmiercionośnych gazów bojowych i tym samym zmienił oblicze I wojny światowej. W artykule autor zaprezentował doświadczenia wojskowej służby zdrowia w zakresie opieki nad zagazowanymi chlorem żołnierzami, płynące z frontów „wielkiej wojny". Omówił także pierwsze badania patomorfologiczne oraz próby leczenia zatrutych pacjentów. Ważnym elementem pracy było przywołanie relacji świadków tamtych wydarzeń. W pracy znalazło się również miejsce na przedstawienie polskich analiz z okresu międzywojennego dotyczących zatrucia chlorem.
Słowa kluczowe: zatrucie chlorem, I wojna światowa, historia medycyny wojskowej

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Introduction

Ypres was not the first place to see the use of gas during the Great War[1]. It is also not true that the Germans were first to commence such attacks, as the French forces were the first to use military gasses, although they were limited in range and chaotic in nature. The gasses they used were not intended to kill the enemy, but to merely reduce their combat capacity. Probably the first gas agent, used during the retreat of the French from Belgium, was a lacrimator – xylyl bromide, while in the initial stage of the military operations they also used chloroacetone. Tear gases were also used by the Germans, and their arsenal included o-dianisidine chlorosulfonate and a preparation called T-Stoff [1]. However, it was the use of chlorine, a lethal gas, that was remembered by everyone and which changed the image of war, and the name of 'small leper' (Fr. Ypres) in Flanders became the synonym of the atrocities of World War 1.

In this article the author attempts to present the pioneering experiences of the military medical services connected with the care of patients poisoned with chlorine vapors. What was the clinical picture of chlorine poisoning? What were the treatment methods employed by physicians? What did we learn based on the post-mortems carried out on soldiers and tests on animals? In seeking answers to these questions, the author consulted archival articles, medical books, the memoirs of people involved in the fighting, and contemporary historical studies.

[1] Before 1939, namely before the outbreak of the second global military conflict of the 20th century, this term was commonly used to denote World War 1. It is still used as such in some British literature

Changes in the West: a new weapon – chlorine

The war entered a new stage in the spring of 1915 when German sappers installed nearly 6000 tanks of chlorine in their first trench line near Langemarck, although more than one month had to pass for the weather to favor an attack. Wind direction was crucial, and such a day came on 22 April. After preliminary artillery preparation, the valves were opened and a heavy, dark-yellow cloud started to crawl towards the French positions. The heavier-than-air gas filled the artillery shell craters and flooded every nook and cranny in the trenches. Oblivious to this new weapon, the French soldiers of the 87th Territorial Division and the 45th Algerian Division were not ready for the attack. They had no gas protection equipment. Coughing and suffocating, with eye burns, they started to retreat in panic. Some of the witnesses to this drama were British soldiers holding nearby defensive positions [2, 3], one of whom recalled, "I watched figures running wildly in confusion over the fields. Greenish-gray clouds swept down upon them, turning yellow as they travelled over the country blasting everything they touched and shriveling up the vegetation... Then there staggered into our midst French soldiers, blinded, coughing, chests heaving, faces an ugly purple color, lips speechless with agony, and behind them in the gas soaked trenches, we learned that they had left hundreds of dead and dying comrades."[2] [2]. Bert Newman of the Royal Army Medical Corps observed the Algerians running away from the gas cloud, and later saw them lying on Menin Road, "gasping for breath" [4]. Soon chlorine reached the British positions, although luckily the lower concentration of toxic vapors resulted in less-devastating losses. As reported by Jack Dorgan of the 7th Battalion of the Northumberland Fusiliers: "Our eyes were streaming with water and with pain. Luckily again for me I was one of those who could still see. But we had no protection, no gas masks or anything of that kind. All we had was the roll of bandages from our first aid kit which we carried in the corner of our tunic. So we had very little protection for our eyes. And then you had to be sent back. Anyone who could see, like me, went in front." [4].

It is unknown how many soldiers died or were wounded in the first chlorine attack. There are significant differences in estimates. Some authors indicate 5000 fatalities and 15,000 injured [1, 5], while other sources state that these numbers are considerably overestimated, and the real number of victims is within the range of one thousand [1, 2]. It is however a fact that the gas attack wreaked havoc among the defenders and resulted in a seven-kilometer-long gap in the positions of the Entente forces. The Germans could not, however, fully capitalize on this success. While German units, equipped with primitive gas masks in the form of gauze wrapped around their faces, started their attack, after piercing three kilometers deep, reaching the trenches of the opponent and seeing hundreds of gassed people, they stopped their advance [1].

Two days later the German forces repeated the gas attack, this time in the direction of Canadian troops. It was not, however, as spectacular as the first one. Chlorine was used many times after that on the Western Front, the most extensive attack commenced by the Germans near Reims in October 1915. They used 25,000 tanks holding 550 tonnes of this gas. Chlorine attacks were carried out also by the British, sometimes to their detriment. Early in the morning, on 25 September 1915, near Loos in Belgium, by order of Gen Douglas Haig, British sappers opened the valves on more than 5000 tanks, releasing gas towards German lines. However, a poor analysis of weather conditions and wind directions resulted in more casualties... on the British side [1].

On the Bzura and Rawka

The Eastern front also became an arena for gas warfare, and the first army to use chlorine here was that of the German Empire. The attack was carried out along a dozen-or-so-kilometer-long stretch of the front, east of Bolimów, at the confluence of the Bzura and Rawka rivers. On the night of 30 to 31 May 1915, the valves for 12,000 gas tanks were opened and a toxic cloud was blown by the wind towards the Russian positions [1, 6, 7]. "That day I was driving a cart with Russian sappers to Wiskitki," said Stanisław Wróblewski, resident of Bolimów. "They had been deploying wire entanglements the entire night. Suddenly, we felt a suffocating odor. We started to run away quickly. Six soldiers who were with us at the time covered me, a young boy, with anything they could. When we reached the village, I noticed a red foam dripping from the sappers' mouths. They were immediately transported to a hospital, established in the local school. I felt better the next day. Later I learned that the sappers who accompanied me had died."

The view of the hundreds of victims of the gas attack who were transported to Żyrardów was truly woeful. Paweł Hulka recollected: "These poor people were lying side by side in their worn and dirty greatcoats, and the few doctors and Red Cross sisters walked among them, wringing their hands helplessly. There were no dressings and too few trained personnel to save those poisoned. They died on the ground peacefully, quietly, without protest and by the dozen." [7].

Chlorine was used in Bolimów twice after that.

[2] All quotes from publications in English were translated by the author.

Determining how many soldiers died as a result of these attacks is impossible, and the differences between the estimates are too large. Some authors state that there may have been even 12,000 fatalities, while others indicate 9000. According to Russian sources, there were slightly more than 2000 fatalities among the soldiers [6, 7].

On the eastern front the Germans used chlorine again several times, such as near Osowiec Fortress in August 1915. The Russians also attempted at least twice to conduct attacks using this gas [1].

Images of death

One British casualty clearing station (CCS), a small field hospital established directly behind the front, admitted nearly 700 soldiers poisoned with chlorine over several days in May 1915. They arrived at the hospital fairly quickly. The attack took place at 19.30, and the convoy with the patients arrived in the hospital as early as at 01.30. Three young doctors, lieutenants of the British Expeditionary Force who took care of the gassed soldiers, decided to share their experience, and in July 1915 in the reputable "British Medical Journal" one could read their article: "Observations on 685 cases of poison gases by noxious gases used by the enemy" [8]. In the introduction they stated that the rush of duties and pressure were so great that they could not describe each case, but the general observations might be of use to other doctors.

When the first batch of gassed patients arrived, it became apparent that the severity of the symptoms varied, even when the soldiers were dragged out from the same trench. Attempts were made to quickly form separate groups of patients. They were divided into two groups: those at risk of death and those in a somewhat better condition. The first group included 120 patients, with 33 of them dying during the first five days (Tab. 1.).

It was probably the first time British doctors faced such a great number of gassed soldiers. The number of patients with respiratory failure was staggering, and there was no way of helping them in any meaningful way.

