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1) On the first page: main title in Polish and English, Author's or Authors' (max. 10 people) first and last names, including academic degrees, full name of affiliated institute (institutes), head of the institute (academic degree, first and last name), below an abstract (up to 15 lines) with keywords in Polish and another abstract with keywords in English, corresponding author, his/her postal address with postal code, telephone (fax) and e-mail address.

2) Main text

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.

Abbreviations and acronyms should be defined when first mentioned in the text and consequently used in the paper.

3) References should be presented according to the order they appear in the text (names of authors or name of the collaborative non-serial publication). If there are many authors, the first three should be named, followed by "et al.", if there are four authors - all authors should be listed. References should be numbered using the keyboard, please do not use automatic numbering. Examples of citations:

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Calpin C, Macarthur C, Stephens D., et al. Effectiveness of prophylactic inhaled steroids in childhood asthma: a systemic review of the literature. J. Allergy Clin. Immunol., 1997; 100: 452-457

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Rudzki E.: Alergia na leki: z uwzględnieniem odczynów anafilaktycznych i idiosynkrazji. Lublin, Wydaw. Czelej, 2002: 338-340

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The list of references should include only those publications that were used by the Author and should be reduced to 20. All references should be cited in the text and the numbers of references should be put in square brackets. In order to avoid errors, titles should be copied from medical databases.

7. The paper should be accompanied by: a) author's request to publish the paper with a declaration that the article has not been published before and not simultaneously submitted to any other journal b) approval of the head of the clinic, head of the department or head of the institute in which the research has been conducted, and in case of a study carried out in several centers - approval of all of them, c) Declaration of Conflict of Interest, d) acknowledgements, if applicable.

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9. The Author receives 1 free copy of the issue in which his or her article has been published. For further copies, contact the Editor.

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CONTENTS

2014, vol. 92, no. 4

ORIGINAL ARTICLES

CASE REPORTS

CONTENTS

REVIEW ARTICLES

HISTORY OF MILITARY MEDICAL SERVICES

CONTENTS

2014, tom 92, nr 4

PRACE ORYGINALNE

PRACE KAZUISTYCZNE

PRACE POGLĄDOWE

CONTENTS

HISTORIA WOJSKOWEJ SŁUŻBY ZDROWIA

Reasons for the medical evacuation of Polish soldiers deployed to the Balkans, Middle East and Sub-Saharan Africa

Przyczyny ewakuacji medycznych polskich żołnierzy pełniących służbę na Bałkanach, Bliskim Wschodzie i w Afryce Subsaharyjskiej

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Abstract. The article presents the results of a study into the causes of medical evacuations (Medevacs) for soldiers serving in the Polish Military Contingent (PMC) deployed to the Balkans, the Middle East and Sub-Saharan Africa between 2006 and 2013. The authors have conducted a retrospective analysis of the medical records collected from 162 PMC soldiers deployed to Kosovo, Bosnia, Iraq, Lebanon, Syria, Chad and Mali who required medical evacuation out of the theater of operations before the scheduled termination of their 6-month tour of duty. The analysis was carried out on the basis of the structure and intensity rate of per 1,000 individuals. The study demonstrated that the majority of medical evacuations from all three areas of the world were due to non-battle injuries. A substantial number of medical evacuations were due to chronic diseases developed prior to deployment. The most common health problems leading to evacuation of military personnel were non-battle related injuries suffered while carrying out professional duties. A carelessly performed pre-deployment health assessment was an essential factor influencing the number of Medevacs.
Key words: medical evacuations, Polish soldiers, military operations

Streszczenie. Cel: W pracy dokonano oceny przyczyn ewakuacji medycznych żołnierzy Polskich Kontyngentów Wojskowych (PKW) pełniących służbę na Bałkanach, Bliskim Wschodzie oraz w Afryce Subsaharyjskiej w latach 2006–2013. Materiał i metody: Przeprowadzona analiza retrospektywna została oparta na dokumentacji medycznej 162 żołnierzy PKW stacjonujących w Kosowie, Bośni, Iraku, Libanie, Syrii, Czadzie i Mali, którzy z powodu problemów zdrowotnych zostali poddani repatriacji do Polski przed planowym ukończeniem 6-miesięcznej służby na teatrze działań. Analizę przeprowadzono na podstawie wskaźnika struktury oraz wskaźnika natężenia w przeliczeniu na 1000 osób. Wyniki: Badania wykazały, że najczęstszą przyczyną ewakuacji medycznych we wszystkich trzech regionach świata były urazy niebojowe. Uwagę zwracały również liczne ewakuacje z powodu chorób przewlekłych, nabytych przez żołnierzy przed wyjazdem w rejon operacji. Wnioski: Występowanie problemów zdrowotnych prowadzących do konieczności ewakuowania żołnierzy było związane głównie z urazami doznanymi podczas wykonywania obowiązków służbowych. Istotny wpływ na liczbę ewakuacji medycznych miała zbyt powierzchowna kwalifikacja zdrowotna kandydatów do służby poza granicami państwa.
Słowa kluczowe: ewakuacje medyczne, polscy żołnierze, operacje wojskowe

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Introduction

The Polish Armed Forces have been participating in international peacekeeping and stabilization operations for the last 60 years, mainly in Europe, Asia and Africa. Polish Military Contingents have been engaged in the NATO-led military operations in Kosovo in the Balkans (KFOR, *Kosovo Force*) as well as in Bosnia and Herzegovina (EUFOR, *European Union Force*). So far, Poland has made its greatest military contribution in supporting the mission in Afghanistan, with the Polish troops to be withdrawn by the end of 2014. Polish soldiers were also involved in military operations carried out in the Middle East – they participated in a stabilization mission in Iraq until 2008 as well as in the UN-led operations in Lebanon and Syria until 2009. Over the last few years, Polish Military Contingents have also supported military operations in Sub-Saharan Africa: in Chad (2008-2009) and Mali (since 2013) [1,2].

The main tasks of Polish personnel deployed to the Balkans involved overseeing the implementation of a peace treaty, preventing escalation of ethnic conflicts, protecting local government, seizing control of illegal arms caches, and protecting humanitarian aid convoys [3]. Poland has made a significant contribution to supporting international forces fighting in Iraq (the Middle East), where the Polish Military Contingent was deployed between 2003 and 2008. The PMC personnel were involved in supervising the restoration of law and order in the Polish area of responsibility, training the Iraqi army and police, providing humanitarian assistance within the available resources, rebuilding schools, medical treatment facilities, roads and bridges [4]. Polish Armed Forces were also involved in the UN-led peacekeeping operations carried out in Southern Lebanon and the Golan Heights (Syria), where they executed logistical and engineering tasks (organization of transport, construction of bridges, and mine clearing) and provided humanitarian assistance [5]. In Africa, Polish soldiers were mainly responsible for maintaining stability in their area of responsibility as well as protecting and ensuring the travel safety of NGO workers providing humanitarian aid to refugees and local people [6]. A small Polish contingent was also involved in a recently launched military operation in Mali, where they executed a variety of logistical tasks.

Personnel undertaking military duties or fulfilling mandated tasks in areas characterized by harsh environmental conditions are at higher risk of serious disease or injury. Hot climatic conditions, poor standards of sanitation as well as ongoing hostilities result in the increased prevalence of injury and disease among military personnel. Soldiers requiring medical assistance in an area of operations can be treated both on an in-patient and an out-patient basis. Some of the soldiers, however, are unable to continue military service in operational conditions and, therefore, should be medically evacuated out of the theater to their home country.

The aim of this article was to analyze the causes behind the medical evacuations in the populations of soldiers serving in the Polish Military Contingents deployed to the Balkans, the Middle East and Sub-Saharan Africa.

Material and methods

The retrospective analysis was conducted on the basis of medical records collected from 162 soldiers of the Polish Military Contingents deployed to Kosovo, Bosnia, Iraq, Lebanon, Syria, Chad and Mali, who were medically evacuated out of their theaters of operations before the scheduled termination of their 6-month tour of duty, between 2006 and 2013. The analysis was carried out on the basis of a structure and intensity rate per 1,000 individuals. 17,621 Polish soldiers were relocated to the Balkans, the Middle East and to Sub-Saharan Africa in the given period. The study population was of an accidental composition (no selection). The data following collection were then presented in the form of figures and tables. The most common health problems were analyzed in line with the ICD-10 classification: infectious diseases, psychiatric disorders, neurological, cardiovascular, respiratory, gastrointestinal, skin, musculoskeletal, urogenital diseases, and injuries (battle and non-battle). Detailed diagnoses of particular disease entities were analyzed in compliance with the same classification. The basis for calculating the intensity rate was the number of hospital admissions according to the diagnosed diseases and injuries as a numerator, and the total number of soldiers of the examined population in the analyzed period used as a denominator, multiplied by the coefficient $C = 10^k$ ($k = 0, 1, 2, 3\ldots$, in the statistical analysis $k = 3$). The intensity rate was used to calculate the incidence of diseases and injuries per 1,000 individuals in the study population. STATISTICA PL software was used to calculate the final values.

Results

Out of a total of 17,621 soldiers serving in the Polish Military Contingents deployed to the Balkans, the Middle East and Sub-Saharan Africa in the period from 2006 to 2013, 162 were evacuated for medical reasons (9.2 evacuations per 1000 soldiers) (Table 1).

The Balkans

Of 5,268 Polish soldiers who participated in the EU-led military operations: KFOR (Kosovo) and EUFOR (Bosnia and Herzegovina), between 2006 and 2013 (Table 1), 46 were medically evacuated out of the operational areas before the scheduled termination of their 6-month tour of duty (8.7 cases per 1,000 soldiers). The majority of the evacuated soldiers had the rank of private (43.5%), and were aged 25-30 (43.5%). Figure 1 presents the structure of the causes for medical evacuations among the PMC soldiers deployed to the Balkans. The leading health problems in the population of Polish soldiers were non-battle related injuries (54.3%). The most common disease entities reported among the evacuated soldiers were bone fractures (14 cases) and joint sprains (8 cases). A number of the evacuated soldiers suffered from health problems for which they should not have been qualified for military service overseas (diabetes, discopathy, peptic ulcer, or urolithiasis). The most spectacular example of a carelessly performed pre-deployment health assessment was the medical evacuation of a soldier with advanced dental decay who required multiple (9) tooth extraction.

Table 1. Medical evacuations of the soldiers serving in the Polish Military Contingents deployed to the Balkans, the Middle East and Sub-Saharan Africa between 2006 and 2013 (n=162)

Polish Military Contingent	period	number of soldiers	number of evacuations	evacuation rate per 1000 soldiers
Balkans				
KFOR	2006–2013	3,792	27	7.1
EUFOR	2006–2009	1,476	19	12.9
Middle East				
Iraq	2006–2008	5,395	71	13.2
UNIFIL	2006–2009	3,500	15	4.3
UNDOF	2006–2009	2,562	16	6.2
Sub-Saharan Africa				
Chad	2008–2009	855	13	15.2
Mali	2013–	41	1	24.4
TOTAL	2006–2013	17,621	162	9.2

EUFOR – Bosnia and Herzegovina, KFOR – Kosovo, UNIFIL – Lebanon, UNDOF – Golan Heights

The Middle East

Of the 11,547 Polish soldiers taking part in the military operations carried out in the Middle East (Operation *Iraqi Freedom,* the UN-led mission in Lebanon – UNIFIL and in the Golan Heights – UNDOF) between 2006 and 2013 (Table 1), 102 were medically evacuated (8.8 cases per 1,000 soldiers). The majority of the evacuated soldiers had the rank of private (30.4%) and were aged 31–35 years (35.3%). Figure 2 presents the structure of the causes for medical evacuations among the PMC soldiers deployed to the Middle East. The dominant health problems reported during the given period were non-battle injuries (31.4%), psychiatric disorders (23.5%) and battle injuries (13.7%). The most common disease entities among the evacuated soldiers were psychiatric disorders (21 cases: acute stress disorder, adjustment disorder, anxiety/depressive neurosis), bone fractures (20 cases); joint sprains (8 cases), and shrapnel or gunshot wounds (7 cases). All of the reported battle injuries and the majority of psychiatric disorders were suffered by soldiers relocated to Iraq. Some of the evacuated soldiers suffered from health problems because that should not have qualified them for military service overseas (ischemic heart disease, neurosis).

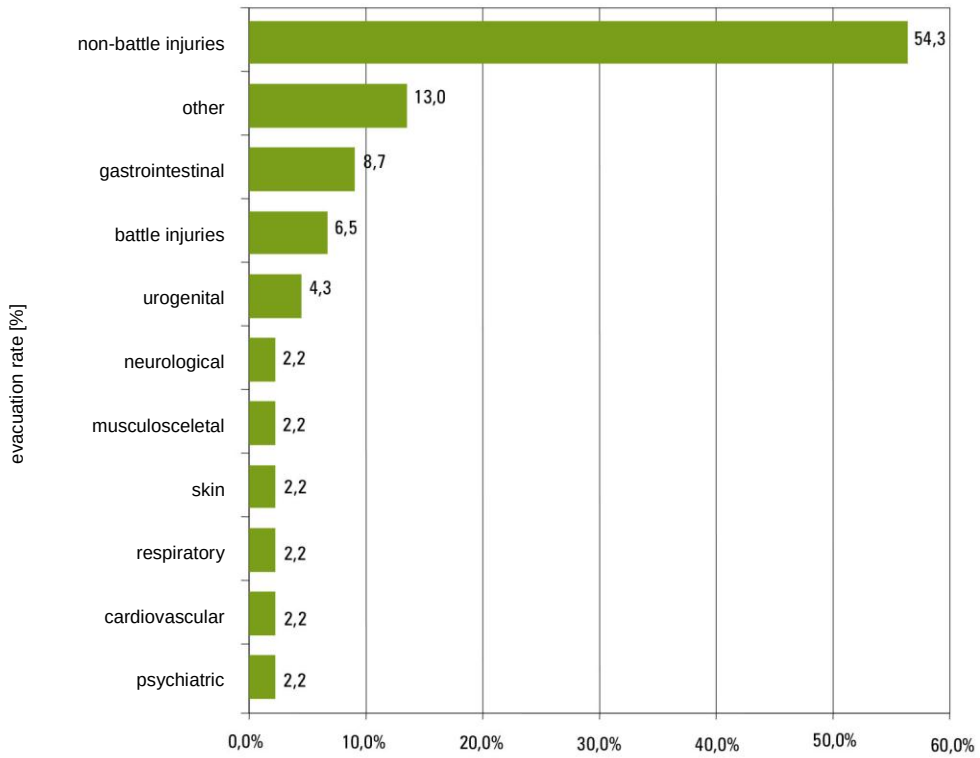

Figure 1. Causes for medical evacuations among the PMC soldiers deployed to the Balkans between 2006 and 2013 (n=46)

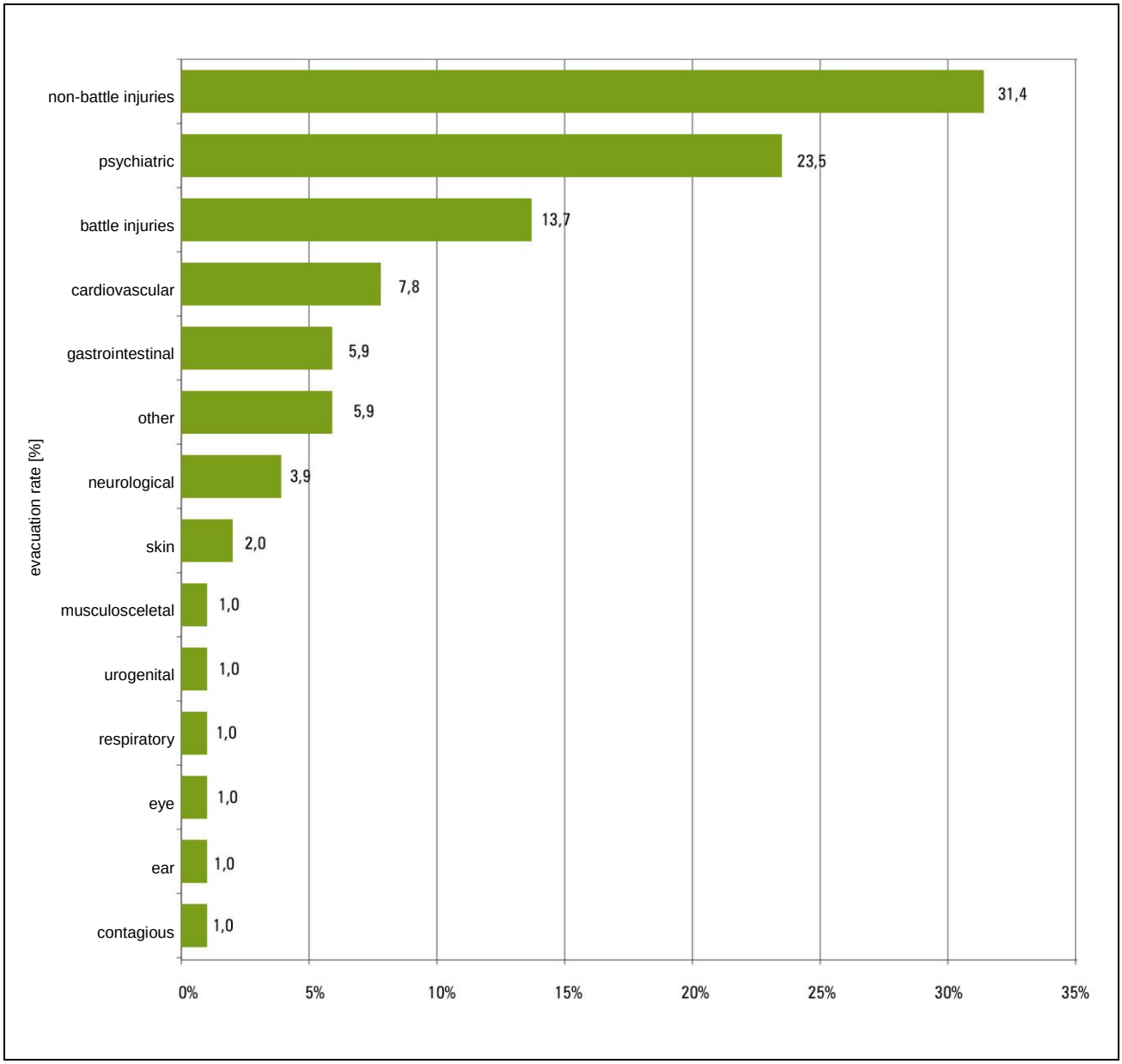

Figure 2. Causes for medical evacuations among the PMC soldiers deployed to the Middle East between 2006 and 2009 (n=102)

Sub-Saharan Africa

Of 896 Polish soldiers participating in military operations conducted in Sub-Saharan Africa (Chad and Mali) between 2008 and 2013 (Table 1), 14 were medically evacuated out of the operational zone to Poland (15.5 cases per 1000 soldiers). The majority of the evacuated soldiers had the rank of NCO (50.0%) and were aged 25–30 (57.1%). The structure of the causes for medical evacuations among the PMC personnel deployed to Sub-Saharan Africa is presented in Figure 3. Non-battle injuries were the leading health issues reported among Polish soldiers (57.1%). The most common health issues among the medically evacuated soldiers were joint sprains (4 cases) and bone fractures (3 cases).