Table 1. Fatal casualties due to chlorine attack hospitalized in one British Casualty Clearing Station on the Western Front in May 1915 [8]
Tabela 1. Zmarli w wyniku zatrucia chlorem wśród hospitalizowanych w jednym z brytyjskich Casualty Clearing Station na froncie zachodnim w maju 1915 roku [8]

Total number of patients	685					
Day of hospitalization	1	2	3	4	5	in total
deaths	16	13	2	1	1	33
mortality [%]	2.3	1.9	0.3	0.1	0.1	4.8

In the article we find a depiction of people desperately fighting for every breath: "One man was dead before he could be removed from the ambulance. Most of the others were in a choking condition, making agonizing efforts to breathe, clutching at their throats, and tearing open their clothes. At one moment they propped themselves up to gasp, at another they fell back exhausted by their struggles. There was marked cyanosis, especially of the lips and ears, and in a few cases a light yellowish frothy discharge was escaping from the mouth and nose. Their faces and hands were of a leaden hue, their heads fallen forward on their chest" [8].

In the acute phase of poisoning the most evident were symptoms of respiratory system irritation, pulmonary edema and respiratory failure. The British doctors also described the typical appearance of the victim of a chlorine attack. The gassed soldiers were admitted with subnormal temperatures, conscious but restless, and with cyanosed faces. Some of them sat with the head thrown back trying to breathe that way, while others lay with their heads over the edge of the stretcher, attempting to aid expectoration. The respirations were jerky and hurried, often exceeding 40 a minute, and were associated with a choking cough. It was noted that the respiratory tract with the auxiliary muscles employed, resembled an asthmatic paroxysm. Auscultation of the lung fields revealed massive rales [8].

By analyzing the course of poisoning, three stages were identified: asphyxial, intermediate and bronchitic. The asphyxial stage symptoms usually passed in 36 hours, after which some exhausted patients fell asleep. Several hours later the bronchitic stage started, with symptoms of bronchitis and pneumonia. Bronchial discharge resumed, and patients coughed up greenish mucopurulent expectoration, with fever also appearing. The symptoms of shock sometimes developed, the pulse being of small volume while its rate increased to more than 150 beats per minute. Respiration was shallow and the patients became delirious. Four patients of the hospital died in the bronchitic stage [8].

Over time, there started to appear subsequent scientific papers in the British medical press that not only presented the clinical experience, but also discussed the pathophysiology of chlorine and other military gas poisoning. Among these was "Gas poisoning" by Prof. Leonard Hill, published in 1916 in "RAMC Journal". The professor highlighted that in the course of chlorine poisoning, not only does pulmonary tissue become damaged but also the functioning of other organs is also impaired, such as the kidneys and the heart. He also mentioned the case of a patient, described by Major Broadbent, in which the aortic valve was torn [9]. What surely killed patients in the first stage of the poisoning was bronchospasm and pulmonary edema. After the war Prof. Hill, in another article, wrote: "I was told at

Bailleul in 1915 that men, poisoned by the first gas attack, hung their heads over the side of the bed to let the liquid run out by gravity. In one fatal case two liters of fluid were coughed up in an hour and a quarter"[3] [10].

Swollen, maroon-red lungs filled with liquid

People also looked for answers to questions concerning the pathomechanism of poisoning in post-mortem examinations. Even the first quoted article, dated 1915, presents an analysis of 10 post-mortem examinations of soldiers killed in the Battle of Ypres.

Understandably, the most massive lesions were found in the respiratory system. Edema started at the laryngeal level. In almost all cases significant inflammation was found in the trachea and the bronchi, which were filled with a light-yellow, frothy secretion with a high protein content. In macroscopic terms, the lungs were clearly edematous, covered with grey and brownish patches, and their weight was several times greater than normal. When incised the lungs were found to be of a maroon-red color and filled with fluid. The small bronchi were hard to find and hidden amid the edematous parenchyma. The pulmonary tissue was strewn with small hemorrhagic foci and, at times, with larger patches, referred to as hemorrhagic infarctions. When it came to the heart, of note was the distension of all chambers, especially the right atrium and right ventricle. In respect of the abdominal organs, no pathologies were identified except the signs of venous congestion. Of note however were lesions in the stomach, in which the mucosa was covered with thick yellowish mucus. Numerous submucosal hemorrhages were also present in nine cases [8]. Carrying out histological examinations in the spartan conditions near the front was very difficult. Therefore, only sections of the lungs were examined. Microscopic analysis revealed that pulmonary alveoli had been seriously damaged and emphysematous foci occurred in the victims. Parts which were not affected by the emphysematous lesions showed congestion of the capillaries, and many alveoli were filled with an albuminous amorphous substance containing fibrin and scarce erythrocytes and leucocytes [8].

These observations were confirmed in animal trials, which was quite evident as these experiments in many cases must have caused the immense suffering. The only scientists to mention that the animals participating in trials were anaesthetized using chloroform of ether was Prof. Edward Albert Schafer[4] [11].

During one such study, animals placed in a toxic atmosphere tried to hold their heads as high as possible, because the concentration of heavier-than-air chlorine was lower there. Quickly however the airways became irritated and respiratory failure occurred. Respiration became faster, labored and chest retractions were observed – the poor animals focused all their energy on attempting to breathe. Breathing became heavier and slower, transformed into whirring, and the animals collapsed. Those which were drawn out of the gas chamber before death, usually perished within 24 hours. In several cases, the animals lived for a couple days more. The picture of the lungs of rats which died during the first 24 hours was almost the same as that observed by the physicians who had examined the bodies of deceased soldiers. The lungs were swollen, congested and of a dark red color. The bronchi were filled with a frothy discharge. Microscopic examinations revealed massive edema and the destruction of pulmonary epithelium. However, in the case of animals that died several days after inhaling chlorine, it was inflammatory lesions that predominated in the lungs, and not edematous lesions. One characteristic feature of the lungs of those animals which managed to survive longer after chlorine inhalation, was their hepatization. It was also indicated that healing lungs were extremely susceptible to repeated damage.

Even in small concentrations in breathing gas, chloroform caused subsequent massive pulmonary edemas. Based on this research it was concluded that in the acute stage of poisoning, death was caused by asphyxia[5], while in the later stages patients usually died as a result of pneumonia [9].

The impact of chlorine on other organs was also investigated. Tests made by Schafer, consisting of the introduction into the jugular vein of a rabbit of 10 c.cm of Ringer's solution saturated with chlorine, immediately resulted in a blood pressure decrease and heavier breathing [9]. In a different study, this time involving cats, the influence of chlorine on blood pressure was corroborated. Gas inhalation resulted in blood pressure falling 50 percent [10]. Major Waiter Broadbent noted: "It looks as if in some cases the chlorine or bromine damages the lung epithelium so severely that it does not allow absorption into the general circulation, while in others the gas passes through the lungs without affecting them permanently, but then sets up an acute nephritis." [9]. Prof. Hill argued with this statement, saying that there was no evidence that

[3] It remains unclear whether Prof. Hill meant here the first chlorine attack near Ypres in spring 1915 or the first gas attack employing the mixture of phosgene and chlorine, used by the Germans against the British forces in December of that year.

[4] Sir Edward Albert Schafer (1850-1935) - British physiologist of German origin, professor at the University of Edinburgh, founder of endocrinology, discoverer of adrenaline, originator of artificial respiration (Schafer's method).

[5] In another study it was demonstrated that the blood of cats which died as a result of being exposed to high chlorine concentrations was of a black "asphyxial" color [10].

free chlorine enters the blood and directly damages organs other than the lungs. He attributed kidney damage to prolonged dyspnea and hypoxia with the centralization of circulation and secondary hypoxia in the parenchymatous organs[6]. Inhaling chlorine vapor also affected the body temperature of the studied animals. Small concentrations increased body temperature in dogs, as stated, "probably through the excitement to escape." Higher concentrations caused a reverse effect [10].