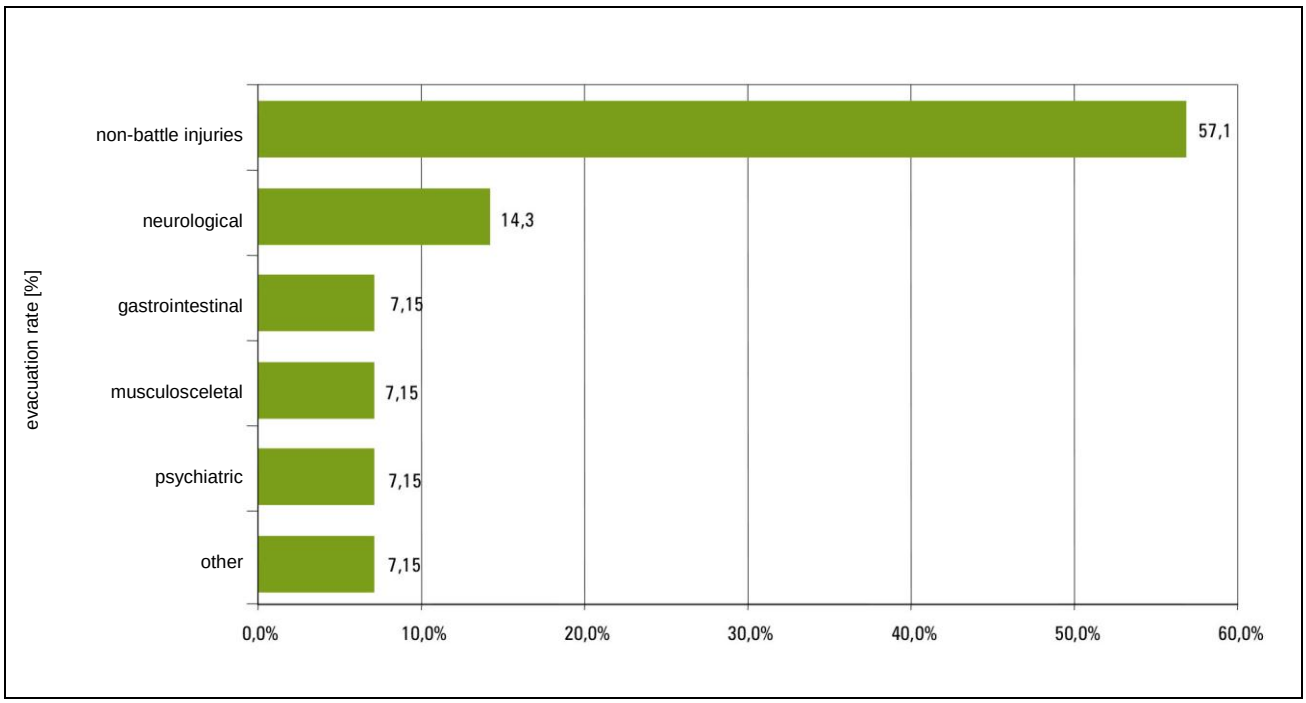

Figure 3. Causes for medical evacuations among PMC soldiers deployed to Sub-Saharan Africa between 2008 and 2013 (n=14)

Conclusions

The majority of medical evacuations from all three theaters, i.e. the Balkans, the Middle East and Sub-Saharan Africa, were due to non-battle injuries, the most frequently suffered while soldiers were carrying out their professional duties. A substantial number of medical evacuations were due to chronic diseases developed prior to deployment into the theater of operations overseas. A carelessly performed pre-deployment health assessment was an essential factor influencing the number of evacuations out of the areas of operations.

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Analysis of patients hospitalized in the Intensive Care Unit of the Military Institute of Medicine before and after opening the Mazowieckie Regional Trauma Center

Analiza pacjentów hospitalizowanych na Oddziale Intensywnej Terapii WIM przed i po uruchomieniu Mazowieckiego Centrum Urazowego

Katarzyna Szostakiewicz, Dariusz Tomaszewski, Adam Machowicz, Zbigniew Rybicki, Andrzej Truszczyński, Jarosław Rytwiński
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Abstract. The regional system of trauma centers reduces mortality rates and improves the outcomes of trauma patients all over the world. Such a system was initiated in Poland in 2011. The objective of this study was an analysis of changes in the patient structure in the Intensive Care Unit (ICU) of the Military Institute of Medicine (MIM) in Warsaw after the opening of the Mazowieckie Regional Trauma Center in 2011. The study involved a retrospective analysis of hospitalizations in the intensive care unit (ICU) at MIM before and after creating the trauma center. Patients treated in 2010 (control group) were compared to patients treated in the years 2011–2013 (test group). The age and duration of treatment at the ICU did not vary.

In the years 2011-2013, males significantly dominated. In the years 2011-2013, the number of trauma patients treated at the ICU increased (2011: p=0.02, 2012: p=0.001, 2013: p=0.001). The number of patients with severe injuries also increased. Isolated head injuries were at a similar level. During the development period the mortality of trauma patients significantly decreased, to 17.7% (p=0.0317) in 2013. In the study period, overall mortality did not change significantly.

Upon the establishment of the Mazowieckie Regional Trauma Center the number of trauma patients at the ICU increased. The mortality of patients after severe injuries decreased. Trends observed in our center are consistent with the data published in the world.

Key words: intensive care unit, mortality, trauma center, trauma patient

Streszczenie. Funkcjonowanie systemu regionalnych centrów urazowych zmniejsza śmiertelność i poprawia wyniki leczenia pacjentów po urazach na całym świecie. W Polsce system ten rozpoczął funkcjonowanie w 2011 roku. Cel: Celem badania była analiza struktury chorych leczonych na Oddziale Intensywnej Terapii Wojskowego Instytutu Medycznego w Warszawie (OIT WIM) po uruchomieniu w 2011 roku Mazowieckiego Centrum Urazowego. Materiał i metody: Retrospektywna analiza hospitalizacji na OIT WIM przed utworzeniem centrum urazowego oraz po jego utworzeniu. Pacjentów leczonych w 2010 roku (grupa kontrolna) porównano z chorymi leczonymi w latach 2011–2013 (grupa badana). Wyniki: Wiek chorych i czas hospitalizacji na OIT nie różniły się. W latach 2011–2013 istotnie przeważali mężczyźni. Wśród chorych leczonych na OIT WIM w latach 2011–2013 zwiększyła się liczba pacjentów leczonych z powodu urazów (p dla lat 2011, 2012, 2013 odpowiednio: 0,02, 0,001, 0,001). Leczono więcej pacjentów z ciężkimi i bardzo ciężkimi obrażeniami. Liczba izolowanych urazów głowy nie zmieniła się. W trakcie rozwoju centrum znamiennie zmniejszyła się śmiertelność pacjentów po urazach – w 2013 roku wynosiła 17,7% (p 0,0317). Nie zmieniła się śmiertelność ogólna chorych. Wnioski: Po rozpoczęciu działalności Mazowieckiego Centrum Urazowego na OIT WIM zwiększyła się liczba pacjentów leczonych z powodu ciężkich obrażeń pourazowych. Zmniejszyła się śmiertelność chorych po urazach. Trendy obserwowane w naszym ośrodku są zgodne z danymi publikowanymi na świecie.

Słowa kluczowe: centrum urazowe, oddział intensywnej terapii, pacjent po urazie, śmiertelność

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Introduction

Trauma is one of the main causes of death in people aged up to 45 years [1-3]. Globally, the incidence of trauma is increasing [1-4], and associated mortality is increasing proportionately to the severity of the injuries and age of the patient [1,5]. The consequences of severe trauma include: inability to work and the need for long-term rehabilitation. It is a serious medical and social problem, and it constitutes a financial burden for national health care systems [2,4]. In the USA, 59.8 per 100,000 people die each year due to trauma, and 180,000 people per year die as a result of severe injuries. In the Netherlands, 110,000 people per year require urgent hospitalization due to trauma [5]. In Poland, approximately 2 million people per year suffer body injuries as a result of accidents. Approximately 30,000 of them die, which accounts for 6.5% of the overall number of deaths per year [6].

The integrated emergency service system is based on multi-specialty regional trauma centers (TC). In all countries where such a system has been implemented, an improvement has been achieved in the outcomes of the treatment of severely injured patients. In the United States and in Europe regional trauma centers started operating in the 1990s. After the introduction of a system based on regional centralization of specialist trauma treatment, mortality among trauma patients was reduced by 5-48% [1,4,5,7-9,10].

Such significant improvements in the treatment outcomes in trauma patients were achieved thanks to organizational changes introduced in the hospitals [11,12], improved patient triage [3,5], and the development of protocols in diagnostics and treatment [1,4,13,14].

The aim of the comprehensive treatment of trauma patients in a multi-specialty center is to reduce high post-trauma mortality and disability. Another advantage of regional trauma centers is the reduction in the number of avoidable deaths, with a coefficient of 2.5-25% [1,2,9,15], due to the procedures for trauma patient treatment followed in these centers reducing the risk of human error [1,2,9,15]. In the literature it is also emphasized that beds are better utilized in intensive care units (ICU) of trauma centers, and the hospitalization period is also reduced [4,9,10]. It has been confirmed that experienced intensive care specialists achieve better treatment outcomes than doctors specializing in other fields, which is reflected in the lower mortality of patients in critical condition [16,17].

Trauma centers in Poland were established on 18 June 2010, by a Ministry of Health resolution [18] as a complement to the Act of 8 September 2006 on State Emergency Medical Services [19,20]. According to this resolution, operating multi-specialty hospitals constitute the basis for the development of a network of thirteen evenly distributed trauma centers, in: Warsaw, Gdańsk, Białystok, Bydgoszcz, Olsztyn, Łódź, Lublin, Krakow, Rzeszów, Sosnowiec, Wrocław, Poznań and Zielona Góra. All the centers were expected to be fully operational before 31 December 2013.

The Ministry of Health resolution on trauma centers specifies requirements as to the accommodation, equipment and personnel, as well as qualification criteria and management of trauma patients. Following initial diagnostics and necessary surgical procedures at the accident and emergency department (A&E) of the trauma centers, patients in severe condition are transferred to the ICU to continue treatment.

To provide comprehensive therapy of trauma patients from the Mazowieckie region, the Mazowieckie Regional Trauma Center was created on the basis of the Military Institute of Medicine. It provides services for approximately 3 million people living in the region. The Mazowieckie Regional Trauma Center started operating at the beginning of 2011, on the basis of the existing equipment and personnel of the Military Institute of Medicine (MIM). By November 2011 its equipment had been upgraded, with over 11 million PLN being spent to adapt the hospital to meet the requirements of the center. The Trauma Center at MIM, according to its definition, should provide comprehensive diagnostics and multi-specialty treatment to patients from the Mazowieckie voivodeship, whose lives and health are at risk due to severe, multiple or multiorgan injuries resulting from an external cause (accident or catastrophe). It is also a designated place of treatment for soldiers injured during missions of the Polish Military Contingent, as a fourth level medical treatment unit.

Aim of the study

The aim of the study is to compare the structure of patients treated at the ICU in 2010, when the ICU functioned as part of a multi-specialty hospital, and the situation in the years 2011-2013, after the Mazowieckie Regional Trauma Center opened at the Military Institute of Medicine.

Material and Methods

Retrospective analysis of the data relating to the hospitalization of all patients treated at the ICU of the Military Institute of Medicine in the period between January 2010 and December 2013. Patients treated in 2010 constituted the control group, and were used to establish a profile for patients treated at the ICU of the Military Institute of Medicine before the opening of the trauma center. Patients treated in the years 2011-2013 constituted the study group. The three years of functioning of the Mazowieckie Regional Trauma Center selected for this analysis reflect changes and

the development of the multi-specialty hospital and the gaining of experience.

The analysis comprised: number of hospitalizations at the ICU, age and sex of the patients, causes for hospitalization according to the ICD-10 classification, and the patients' history after treatment at the ICU. Trauma patients were identified, and their types of injuries were analyzed.

Hospitalization data in the years 2010-2013 were collected prospectively with the use of the Windows Access 2008 program, and archived for retrospective statistical analysis in Microsoft Excel 2013.

Statistical analysis

The R program was used for statistical analysis [20], and descriptive statistics were used. To analyze distribution for the variables "patients' age" and "duration of hospitalization at the ICU", the following normality test were used: Kolmogorov-Smirnov test (KS) and Shapiro-Wilk test (SW). To compare the number of patients hospitalized in different years at the ICU due to trauma, and the sex of patients treated at the ICU in different years, the $\chi 2$ test was used, whereas to compare the duration of hospitalization of patients in various years the Mann-Whitney U test was used.

The level of significance was established at $p<0.05$.

Figures were prepared with the use of the ggplot2 package [21].

Results

The data involved a total of 752 patients. 175 patients were treated in 2010 (23%), 224 patients in 2011 (30%), 179 in 2012 (24%), and 174 patients in 2013 (23%). The population analyzed was predominantly male – 485 males (64.5%) and 267 females (35.5%).

In 2010, 97 males and 78 females were treated at the ICU, while for the next three years the numbers were as follows: 148 males and 76 females in 2011, 122 males and 57 females in 2012, and 118 males and 56 females in 2013.

Compared to 2010, significantly more patients treated at the ICU were male in the years 2011, 2012 and 2013 (p=0.0468; 0.018; 0.0274, respectively).

Table 1 presents data concerning the age of the patients and duration of treatment at the ICU.

Table 2 presents the diagnosis (according to ICD-10) established during patient admission to the ICU; the data comprise all the analyzed patients. For the purpose of this study, trauma patients are those whose diagnosis (according to ICD-10) was classified as "S" or "T".

The number of patients with injuries suffered due to trauma compared to all the patients treated at the ICU was: 2010: 46/175 (26.2%), 2011: 84/224 (37.5%), 2012: 77/179 (43%), and 201: 77/174 (44.2%). This means that, compared to the year 2010, the number of trauma patients increased significantly (p-values for the years 2011, 2012, 2013 were 0.02; 0.001; 0.001, respectively). Among the trauma patients requiring treatment at the ICU, soldiers injured during Polish Military Contingent missions constituted: 2010: 2.17%, 2011: 1.19%, 2012: 1.29%, and 2013: 1.29% of all the trauma patients. Therefore, following the establishment of the trauma center, the ratio of trauma patients to all the patients treated at the ICU in a given year gradually increased: in 2011 by 11.5%, in 2012 by 16.8%, and in 2013 by 18%, while the number of soldiers treated for post-trauma injuries remained similar (Fig. 1.).

Table 1. Patient age and duration of hospitalization at the ICU
Tabela 1. Wiek pacjentów oraz długość hospitalizacji na OIT

year		median	min.	max.	Q1	Q3	95% CI for median
2010	age	58	18	95	42	71	55-62
	duration of hospitalization	7	0	137	2	16	5-8
2011	age	53	16	92	37	70	50-59
	duration of hospitalization	6	0	126	2	14	5-7
2012	age	54	16	89	30	65	46-58
	duration of hospitalization	8	0	107	3	19	7-10
2013	age	54	14	88	32	67	51-60
	duration of hospitalization	7	0	211	3	16	6-9

Table 3 presents data on the types of injuries suffered by the trauma patients treated at the ICU.

In the analysis, severe injuries included multiorgan injuries, whereas very serious injuries comprised multiorgan injuries accompanied by a head injury. In the years 2011-2013, an increase in the number of patients with severe and/or very serious injuries was observed. All patients with the above injuries required mechanical ventilation.

The data in Table 3 demonstrate that, compared to 2010, in 2013 the number of patients with multiorgan injuries accompanied by a head injury – that is with injuries qualified as the most serious – increased by over 100%. The greatest increase in the number of patients with multiorgan injuries without head injuries was observed in the years 2011 and 2012. The number of patients with isolated head trauma remained at the same level, except for 2011, when it was the lowest (Fig. 2).

During the development of a trauma center created on the basis of the Military Institute of Medicine, the number of patients who, after preliminary injury treatment, were transferred from the A&E department to continue treatment at the ICU gradually increased. A total of 19 patients were transferred in 2010 (41.3%), 23 in 2011 (27%), 28 in 2012 (36.4%), and

Table 2. Clinical diagnosis, according to ICD-10, made on patients' admission to the ICU
Tabela 2. Rozpoznania wg ICD-10 ustalone przy przyjęciu pacjenta na OIT

diagnostic group	2010	2011	2012	2013
A	0 (0.0%)	0 (0.0%)	2 (1.1%)	1 (0.6%)
infectious and parasitic diseases	1 (0.6%)	1 (0.4%)	0 (0.0%)	0 (0.0%)
B				
C neoplasms	31 (17.7 %)	31 (13.8%)	19 (9.5%)	30 (17.2 %)
D diseases of the blood	6 (3.4%)	5 (2.2%)	6 (3.6%)	4 (2.3%)
E metabolic diseases	2 (1.1%)	2 (0.9%)	0 (0.0%)	1 (0.6%)
G diseases of the nervous system	3 (1.7%)	2 (0.9%)	2 (1.1%)	2 (1.1%)
H diseases of the eye, ear and mastoid process	1 (0.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
I diseases of the cardiovascular system	19 (10.9%)	25 (11.1%)	23 (12.8%)	13 (7.5%)
J respiratory diseases	19 (10.9%)	27 (12.0 %)	18 (10.1%)	9 (5.2%)
K diseases of the digestive system	25 (14.3%)	20 (8.9%)	13 (7.3%)	19 (10.9%)
L diseases of the skin and subcutaneous tissue	0 (0.0%)	0 (0.0%)	1 (0.6%)	2 (1.1%)
M diseases of the musculoskeletal system and connective tissue	3 (1.7%)	1 (0.4%)	2 (1.1%)	2 (1.1%)
N diseases of the genitourinary system	2 (1.1%)	7 (3.1%)	4 (2.2%)	3 (1.7%)
R diseases and symptoms not elsewhere classified	8 (4.6%)	9 (4.0%)	5 (2.8%)	7 (4.0%)
S	12 (6.9%)	12 (5.3%)	9 (5.0%)	17 (9.8%)
Injury, poisoning and other	34 (19.4%)	72 (32.0%)	68 (38.0%)	60 (34.5%)
consequences of external causes	1 (0.6%)	4 (1.8%)	1 (0.6%)	0 (0.0%)
T	5 (2.9%)	0 (0.0%)	4 (2.2%)	0 (0.0%)
V	1 (0.6%)	4 (1.8%)	1 (0.6%)	0 (0.0%)
W	2 (1.1%)	2 (0.9%)	1 (0.6%)	2 (1.1%)
external causes of disease and death				
X				
Y				
no data	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.1%)
in total	175	224	179	174
including trauma-induced ("S" and "T" according to ICD-10)	46 (26.3%)	84 (37.3%)	77 (43.0%)	77 (44.3%)

37 in 2013 (48% of all the trauma patients admitted to the ICU). Patients admitted directly from the A&E department in the analyzed period of 2010-2013 accounted for 10.8%, 10.2%, 15.6% and 21.2%, respectively, of the total number of patients treated at the ICU in a given year.

Figures 3-6 present the history of patients after their treatment at the ICU.

In the periods analyzed, the overall mortality of patients treated at the ICU ranged from 36% in 2010 and 2011, to 34.1% in 2012, and 32.2% in 2013. These changes, compared to 2010, were not statistically significant (p-value: 1.0; 0.7891 and 0.5228, respectively).

The situation is different regarding patients treated at the ICU due to post-traumatic injuries. In the period analyzed, after the creation of the trauma center, the mortality ratio constantly decreased. The mortality rates among trauma patients in the years 2010, 2011, 2012 and 2013 were: 33.3%, 34.1%, 27.3% and 17.7%, respectively.

Table 3. Spectrum of injuries of the traumatic patients hospitalized at the ICU
Tabela 3. Rodzaje obrażeń u pacjentów po urazach

	2010	2011	2012	2013
MOIHI – multiorgan injury accompanied by head injury	11 (24.4%)	11 (16.4%)	17 (25.8%)	32 (51.6%)
MOI – multiorgan injury	25 (55.6%)	52 (77.6%)	45 (68.2%)	26 (41.9%)
HI – isolated head injury	3 (6.7%)	3 (4.5%)	4 (6.1%)	4 (6.5%)
TERM – burn	4 (8.9%)	1 (1.5%)	0 (0.0%)	0 (0.0%)
HANGING	2 (4.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
OTHER INJURIES	1	17	11	15
in total	46	84	77	77

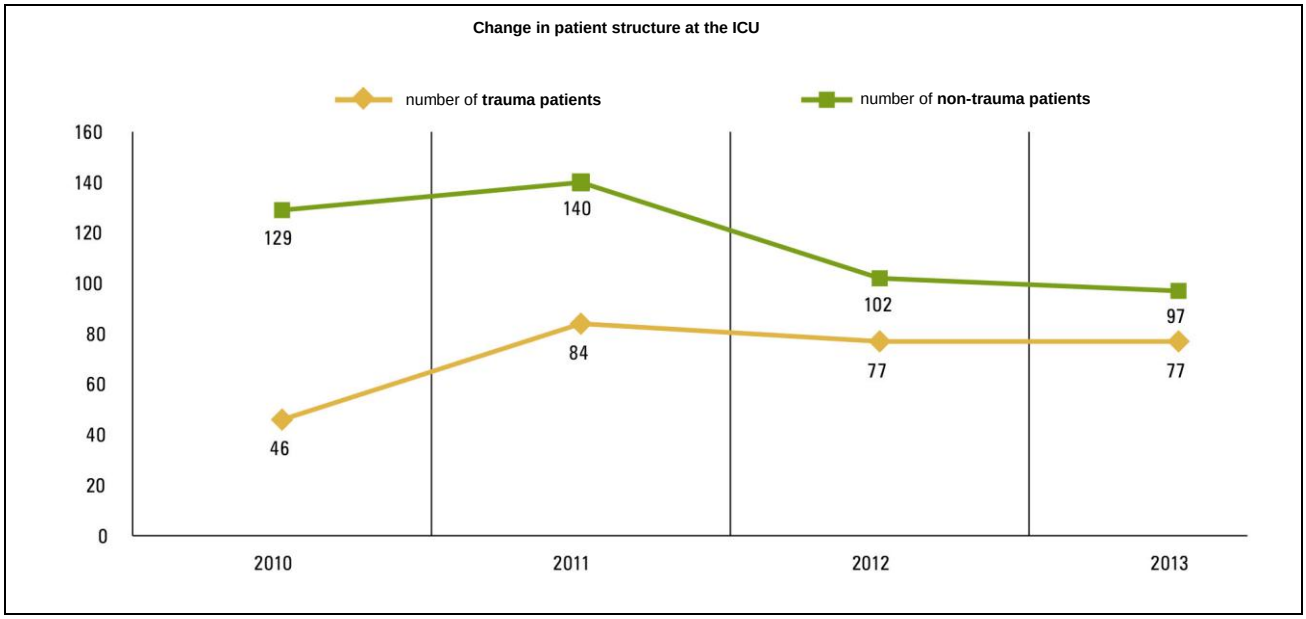
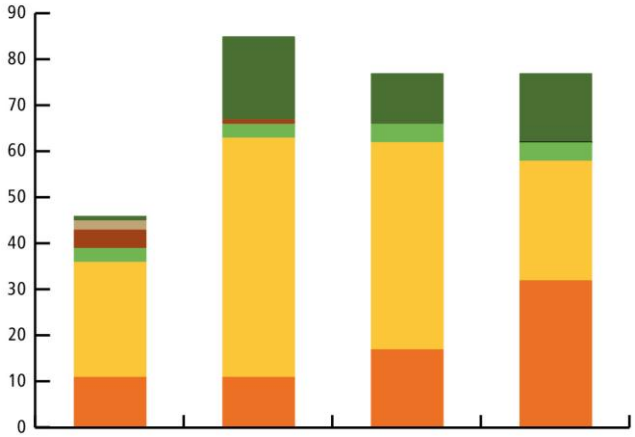


Figure 1. Number of trauma patients in relation to non-trauma patients treated at the ICU in the years 2010–2013
Rycina 1. Liczba chorych urazowych w odniesieniu do nieurazowych leczonych na OIT w latach 2010–2013



	2010	2011	2012	2013
other trauma	1	18	11	15
hanging	2	0	0	0
TERM – burn	4	1	0	0
HI – isolated head injury	3	3	4	4
MOI – multiorgan injury	25	52	45	26
MOIHI – multiorgan injury accompanied by head injury	11	11	17	32

Figure 2. Spectrum of injuries in patients hospitalized at the ICU in 2010-2013
Rycina 2. Rodzaje urazów u pacjentów hospitalizowanych na OIT w latach 2010-2013

There was a statistically significant change in 2013 compared to 2010 ($p<0.05$).

A partial analysis of treatment costs (covering only the cost of drugs and single-use materials) reveals that in the following years the amounts spent on patient treatment increased proportionately to the number of patients treated at the ICU due to post-traumatic injuries. These costs increased in the following years, compared to 2010, by: 64% in 2011, 92% in 2012 and 96% in 2013. This calculation does not present fully the real costs associated with the treatment of trauma patients, as it is based on mean values for all the patients treated at the ICU; however, it indicates increasing participation of the costs of

trauma patient treatment in the total pool of financial resources intended for ICU patients.

Discussion

Regional trauma centers are the final element in the medical emergency services system. By reducing the time to arrival of the emergency team to the site of the casualty, and by the use of air transport, the time until transfer of the patient to a multi-specialty center (trauma center) is also reduced. This increases the patient's chances of surviving a severe trauma [11]. This procedure was introduced over 20 years ago in the USA, and now it is being implemented in Poland.

The analysis of our own materials indicates that, following the creation of a regional trauma center based on the Military Institute of Medicine, the number of trauma patients treated at the ICU increased significantly. Together with the development of the Mazowieckie Regional Trauma Center, the number of patients with post-traumatic injuries transferred directly from the A&E department to the ICU systematically increased. This is most clearly visible in the years 2012-2013, when the system of medical emergency services began to use the growing potential of the Mazowieckie Regional Trauma Center. In 2010, trauma patients constituted 26.2% and in 2013 44.2% of the total number of patients treated at the ICU. Similar trends are observed around the world [1,4].

The analysis also demonstrates that in the study period the number of patients with very serious (multiorgan) injuries accompanied by a head injury also increased. Patients diagnosed with T06 ("multiple body injuries") in the years 2010-2013 accounted for: 53.3%, 73.1%, 83.3% and 88.7% of all the trauma patients treated at the ICU. The same trend is observed globally. As demonstrated in the literature, after creating a trauma center on the basis of a multi-specialty hospital, the number of patients referred there immediately after suffering a trauma increases considerably [1,4,5,9]. Simultaneously, the number of trauma patients at the ICU continues to grow [5,23].

Despite the increasing number of patients with severe and very serious injuries in the studied period, the mean duration of hospitalization at the ICU of the Military Institute of Medicine did not change significantly, and it lasted 7 days. According to the literature, the mean length of ICU stay is 7-14 days [4,14,16], but it should be noted that, following the development of the trauma centers, the duration of treatment at the ICU is reduced [4,10].

The main purpose of regional trauma centers is to improve trauma patient survival. Implementation of centrally organized specialist care for trauma patients results in reduction of patient mortality by 15-20% [7,8,10].

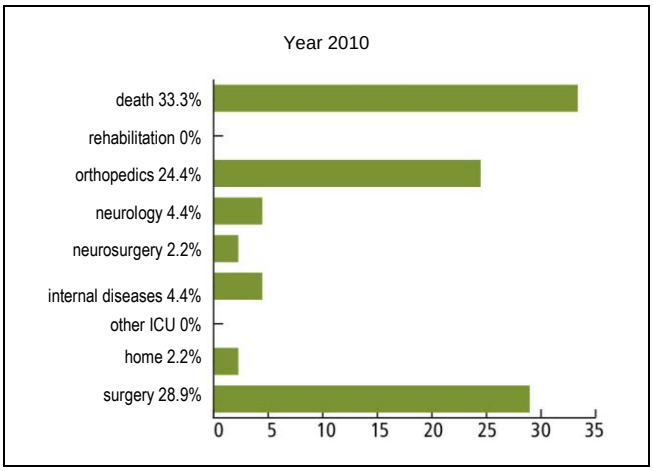


Figure 3. The end of treatment at the ICU
Rycina 3. Zakończenie leczenia na OIT

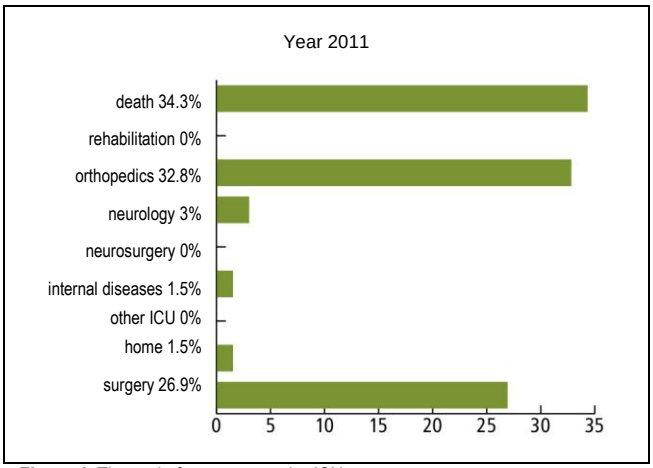


Figure 4. The end of treatment at the ICU
Rycina 4. Zakończenie leczenia na OIT

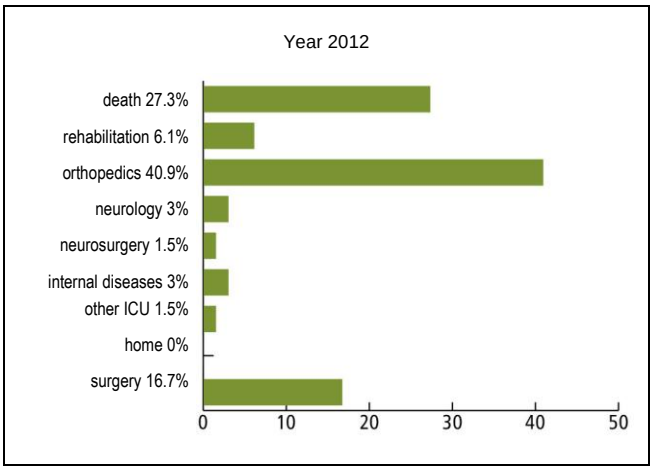


Figure 5. The end of treatment at the ICU
Rycina 5. Zakończenie leczenia na OIT

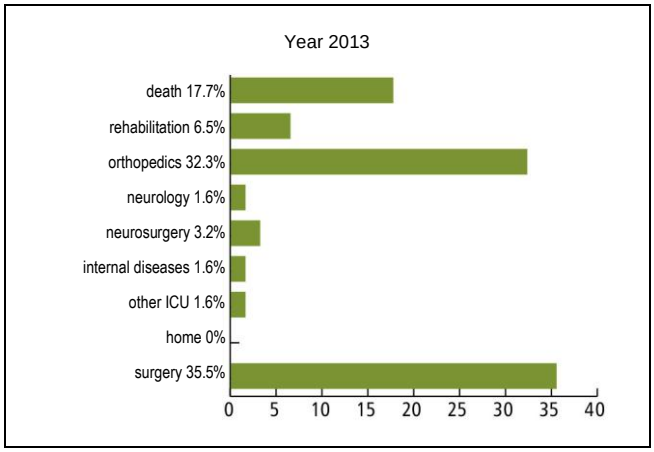


Figure 4. The end of treatment at the ICU
Rycina 4. Zakończenie leczenia na OIT

This effect was observed first in the USA and was related to the significant reduction in transport time of the patient to a regional trauma center, and providing the patient with multi-specialty, well-organized assistance. Along with the development of trauma centers, a systematic improvement was observed in the survival of patients with the most serious injuries [3,4].

MacKenzie et al. [7], following the analysis of data from 5,191 patients with severe injuries treated in 18 trauma centers and 51 hospitals outside the medical emergency service system in 14 states of the USA, demonstrated reduced mortality of patients with post-trauma injuries treated in trauma centers compared to patients treated in other facilities: 7.6% *vs* 9.5%. Also metaanalysis by Celso et al. [10] of 14 studies on the functioning of regional trauma centers in the USA demonstrates that the survival of severe trauma patients treated in specialist trauma centers increased by 15%.

Initially, in Europe the outcomes were not as good as in the USA, and, following the introduction of the trauma center system, a lack of improvement in the results of treatment in patients with severe injuries was recorded. Osterwalder [24] in Switzerland and Nicholl and Turner in Great Britain [25] did not observe a significant reduction in mortality in this group of patients.

Only a study published in 2010 by Dutch authors, Twijnstra et al., which compared treatment outcomes of patients in the period of 1996-1998 with the years 2003-2005, when the system of regional trauma centers had been introduced in the Netherlands, revealed a reduction in hospital mortality among all trauma patients from 2.6% to 2.3%. This corresponded to a reduction of the risk of death as a result of trauma by 16%, primarily due to triage of trauma patients. The study also indicates that the most injured patients were more often transferred to specialist trauma centers [5].

The analysis of overall mortality, including all the patients treated in our department before the trauma center was created and after its creation, demonstrated the absence of significant differences between 2010 and the following years, although a decreasing tendency was visible: in the years 2012 and 2013 this tendency was 34.15 and 32.2%. This result is consistent with observations made by other authors [1,4].

The treatment outcomes in trauma patients hospitalized at the ICU improved during functioning of the Mazowieckie Regional Trauma Center. In 2011, mortality of trauma patients (34.3%) was similar to overall mortality, in 2012 it was 27.3%, and in 2013 it decreased to 17.7% (p=0.0317). This tendency is consistent with the results published in European literature. The data presented are similar to the results of the study by Davenport et al. [9]. The authors analyzed patients with the most severe injuries, treated at the university center of the Royal London Hospital (RLH), which specializes in the therapy of injuries, and they demonstrated a reduction in mortality from 34.2% in 2000 to 17.9% in 2005. Also in Maryland, USA, following the transformation of a university hospital into a trauma center, a significant reduction in the mortality of the patients with severe injuries was observed (ISS 17–25 points). Among the patients with the most severe injuries, in the analyzed period of 11 years (1997-2008), no significant changes in mortality were reported; remaining at 28.3% on average (19.9-31.5%) [1], as the severity of such injuries often goes beyond the options of modern medicine.

Most researchers emphasize that improvement in the treatment outcomes occurs after stabilization of the center's functioning and its development. Time is required to implement further procedures to improve diagnostics and treatment, as well as to gain experience by the teams treating trauma patients [1,3-5,9,14,15]. The number of injured soldiers treated at the ICU at the Military Institute of Medicine did not change significantly in the period analyzed, as it is associated rather with the situation in the region of military operations than with centralization of the system of post-trauma injury treatment.