Research into the pathomechanism of death in the course of respiratory exposure to chlorine was also conducted by a famous physiologist of that era, Prof. Edward Albert Schafer. Based on experiments involving animals, he proposed a thesis that the cause of death of the studied animals was primarily due to obstruction[7] in the pulmonary vessels "rendering it impossible for the blood to pass freely to the left auricle and ventricle", and not bronchospasm [11]. Therefore, according to Prof. Schafer, death was caused by heart failure secondary to pulmonary hypertension and what we would call today obstructive shock, and not respiratory failure.

Oxygen, emetine and bloodletting

The protagonists of the previous sections, Lieutenants J.E. Black, E.T. Glenny and J.W. McNee, based on their experience, proposed a standard procedure for patients poisoned with chlorine. According to them, the treatment of gassed patients should focus on facilitating the extraction of content from the respiratory tract, diminishing bronchial secretion, supporting the failing heart and re-oxygenating the blood. As a rule, after having been admitted to the hospital, the patients were placed in the open air or in well-ventilated rooms. Windows and doors were opened in rooms to create draught. Hypothermia was prevented at this stage by covering the soldiers with blankets and providing them with hot drinks. In the case of the first 80 cases, vomiting was induced. It was acknowledged that strongly salted water administered orally would serve the best. The vomiting reflex was also triggered through the mechanical irritation of the back of the throat. Attempts were made to give the patients apomorphine hydrochloride and ipecacuanha extract made from a plant whose roots contain emetine, which has emetic and expectorant effects. Later, these procedures were limited to selected cases. All patients received expectorant preparations. Of particular use were ipecacuanha alkaloids and ammonium carbonate, which is the basic ingredient of smelling salts. To reduce bronchial secretion atropine was administered in a dose of 1/50 grain[8] to the most severe cases. The effect was, however, rather poor. The authors debated whether the drug had not been administered too late and whether it should be used in early stages of the evacuation in sanitary companies. Artificial respiration had to be employed in several cases. During World War 1, respiratory support involving interrupted positive pressure was basically unknown and unused. Therefore, in several cases Schafer's method[9] was employed, which was, according to the authors, "strikingly successful" [8]. One patient had to undergo such a procedure as many as four times. The effect was indeed surprising, as reported by the doctors, the patient recovered. Many victims, especially those with marked cyanosis, were treated with oxygen. In two cases it was supplemented subcutaneously, creating subcutaneous emphysema. The expected result was not achieved, and no further attempts were made.

The doctors tried to combat cyanosis using venesection and bloodletting. However, the therapeutic effect was temporary. According to Black, Glenny and McNee: "It occurred to us that a more gradual and protracted depletion of the right heart would give better results [than bloodletting]. Accordingly, leeches were procured. Sufficient suitable cases did not then remain, however, to enable an opinion to be formed as to their value." [8]. When the pulse became weakened, barely perceptible, pituitary extract injections were administered, and opium was used in the case of very restless patients. The doctors proposed a treatment regimen for patients poisoned with chlorine vapors that included the following six points: (1) Abundant supply of air and warmth; (2) Use of emetics if the patient was very cyanosed and had not already vomited; (3) Administration of ammonium carbonate or ipecacuanha extract every three hours; (4) Oxygen supplementation in cases of dyspnea and cyanosis; (5) Administration of opium in case of restlessness and mental strain; (6) Administration of pituitary extract (1 ml) and brandy (sic!) when the heart is at risk of failure [8].

Similar treatment methods were employed by Captain A.S. Hebblethwaite, who, between 27 and 29 April 1916, provided care for patients injured in the attack in the Hulluch region. He shared his experience the following year in "RAMC Journal"

[6] Orig.: *(...) long-lasting intense dyspnea should produce nephritis, accompanied, as it is, with convulsive breathing which just maintains the cerebral circulation within viable conditions at the expense of the abdominal circulation.*

[7] Orig.: *obstruction of the pulmonary vessels.*

[8] Grain is a unit of measurement of mass, one which is rarely used today. Once popular, especially in pharmacy. 1 grain equals roughly 65 mg. Thus 1/50 grain of atropine is approx. 1.3 mg of the drug.

[9] In this method the patient was positioned face down on the ground, with their upper limbs bent in the shoulders. The rescuer, while kneeling to the side and a little to the back, exerts pressure on the chest at the lower rib level, directing the force vector towards the abdomen and the head. The rhythmical compression of the chest was to facilitate ventilation.

[12]. In slight cases he used smelling salts containing ammonia, 1/50 grain of atropine administered subcutaneously, fluid, light diet for at least 24 hours and expectorants. Patients were evacuated to base hospitals on the third day. When it came to serious cases, Hebblethwaite divided them into two groups: "pulmonary cases" and "cardiac failure cases". Patients with predominating respiratory failure symptoms were treated using ammonia and atropine. Oxygen was also given through a system composed of a rubber mouthpiece, a gas-bag and a valve. In cases of marked cyanosis, bloodletting was performed. As highlighted by Dr. Hebblethwaite, more difficult were patients with developing heart failure, as these cases could have been missed or initially qualified for the group of patients in a better clinical condition. Often the first symptom of the disease was a sudden loss of consciousness. For heart failure he used cardiac stimulant drugs, such as strychnine, digitalin and pituitrin. To alleviate pleuritic pain, he administered morphine [12].

From the contemporary point of view, bloodletting appears to be the most interesting method used in the treatment of patients poisoned with chlorine during World War 1. Based on an analysis of the afore-quoted articles, one can state that this kind of treatment was commonly used, and should be discussed in detail. The suggestion of using bloodletting in the treatment of patients poisoned with chlorine can be found in a short letter by Prof. Schafer to the editorial staff of "British Medical Journal". "I have not noticed that it has occurred to any of the RAMC men at the front to try the effect of venesection in acute poisoning by chlorine gas. It appears to me, seeing that the fatal effects are due to obstruction in the pulmonary circulation and edema of the lung tissue, that copious blood-letting is the only remedy which could be expected to produce any immediate effect. It is at any rate worth trying (...)" [13]. Captain Hebblethwaite was also an advocate of venesection and bloodletting. He employed it in 42 cases, 12 of these patients dying. Among the therapeutic effects of this method he enumerated decreased cyanosis and congestion in the lungs[10], and thereby improved ventilation and relieved headache. After the use of blood-letting, patients were to fall into a beneficial sleep, and experienced a subjective sensation of relief [12, 14]. The team of three doctors from the Casualty Clearing Station was more cautious. They employed this method in case of cyanosis and dyspnea, letting 10-15 ounces of blood at a time, which is more than 400 ml[11]. Rapid blood clotting was a problem, and the obtained results, were according to them, transient [8]. The method was defended by Hebblethwaite, who reckoned that the faster bloodletting is carried out, the better. Arguing in favor of this method, he evoked two theoretical physiological mechanisms. First, bloodletting was supposed to reduce work performed by the heart. Second, as a result of reduced volume of circulating blood, fluid from, for example, edematous lung tissue, was to flow into the vessels to make up of for the loss. Thus, hypothetically, the procedure was to reduce lung edema [14]. He provided numerous examples to back his opinion. It is worth quoting some of these. Private McF., aged 28, admitted cyanosed, pulse rapid. Bled 20 oz. He later said, "It relieved my chest, which was fairly choked, and made me sleep well" [12]. Bloodletting alleviated cyanosis. In the case of Sergeant McC., aged 47, cyanosis was marked, and the patient was delirious and had collapsed. He had 15 oz. of blood bled, which reduced cyanosis and slowed down the pulse. He said to the doctor, "It did good to the breathing, and relieved the pain in the head." Accounts given by other soldiers were almost identical, and many of them fell asleep after having their blood let [12]. In some patients, the procedure was performed more than once: "Lance-Corpl. C., aged 38. Admitted very cyanosed and distressed. Brandy and oxygen given. Had been bled at field ambulance, but, on account of cyanosis, venesection was again done. Bled 20 oz. Color improved and the patient became less distressed. Five days later still unconscious (...)" [14].

Hebblethwaite recommended making an incision in the cephalic or basilic vein with a possible ligature of the proximal end of the planned location of the incision. The recommended amount of extracted blood was 15-25 ounces, i.e. 420-700 ml, with a bloodletting time of at least 15-20 min, to avoid collapse [14].

Before the introduction of loop diuretics, bloodletting was among the basic methods of treating pulmonary edema. Even currently, in some handbooks it is presented as a way of "buying time" in edema with a dramatic course [15]. This primarily means a sudden reduction of left ventricle preload. The utilization of this method can be justified in cardiogenic pulmonary edema. The problem is that in the case of acute inhaled chlorine poisoning, pulmonary edema is primarily non-cardiogenic in nature, and heart strain, and its subsequent failure, are secondary to pulmonary hypertension. In most cases of severe chlorine poisoning the most evident are respiratory failure symptoms with profound gas exchange disorders. Hypoxemia and hypercapnia are observed, which result in hypoxia, i.e. oxygen deficiency in the tissues. Meanwhile, bloodletting

[10] Orig.: *congestion in lungs.*

[11] One fluid ounce (fl oz) equals 1/600 of an imperial gallon, i.e. 28.41 ml.

[12] It is worth noting that a patient poisoned with chlorine and treated at the home department of the author also reported "chest being clogged by secretion" (see: description in the same issue of "Military Physician").

results in patient anemization, therefore reducing the possibility of oxygen transport to the tissues. When there is insufficient oxygen in the tissues, such a process can intensify the negative effects of the poisoning. The quick regression of cyanosis observed by British physicians was in all likelihood connected with the anemia caused in their patients. Since cyanosis is the effect of deoxygenated hemoglobin prevailing in blood, when we remove it, cyanosis should also be eliminated.

We should remember that the knowledge of physicians present on the fronts of the Great War was far from what we know today. They were aware that they were dealing with pulmonary edema. Therefore, their theories were not completely incorrect and in individual cases bloodletting could have had a positive effect. On the other hand, it appears that more than 100 years ago too much attention was devoted to one symptom – cyanosis. Its remission did not necessarily mean that the clinical condition of the patient improved, as the cyanosis was replaced with anemia. Thus, one can ask the question whether the patients poisoned with chlorine, especially those in the most serious condition, survived thanks to bloodletting, or in spite of it. This question is still open, as World War 1 was an era before great scientific research conducted in line with the principles of "evidence-based medicine".

Chlorine in Polish medical literature from the inter-war period

The Great War changed the world. What had only been imaginable before, became real. The perspective of another gas war occupied the minds of the military, politicians and entire societies. Gas attacks in future wars were probable and every army aspiring to being "modern" had to prepare itself for such a contingency.

The emergence of chemical weapons created new challenges for the medical service. The medical service of the restored Polish Army quickly recognized the importance of this issue. Not only did the medical staff have to be acquainted with the experience gained on the fronts of the previous war and the mechanisms of action of individual gasses, but also, and more importantly, prepared for treating patients exposed to poison.

As early as in 1925, the Military Scientific and Medical Institute published a handbook authored by Prof. Włodzimierz Lindeman, entitled "Toksykologja chemicznych środków bojowych" [The Toxicology of Chemical Warfare Agents] [16]. This comprehensive and detailed study is still impressive, which should be of no surprise as the author was not a random person. Before he began working for the Polish Army, he taught pathology at the National University of Kyiv[13]. From 1922, he was employed in the Military Gas Institute, acting as head of department, and in 1924 he was General Pathology and Pathological Anatomy Professor at the Faculty of Veterinary Medicine of the University of Warsaw [17].

Chlorine is commonly classified in the group of asphyxiant gases, i.e. "inhalation poisons" (together with phosgene and chloropicrin). It was classified by Lindeman in a similar way (Tab. 2). In his publication, he identified three forms of poisoning: instantaneous death, acute poisoning and subacute poisoning. According to Lindeman, chlorine concentrations of >0.1% caused instantaneous death in the course of a laryngospasm, and primarily due to the violent decomposition of the blood and the occurrence of acid hematin in response to HCl. He wrote, "Post-mortem examination reveals in these cases the exceptional color of the lungs, which are covered with brown, green and yellow patches. However, pulmonary edema and inflammation are not clearly associated with the sudden death."

Table 2. Division of chemical warfare agents by Lindeman [16]
Tabela 2. Podział chemicznych środków bojowych wg Lindemana [16]

1. Inhalation poisons
1.1. a group of agents with effect similar to chlorine
1.1.1 halogens – chlorine, bromine, iodine
1.1.2. organic derivatives of sulfur - methyl sulfate, methyl chlorosulfate
1.1.3. sulfuric anhydride and sulfur dioxide
1.1.4. sulfur chloride
1.2. the phosgene group (bromophosgene and thiophosgene)
1.3. the chloropicrin group (chloropicrin, acrolein, crotonaldehyde)
1.4. the nitric oxide group
1.5. the military fumes group
1.5.1. neutral fumes, e.g. ammonium chloride
1.5.2. caustic fumes, e.g. sulfuryl chloride
1.5.3. poisonous fumes, e.g. arsenic chloride
1.6. the ammonia group
2. reflex agents
2.1. lacrimators
2.2. sternutators
2.3. emetics
3. skin contact poisons (e.g. Yperite, Lewisite)
4. general-effect poisons (carbon monoxide, hydrogen sulfide)

[13] Włodzimierz Lindeman was not of Polish origin, but was granted Polish citizenship in 1925.

Acute poisoning was reported to cause death between 30 minutes and 3 days. To the forefront comes here pulmonary edema "with subsequent anhydremia, later accompanied by the symptoms of cardiac fatigue." Subacute poisoning involves first and foremost mucosa and mucous membrane irritation, which is "quickly accompanied by strong catarrh and the creation of false membranes in the throat and nasal cavity, as in the course of diphtheria." Later stages involved pneumonia, initially of a toxic nature, and later bacterial. Lindeman also noted the occurrence of acidosis in the course of chlorine poisoning [16].

Of course the work by Włodzimierz Lindeman was not the only publication devoted to gas warfare published at the time. The issue was taken up by medical professionals, military tacticians, engineers, chemists and specialists in civil defense. Some publications were addressed to civilian audiences. The whole inter-war period saw the publication of countless articles, handbooks, pamphlets and instructions. Also the specialist medical press quite regularly published articles discussing the pathophysiology of poisoning, the most recent studies, organization of help for gassed individuals and poisoning treatment methods. A notable position is held here by "Military Physician", published since 1920, and it would suffice to mention a comprehensive seven-segment article published and authored by Lt Col Montrym-Żakowicz MD, in which he analyzed the losses sustained by the Entente forces in gas warfare in 1915-1918 [18].

In the second half of the 1930s, the specter of a new conflict loomed again over Europe. Bearing in mind the not-so-distance experience of World War 1, gas attacks were greatly feared. People were well aware that technological progress, manifested among other things in the development of aviation, significantly increased the range of chemical weapons. Not only were units fighting in the first front line exposed to the attack, but also cities and civilians. Finally, it is worthwhile to consult "Vadamecum obrony przeciwlotniczej i przeciwgazowej ludności cywilnej" [Vadamecum of anti-aircraft and gas defense for civilians] published by the Social Insurance Institution in 1936 [19]. The mechanism of chlorine poisoning was rather similar to that presented in other publications. Of note, however, was the way of treating patients exposed to asphyxiant gases, as suggested by Col Stanisław Przychocki MD, author of the chapter devoted to treating patients poisoned with military gasses. According to Przychocki, in such cases "the basic rescue and medical activities involve pulmonary edema prevention" [19]. In addition to oxygen therapy, the administration of sedatives, appropriate care and preventing hypothermia, among the methods reducing pulmonary edema, he included osmotically active agent infusions, e.g. a 25% dextrose solution. "Vadamecum" was another publication advocating the use of bloodletting. Przychocki, however, indicated that this method was not effective in pulmonary edema treatment, but rather in its prevention. "During plum-colored cyanosis, in the course of pulmonary edema or at its peak, when the dyspnea is the most severe, bloodletting is often significantly hindered due to considerable blood thickening (...) In such cases oxygen therapy should be employed and one should make every effort to keep the patient's heart beating, and prevent restlessness". To support a failing heart, Dr. Przychodzki recommended preparations with camphor, strophanthin and digitalis alkaloids. When "plum-colored cyanosis" transitioned into "grey-colored cyanosis" bloodletting was to be discontinued, "in the case of prolonged or extensive pulmonary edema, severe anoxemia, failing heart and exhausted respiratory and vasomotor systems, bloodletting is usually no longer a viable option." In such circumstances, in addition to oxygen and cardiac medications, one could consider an intravenous infusion of physiological saline or modified Ringer's solution ("9 gr NaCl, 0.24 $CaCl_2$, 0.42 KCl, 0.2 $NaCH0_3$, per 1000 cm^2 of water"). When it came to drugs used in treating asphyxiant gas poisoning, he listed codeine (to alleviate the cough), 2.25% soda solution (topically onto mucous membranes and conjunctively), and calcium salts (administered intravenously to have an anti-inflammatory effect and "prevent capillary wall damage"). "Vadamecum" was written in the pre-antibiotic era; therefore, the prevention of secondary pulmonary infections had to be based on isolating poisoned patients from those with infections [19].