The costs of treatment of trauma patients, considering the amounts spent on drugs and single-use equipment, are estimated to constitute nearly half of the entire ICU budget. The amounts spent on the above purposes increased in consecutive years (compared to 2010) only by 12.8% in 2011, and 15% in the years 2012-2013. The results of financial analysis should be treated with some reservation, as it only included partial costs. However, it indicates a considerable increase in the costs of the treatment of trauma patients in the department's general budget.

The study is limited primarily by the relatively small number of patients analyzed. This results from the

small, typical for a trauma center, number of beds at the ICU (8 places). It is also impossible to analyze the history of all the trauma patients hospitalized at the Mazowieckie Regional Trauma Center. Moreover, the absence of preliminary assessment of trauma patients using one of the scales of trauma severity, which should be performed at the A&E department and during admission to the ICU, makes it difficult to compare the obtained results with the results from other centers.

Conclusions:

1. After creating a trauma center based on the Military Institute of Medicine, the number of trauma patients treated at the ICU increased significantly.
2. The number of patients with severe and very serious injuries increased.
3. Despite a higher number of patients with severe injuries, mortality of trauma patients treated at the ICU reduced significantly: from 34.3% in 2011 to 17.7% in 2013.

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Psychological consequences of participation in military operations in Afghanistan

Psychologiczne konsekwencje udziału w operacji wojskowej w Afganistanie

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Abstract. The number and size of the allied peacekeeping deployments have increased over the last decade. Simultaneously, the increase in threats causes the probability of negative consequences of deployment on the mental state of soldiers, requiring an assessment of the influence of deployment on the psychological functioning of Polish soldiers. The sample consisted of 735 soldiers who participated in the 11th rotation of the Polish Military Contingent in Afghanistan. After returning from the deployment they were asked to complete a questionnaire designed for the study. Almost all the subjects had traumatic experiences, the majority reporting that they can now better cope with stress, but 10% confirmed suffering from the negative consequences of deployment. The most common symptoms of emotional problems were: sleep disturbances (13%), explosive outbursts of anger (12%), aggressiveness (11%), increased smoking (9%) and consumption of alcohol (7%). Almost one in three subjects confirmed at least one such symptom. The indications for psychological or psychiatric help was found in approximately 20% of the subjects. Exposure to stress during deployment often brings problems in the emotional functionality of the soldier. Psychological or psychiatric support is mostly needed if a soldier suffers from numerous symptoms of emotional functionality problems, or if he is aware of the need for specialist help.
Key words: PTSD, stress, Afghanistan, psychologist, psychiatrist

Streszczenie. Wstęp: W ostatniej dekadzie zwiększyło się sojusznicze zaangażowanie w operacje na rzecz pokoju. Jednocześnie wzrost zagrożeń skutkuje prawdopodobieństwem negatywnego wpływu służby na misji na stan psychiczny żołnierzy. Cel pracy: Ocena wpływu służby na misji wojskowej na psychologiczne funkcjonowanie polskich żołnierzy. Materiał i metody: Próbę badawczą stanowiło 735 uczestników XI zmiany Polskiego Kontyngentu Wojskowego w Afganistanie. Badanie polegało na wypełnieniu po powrocie do kraju kwestionariusza przygotowanego na potrzeby badania. Wyniki: Niemal wszyscy żołnierze doświadczyli na misji sytuacji traumatycznych. Większość uważa, że lepiej teraz potrafi radzić sobie w sytuacjach stresowych, ale 10% potwierdza odczuwanie ich negatywnych skutków. Najczęstsze objawy zaburzenia funkcjonowania emocjonalnego to: problemy ze snem (13%), napady złości (12%), agresywność (11%), nasilenie palenia tytoniu (9%) i spożycia alkoholu (7%). Przynajmniej jeden objaw stwierdzono u niemal co trzeciego żołnierza. Wskazania do skorzystania z pomocy psychologa lub psychiatry wystąpiły w przypadku około 20% uczestników misji. Wnioski: Ekspozycja na stres w trakcie misji często skutkuje zaburzeniami w funkcjonowaniu emocjonalnym. Wskazania do konsultacji psychologa lub psychiatry dotyczą zwłaszcza żołnierzy, u których występują liczne objawy zaburzeń w tym funkcjonowaniu, oraz tych, którzy mają świadomość potrzeby pomocy specjalisty.
Słowa kluczowe: PTSD, stres, Afganistan, psycholog, psychiatra

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Introduction

The engagement of Polish soldiers in allied military operations abroad has continued to increase over the last decade. This is largely a consequence of Poland's accession to the North Atlantic Treaty Organization (NATO). The benefits of this engagement are frequently emphasized [1]; however, its negative consequences should also be analyzed. An important tendency needs to be emphasized: there is a gradual intensification of the level of difficulty associated with situations that the soldiers experience. Participants of missions in the Balkans (or peacekeeping missions in the Middle East) less frequently experienced traumatic

situations[1] [2] than those who took part in operations in Iraq or Afghanistan. The experience of other armies participating in intensive armed conflicts indicate that traumatic situations are associated with significant risks for the condition and mental health of soldiers (as we know, many observations in this respect were made by Americans, due to the engagement of their armed forces in the Vietnam war) [3,4].

This noticeable shift in the situation in the theatre of operations requires analyses. Research conducted among the participants of peacekeeping missions in regions of clearly less intensive combat operations revealed that they felt frustration, boredom or role conflict, but they did not present chronic reactions to stress or psychopathological symptoms. However, when the peaceful conditions were disturbed, and the soldiers felt their lives were threatened for prolonged periods, the probability of greater adaptation problems, resembling those associated with the military operations zone, was higher [5].

Potential, strictly clinical, consequences of service in such conditions for the mental functioning of soldiers include those associated with the theory of reaction to traumatic experience: acute stress disorder (ASD), post-traumatic stress disorder (PTSD), reactive psychotic conditions and adaptation disorders presenting as neurosis or abuse of psychoactive substances. It is worth emphasizing that ASD and PTSD were identified and described in specialist psychiatric literature as a result of observations regarding the consequences of soldiers' participation in armed conflicts. In the past, those consequences were recognized as combat stress reactions (CSR), now considered a historical concept. This term is still sometimes used to describe mild, mental disorders in soldiers, which do not come under the earlier mentioned types of mental problems or symptoms of emotional function disorders [6].

The spectrum of possible manifestations of emotional function disorders experienced by a soldier as a result of participation in military operations is wide. To analyze in a sociological research the problem of the effects that participation in missions has on a soldier's psyche, the frequency of various symptoms needs to be established. It should be assumed that in certain individuals these may be elements of a clinical picture of a classified mental disorder, whereas in others (probably a more numerous group) these are symptoms of mental discomfort. However, all these individuals certainly need support. Even if specialist treatment for some of these soldiers is not currently necessary, knowing the scope and specificity of the problem would facilitate development of therapeutic and prophylactic programs to help soldiers deal with emotional problems, thus improving their quality of life, or even preventing the development of more serious psychopathological problems.

[1] In line with conditions of acute stress syndrome and post-traumatic stress disorder, this is a situation in which a person experiences an event in which their life, or the life or another person, is threatened, or in which they witness such an event.

Aim of the study

The primary aim of the study is to present the effect of participation in a stabilization mission abroad on the mental health and condition of soldiers. Manifestations of emotional function disorders in soldiers participating in a mission will be presented, as well as their assessment of psychological and psychiatric support received, and information as to how the soldiers use such support.

The results have been collected as part of a larger study: "Social aspects of service abroad (based on the 11th rotation of the PMC in Afghanistan)", one of the projects conducted in 2013 by the Military Center for Citizenship Education, of which the Military Office for Social Studies forms a part. The aim of the article is to provide doctors and psychologists with information gathered as a result of this study, since access to the summary report is limited [7]. The number of soldiers who participated in missions abroad increased significantly; therefore, it should be expected that the number of soldiers who experience emotional function disorders, as well as specialists who may meet them in their clinical practice, will also grow. It is emphasized that soldiers are not entirely ready, or sometimes even unwilling to seek the help of mental health specialists. Therefore, the role of other medical personnel, to whom soldiers report somatic disorders, is very important in identifying this type of problems in veterans [8].

Material and Methods

The research subjects were selected by purposeful sampling. To ensure that the sample was homogeneous and representative for the problems analyzed, the research was conducted among the soldiers of the 11th rotation of the Polish Military Contingent in Afghanistan. During the field work, 735 correctly completed questionnaires were collected, which enabled the determination of the expected statistical error at 3% for a population of 2,500 professional soldiers in the 11th rotation of PMC in Afghanistan. The soldiers completed the questionnaires approximately six months after their return to Poland.

The 11th rotation was chosen because it ended relatively shortly before the beginning of the study and due to its specificity: it was a stabilization and training mission, and it did not differ considerably from other rotations as to the frequency of traumatic events (operational conditions were of average severity). An important advantage of adopting this sampling

methodology is the ability to learn the statistical frequency of the occurrence of certain effects associated with participation in an Afghanistan-type mission; conducting the research among soldiers from different missions or rotations (particularly of different character and operational dynamics) would not justify adopting its results as indicators of the level of risk of a certain type of consequences resulting from participation in a mission, and the research would be deprived of its epidemiological value.

The subjects were selected proportionately from different military units, so that the sample reflected the population structure of the soldiers in the 11th rotation. The research took place from March to June 2013, using the auditorium questionnaire method, with a questionnaire to be completed individually. The questionnaire was developed as part of a research project of the Military Center for Citizenship Education; therefore, it contained sections of questions which enabled evaluation of how the mission influenced not only the psychological but also the social and professional functioning of the subjects. The subjects were asked to discuss any psychological assistance during preparation for the mission, in the course of the mission, and after their return from Afghanistan, as in these three periods they could receive such assistance.

The empirical data obtained in the research was analyzed qualitatively and quantitatively. The analysis was performed with the use of the PASW Statistic Base 18.0 package and MS Office Excel 2007 PL. To verify the hypotheses of the concept, the chi^2 statistical significance test was used to compare the frequency of a nominal variable occurrence, and a non-parametric Mann-Whitney U test to verify the statistical significance of differences on the level of ordinal or interval variables in two groups. Hierarchical cluster analysis was used for segmentation of the studied group of subjects (the *cosinus* section was used as a measurement of similarity between objects, and Ward's method to estimate the distance between clusters). Spearman's rank (order) correlation coefficient Rho was also used. The hypotheses were tested at the significance level of $p<0.05$.

Results

Risk of traumatic experience

Considering the specificity of service on a foreign mission, and the increased risk towards life and health during the time spent away from the base, the subjects were asked if the tasks they performed required leaving the base frequently. 77% of subjects gave positive answers. To verify the subjects' exposure to different traumatic experiences, a set of questions regarding the frequency of participation in various situations was prepared. The results demonstrated that the subjects were most often exposed to artillery fire (mortar fire) – this was reported by 90% of the subjects. Only slightly fewer (83%) of the subjects experienced a direct threat to life. The majority of them were also under gunfire (76%), near explosions of explosive device (75%), saw injured soldiers of their army or allies (71%), or injured adversary soldiers or civilians (69%). Over half of the subjects had to use a weapon (64%), participated in a fire exchange (63%), fired a weapon towards people (54%), and saw dead adversary soldiers or civilians (52%). The smallest number of subjects stated that they saw dead soldiers of their own army or allies, but the rate was also high at 39%.

Resistance to stress

Asked about how the service during the mission affected their mental condition, the majority of the subjects (69%) declared it improved. 5% of the subjects reported deterioration of mental condition, others did not observe any changes. The subjects also assessed their functioning in difficult situations. 84% reported improvement in their ability to deal with stress and difficult situations, 82% in the ability to remain calm in difficult situations, and 79% in the ability to act despite fear and feeling unsafe. At the same time only 1% of the subjects reported deterioration in these areas.

Statistically significant correlations were found between the assessment of the effect of service on a mission on the subjects' mental condition and their functioning in difficult situations, and selected variables illustrating their exposure to traumatic experiences and the subject's social and professional situation[2]. To generalize the identified correlations, the more difficult and stressful the situations the subjects experienced in Afghanistan, the more they appear to appreciate the positive effect of participation in a mission on their mental condition and ability to function in difficult situations. Also, the lower the professional rank and the shorter the time of service, the better the assessment of the rotation.

Symptoms of functioning disorders

In the questionnaire the subjects were asked about occurrence of consequences of strong emotions and stress associated with service on a foreign mission. 10% of the subjects noticed such consequences, and 83% did not observe them. A comparison of their answers demonstrated that individuals who experienced such consequences may be characterized as follows:

[2] All the relations discussed here and further are statistically significant, but the values of correlation coefficients were low, which means that although some correlation between variables was found, it was not strong, and the relations were not strict or of a deterministic character. Due to limited significance of the information about the value of correlation coefficients, their values are not presented.

a) a wider range of types of traumatic situations that the subject experienced,

b) they more often participated in situations including artillery fire (mortar fire), necessity to use weapons, seeing dead or injured soldiers of their own army, allies, adversary soldiers or civilians.

The subjects were also asked if they required specialist psychological assistance due to recent participation in a mission. During preparation for the mission, 1% of the subjects confirmed such a need, 2% during the mission, and 3% after return from the mission. 8% of the subjects stated that they received psychological assistance during preparation for the mission, 7% received it during the mission, and 8% after their return. One in a hundred subjects confirmed receiving psychological assistance outside the military health service. The same rate of subjects stated that they received specialist psychiatric help after they returned from the mission (9 subjects). 3% of the subjects felt they needed psychiatric help. To isolate all the individuals who realized that in their case there were reasons to receive psychological or psychiatric assistance, the number of subjects who felt they needed specialist help, or actually received it, was determined. It appeared that 12% of the subjects were aware of such a need.

Apart from a direct request to assess if the consequences of stress affect the subject, a question was also asked about objective signs of emotional functioning disorder; however, without referring to them as stress symptoms to prevent possible filtering of such information by a subject who might want to avoid stigmatization and being treated as a "disturbed" person. The results demonstrated a high frequency of those symptoms (Fig. 1.). It should also be noted, that the occurrence of at least one of those symptoms of emotional functioning disorder was reported by as many as 31% of the subjects.

Statistically significant correlations between the number of manifestations of emotional functioning disorders and selected variables illustrating exposure of the subject to traumatic experiences were found. The number of manifestations of emotional functioning disorder increases with:

a) increasing number of types of traumatic situations the subject experienced,

b) the number of times the subject participated in situations such as being under gunfire, in proximity of explosion of an explosive device, direct threat to life, fire exchange, firing toward people, seeing dead or injured soldiers of their own army, allies, adversary soldiers or civilians.

Assistance provided to soldiers

The subjects were also asked about forms of psychological assistance they received during the last mission or after their return, and assessment of the assistance they received in the army due to their last service on the mission. Usually psychologists had individual conversations with them (15%), and 20% of the soldiers participated in "psychological training" as part of the therapeutic and prophylactic treatment after their return from the mission. Half of these subjects participated in training in how to deal with stressful situations or training of psychological skills, as well as in group discussions on their experiences, organized by a psychologist.

Most subjects who assessed the psychological assistance they received in the army due to their last participation in the mission provided positive comments. Assistance provided during preparation for

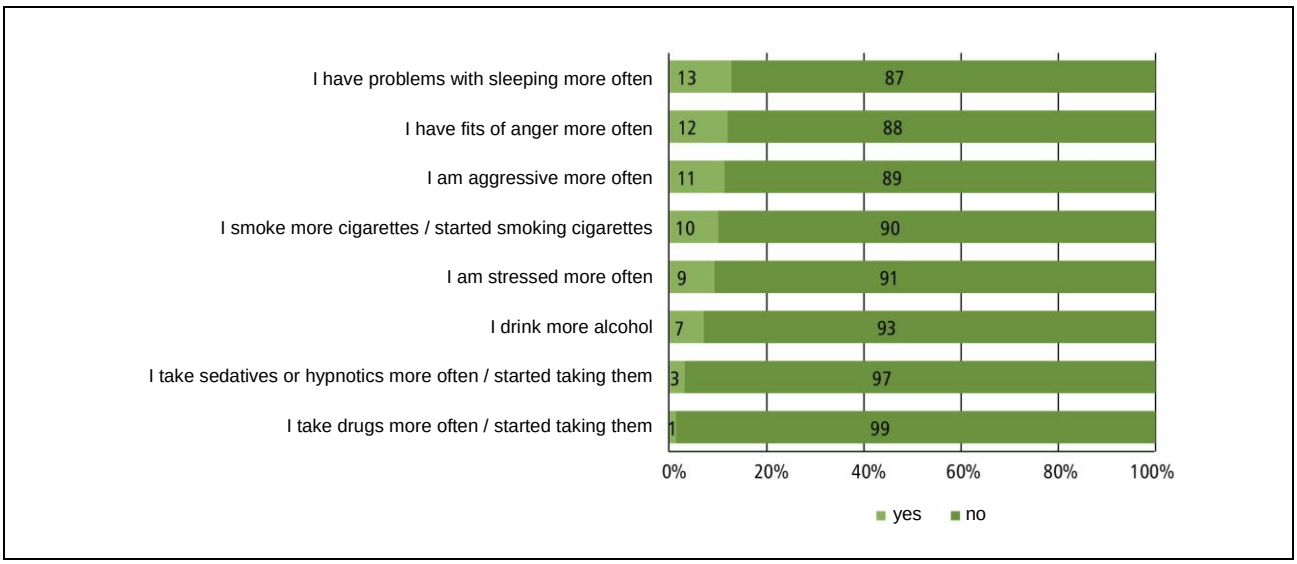

Figure 1. Symptoms of emotional functionality problems among soldiers after deployment
Rycina 1. Występowanie poszczególnych przejawów dyskomfortu psychicznego po powrocie z misji

the mission (N=248) and after return from the mission (N=242) was positively evaluated by 67% of the subjects, and assistance provided during the mission by 64% of the subjects (N=240). One in three subjects gave a negative assessment.

Statistically significant correlations were found between subjects' assessments of specialist psychological assistance provided as part of the preparation for a mission, during a mission and after return from a mission, and selected variables illustrating exposure to traumatic experiences and the social and professional situations of the subject. In general, the more difficult and stressful the situations the subjects experienced in Afghanistan, the poorer their assessment of this assistance. Assistance received during preparation for the mission and after return from the mission is evaluated as worse by subjects from smaller garrisons.

Differentiating features between participants of the mission

The occurrence of indications for specialist help are not strictly related to actual receiving it. Therefore, an attempt was made to identify in the sample studied potential subgroups of subjects according to such criteria as: current experience of mental discomfort, informing about negative effects of experiences and stress on social functioning (family life, social contacts and professional relations), and receiving specialist psychological and psychiatric assistance. The results of segmentation of the studied group considered the most adequate revealed the presence of five clusters of subjects. Cluster (segment) 1 comprised 62% of the subjects – individuals who did not report the occurrence of symptoms of mental discomfort or negative effects of stress on their social functioning, and who did not receive specialist assistance. Cluster 2 comprised 9% of the subjects – individuals who observed symptoms of mental discomfort or negative effects of stress on their social functioning, and who did not receive specialist assistance. Cluster 3 comprised 11% of the subjects – individuals who observed symptoms of mental discomfort, but no negative effects of stress on their social functioning, and who did not receive specialist assistance. Cluster 4 comprised 9% of the subjects – individuals who observed symptoms of mental discomfort or negative effects of stress on their social functioning, and who, contrary to all the previous groups, received specialist assistance. Cluster 5 comprised 9% of the subjects – individuals who observed numerous symptoms of mental discomfort (median was 2, arithmetic mean – 2.99), but did not experience negative effects of stress on their social functioning, and who did not receive specialist assistance (Fig. 2.).

Discussion

Over 75% of the subjects reported that the tasks they performed in Afghanistan required frequent absences from the base. Almost all the subjects experienced traumatic situations, including a high percentage (8 out of 10 subjects) of subjects stating a direct threat to their lives as a result of participating in combat operations. Over half of the subjects experienced a similarly difficult psychologically situation of firing a weapon at a human being [4]. This indicates that participation in a military mission in Afghanistan is associated with a high risk of exposure to a traumatic situation, as well as a high risk of disorders in the mental and social functioning of a soldier due to those experiences. The relation between the intensity of traumatic situations during the mission and the intensity of mental discomfort after the return from it was demonstrated in studies conducted among soldiers of different armies [3]. Additionally, the specificity of those experiences shows how high was the risk of physical injury. Moreover, increased exposure of soldiers to traumatic brain injuries (TBI) and mild traumatic brain injuries (mTBI), which can adversely affect their health and mental condition, is emphasized, due to the specificity of military operations in Iraq and Afghanistan, including common use of improvised explosive devices (IED) by terrorists [3,9].

Most subjects positively assessed the effect of participation in the mission on their mental condition, especially in the area of dealing with stress and difficult situations: the more stressful experiences they had, the better they evaluated their mental condition. The results confirm that such experiences act as a training which strengthens the soldier's ability to cope with this kind of situations. Similar observations were made by other researchers [4, 6].

Regardless of the above, difficult experiences usually are associated with human suffering. One in ten soldiers experiences consequences of strong emotions and stress related to service on foreign mission. Clearly, it should be taken into account that this attribution of one's emotional problems to participation in a foreign mission is subjective; however, the consequences of traumatic experiences were confirmed statistically: individuals experiencing such consequences reported a higher burden with traumatic situations during the mission. Authors of other studies have arrived at similar conclusions [3].

The subjects rarely declared that they required specialist psychological assistance in relation to their participation in a mission. The number of those who actually received help was visibly higher. This discrepancy may be explained by the fact that soldiers partially question the need for such assistance. In the army a soldier visits a psychologist not only on his/her own initiative, but also as a result of his superior's

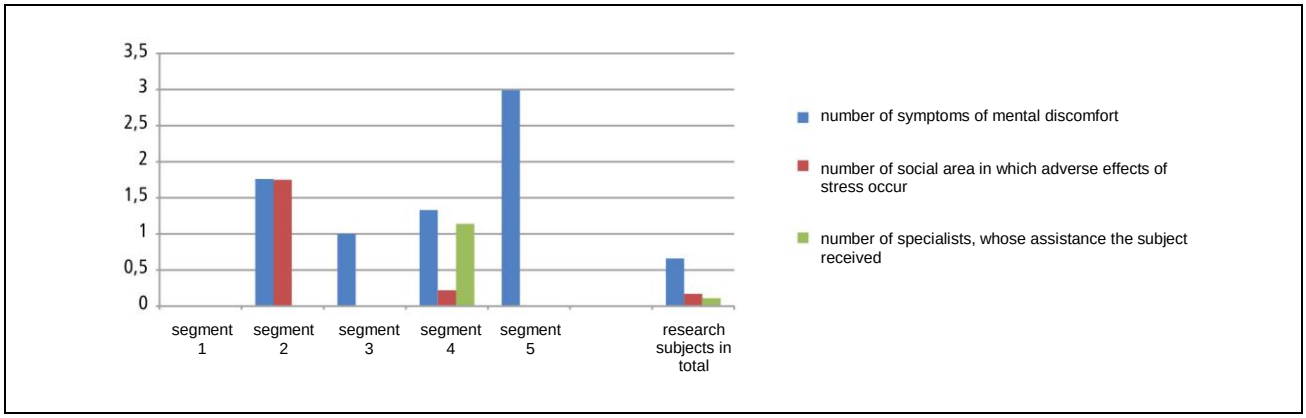

Figure 2. Differences between clusters of subjects (arithmetic means)
Rycina 2. Różnice pomiędzy poszczególnymi skupieniami respondentów (średnie arytmetyczne)

orders. Despite being referred by authorized persons to receive specialist assistance, the soldiers might not feel the need for such help, or the discrepancy emphasized earlier was a sign of a psychological defense mechanism denying the existence of problems requiring psychological help.

One in a hundred subjects stated that they received specialist psychiatric help after they returned from a mission. However, three times more subjects felt the need to receive such help. In discussing this discrepancy it should be emphasized that psychiatric consultation is treated as addressing problems not only in functioning, but in mental health. Moreover, access to a psychiatrist in the army is much more limited than to a psychologist, who often works full-time in a military unit or contingent. It is not surprising then that despite a larger number of subjects feeling the need to receive psychiatric help, only a third of them actually uses it. It should also be considered that soldiers are afraid of stigmatization if it is revealed that they see a psychiatrist. It is important that the problem occurs in other armies as well – the stigma of mental health is deeply rooted in the military milieu [6].

The awareness of premises for psychological or psychiatric help was found in 12% of the subjects. They cannot be automatically treated as individuals with mental disorders, but it provides some idea of the rate of soldiers who on their own initiative, or as a result of referral by authorized personnel, may become potential recipients of specialist psychological or psychiatric assistance, since they have already received such help, or feel the need to receive it.

After the return from a mission, different symptoms of emotional functioning disorders may occur. The most common ones include: sleeping problems, fits of anger, more frequent aggressive behaviors, and intensified smoking of cigarettes; these affect at least one in ten subjects. However, in a study in 2011, when soldiers were asked about the occurrence of certain symptoms of emotional functioning disorder, twice as many of them report experiencing such symptoms [10]. Sleeping problems and fits of anger were reported in 2011 by 27% of the study subjects, stress and more intensive smoking of cigarettes by 20%, more frequent aggressive behaviors by 18%, and increased alcohol consumption by 13%. Considering that in both studies a similar exposure of subjects to traumatic situations was found, the results from 2013 may be viewed as the sign of a positive trend.

The fact that negative consequences of participation in a mission for a soldier's mental condition are currently widespread is well-illustrated by observation in the 2013 study that at least one of the signs of emotional functioning disorder occurs in almost one in three subjects. This does not have to mean that they need specialist assistance. However, it certainly illustrates the scale of the costs borne by soldiers participating in foreign missions, and actions should be taken to help them to improve the ability to deal with mental discomfort. Also in this case the influence of participation in a mission on occurrence of those problems was confirmed statistically: the more often a soldier experienced stressful situations, the higher the number of emotional functioning disorder symptoms they report.

Most subjects who assessed psychological assistance they received in the army due to their last participation in a mission provided positive comments. However, negative assessments were not rare, as they were provided by one in three subjects. It is worth noting that the number of individuals who assessed the psychological assistance received was higher than of those who reported receiving such help. The difference suggests that not all the subjects admitted to receiving such help in the army, or that subjects included in their assessment all psychological activities they experienced (such as prophylactic, training etc.).

It is visible that the more difficult and stressful the situations that the soldiers experienced in Afghanistan,

the worse their assessment of the specialist psychological and psychiatric assistance they received. Probably, due to their experience, they have higher expectations as to the quality and effects of the assistance received, so they are more easily disappointed. This type of help was also evaluated more negatively by individuals serving in smaller garrisons, which probably reflects the limited access to specialists in those places.

Summing up the results of segmentation, it is worth emphasizing that nearly two thirds of the subjects did not experience in their present social functioning any negative effects of their participation in the mission. Simultaneously, attention should be drawn to individuals in cluster 5, since it appears that almost one in ten subjects experience numerous symptoms of mental discomfort, but did not receive specialist assistance. Considering the fact that in this case it is not only a single symptom, such individuals should be identified in the population of mission participants, and provided with specialist help. If these people remain anonymous, then training and lectures for wide groups of soldiers need to emphasize that they should undertake actions to deal with stress more effectively, and to minimize its effects, including symptoms of this type.

A comparison[3] was made of clusters the subjects were classified in, and the group of individuals aware of the grounds for receiving psychological or psychiatric assistance (12% of the subjects received such help or felt the need to receive it), provided additional important information. Nearly all individuals in clusters 1 and 3, and the majority of those in cluster 2 did not reveal such grounds; all individuals in cluster 4 revealed the grounds, while 94% of individuals in cluster 5 did not reveal the grounds (Fig. 3.). The results demonstrate that both methodologies to a large extent lead to similar identification of individuals for whom undertaking assistance actions is not recommended as a priority. However, the indications of the subjects who require such actions seem to be entirely different. Considering that classification by both methods was conducted with the use of very different criteria, it seems reasonable to assume that specialist assistance may be required in case of both groups; thus, the aid would need to be provided to approximately 20% of participants of missions (this value is a sum of only the indications of subjects using both methods, the rates were approx. 12% and 8%).

Adopting this value is justified by the fact that meeting PTSD criteria, that is the occurrence of serious mental disorders, was found in 8% of American soldiers five months after their return from a mission in Somalia [5], where they had experienced temporary and unpredictable threats to their lives and health. PTSD or signs of depression were also

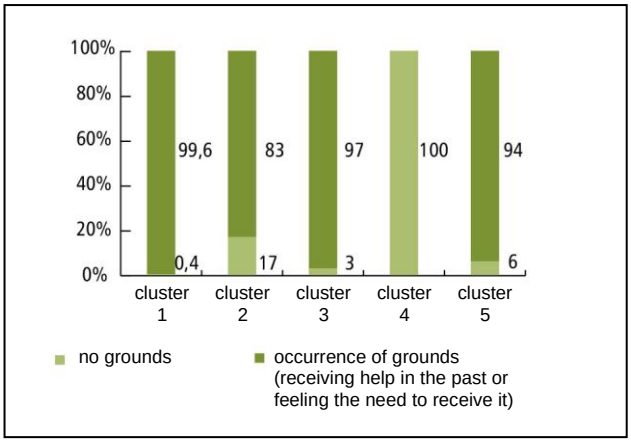

Figure 3. Relationship between output of cluster analysis and being aware of the grounds for receiving psychological or psychiatric aid

Rycina 3. Związek pomiędzy przynależnością respondentów do skupień oraz do grupy osób mających świadomość występowania u nich przesłanek do skorzystania z pomocy psychologicznej lub psychiatrycznej

reported by approx. 20% of the subjects who served in Iraq or Afghanistan, but only 10% were treated [6]. The number of American veterans with any grounds for receiving psychological and psychiatric assistance was certainly higher.

Therefore, assuming that one in five soldiers who participated in the 11th rotation of PMC in Afghanistan presents grounds for specialist psychological or psychiatric assistance does not seem to be an overestimation. However, the need to interpret this indicator carefully needs to be stressed. There are no grounds to treat it simultaneously as a percentage of soldiers with psychopathological disorders, but only as an estimated level of participants of Afghanistan-type missions who require psychological or psychiatric assistance. It should also be noted, that monitoring of soldiers' mental condition might be required, because the consequences of participation in a mission often occur only after a certain period following the return to their home country, or after the soldier has been transferred to the reserve [3].

Conclusions

1) The effect of participation in a mission on a soldier's mental condition can be more than incidental, and it should be treated as a problem affecting the functioning of the military environment, including the Polish Armed Forces.

2) Exposure to stress during missions often results in emotional functioning disorders, although at the same time the majority of soldiers believe that it improved their ability to deal with difficult situations.

3) As a result of a mission, adverse changes in emotional functioning occurred in 31% of the soldiers. In approximately one in five participants of a mission

[3] [3] Chi square = 575.74; p <0.001

clear grounds for receiving psychological or psychiatric assistance were observed.

4) Soldiers who experience adverse changes in their mental well-being should be recipients of at least prophylactic actions to develop their ability to deal with mental discomfort and to prevent transformation of such discomfort into various mental health disorders.

5) Faster identification of individuals who require specialist assistance should be facilitated by dispersal in the military milieu (medical personnel, psychologists, commanders) of the information obtained in the study concerning the types and incidence rates of the symptoms of emotional functioning disorders in participants of missions.

6) Increased danger in the theater of operations determines higher expectations toward the quality of specialist support provided by psychiatrists and psychologists. Therefore, a review should be made of the access soldiers have to such assistance, especially in small/distant garrisons.

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Analysis of the results of fitness tests in professional soldiers

Analiza wyników testów sprawnościowych żołnierzy zawodowych

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Abstract. The results of investigations undertaken in our department and confirmed by other authors have shown the progressive decrease in fitness levels in the Polish Army. Currently, the only criterion in the Polish Army for the estimation of physical condition of soldiers is the obligatory annual fitness test. The aim of this study was to attempt to explain the reason for the apparent incompatibility between the results of studies showing decreasing soldiers' fitness and the good results of the obligatory test. The results of the obligatory fitness test in one battalion were analyzed for two years. Running a distance 3000 m is considered to be the most important element of the obligatory fitness test. In consecutive years, age categories were analyzed to estimate the percentage of: soldiers graded the best for all exercise tests, soldiers graded the best at the run, soldiers who failed the run, soldiers who failed the test and soldiers who achieved a good result for the test despite failing the run. The possibility of passing the test while still failing the run gives a false fitness image of the soldiers. The proportion of bad and very good ratings was the poorest for the youngest age category.
Key words: fitness tests, rating, run

Streszczenie. Wyniki badań – i to zarówno prowadzonych w naszym zakładzie, jak i przez innych autorów – potwierdzają postępujące zmniejszenie wydolności fizycznej w wojsku polskim. Obecnie w polskiej armii jedynym kryterium oceny wydolności fizycznej żołnierzy jest test z WF, zdawany raz w roku. Celem pracy była próba wyjaśnienia przyczyny braku kompatybilności wyników badań naukowych oceniających wydolność żołnierzy jako słabą z dobrymi wynikami testu WF. Analizowano oceny z WF uzyskane przez żołnierzy jednego batalionu w dwóch kolejnych sezonach. Za najistotniejszy element obowiązkowego testu sprawności uznano wynik biegu na dystansie 3000 m. W kolejnych latach oceniano w poszczególnych kategoriach wiekowych, jaki procent badanych uzyskał: ocenę bardzo dobrą za wszystkie ćwiczenia, ocenę bardzo dobrą za bieg, ocenę niedostateczną za bieg, ocenę niedostateczną za cały test, ocenę dobrą za test mimo oceny niedostatecznej za bieg. Przyczyną błędnej oceny wydolności żołnierzy jest możliwość zaliczenia sprawdzianu WF przy niezaliczonym biegu. Zaliczenie testu bez zaliczenia biegu nie powinno być możliwe. Proporcjonalnie najwięcej ocen złych i najmniej bardzo dobrych uzyskiwali żołnierze najmłodszej kategorii wiekowej.
Słowa kluczowe: testy wydolnościowe, bieg, oceny

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Introduction

The word "soldier", apart from association with a uniform, evokes the image of a fit, male figure, capable of great effort. Unfortunately, the results of research both in our facility and by other authors do not confirm this optimistic association [1-6]. In the army, as in the entire population, a progressive decrease is observed in fitness level, as well as an increasing number of overweight and obese people. Those adverse changes result primarily from limited physical activity and incorrect eating habits. In the population of civilians, a rapid increase in the number of people running or cycling is visible, as well as non-smokers. This tendency is not present yet among soldiers. Over half of the soldiers smoked [7], and comparisons of fitness between a group of young civilians and soldiers revealed that in the group of soldiers only the rate of people with a very high fitness level was higher, whereas the mean fitness level of civilians was higher than that of soldiers [8]. Decreasing fitness level and increasing BMI are harbingers of lifestyle diseases, such as circulatory system diseases, diabetes and problems with the locomotor system. The same adverse tendencies are visible in the Polish population of children and

teenagers [9], so it is no surprise that they occur also in the army. Since this negative phenomenon is widespread, decided and concrete actions are necessary, with an entire program required to reverse the trend.

Presently, in the Polish Army the only assessment criterion for the physical condition of a soldier is a physical fitness test performed once a year. The test is regulated in detail by Ministry of National Defense instruction (no. 138 of 12.02.2010). The test comprises four elements: sit-ups, push-ups, running across a rectangle, and a 3,000 m run. The soldiers were divided into 8 age categories for which minimum standards were developed for grades 2-5. To pass the test, at least three positive grades must be obtained.