Summary

When preparing this article, it was not coincidence that the author based his work mainly on publications in English, which does not apply only to a language barrier of some kind. It was indeed the British Expeditionary Force that, shortly after the French army, was hit the most by chemical warfare, and the doctors of the Royal Army Medical Corps gained invaluable experience in the treatment of victims exposed to chemical attacks [18]. Though the imagery of mass poisoning can stimulate one's imagination while the suffering of soldiers terrifies even today, it should be clearly stated that these chemical weapons failed to meet the expectations. Their use contributed only to a small degree to local tactical successes. Furthermore, the share of military gasses in the total of soldiers wounded and killed on World War 1 fronts was insignificant. Statistics do not lie: the greatest losses on both sides of the conflict were caused by artillery fire. Undoubtedly the wide-scale use of military gasses in

1915-1918 was associated with a striking psychological effect, one which continues to this day.

In the case of chlorine it quickly became apparent that the gas was relatively ineffective, and appropriate protection was provided even by a cloth or gauze soaked in a solution of sodium thiosulfate and soda [16, 18]. Therefore the extensive losses sustained by the French, Canadian and British forces on the West and the Russian troops in the Battle of Bolimów, resulted from the soldiers being unprepared for such an attack. The introduction of, initially primitive, gas masks, and their subsequent evolution resulted in chlorine being used less frequently and its replacement with other gasses: chloropicrin and phosgene (Fig. 1.). There was also another reason for chlorine's failure as a weapon of mass destruction. The "wave" attack technique, the only one applicable in the case of chlorine, required the use of a significant number of tanks, long-term sapper preparation and appropriate weather conditions. This reduced the effect of surprise and, more importantly, limited the possibility of using the gas in the case of a dynamically changing tactical situation.

It was not without a reason that chlorine lost its importance as a military gas. This is clearly seen in the Polish "Vadamecum" journal, which devotes relatively little space to chlorine [19]. The analyses focused on phosgene, which was much more lethal and provided more opportunities for use as a military gas.

Postscript

When this article approached completion (August 2016) the world was hit by the news from Aleppo, Syria. As reported by the physicians, not a day goes by without civilians poisoned with chlorine being admitted to hospitals. However, this is not chlorine intended for military purposes, instead Assad's regime used gas from civilian installations. One would think that, due to its specificity, chlorine used as a weapon of mass destruction had become a thing of the past...

Figure 1. Chlorine as weapon lost its importance due to widespread introduction of gas masks. The photograph shows *Respirator, Small Box Type,* a gas mask first introduced to the British Troops in 1916 [author's collection].
Rycina 1. Chlor stracit na znaczeniu między innymi ze względu na wprowadzenie do powszechnego użycia masek przeciwgazowych. Na fotografii maska Respirator, Small Box Type, która pierwszy raz znalazła się na wyposażeniu brytyjskich oddziałów w 1916 roku [zbiory wtasne autora].

Literature

1. Konopski L. Historia broni chemicznej [The history of chemical weapons] Warsaw, Bellona, 2009: 28-38
2. Fitzgerald GJ. Chemical warfare and medical response during World War I. Am J Public Health, 2008; 98 (4): 611-625
3. Heller CE. Chemical warfare in World War I: The American Experience, 1917-1918, Combat Studies Institute, Fort Leavenworth, 1984: 3-12
4. Gas Attack at Ypres, Strona internetowa Imperial War Museum: http:// www.iwm.org.uk/history/podcasts/voices-of-the-first-world-war/pod-cast-13-gas-attack-at-ypres (dostęp z 02.07.2016)
5. Marrs TC, Maynard RL, Sidell FR (ed.). Chemical Warfare Agents-Toxicology and Treatment. Wiley, Chichester 2007: 3-5
6. Młyńska A. Chlor pod Bolimowem. [Chlorine near Bolimów. Gas attacks in the Battle of the Rawka-Bzura (January-July 1915)]. Militaria XX Wieku-Wydanie Specjalne [20th-century Militaria - Special Issue],
7. The 1915.pl website: www.dobroni.pl/media/bolimow1915,352 (accessed on 11.07.2016)
8. Black JE, Glenny ET, McNee JW. Observations on 685 cases

of poisoning gases by noxious gases used by the enemy. Br Med J, 1915; 2 (2848): 165-167
9. Hill L. Gas Poisoning. J R Army Med Corps, 1916; 26 (1): 110-121
10. Hill L. Lecture on the Pathology of War Poison Gases, J R Army Med Corps, 1920; 35 (4): 334-342
11. Schafer EA. On the immediate effects of the inhalation of chlorine gas. Br Med J, 1915:245-247
12. Hebblethwaite AS. The treatment of chlorine gas poisoning. J R Army Med Corp, 1917; 29: 694-699
13. Schafer EA. Treatment of chlorine gas poisoning. Br Med J., 1916; 1 (2891): 774
14. Hebblethwaite AS. The treatment of chlorine gas poisoning by venesection. Br Med J, 1916; 2 (2899): 107-109
15. Keith Allman K, Mclndoe A, Wilson I. Emergencies in anaesthesia. Oxford University Press, Oxford 2010: 53
16. Lindeman W. Toksykologja chemicznych środków bojowych [The Toxicology of Chemical Warfare Agents]. Wojskowy Instytut Naukowo-Wydawniczy, Warsaw 1925: 184-189 184-189
17. Jastrzębski D. Ś.P. Prof. Włodzimierz Lindeman. Biologja Lekarska [Medical Biology], 1933; 12(3):86-88
18. Montrym-Żakowicz M. Statystyka strat od broni chemicznej w czasie wojny światowej (cz. 1-7) [The statistics of losses sustained due to exposure to chemical weapons in the World War (parts 1-7)]. Mil. Phys., 1932; 19 (5): 225-233; (6): 310-317; (7): 367-374; (8): 439-444; (9): 508-513; (10): 579-584; (11): 641-652
19. Vadamecum obrony przeciwlotniczej i przeciwgazowej ludności cywilnej [Vadamecum of anti-aircraft and gas defense for civilians]. Zakład Ubezpieczeń Społecznych, Warsaw 1936: 227-231, 563-568, 701-714

Col Jan Józef Krusiewicz, PhD (1873-1930) - founder and first commandant of the 9th Regional Hospital in Brześć nad Bugiem

Płk dr Jan Józef Krusiewicz (1873-1930) - twórca i pierwszy komendant 9. Szpitala Okręgowego w Brześciu nad Bugiem

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Abstract. The article presents a Polish military physician, founder and first commandant of the 9th Regional Hospital in Brześć nad Bugiem. He was born in Płońsk, on January 27, 1873. In 1898, he graduated from the Imperial University in Warsaw. He then served for a long period in the Russian Army as a physician of the 16th regiment in Odessa. He took part in the China Campaign (1900-1901), the Russo-Japanese War (1904-1905) and the Great War. In 1919, he joined the Polish army and took part in the war against Russia in 1920. Colonel Krusiewicz was the founder and the first commandant of the 9th Regional Hospital in Brześć nad Bugiem. Constituting a part of the famous Brześć Citadel, it was one of the most important military hospitals in Poland during the interwar period. Colonel Jan Józef Krusiewicz died in Warsaw on January 23, 1930.
Key words: Krusiewicz, physician, officer, military hospital, Brześć

Streszczenie. W artykule przedstawiono sylwetkę polskiego lekarza wojskowego, który był twórcą i pierwszym komendantem 9. Szpitala Okręgowego w Brześciu nad Bugiem. Urodził się 27 stycznia 1873 roku w Płońsku. W 1898 roku ukończył Cesarski Uniwersytet w Warszawie. Następnie przez długi czas służył w armii rosyjskiej, był lekarzem 16. pułku w Odessie. Brał udział w kampanii chińskiej (1900-1901), wojnie Rosji z Japonią (1904-1905) i I wojnie światowej. W 1919 roku został polskim żołnierzem i wziął udział w wojnie 1920 roku przeciwko Rosji. Pułkownik Krusiewicz był twórcą i pierwszym komendantem 9. Szpitala Okręgowego w Brześciu nad Bugiem. W okresie międzywojennym był to jeden z najważniejszych szpitali wojskowych w Polsce i stanowił jedną z części słynnej Twierdzy Brześć. Pułkownik Krusiewicz zmarł w Warszawie 23 stycznia 1930 roku.
Słowa kluczowe: Krusiewicz, lekarz, oficer, szpital wojskowy, Brześć

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Brześć nad Bugiem was the capital of the Polesie Voivodship during the Second Polish Republic; today it is within the boundaries of Belarus. All devotees of history know it as a place where a mighty citadel was built, located on four islands, in 1836-1842 according to a project accepted in 1830 by a decree of Tsar Nicholas I. The constructors were Russian military engineers: Gen N.M. Małecki, Gen K.I. Opperman and Col A.I. Feldman.

This fortification played a role in several armed conflicts. It was particularly important for Poles during the war with Soviet Russia in 1920 and the September Campaign in 1939. During the Campaign it came under the Soviet occupation, the Red Army using it for their own protection. This bastion became famous for heroic acts of the Red Army soldiers, who defended it in 1941 when Adolf Hitler attacked his former ally. In the interwar period, the 9th Regional Hospital constituted a part of the citadel - one of the ten most important medical facilities of the military health service of Poland at that time. It was on Hospital Island in a former convent of the St. Bernard Sisters and a Bernardine monastery where, during Tsarist times, a fortress hospital was created [1-3]. The first commandant and organizer of this outstanding facility was Col Jan Józef Krusiewicz MD, a very interesting and experienced person, who is worth remembering by younger generations of military medics.

Figure 1. Jan Józef Krusiewicz as a physician in the Russian Army (with permission of B. Krusiewicz)
Rycina 1. Jan Józef Krusiewicz jako lekarz armii rosyjskiej (za zgodą B. Krusiewicza)

He was born on 27 January 1873 in Płońsk, in the Płock Governorate of that time, i.e. in Poland under Russian rule. His parents were Józef and Pelagia née Budaszewska. They were a middle class Roman Catholic family, and his parents provided their son with intellectual development and education, sending him to the capital of the Governorate where he joined a renowned Male Classical Middle School. In 1893 in Płock, he obtained a matriculation certificate, which allowed him to undertake studies at the Medical Department of the Imperial University of Warsaw. A medical diploma was awarded to him in 1898, after which he signed voluntarily a commitment to serve in the army for two more years [4, 5]. It must be admitted that imperial commanders cared for staff members in the military health service by attracting physicians with advantageous working conditions. It is enough to say that for a start Jan Krusiewicz received an annual remuneration of 330 rubles in gold, a set of handheld surgical instruments and a set of ophthalmic instruments. In April 1899, he became a junior physician of the 16th Regiment of Riflemen of Tsar Alexander III in beautiful Odessa, in the Kherson Governorate, where he would settle for many years. Early in 1901, he was detached from his parent unit to Vladikavkaz with a sanitary train transporting the mentally ill. For his direct participation in the battles between Russian intervention units and Chinese units during the Boxer Rebellion on 6 May 1901, he was awarded a silver "1900-1901 China expedition medal" on the ribbon of Andrzej-Włodzimierz.

The advantages of practicing as a military physician appealed to Jan Krusiewicz, as after the two years were up he decided to stay in the army for life. On 8 July 1903, he became a titular counsellor, which corresponded to the rank of a captain. At the time of his service in the regiment, he was delegated many times to perform various duties in other units and garrisons, e.g. in 1902 he served as a junior physician in the Collective Hospital in legendary Sevastopol and as a junior head of the unit at the Military Hospital in Odessa. He also supervised the enrolling in the army in the Caucasus Military District and the Turkestan Military District. He performed his tasks duly and therefore on 21 September 1903 he became a collegiate assessor (an equivalent of the rank of major). For another few years he served as a chief physician in his regiment, including during the Russo-Japanese war of 1904-1905. For his commitment during this war, by Order No 401 of 31 November 1905 of the 37th Manchurian Army, he was presented with the Order of Saint Anna, third class. His superiors appreciated his commitment, professional skills and courage, which resulted in subsequent promotions. On 9 July 1906, he achieved the title of court counsellor, i.e. equivalent to a lieutenant colonel. He lived for several years in sunny Odessa, had a group of friends and gained the trust of patients, who would come to his private practice at 57 M.A. Nowosielskiego St. (a historical building, which survives to this day).

It was probably one the best periods in his life, but nothing lasts forever, especially in the career of a military physician.

Figure 2. Personnel of the 9th Regional Hospital in Brześć nad Bugiem, 1920s, in the center Col Jan Józef Krusiewicz, PhD (with permission of B. Krusiewicz)

Rycina 2. Personel 9. Szpitala Okręgowego w Brześciu nad Bugiem, w centrum płk dr Jan Józef Krusiewicz, lata 20. XX wieku (za zgodą B. Krusiewicza)

By the order of the Minister of Military Affairs of 31 December 1912, he was appointed as chief physician of the 27th Artillery Brigade in Vilna. He regretted having to leave forever such a popular Black Sea resort, but on 22 February 1913 he started work in a new unit. The trauma after the sudden leave was definitely eased by promotion to a collegiate counsellor (the rank of colonel), in the beautiful and wonderful atmosphere of a city on the Neris River.

Following the outbreak of World War I in 1914, he went with his unit to the front in the East Prussia to fight against Germany. It is worth remembering that, from the point of view of Poles, it was a fratricidal war because Poles were soldiers in the units of all the partitioning powers. In July 1915, Jan Krusiewicz became the divisional physician of the 27th Infantry Division, and then his last promotion during his imperial service was on 5 February 1917 when he became a state counsellor (equivalent to colonel, with prospects for the title of general). He walked with his unit along the route of the battles in East Prussia. In early 1918, he was taken prisoner in Germany, which ended his participation in the military operations of the war.

During his 19 years of service as a military physician in the Russian Army, Jan Krusiewicz took part in three armed conflicts, was frequently promoted and awarded, including with the Order of Saint Stanislaus, third and second class, the Order of Saint Anna, third and second class (with swords), the Order of Saint Vladimir, fourth class, and a bronze “Medal for the Russo-Japanese War 1904-1905” [4, 6].

It should be emphasized that although many Poles served in the partition armies as officers and non-commissioned officers, they did not become Russified or Germanized, but acquired appropriate knowledge and experience to use their skills in favorable circumstances for the benefit of their fatherland. This is very well presented by J. Krusiewicz, PhD, who was released from captivity in Germany on 24 February 1919 and on 4 March volunteered for the Polish Army. When he was a lieutenant colonel (positive verification of his rank gained in the imperial army did not take place until 1922), he was appointed the Head of the Sanitary Command of the “BUG” Group.