The study conducted in Cadet Academies mostly demonstrated a high level of fitness among the students [10, 11]; however, it decreases over consecutive years of the study. Studies involving soldiers in service for several years indicate the progression of adverse changes [5, 6]. In the context of the outcomes of our own studies, as well as numerous publications, the good results achieved by soldiers during the annual fitness test seemed paradoxical.

Aim of the study

The aim of the study was to find the cause for the discrepancies between the scientific research results assessing soldier's fitness levels as low and the better results from the official fitness test.

Material and Methods

The fitness grades obtained by soldiers from one ground forces battalion for two consecutive years were analyzed. A total of 404 soldiers took the test in the 2012 season and 396 soldiers in 2013. Due to the limited number of soldiers in the older age categories, groups IV to VII were analyzed together (Tab. 1.).

From the point of view of the fitness capability of soldiers, the most important element of the obligatory fitness test was the result of the 3,000 m run. In both years and the individual age categories, the success rate of the soldiers were evaluated in terms of who:

- received the best grade for all exercises,
- received the best grade for the run,
- failed the run,
- failed the entire test,
- received a good grade for the test, despite failing the run.

Table 1. Number of soldiers in each age category
Tabela 1. Liczebność żołnierzy w poszczególnych kategoriach wiekowych

age categories	2012	2013
N	404	396
I ≤25	150	93
II 26–30	150	181
III 31–35	49	66
IV 36–40	35	34
V 41–45	10	13
VI 46–50	7	7
VII 51–55	3	2

Results

In both years the smallest rate of best grades only was found in the youngest age category. In groups II and III, the percentage of subjects with the best grades was twice as high as among the youngest soldiers. In the oldest age categories 40% of the subjects received only very good grades (Fig. 1.).

The youngest group contained the fewest highly graded soldiers. It is noteworthy that in all age categories the results in 2013 were better than in 2012. This favorable change was pronounced the most significant in the youngest group. In groups II and III the results for each year were almost identical. Nearly half of the soldiers in the older age groups received the best grade for the run (Fig. 2.).

In all age categories there was a considerably lower percentage of failed grades in 2013 compared to 2012 (Fig. 3.). In 2012, the highest rate of subjects failing the run was group III (30%), while in 2013, 19% of subjects in the youngest group failed the run.

The test results in 2013 were better than in 2012 (Fig. 4.). In 2012, 6% of soldiers in group III and approx. 5% in groups I and II failed the test. In 2013, 4.3% of the soldiers in group I, and <2% in group II and the oldest groups failed the test. All soldiers in group II passed the test.

In 2012, nearly 25% of the soldiers in group III who failed the run received a good final grade.

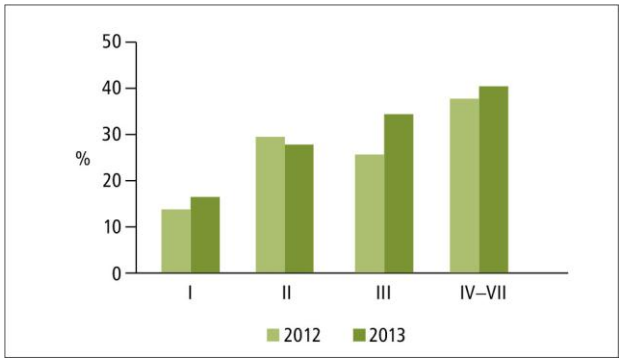

Figure 1. Percentage of soldiers in each age category graded the best in all exercise tests

Rycina 1. Procent żołnierzy w poszczególnych kategoriach wiekowych z bardzo dobrą oceną za wszystkie ćwiczenia

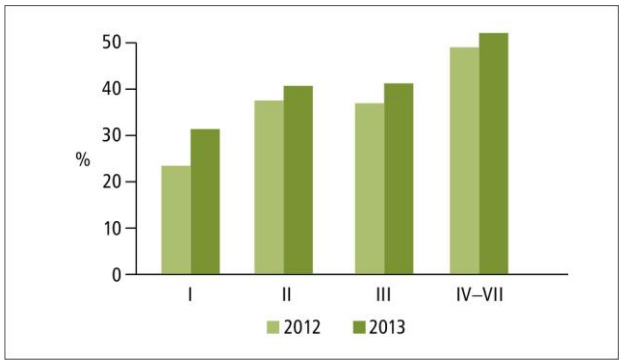

Figure 2. Percentage of soldiers in each age category graded the best in the run

Rycina 2. Procent żołnierzy w poszczególnych kategoriach wiekowych z bardzo dobrą oceną za bieg

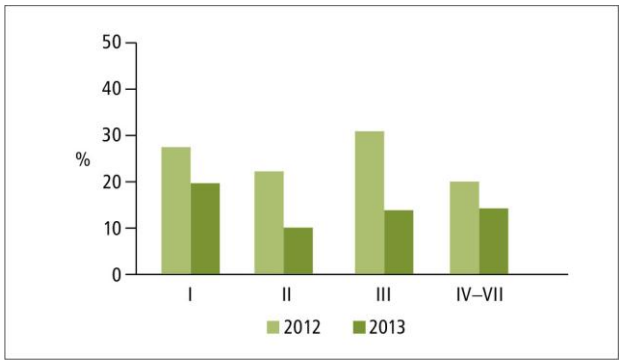

Figure 3. Percentage of soldiers in each age category who failed the run

Rycina 3. Procent żołnierzy w poszczególnych kategoriach wiekowych z niedostateczną oceną za bieg

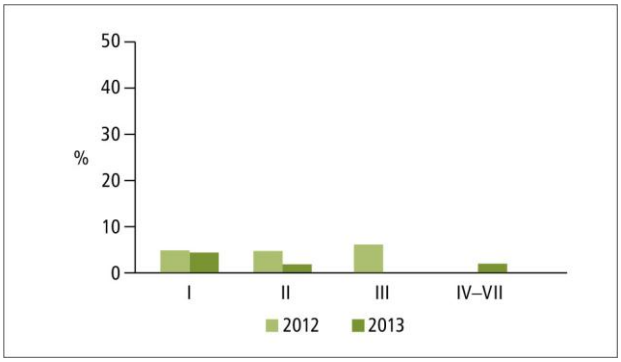

Figure 4. Percentage of soldiers who failed the test in each age category

Rycina 4. Procent żołnierzy w poszczególnych kategoriach wiekowych, którzy nie zaliczyli testu

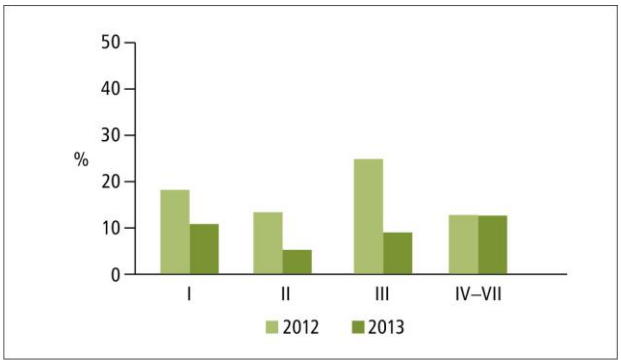

Figure 5. Percentage of soldiers in each age category who achieved good result for the test despite failing the run

Rycina 5. Procent żołnierzy w poszczególnych kategoriach wiekowych, którzy uzyskali ocenę dobrą za test mimo oceny niedostatecznej za bieg

In the following year the value dropped below 10%. In groups I and II the percentage of soldiers who received a good final grade despite poor run results decreased in 2013 compared to 2012. In the oldest age groups no significant changes were observed, and approximately 12% of the subjects received good grades, despite failing the run (Fig. 5.).

Out of the remaining elements of the obligatory tests the most difficult was the test of arm strength consisting in bench push-ups, or pull-ups on a high bar. In both periods this exercise was best performed by soldiers aged 31-36 years old.

Table 2. Percentage of soldiers in each age category who failed other parts of the fitness test
Tabela 2. Procent żołnierzy w poszczególnych kategoriach wiekowych, którzy nie zaliczyli pozostałych elementów obowiązkowego testu

age group	push-ups/pull-ups		sit-ups		run along a crossed rectangle	
	2012	2013	2012	2013	2012	2013
I	27.3	22.6	4	5.4	0.7	2.2
II	24	17.1	1.3	3.3	0.7	1.7
III	14.3	6	6.1	3	6.1	1.5
IV–VII	31.4	35	0	0	11.4	11.8

Discussion

The occurrence of the poorest results in the youngest age category questions whether the better results in older age groups is indicative of the beneficial effect of military service on soldiers' fitness, contradicting the scientific research mentioned earlier, or whether individuals in the age category of up to 25 years old demonstrated their poorer fitness parameters at the moment of joining the army combined with a lack of improvement. Another possibility is that the requirements necessary to achieve a good grade are disproportionate, so it is easier to obtain it in the older age categories. Niespodziński et al. [6] expressed similar doubts. The Ministry of National Defense resolution containing the list of exercises and standards for the fitness test of professional soldiers distinguishes five groups of professional soldiers, and seven age categories within each group. It is clear that the requirements for a member of the special forces will be stricter than that for a band member or a priest, but the high percentage of individuals failing the run test is not justified, and, regrettably, confirms the results of earlier research regarding the decreasing fitness of soldiers.

The main characteristic of a soldier should be endurance, so adaptation to long-term oxidative stress of limited intensity is necessary. Passing the run test confirms such an adaptation. If this approach is used to evaluate the fitness of soldiers, the possibility to receive good overall results despite failing the run is a great mistake. If the soldier fails the run, he should, as in the American army, have 90 days to re-take the test.

Apart from the run, another exercise which caused problems was the exercise evaluating arm strength (Tab. 2.). The rates of failed runs (Fig. 3.) and failed arm strength exercises (Tab. 2.) in some age categories amounted to over 50% of the subjects. Considering the difficulties involved in passing these two exercises, training drills should be developed to help soldiers improve their endurance and strength. The least problematic exercise was the push-up. However, this exercise might be problematic for the spine, especially without proper warmup.

Following the reactivation of the Military Physical Fitness Award in 2012 by the minister of national defense, making it a financial award should also be considered, not just a prestigious one. Moreover, soldiers who received the award could become patrons of colleagues who failed the run, and help them in training and improving their results. Such aid could be provided on a friendly basis, and be a source of satisfaction to the person providing it, as well as being officially sanctioned and, for instance, result in additional days off. All such assistance should be related to broadly understood prophylactics in the army, and contribute to popularization of an active lifestyle and proper nutrition.

Typical lifestyle diseases are already visible in the army, so if preventive measures in the entire army are not undertaken immediately, the costs of treatment of soldiers with ischemic heart diseases, locomotor system diseases or metabolic diseases will increase considerably within a few years.

The problem is complex, as a prophylactic program on such a large scope should be financed by the Ministry of National Defense. However, many decision makers seem to believe that the deteriorating fitness of soldiers, or the increasing number of overweight or obese soldiers, is not as important a problem as acquiring a new multi-task aircraft, or the design of an armored vehicle. It is crucial to realize that state-of-the-art products of military technique will not work if their operator cannot fit in the chair due to excessive bodyweight, or if increased blood glucose disturbs his vision.

Conclusions

- The possibility to pass the fitness test despite failing the run results in erroneous assessment of soldiers' fitness.
- The lowest fitness grades are obtained by soldiers in the youngest age category.
- We suggest establishing a time limit to improve failed exercises in the fitness test.
- It is necessary to develop and implement in the army a large prophylactic program promoting physical activity and proper nutrition.

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Diagnostic and therapeutic problems of rare tumors of the digestive duct

Trudności diagnostyczno-terapeutyczne dotyczące rzadkich

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Abstract. The paper describes a case of a 77-year-old male with a gastrointestinal stromal tumor. Although the upper and lower part of the gastrointestinal tract were thoroughly examined, even after almost two years of surveillance the cause of the hemorrhage remained unknown. Finally, a not easily available enteroscopy examination provided the tumor diagnosis, but still without any histological outcome. Therefore, diagnostic laparotomy and resection were necessary, although without any prior knowledge of the nature of the tumor. The sample obtained allowed the pathologist to reveal the presence of a gastrointestinal stromal tumor. The paper also describes "therapeutic traps" related to differences between radical surgical treatment of adenocarcinoma and stromal tumors. The tumor neoadjuvant treatment with imatinib tyrosine-kinase inhibitor is also described.
Key words: diagnostic problems, gastrointestinal stromal tumor, imatinib, rare tumor

Streszczenie. W pracy przedstawiono przypadek 77-letniego pacjenta z nowotworem podścieliskowym jelita cienkiego. Pomimo wielokrotnie wykonywanych badań endoskopowych dolnego i górnego odcinka przewodu pokarmowego oraz niemal dwuletniego okresu obserwacji nie można było ustalić przyczyny krwawienia do przewodu pokarmowego. Dopiero enteroskopia – badanie o ograniczonej dostępności – umożliwiła ustalenie rozpoznania guza jelita cienkiego, ale nie dała odpowiedzi, jaki ma on charakter histologiczny. Dlatego też konieczna była laparotomia diagnostyczna i usunięcie guza bez wiedzy o jego naturze. Uzyskany w ten sposób preparat pozwolił patologowi na rozpoznanie GIST. Opisano „pułapki terapeutyczne" związane z różnicami w leczeniu radykalnym i chirurgicznym gruczolakoraka oraz nowotworu podścieliskowego, a także związaną z GIST uzupełniającą lub neoadjuwantową terapię biologiczną inhibitorem kinazy tyrozynowej – imatynibem.
Słowa kluczowe: rzadki nowotwór, guz podścieliskowy przewodu pokarmowego, trudności diagnostyczne, imatynib

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Introduction

Neoplasms in rare locations or of histological types pose an immense diagnostic and therapeutic problem. Limited symptomatology and the possibilities of imaging or endoscopic diagnostics often result in no detection until the neoplasm is already highly advanced. Often correct diagnosis requires open surgery, with some neoplasms being found accidentally during surgical treatment for other conditions. This group includes small intestinal neoplasms.

In 2010, in Poland 241 cases of these neoplasms were reported, and 139 associated deaths (standardized coefficient of 0.2 and 0.4, respectively).

Case report

In January 2014, a 77-year-old patient was admitted to the Department of Internal Diseases at the 7th Navy Hospital in Gdańsk for diagnostic purposes. The symptoms included hemorrhage from the lower gastrointestinal tract in the form of tarry stools. The symptoms were accompanied by progressing

weakness and weight loss (4 kg in 3 months). Moreover, symptoms of severe permeable obstruction in the form of temporary vomiting with gastric content occurred, which resulted in dehydration. The first incident of hemorrhage occurred in December 2012. The patient was then admitted urgently to a surgical department in one of the hospitals in Gdańsk. Endoscopic examinations performed at that time (gastroscopy and colonoscopy) revealed third degree rectal varicose veins, diverticulosis of the descending colon and sigmoid colon, gastropathy, as well as edema and reddening of the duodenal bulb, without active hemorrhaging. The patient received conservative treatment, and was discharged with the recommendation to use a proton pump inhibitor.

The interview revealed cigarette smoking equivalent to 40 pack-years although no smoking in the past 15 years, chronic treatment due to benign prostatic hyperplasia, and the father having had lung cancer.

The physical examination revealed a palpable, pulsing abnormal mass in the lower abdomen. Laboratory tests presented ischemia (hemoglobin concentration of 9.5 mg/dL), slightly elevated creatinine concentration as a result of dehydration, minor leukopenia, slightly elevated ESR and increased C-reactive protein concentration, as well as double positive fecal occult blood test results. During hospitalization another gastroscopy and colonoscopy were performed, the diverticulosis of the sigmoid colon, rectal varicose veins and gastropathy with completely negative urease results were confirmed. Deformation of the duodenal bulb was also found, similarly to out-patient tests performed in February and December 2013. Again, hyperplastic abnormalities or a site of active hemorrhage were not found.

The pathologist examining samples obtained from the endoscopy did not find a hyperplastic disease either. Abdominal ultrasound did not reveal a significant abnormality, apart from small cysts in the kidneys and liver, and a 4 cm aneurism in the abdominal aorta. The patient was hydrated and discharged.

After a month, the patient was re-admitted to the Navy Hospital with similar symptoms, this time to the gastroenterology department. The decision was made to increase the scope of endoscopic diagnostics, and, after preparation of the patient, enteroscopy under intravenous general anesthesia was performed. At 100-150 cm a bleeding tumor was found, obstructing the small intestinal lumen, which prevented further passage of the device (Fig. 1.–4.).

Figure 1. Double-balloon enteroscopy picture of tumor
Rycina 1. Zdjęcie guza z enteroskopii dwubalonowej

Figure 2. Double-balloon enteroscopy picture of tumor
Rycina 2. Zdjęcie guza z enteroskopii dwubalonowej

Figure 3. Double-balloon enteroscopy picture of tumor
Rycina 3. Zdjęcie guza z enteroskopii dwubalonowej

Figure 4. Double-balloon enteroscopy picture of tumor
Rycina 4. Zdjęcie guza z enteroskopii dwubalonowej

Figure 5. Intraoperative picture of tumor
Rycina 5. Zdjęcia śródoperacyjne guza

A computed tomography scan of the abdominal cavity was performed, which did not reveal any dissemination of the neoplastic disease, except for a small dilation of the hepatic portal vein; the small intestinal tumor was not shown either. Again, the pathologist did not find any hyperplastic abnormality in the samples obtained. However, based on the clinical picture, the patient was qualified for a planned surgical treatment, accelerated due to the progressive symptoms of obstruction. On 16 March 2014 the patient was admitted to the Department of General and Oncological Surgery at the Navy Hospital, where the next day a laparotomy was performed, and during the surgery, halfway along the jejunum, a tumor was found approx. 6 cm in diameter, obstructing the intestine. Resection including wide margin of normal intestine (10 cm on both sides of the tumor) and a mesentery was performed, to ensure proper lymphadenectomy, and the specimen was sent for a planned histopathological examination. Based on the macroscopic presentation (Figs. 5-7) the removed tumor appeared to be adenocarcinoma, and since the intraoperative examination did not reveal any suspicious lymph nodes or metastasis through the bloodstream, it was clinically classified as cT3N0M0.
It was a surprise when the histopathological and immunohistochemical test results defined the tumor as a gastrointestinal stromal tumor (GIST).

Figure 6. Intraoperative picture of tumor
Rycina 6. Zdjęcia śródoperacyjne guza

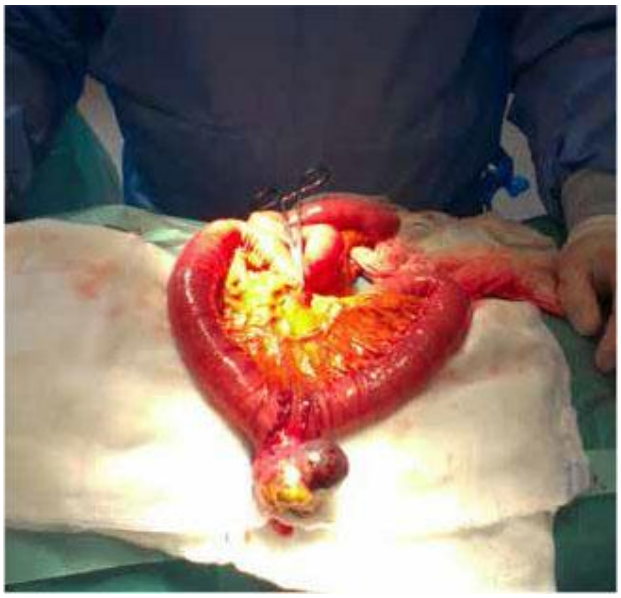

Figure 7. Intraoperative picture of tumor
Rycina 7. Zdjęcia śródoperacyjne guza

Discussion

Small intestinal neoplasms account for less than 0.5% of all malignant neoplasms, and approximately 2% of gastrointestinal neoplasms. In 2011, 252 patients in Poland were diagnosed with malignant intestinal neoplasms, and 179 patients died. The increased risk of developing a malignant neoplasm of the small intestine applies to patients with Crohn's disease, familial polyposis syndrome, Lynch syndrome, Peutz-Jeghers syndrome, coeliac disease and acquired immunodeficiency syndrome (AIDS). The most

common histological types among small intestinal malignant neoplasms include: adenocarcinoma (50%), carcinoid, less often lymphoma, sarcoma or GIST [2].

Small intestinal neoplasms develop without apparent symptoms over a long period, and since imaging diagnostics is limited they may be diagnosed only accidentally during the early stages. At the beginning, the symptoms are non-specific, which delays diagnosis. Pain in the abdomen, obstruction and vomiting, colic abdominal pains, flatulence, gas and stool retention, bodyweight loss, palpable abnormal mass and gastrointestinal hemorrhage occur. Most often the neoplasm is diagnosed at a late stage of advancement, with metastases to the lymph nodes or through the bloodstream. Despite using modern imaging techniques, such as contrast-enhanced computed tomography, double-balloon enteroscopy or, less accessible, capsule endoscopy, pre-operative diagnosis of a small intestinal neoplasm is rare, patients usually undergoing surgery for urgent indications or diagnostic laparotomy [3].

Similar diagnostic difficulties occurred in the case described. The symptoms indicated a malignant gastrointestinal neoplasm, but repeated endoscopic examination of the upper and lower gastrointestinal tract did not confirm the diagnosis. Detecting an aneurism of the abdominal aorta somehow "dulled" the diagnostic inquisitiveness, as it was believed to explain the pulsing tumor in the lower abdomen. The tumor did not present either in a contrast-enhanced abdominal computed tomography scan. Only enteroscopy enabled diagnosis, which, despite the lack of unambiguous histopathological confirmation, due to the significant obstruction symptoms, formed the motivation to perform a laparotomy. This, in turn, provided the diagnosis of a gastrointestinal stromal tumor (GIST), which occurs in this location less often than adenocarcinoma.

It should also be mentioned that surgery has another diagnostic "weapon": laparoscopy, which now plays an increasingly important role in the diagnostics of abdominal diseases as well as in clarifying the clinical advancement of gastrointestinal malignant neoplasms. In the described case, as the gastroenterologists diagnosed the tumor as a result of enteroscopic examination, further searching for the causes of the symptoms was unnecessary, such as by use of diagnostic laparoscopy. In the case of small, primary GISTs, laparoscopic resection with preservation of the principles of oncological purity may be considered; but it is contraindicated with larger lesions [4].

GIST is the most common mesenchymal gastrointestinal neoplasm. It probably originates in the precursors of the cells of Cajal responsible for intestinal peristalsis. Clinically GIST may be a small, benign tumor, but also a very aggressive neoplasm with massive metastases. The most effective method of treatment is radical surgery with the intention to cure (35-65% of 5-year survival without recurrence) [5].

In the case of our patient with a locally advanced disease, radical resection was performed within the healthy tissue, with a large margin of 10 cm, and a wide resection of the mesentery and lymphadenectomy, as without the microscopic diagnosis the statistically most common neoplasm of the small intestine was assumed, i.e. adenocarcinoma. If the gastrointestinal stromal tumor had been recognized, a healthy tissue margin of 1-2 cm would have sufficed, without lymphadenectomy, as GIST only sporadically results in metastases to the lymph nodes (<3% of cases). In advanced GIST multiorgan resections are not recommended, but neoadjuvant treatment with tyrosine kinase inhibitor: imatinib. The median survival of patients treated with this method is presently 6.5 years. Surgical treatment of the residual tumor mass or metastases after the treatment with imatinib reduces the effect of the neoplastic tumor size, and balances long-term therapy outcomes [6].

The presence of a mutated *KIT* gene or *PDGFRA* gene in GIST significantly affects the predicted response to imatinib treatment, so part of the fresh specimen should be stored for freezing at -70 to -80°C in order to perform molecular tests in case of doubts as to the prognosis while expression of the *CD 11 7*gene, which confirms expression of the KIT receptor on the membrane, may be determined with immunohistochemical methods. In the case described the following histopathological diagnosis was made: spindle cell stromal tumor of intermediate malignancy according to the ESMO 2012 guidelines, with 3 mitoses per 50 high power fields, indicative of low mitotic index (<5), *CD 117* (+), mesenteric lymph nodes without metastases, in the macroscopically suspicious specimen collected from a distant part of the peritoneum no abnormality was found. This is stage 2 of clinical advancement, pT3N0M0. The epitope of the *KIT* gene, *CD 117,* was positive, so the expected response to biological adjuvant therapy was positive, and due to location in the small intestine, adjuvant therapy with imatinib was indicated [7].

As in any oncological surgery center, according to the principles of multidisciplinary management, the patient described was referred to further oncological treatment, as adjuvant therapy with imatinib for three years in the group of patients at high risk of recurrence extends disease-free survival period and overall survival. In case of non-resective, metastatic or recurrent GISTs, due to resistance to conventional chemotherapy, introducing a small molecule tyrosine kinase inhibitor, imatinib, was a breakthrough. In case of developing resistance, therapy with sunitinib or regorafenib may be considered. Treatment is conducted under control of computed tomography with intravenous contrast, and the tumor response is

monitored according to the RECIST (Response Evaluation Criteria in Solid Tumors) criteria, by assessment of the sum of the longest dimensions of the measurable lesions [8]. The most sensitive method of monitoring the response to tyrosine kinase inhibitor treatment in patients with GIST is PET-CT examination [8].

Summary

1. Malignant neoplasms of the small intestine are very rare. They present late symptoms, and despite high availability of imaging and endoscopic diagnostic methods, such as enteroscopy, often the final diagnosis requires a diagnostic laparotomy and tumor resection, or collection of a specimen.

2. Although GISTs occur much less often than adenocarcinoma or carcinoid in the small intestine, they are the most common group of mesenchymal gastrointestinal neoplasms.

3. Wide resection margins in lymphadenectomy are not recommended, as the probability of lymph node metastases is very limited.

4. Multiorgan resection in case of advanced tumors is not recommended, because GISTs in most cases have *KIT* gene mutation, so neoadjuvant therapy with imatinib provides good results and resectability.

5. In case of a suspected GIST, part of the specimen should be secured by freezing for molecular studies

6. GIST is resistant to conventional chemotherapy, but using tyrosine kinase inhibitor, imatinib, provides good results, both as an adjuvant therapy, and in the treatment of generalized disease and non-resective or recurrent tumors.

7. Patients with GIST should be treated in multi-disciplinary centers. Registering GISTs with the National Clinical Register is recommended (gist@coi.waw.pl), as well as including new cases in prospective clinical studies [10]. Further understanding of the biology of GIST neoplasms and more effective pre-operative diagnostics enable earlier introduction of proper treatment [11].

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Adenocarcinoma of the appendix

Gruczolakorak wyrostka robaczkowego

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Abstract. Adenocarcinoma of the appendix occurs rarely. There are no characteristic clinical symptoms and it is difficult to make a correct preoperative diagnosis. The peak incidence is observed in the age group of about 55–65 years, and is more common in males (4:1 in relation to females). Dependent on the TNM stage, the correct treatment is right hemicolectomy, possibly including adjuvant chemotherapy.
Key words: adenocarcinoma, appendix, diagnostics, treatment

Streszczenie. Pierwotny gruczolakorak wyrostka robaczkowego występuje rzadko. Ze względu na brak charakterystycznych objawów klinicznych ustalenie właściwego rozpoznania przedooperacyjnego jest trudne. Szczyt zachorowań występuje około 55.–65. roku życia, z przewagą u mężczyzn (M:K 4:1). W zależności od stopnia zaawansowania procesu właściwym leczeniem jest prawostronna hemikolektomia, ewentualnie poszerzona o chemioterapię adjuwantową.
Słowa kluczowe: gruczolakorak, wyrostek robaczkowy, diagnostyka, leczenie

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Introduction

Primary appendiceal adenocarcinoma is rare – the estimated incidence is 0.01-0.2 cases per 100,000 citizens/year and accounts for less than 0.5% of all malignant gastrointestinal neoplasms [1]. Due to the absence of characteristic clinical symptoms, accurate pre-operative diagnosis at an early stage is difficult; it is estimated to be approximately 6-25%, depending on the center [2,3]. Initial diagnosis is acute appendicitis or gastrointestinal obstruction. The imaging tests results describe a pathological mass in the projection of the appendix, interpreted as acute inflammation. Laboratory tests usually present slight leukocytosis (with a leftward shift), as well as increased ESR and CRP concentration [4].

Histologically, four types of appendiceal neoplasms are distinguished:

- carcinoid,
- mucinous or intestinal adenocarcinoma,
- *adenocarcinoid*,
- *signet ring cell* [5].

The peak incidence is observed in the age group of about 55–65 years, and is more common in males (4:1 in relation to females) [6, 5].

Case report

A patient aged 87, admitted to the department in March 2014 due to pain in the right iliac fossa present for several hours, and body temperature increased to 38°C. Family history of neoplasms: mother died of liver cancer. On admission the stomach was soft, slight pain in the right iliac fossa, with a pathological mass palpable through the abdominal wall in the projection of the appendix. Cardiovascularly and respiratorily stable. Laboratory tests results: leukocytes 16,000/ml and ESR 56 mm/h, no other deviations from generally accepted standards found.

Contrast-enhanced abdominal computed tomography test revealed in the area of the right iliac fossa, near the anterior wall, an agglomerate of partially thickened and adhered small intestinal loops which created an inflammatory tumor of 4.1 × 5.3 × 6.8 cm, in which minor calcifications were visible. The lesion infiltrated also the abdominal wall, i.e. the lateral edge of the rectus sheath and adjacent internal oblique muscles, as well as the transverse abdominal muscle. During hospitalization the pain increased. The patient was qualified for surgery with an initial diagnosis of pericecal abscess. During the surgery the agglomerate of the small intestinal loops was shown,

and between the loops, a cyst with a gelatinous, unclear content. The entire small intestine was freed. Massive thickening in the proximity of the appendix, the cecum was mobilized, and fecal stone was removed from this area. The appendix was removed with the classical method. There was suspected ischemia of the section of the ileum 40 cm from the Bauhin's valve; therefore it was resected and the continuity of the gastrointestinal tract was restored via side-to-side anastomosis with a stapler. The material was sent for histological analysis. No complications were observed in the post-operative period. The patient was discharged in good general and local condition, on the third day following the surgery.

The patient attended a surgical clinic 10 days following the surgery for a follow-up visit and to have the sutures removed. During the physical examination the abdomen was soft, no pain was observed, no peritoneal symptoms were found, peristalsis was present. The skin sutures were removed.

Result of the histological examination of the material resected during the surgery: Adenocarcinoma tubulare partim gelatinosum parietis processus vermiformis G1, pT2. Periappendictis purulenta. The neoplastic lesion is located along the appendix amputation line. After the histology test result was obtained, the patient was re-hospitalized for a more radical treatment. Colonoscopy was performed to find a synchronous tumor – no pathological lesions were observed. Additionally, another contrast-enhanced abdominal computed tomography was performed, which did not reveal any pathological lesions. The patient was qualified for right hemicolectomy, along with resection of the ileocolonic anastomosis. The patient was discharged in good general and local condition, on the fifth day following the surgery. The material obtained during right hemicolectomy did not contain neoplastic cells in the lymph nodes.

The patient remains under supervision of the Regional Oncological Center.

Discussion

Appendiceal adenocarcinoma is rare. This diagnosis is estimated to apply to 1% of preparations during standard histological examination of an appendix removed due to acute inflammation [5]. In a study by Nitecki, in 96 patients with a post-operative diagnosis of adenocarcinoma, it was not suspected before the surgery [7]. Symptoms reported by patients were not specific, and the neoplasm was diagnosed during histological examination of the material collected during the appendectomy. In the case described above, the patient presented symptoms of acute appendicitis during the physical examination. The laboratory and imaging tests results indicated an ongoing inflammatory process. In over 70% of appendiceal adenocarcinoma cases, the patients demonstrate symptoms of acute inflammation [8]. The literature also provides pre-operative descriptions of a mass in the right lower abdomen, and symptoms of acute appendicitis [9]. Pain symptoms in the lower right abdominal quarter, fever and leukocytosis were the most common problems observed in the patients with adenocarcinoma. During appendectomy an inflammatory lesion is usually indistinguishable from a neoplasm [10,11].

In our material, after the result of histopathological examination was obtained, the patient was qualified for a more radical procedure, a right hemicolectomy. The available literature recommends such a procedure also in the case of advanced proliferation processes. Removal of the cecum and of the end part of the ileum may also be performed. In both cases, a lymphadenectomy is recommended [3,4,12]. Only in the case of pT1 tumors may an appendectomy be deemed sufficient [13].

In advanced cases, with metastases to the lymph nodes, adjuvant systemic chemotherapy or possibly intraperitoneal chemotherapy is required. Recommended chemotherapy is based on 5-FU [7, 14,15]. Prognosis in patients with appendiceal adenocarcinoma depends on the stage of advancement of the disease, and on the type of surgical procedure performed. Five-year survival in the group of patients who underwent simple appendectomy is 20% on average, and 45-65% in patients after hemicolectomy (primary or secondary) [3,7,14]. The study by Nitecki confirms this data – 44% for appendectomy and 73% for hemicolectomy [7]. An improved prognosis is observed in the group of patients with intestinal type adenocarcinoma, compared to those with mucinous adenocarcinoma [14].

Summary

Appendiceal adenocarcinoma occurs rarely; however, due to standard histological examination of the material collected during appendectomy, these cases may be identified and proper treatment may be implemented.

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Effects of hyperbaric oxygen therapy in a PMC Iraq veteran with acoustic trauma, symptoms of mTBI and PTSD – a case study

Efekty zastosowania hiperbarycznej terapii tlenowej u weterana PKW Irak z urazem akustycznym, mTBI i objawami PTSD – opis przypadku

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Abstract. A case study of a soldier of the Polish Military Contingent (PMC) in Iraq evacuated due to symptoms of "acute stress". Symptoms defined as stress occurred in the soldier on the third day after the base was fired upon by enemy missiles. During hospitalization in the Department of Psychiatry and Combat Stress of the Military Institute of Medicine the soldier showed symptoms of post-traumatic stress disorder (PTSD) which did not lessen, despite application of psychotherapeutic and pharmacotherapeutic treatment. Enhanced diagnostics revealed that the soldier had hearing disorders and new-onset vascular brain damage. Hyperbaric oxygen therapy (HBOT) brought stabilization of the hearing and resolution of the PTSD symptoms. After 61 days of treatment the soldier was discharged from the hospital with complete symptomatic improvement. He returned to military service.
Key words: HBOT, hyperbaric oxygen therapy, mTBI, post-traumatic stress disorder, PTSD

Streszczenie. Opis przypadku żołnierza Polskiego Kontyngentu Wojskowego (PKW) w Iraku ewakuowanego z powodu objawów „ostrej reakcji na stres". Objawy określone jako stresowe wystąpiły u opisywanego żołnierza w trzeciej dobie po ostrzale rakietowym bazy. W trakcie hospitalizacji w Klinice Psychiatrii i Stresu Bojowego Wojskowego Instytutu Medycznego (WIM) stwierdzono objawy zaburzeń stresowych pourazowych (PTSD), które pomimo oddziaływań psycho- i farmakoterapeutycznych nie ulegały redukcji. Poszerzona diagnostyka wykazała występowanie u chorego zaburzeń słuchu oraz świeże naczyniopochodne uszkodzenie mózgu. Hiperbaryczna terapia tlenowa (HBOT) doprowadziła do stabilizacji słuchu i ustąpienia objawów PTSD. Żołnierz został wypisany z kliniki po 61 dniach leczenia w stanie pełnej poprawy objawowej. Wrócił do służby wojskowej.
Słowa kluczowe: HBOT, hiperbaryczna terapia tlenowa, mTBI, zespół stresu pourazowego, PTSD

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Introduction

The simultaneous occurrence of the symptoms of post-traumatic stress disorder (PTSD) and organic changes in the brain are confirmed by imaging and functional tests of the central nervous system (CNS). However, it has not been determined which disorder is primary, and which is secondary [1, 2]. Therefore, it has not been established if PTSD is a functional disorder which requires mostly psychotherapy, or a biological one which requires other methods of treatment. Answering the question as to whether the trauma results in changes to the CNS, or on the contrary, the changes in the CNS predispose to the development of PTSD is of great importance in choosing the most appropriate treatment.