At that time, the activity of the army on the eastern

frontiers was increasing, liberating more areas on the Eastern Borderlands of the Polish Republic. In November, Lt Col J. Krusiewicz, PhD became the Sanitary Head of the Stage District Command in Vawkavysk. Shortly before that, in February 1919, the Podlasie Group commanded by Gen Antoni Listowski liberated Brześć, where in the local citadel a former German hospital (previously belonging to Russians) became the Team Hospital. Outbreaks of diseases such as typhoid fever, dysentery, Spanish flu, smallpox, and cholera were a serious threat not only to soldiers, but to the entire population of the country. Disease decimated the populations of the eastern borderlands, with the passage of soldiers as vectors of the spreading diseases. As a result, the main task of the sanitary service was to prevent these epidemics from spreading and to treat and keep sick people in isolation. It was both a very important and dangerous task, performed by the personnel of medical facilities, since they were exposed to disease in a degree incomparably higher than the average soldier. A significant number of stretcher bearers, paramedics and physicians died as they tried to save others, something that should always be remembered.

The typhoid epidemic was also fatal for the commandant of the Team Hospital of the Brześć Citadel - Lt Col Eugeniusz Karchezy, PhD. His position was taken by Lt Col Jan Krusiewicz, PhD, who also took the position of Sanitary Head of the Brześć Citadel. Despite the great threat of loss of life, this experienced physician who had gained experience on different fronts, began to organize the military medical services within a specified area. Owing to the great effort of his subordinates, he created a facility that could operate tolerably well under really extreme conditions - with a continuing lack of basic materials and equipment, shortages of medicines and dressing materials, and problems with other supplies [4, 7]. On 1 February 1920, the Team Hospital of the Brześć Citadel was named the Brest-Litovsk Fortified Camp Hospital. There were 430 beds divided between 4 units: internal medicine, surgery, infectious diseases and venereal diseases. It should be remembered that Lt Col J. Krusiewicz, PhD, as the Sanitary Head, also supervised other military healthcare facilities in Brześć - Polish Army Epidemic Hospital No 1, Polish Army Epidemic Hospital No 2 for captives, military baths and laundry services, hence he could not complain of a lack of work.

In July 1920, due to the quick Soviet offensive, Brześć was conquered and the people from the facility commanded by Lt Col Krusiewicz were evacuated to Toruń. Only victory at the Battle of Warsaw and a military operation on the Niemen River resulted in the recovery of Brześć, where the hospital was re-established. In January 1921 this was converted into the Stage Treatment Hospital No 51, with the number of beds increased to 600-700. In the place of this hospital, in August 1921, Regional Hospital No. 9 was established [3, 4, 8]. Through all this difficult and exhausting time, Lt Col Jan Krusiewicz, PhD served as the commandant. He tried to provide the best possible conditions for his patients and the injured. Gen Leonard Skierski, the commander of the 4th Army, on 23 April 1921 summed up the efforts expended on the fronts by this experienced military physician (when Stage Treatment Hospital No. 51 was no longer assigned for the army): "Lt Col Krusiewicz, commander of Stage Treatment Hospital No. 51, who, as a result of hard and devoted work, built among the ruins of the Brześć Citadel, in buildings requiring extensive renovation, in a short time and with meagre auxiliary means, a high-class and exemplary hospital in terms of professionalism and management."

This is how the Regional Hospital No. 9 was established (in 1926 its name was changed to the 9th Regional Hospital), which in the interwar period was one of the ten most outstanding and largest facilities of military medical service in Poland. It contained almost all the units of the most important branches of medicine: surgery internal medicine, infectious diseases, dermatology and venereology, ophthalmology, ear diseases, nervous system, gynecology and obstetrics, radiology laboratory, and dental clinic. At its peak, the hospital had 500 beds, and its own affiliate in the Military Seasonal Hospital in Damachava near Leśna. Without a doubt, this founder and organizer, and first commandant of this particularly important healthcare facility for the entire military service, was Col Jan Krusiewicz, PhD (verified from the imperial army of his proper rank on 22 April 1922). He performed his duties for over a 5 year period, and then in April 1925 he handed over a well-functioning and well-established facility to his successor, Commandant Col. Bronisław Paklikowski, PhD [3, 4, 8].

Shortly before retirement, he served as a school physician in the Artillery School Camp in Toruń, after which, on 31 December 1926, he ended his professional military service.

In private, he was a happily married husband of Stefania Wanda née Witkowska (daughter of collegiate counsellor Jan and Józefina née Iwanicka), whom he married in 1903. They had two children: a daughter - Wanda Józefina (1907), and a son - Włodzimierz Mieczysław (1910). His retirement did not last long. His wife died in March 1929, which struck him greatly and that was the reason why his health and mood deteriorated. On 23 January 1930, Józef Krusiewicz, physician, former state counsellor of the imperial army, Colonel of the Polish Army, founder and first commandant of the 9th Regional Hospital in Brześć nad Bugiem, passed away as well. He was buried at the Powązki Cemetery in Warsaw, quarter 215 [4, 6].

While studying the material archives concerning the life of this Polish physician, it is difficult not to get the impression that the re-born fatherland did not repay its defenders their due. Well-known are the unpraiseworthy, to put it mildly, examples of the conduct of the state authorities towards the main creator of the plan of the Battle of Warsaw and the defender of Lwów - Gen Tadeusz Rozwadowski or Gen Pil Włodzimierz Zagórski. Many officers did not experience so much persecution, but definitely were not given due recognition by their superiors for non-essential reasons. Col Jan Krusiewicz, PhD created one of the best military hospitals of the Second Polish Republic, participated in the Polish-Soviet War in 1920. He was on the front line in fighting with the epidemics of infectious

diseases (his predecessor died because of typhoid fever); however, despite such unquestionable merits, he was never awarded any military decorations. It should be admitted with humility that the Russian Tsar cared more for his physicians and presented them with many orders for their commitment. In this case, i.e. the attitude of military superiors towards physicians, a good solution would be to imitate the Russian emperor, which was not so common in an army in which medics are neglected. Maybe it was the effect of the insufficiently gracious attitude of Polish commanders towards former Red Army officers (but not only). Possibly the legions, i.e. soldiers of the former Austrian army, were more recognized. This was neither reasonable nor justified. After all, one should remember that credit for the greatest victory of the Polish Army in the 20th century, that is victory over Soviet Russia in 1920, should go to the generals and officers, Polish patriots, who acquired military knowledge and experience from their oppressors to defeat the partitioning countries and win independence at the right time. There is no doubt that one of such officers was Col Józef Krusiewicz, PhD, anonymous and forgotten, but also the founder and first commandant of one of the ten most important military hospitals in Poland in the interwar period. The adventures and experience he gained while taking part in several armed conflicts (China, Japan, the Great War, the war with Russia in 1920), and during his numerous travels to remote destinations, could be easily shared with several other figures. His life would make a perfect screenplay or an interesting historical story. It is high time to restore the collective memory of such an honored and brave military physician, because he is worth it.

Literature

1. Sroka J. Brześć-dzieje miasta i twierdzy. [Brześć – history of the city and the citadel]. Biała Podlaska 1997: 82 -86
2. Goszcz K, Więckowski J, Zieliński W. Kronika m. Brześcia nad Bugiem [Chronicle of Brześć nad Bugiem]. Brześć nad Bugiem 1930: 49 -84
3. Felchner A. Pod znakiem Eskulapa i Marsa Służba zdrowia Wojska Polskiego (od jesieni 1918 r. do mobilizacji w 1939 r.) [Under the sign of Aesculapian and Mars. Health services of the Polish Army (since autumn 1918 until mobilisation in 1939)]. Napoleon V Publishing House, Oświęcim 2016: 81 97 -98 249
4. Central Military Archive (CAW) in Warsaw: AP-11511, AP-14737, 1.301.17.9,1.371.4.12
5. Kalendarz Informator Płocki [Płock Calendar]. Kupców Płockich Chrześcijańskich Publishing House, Płock 1899: 34-35, 52-53
6. Materiały dokumentalne, udostępnione dzięki uprzejmości Bohdana Krusiewicza [Documentary references made available by courtesy of Bohdan Krusiewicz].
7. Jeśman Cz. Choroby zakaźne w Wojsku Polskim w latach 1918-1939 jako zagadnienie epidemiologiczne i profilaktyczno-lecznicze. [Infectious diseases in the Polish Army in the years 1918-1939 as an epidemiological, prophylactic and medicinal issue] Habilitation thesis. Łódź 1997 22, 37, 46
8. Kopociński K, Kopociński Z. Zarys organizacji i działalności IX Szpitala Okręgowego w Brześciu nad Bugiem w latach 1920-1939 [An outline of organisations and activity of the 9th Regional Hospital in Brześć nad Bugiem in the years 1920-1939]. In: Meissner R, (ed.) Medycyna i farmacja XIX i XX wieku [Medicine and pharmacy in the 19th and 20th centuries]. Poznań 2007: 194 -198
9. Kryska-Karski T, Żurakowski S. Generałowie Polski Niepodległej [Generals of the independent Poland]. London, 1976:

Colonel (retd) Professor Sylwester Czaplicki (1925-2016)

Płk w st. spocz. prof. dr hab. n. med. Sylwester Czaplicki (1925-2016)

The 1970s saw Professor Czaplicki working in a popular hospital on Szaserów Street. This was a time full of glory for the hospital, while under the supervision of Prof. Czaplicki. It was first converted from 2nd Central Clinical Hospital of the Military Medical Academy into the Postgraduate Education Institute and then later into the Postgraduate Education Centre of the Military Medical Academy (CKP WAM), the hospital where the personnel policy of the time began to develop, to which the best graduates of the Military Medical Academy were immediately directed, even without giving several years of service in a military unit, and where they had an opportunity for fast professional and scientific development. However, CKP WAM was not only serving them, it was visited twice a year by military physicians from all over Poland for three-month attestation courses. They were accommodated in the dormitory on Garwolińska Street, where they also prepared for a specialty examination. Those who passed the examination with the best results were offered a job at the hospital on Szaserów Street or other military hospitals. All this helped to establish both the reputation of the hospital and that of military medicine in its entirety.

Professor Czaplicki was born on 4 January 1925 in Bartołty near Olsztyn. As a child, he moved with parents to Warsaw where he completed underground secondary education during the Second World War. During the last two years of the war his family moved several times to and from Warsaw, and then just after the war he was drafted into the army and decided to start medical studies at UMCS in Lublin as part of the Faculty of Military Medicine. After less than three years, he continued his medical studies at the Medical Faculty of the University of Warsaw, from where he graduated in 1950 (at that time the University had changed its name to Medical Academy). Shortly thereafter, he began his service at the Central Clinical Hospital of the Ministry of National Defence at Koszykowa Street under the supervision of the following professors, in date order: Fejgin, Kędra and Bober, while being on 1958-1964 an Assistant Professor at the Clinic of Internal Medicine of the Central Clinical Hospital. After obtaining a specialty in internal diseases and cardiology in 1961, he completed his PhD. In 1964, after the opening of the 2nd Central Clinical Hospital of the Military Medical Academy in Grochów, he became Head of the 3rd Department of Internal Diseases (later transformed into the Clinic). He received a postdoctoral degree in 1968, the title of associate professor was then conferred upon him in 1974 and that of full professor in 1980. From 1972 he was the Commandant of the Postgraduate Education Institute of the Military Medical Academy (two years later converted into the Postgraduate Education Centre of the Military Medical Academy (CKP WAM)) and Chairman of its Scientific Board.

He resigned from this function in 1983 due to organizational changes, which confined the development to some extent, imposed by the General Quartermaster Corps of the Polish Army, but remained the Head of the Clinic. In 1984-1990, he was also Chief Internist in the Polish Army. He belonged to the Polish Medical Association, Polish Society of Internal Medicine, Polish Cardiac Society, Committee on Clinical Pathophysiology of the Polish Academy of Science, Central Qualifying

Committee for Academic Staff and Main Council of Science, Higher Education and Technology. For many years he was a chief editor of "Wiadomości Lekarskie" [Medical News] (1975-1979) and "Polski Tygodnik Lekarski" [Polish Medical Journal] (1980), and for twenty years he was an editor of "Military Physician". For his merits he was awarded with many orders and decorations, including the Commander's and Knight's Cross of the Order of Polonia Restituta, Medal of the Commission of National Education, 2nd degree award of the National Atomic Energy Agency, title of Meritorious Physician of the People's Republic of Poland, Polish Red Cross Decoration of Honor and Cross of Merit for the ZHP. Also, a degree honoris causa of the Military Medical Academy was conferred upon him.

He retired in 1990, but still belonged to the Scientific Board of the Central Clinical Hospital of the Military Medical Academy and after that of the Military Medical Institute until 2015. He wrote nearly 200 scientific works concerning various areas of internal medicine. He was an author or co-author of eight books and guides concerning cardiology (mainly electrocardiographic diagnostics) read by generations of internists and cardiologists from all over Poland, some of which were reissued several times. His most popular books were "Diagnostyka elektrokardiograficzna" [Electrocardiographic diagnostics] and "Graficzne metody badania układu krążenia" [Graphic methods of examining the cardiovascular system]. He supervised a dozen PhD degree physicians and several holders of post-doctoral degrees. Over twenty internists and cardiologists owe their education to him.

Professor Czaplicki had an outstanding and strong personality. He demonstrated all leadership features and was a true commander, not on a battlefield, but at work. It would be difficult to name all these features, but the most visible were decisiveness, a methodological approach to problem solution, and consistent actions. He knew what he wanted and achieved his goals in stages, consistently. Other people's advice rarely interested him, but when asking for it, he definitely put it to good use. He was extremely hard-working, taking very short breaks and working very quickly. While performing many social and professional functions, and spending time on scientific works, he had no time for rest or a social life. As an editor of journals and the author of his own works, he was not in the habit of looking at them again - he was confident the text was very good. He paid a lot of attention to the purity of the Polish language and therefore he fought against macaronic language. He rarely relied on reviewers' assistance because he had broad knowledge and great experience in various areas of internal diseases. The articles sent to his journals did not wait long to be published.

His attitude to subordinates is also noteworthy. He was a righteous and demanding person (demanding from himself even more than from others). He was also a man of principles. Being honest himself, he required the same from his colleagues. He could not stand dodging, kept his promises, even though that proved difficult at times, and respected his employees regardless of their professional status. As Head of the Hospital, he still had time to listen to technical and auxiliary personnel. He knew how to defend his subordinates and was loyal to them. While appreciating progress, he always emphasized that the most important investment is the development of people, which is why he followed people's careers, especially of young physicians. He started the so-called "gold fund", i.e. a developmental path for young medical officers which at the very beginning helped to describe which path a physician would choose and what career would (s)he make if they worked hard. This path also included quicker than usual promotions to further military ranks. As Chief Internist of the Polish Army, he played a significant part in the development of this field of medicine and in shaping the attitudes of military doctors. The feeling of envy and keeping things to himself were alien to him. He inspired young physicians and supported them in their careers, which is best proved by the fact that many of his students or postgraduate students became professors, and heads of clinics and departments.

He was never part of any coterie or any system whatsoever, but a truly independent person, who clearly presented his stance and never changed it for anything but a good reason. This also lay behind his disagreements with superiors, who tried to impose on him their ideas concerning areas of hospital management of the military health service in which he felt most competent. As a long-standing Commandant of the Postgraduate Education Centre of the Military Medical Academy, he played a vital role in its functioning and, at the same time, the specialist training of military physicians. Thousands of physicians worked in our facility thanks to him. Unfortunately, a number of decisions of the then superiors destroyed and undermined the role of the hospital. The straw that broke the camel's back was the liquidation of the Military Medical Academy (the Professor even planned to move the University to the hospital on Szaserów Street).
He had a sense of humor, which he enjoyed in the family home and improved even more by wearing an officer's uniform, which he really appreciated. In our memory, of students and subordinates, Professor Sylwester Czaplicki set an example as a man of deeds, great courage and professional achievements, a great clinician and cardiologist, teacher of many generations of physicians, rightful commander, honorable officer and good man. Honor his memory!

Students and subordinates