Clarifying this correlation is particularly important in the case of soldiers. Any combat situation is almost always associated with a risk of brain injury. The increased availability of new neuroimaging techniques, including functional neuroimaging such as positron emission tomography (PET-CT), single-photon

emission computed tomography (SPECT)and functional magnetic resonance imaging (fMRI), has enabled correlations to be established between disorders or dysfunctions in mental condition and mild traumatic brain injury(mTBI) or functional brain disorders [1, 2]. In the case of soldiers it concerns not only immediate combat trauma to the skull or brain, but also the frequently ignored intermediate injuries, due to explosion shockwave or toxic effects on the brain of gases released as a result of burning explosives or gases emitted by burning devices and items, such as rubber, plastic and fuel [3-7]. The case presented illustrates the relation between PTSD and damage to the CNS and sensory organs, in this case the organ of hearing. It also presents hyperbaric oxygen therapy (HBOT) used as an alternative to previous methods of helping patients with PTSD symptoms [8, 9].

Case report

A junior warrant officer, aged 34, married for 12 years, two children (10-year-old son and 2-year-old daughter), in professional military service for 14 years, was urgently evacuated from Iraq due to an acute reaction to stress. The traumatic event in question took place in the military base during the third month of his stay in the military zone. While he was returning from the place of service to the living quarters, a 240 mm rocket exploded approximately 40 m away (26 kg of explosive, fragment zone of approx. 600 m). Regarding the event, the patient remembered only the blast wave which threw him to the ground; he did not recall further events. He regained consciousness in the Polish Medical Support Group MND CS hospital – Iraq. According to his colleagues who rushed to help him, he was conscious immediately after the event, but unresponsive. He fully lost consciousness after arrival at the hospital. He did not remember his admission, but remembered the pain associated with injections. During a 24-hour observation the patient reported pain (stinging sensation) in the cardiac area, headache, trembling of the hands and tinnitus. No somatic or neurological abnormalities were found upon examination. Three days before a similar missile had exploded near his living quarters, and his symptoms were qualified as psychogenic, resulting from the accumulation of traumatic events involving a direct threat to life.

He was diagnosed with severe, acute reaction to stress, and urgent evacuation to Poland was recommended, directly to the Department of Psychiatry and Combat Stress at the Military Institute of Medicine in Warsaw. He was to await evacuation at the living quarters in the military base.

Before the traumatic event the patient he was considered a "very lively, fast and effective person, cheerful, sociable, and self-confident". According to his colleagues, after being discharged from the hospital he had changed entirely. He became constantly anxious and afraid that something would happen, tearful, tremble visibly, helpless. He was anxious about the change in his behavior and about his symptoms. He told his colleagues: "I have spent such a long time in Iraq, I've survived so much gunfire, and this event has caused such a strange reaction in me". During the next gunfire alarm, he quickly went to the shelter. After the alarm was called off, he felt an urge to urinate and developed a strong fear of death.

The patient was admitted to the Department of Psychiatry and Combat Stress at the Military Institute of Medicine on the 7th day after the event. On admission he reported pain and stinging in the heart area, constant anxiety increasing during talking about the traumatic events or recollecting them. "When I think or talk about it, I feel a lump in my throat, I have difficulty breathing, and my ears are blocked. While I was there, following the incident, I was constantly afraid that something could happen, I was alert, I couldn't sleep at night, I was expecting the sound of missiles, the alarm signal". The patient did not understand the symptoms. He was surprised that his suffering was somatic. The only symptom he understood was tinnitus, which he explained as "typical after such an explosion".

The examination of the mental condition revealed a lowered mood, tearfulness, increased difficulties with speech (stammering and stuttering), increased manipulation anxiety and place-related anxiety, incoherent sentences, utterance disorganization due to high anxiety level. No psychotic symptoms, consciousness disorders or disorientation were observed. A standard examination of somatic and neurological condition did not reveal any abnormalities.

During conversations with the patient in the first days of hospitalization it was determined that he had never been treated psychiatrically, and had not had any other health problems. The patient denied experiencing fainting, head trauma, epileptic attacks, or poisoning with toxic substances. He commented during his stay at hospital: "I'm glad that I was evacuated directly to hospital, because after that event I've changed completely, I'm more nervous about everything, I've got small children, now I'm afraid about my behavior at home, towards my family. Until now I was doing a lot of things, I even had the nickname 'Quickie', because everything had to be done before the deadline, and now I'm so slow and sluggish. Now I've got problems with speaking, it is difficult for me to talk, I stammer, after the event they couldn't understand my recollections, I was stammering so much. I can't think about what happened in Iraq. When I think about it, or about my colleagues who remain there, I feel fear and anxiety inside my body".

Psychological and neuropsychological tests revealed symptoms indicating the development of PTSD syndrome, while depression or psychotic disorders were excluded, as well as personality disorders. No features of organic brain damage were found. The patient was qualified for a program of individual and group psychotherapeutic activities, used by the Department of Psychiatry and Combat Stress in soldiers with PTSD symptoms. A typical symptomatic pharmacological treatment was also implemented: fluvoxamine 200 mg/day, propranolol 120 mg/day and alprazolam 1 mg/day. The aim of the pharmacological treatment was to reduce anxiety, thus increasing psychotherapeutic compliance and prevent the development of fully symptomatic PTSD.

During the prolonged stay of the patient in hospital, despite pharmacological and psychotherapeutic treatment, the psychopathological symptoms of post-traumatic stress disorders persisted, and the patient did not function well in the therapeutic community. The patient's isolation, constant anxiety, fear, lowered mood and resulting reduced engagement in the psychotherapeutic program were observed.

Further observation revealed a hearing disorder for which the patient compensated by lip reading. The patient denied hearing impairment, reported only a temporary buzzing in the ears and head, persisting since the event. Audiometric and tympanometric tests were performed, as well as a head CT scan; the patient also received laryngological and audiological consultation. Apart from bilateral reception hearing loss, a nasal septum deviation was found, as well as an elongated hypodense ischemic focus in the parasagittal basal left frontal lobe. All the changes were considered to result from the combat trauma associated with the explosive blast effect. The patient was qualified for treatment in a hyperbaric chamber, procognitive and cerebral circulation-improving therapy was implemented, as well as steroid therapy.

Treatment in the hyperbaric chamber, although introduced in the fifth week following the injury, led to very rapid hearing stabilization. After 15 sessions, the symptoms of hearing loss were almost completely reduced, which was confirmed by audiometric tests. Following modification of the pharmacological treatment and introduction of the therapy in a hyperbaric oxygen chamber, the tinnitus subsided, anxiety was reduced, mood, communication and sociability improved, and the tendency for isolation disappeared while the engagement in the psychotherapeutic program increased significantly.

The patient was discharged after 61 days of treatment with complete improvement of symptoms. He returned to military service. The recommended treatment (fluvoxamine, propranolol, piracetam) was continued for 6 months. The patient did not require further treatment or psychotherapeutic help.

Discussion

The case presented shows that in soldiers who are directly involved in military actions, psychopathological symptoms, initially qualified as mental disorders associated with combat stress, may be caused by post-traumatic injuries to the CNS and sensory organs, in this case – the organ of hearing. The injuries were not found at any stage of the medical evacuation, due to the absence of clear clinical symptoms, neither were they observed during the standard examinations with the use of neuropsychological tests performed at the Department of Psychiatry and Combat Stress. Only during hospitalization, based on observation and additional tests, was it found that the absence of improvement in the patient's mental condition, despite the implementation of complex pharmacological and psychotherapeutic treatment, had biological rather than psychogenic grounds. Hyperbaric oxygen therapy introduced due to post-traumatic reception hearing loss not only improved the patient's hearing, but also mental condition. Since treatment in the hyperbaric chamber was implemented only in the fifth week following the acoustic trauma, which is very late, it is unlikely that the comprehensive improvement in the patient's mental condition was associated with a hearing improvement resulting from oxygen therapy. In our opinion, treatment with compressed oxygen in a hyperbaric chamber comprehensively affected the CNS structures damaged as a result of the explosive blast wave, which found reflection in stabilization of the mental condition.

Conclusions:

The case presented indicates the need to initiate Polish research among PMC veterans regarding correlations between mental disorders associated with combat stress and brain microinjuries.

The effect of treatment with compressed oxygen suggests that oxygen therapy may be an alternative therapeutic technique to treat soldiers with symptoms of mental disorders associated with participation in military actions.

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Orbital abscesses that imitate tumors – two case reports

Ropień oczodołu imitujący guz – opis dwóch przypadków

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Abstract. An orbital abscess presents an interdisciplinary problem for ophthalmologists, laryngologists and maxillofacial surgeons. This is the one of the more severe complications of rhinosinusitis; however, it may be also caused by otitis, skin infections or trauma. This disease affects mainly children but it can occur at any stage of life. Typical symptoms include pain, erythema, and sometimes proptosis and decreased visual acuity. The diagnostics is based on medical history, physical examination and a CT or MRI scan of the head. Treatment includes surgical abscess drainage and antibiotic therapy. In some cases, the course of the disease is slow and mildly symptomatic, and may suggest cancer. The aim of this paper is to present two cases of orbital abscess, treated at the Department of Maxillofacial Surgery of the Military Institute of Medicine in Warsaw. Based on physical examination and imaging, both cases were initially recognized as a tumor of the orbit, with the diagnosis being altered after the biopsy.
Key words: orbital abscess, orbital tumor, rhinosinusitis

Streszczenie. Ropień oczodołu stanowi problem interdyscyplinarny okulistów, laryngologów i chirurgów szczękowo-twarzowych. Jest jednym z poważniejszych powikłań zapalenia zatok przynosowych, ale może wystąpić także jako powikłanie w przebiegu zapalenia ucha środkowego, zakażenia skórnego bądź urazu. Dotyczy głównie dzieci, ale może wystąpić w każdym okresie życia. Pojawia się ból, zaczerwienie, a w niektórych przypadkach wytrzeszcz gałki ocznej i zaburzenia ostrości wzroku. Diagnostyka opiera się na wywiadzie, badaniu przedmiotowym oraz badaniach obrazowych: tomografii komputerowej głowy lub rezonansu magnetycznego. Leczenie obejmuje nacięcie ropnia, jego drenaż oraz antybiotykoterapię. W niektórych sytuacjach przebieg jest skąpoobjawowy, powolny, mogący sugerować chorobę nowotworową. Celem pracy jest przedstawienie dwóch przypadków ropnia oczodołu leczonych w Klinice Chirurgii Twarzowo-Szczękowej WIM, w których na podstawie badań przedmiotowych i obrazowych rozpoznano wstępnie guz oczodołu, a weryfikacja rozpoznania nastąpiła podczas biopsji diagnostycznej.
Słowa kluczowe: ropień oczodołu, guz oczodołu, zapalenie zatok przynosowych

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Introduction

Depending on its etiology, location, symptoms, course and treatment, an inflammation of the orbital soft tissues may be categorized as preseptal inflammation or orbital cellulitis, including fungal orbital cellulitis [1-3]. The septum is a layer of compact connective tissue ranging from the verge of the orbit to the edges of the upper and lower eyelids, comprising a barrier to protect the orbit from the expansion of external inflammatory processes [1,2].

Preseptal inflammation

Preseptal inflammation may be suggested by single-side eyelid edema together with pain and erythema, usually without systemic symptoms, pain while moving the eyeballs and sight acuity disorders [1]. The most frequent causes are injuries, insect bites, expansion of a local infection, such as a stye, chalazion, or dacryocystitis, and conjunctivitis; less frequently it is caused by systemic bacteriemia or erisypelas [1,2,4]. It occurs mainly in children, usually before the age of

10 [2]. In the majority of cases, it can be diagnosed on the basis of an interview and clinical image. To differentiate from orbital cellulitis, a computer tomography or magnetic resonance imaging of the orbit and paranasal sinuses is recommended. A lumbar punction may be indicated in order to exclude meningitis [1]. Empirically supported treatment involves the administration of amoxicillin with clavulanic acid as an out-patient technique. If there is no improvement within 48 hours, or the inflammatory process expands, hospitalization and intravenous administration of an antibiotic, usually from among the cephalosporins, should be considered [2].

Orbital cellulitis

Inflammatory processes of the tissues inside the orbit is characterized by symptoms similar to preseptal inflammation and systemic symptoms, such as fever and malaise, together with proptosis, pain and eyeball mobility disorders. The symptoms which should arouse concern are loss of sight acuity and lack of reaction of pupils to light, which indicate that the tissues of the superior margin are inflamed [1]. The cause of the disease is usually an exacerbation of rhinosinusitis, mainly of the frontal and ethmoidal sinuses [1-3], but may also include periodontal abscesses, injuries of maxillofacial areas and paranasal sinuses [1,4,5]. The diagnostics involve ophthalmological and laryngological examination, together with the consultation of a maxillo-facial surgeon. For additional tests and scans, computer tomography is the basic tool. If cavernous sinus thrombosis is suspected, the diagnostics should be extended with MRI and CT venography, and a lumbar punction should be considered. The patients require hospitalization, identification of the source of the orbital infection and intravenous administration of antibiotics in the empirical scheme: vancomycin with ceftriaxone or cefatoxime, vancomycin with ampicillin sulbactam, and vancomycin with piperacillin-tazobactam. In order to broaden the spectrum, metronidazole is included as well [2,6]. Disorders of sight acuity and pupil reflexes and the presence of purulent content are indications for surgical treatment: incision of the abscess and sometimes also drainage of the paranasal sinus which is the cause of the inflammatory process. Intravenous antibiotic therapy should last up to 14 days. Then, depending on the patient's condition, oral supportive therapy should be administered for the next 14–21 days [2].

A special case of orbital cellulitis is fungal cellulitis. Due to inflammation of the blood vessels, a characteristic necrosis of the eyelid tissue may be observed, together with face edema, worsened sight acuity or blindness, incorrect pupil reflex, lack of corneal reflex and droopy eyelids. The most frequent pathogen is *Aspergillus mucormycosae.* The infection expands from the paranasal sinuses or nasal cavity. The prognosis is serious, mortality reaches 30% despite intensive care. The treatment involves the surgical management of necrotic tissues, drainage of the sinuses, administration of amphotericin B, as well as oxygen therapy in a hyperbaric chamber [2,7].

The discussed forms of orbital cellulitis are usually of acute character. Chronic forms are infrequent and their symptoms may indicate a neoplastic process. The aim of this paper is to discuss two cases of patients treated in Clinic of Cranio-Maxillofacial Surgery of the Military Institute of Medicine who, on the basis of physical examination and imaging, were diagnosed with orbital tumors. The diagnoses were verified during the surgical procedure.

Case 1.

A 62-year-old male patient was being prepared to phacoemulsification due to bilateral cataract. During the pre-surgery examination, proptosis of the left eyeball was observed. The CT image description indicated a tumor in the superior-medial area of the orbit. The patient was admitted to the Clinic of Cranio-Maxillofacial Surgery of the Military Institute of Medicine for a biopsy. During the surgery, after the tumor wall had been cut through, a flow of purulent content was observed. Pus samples were collected for microbiological tests and a specimen of the abscess capsule was cut out for histopathological examination. As the chronic inflammatory process had destroyed the medial wall of the orbit, as a result of which the orbit was joined with the ethmoidal and frontal sinuses, the access was widened and a sample of mucus of the sinuses with polyp-like lesions was taken for histopathological examination. Next, the frontal sinus was abundantly rinsed with metonidazole and drainage was applied. No complications were observed in the post-surgical period. Results of the histopathological examinations: fragments of inflammatory granulation tissue and histological structures typical of sinuses partially with chronic purulent inflammation *(sinusitis chronica hypertrophica partim polyposa cum calcifcationibus multifocalibus).* In the microbiological tests, *Staphylococcus epidermidis* was cultured. The patient was referred to an otolaryngology clinic for further treatment of the inflammation of the frontal and ethmoidal sinuses.

Case 2.

An 81-year-old woman was admitted to the Clinic of Cranio-Maxillofacial Surgery for diagnostics concerning a tumor located in the right orbit (Fig.). The patient felt pain in the eye and it had been watering for three months. A few weeks before admission, a slight exophthalamos was observed. The patient was diagnosed in the ophthalmology department of another

Figure. Orbital abscess imitating a tumor
Rycina Ropień oczodołu imitujący guz

hospital. The CT image showed a tumor, located in superior-medial area of the right orbit. The patient was sent to have a diagnostic biopsy. During the tissue preparation, a large amount of pus exudate were observed, the fluid was collected for microbiological tests. The cavity remaining after the abscess was rinsed with metronidazole, and a drain was inserted. In the post-surgery period, amoxicillin with clavulanic acid and metronidazole were administered, which led to the disappearance of the symptoms. Results of the culture were: *Staphylococcus haemolyticus*, strain resistant to metycillin and MLSb, sensitive to vancomycin and ciprofloxacin. The patient was referred to an otolaryngology clinic for further treatment.

Discussion

Orbital cellulitis is a complex issue requiring interdisciplinary treatment. In the majority of cases, it can be diagnosed on the basis of an interview and clinical examination. More detailed information may be obtained from imaging, such as computer tomography or MRI. However, there are cases in which a deeply located orbital abscess may develop without symptoms and which may be described in scans as a tumor. In such cases, it is advisable to collect a specimen for histopathological examination in order to obtain a correct diagnosis before the planned surgical treatment.

In the presented cases, the diagnostic biopsy led to a change of diagnosis and therapeutic proceedings. The patients were referred for surgical treatment of the paranasal sinuses.

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Hirayama disease

Choroba Hirayamy

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Abstract. This article describes the case of an 18-year-old Caucasian male patient with an 18 month history of progressive distal upper extremity paresis and muscular atrophy of the right hand and forearm. The clinical examination combined with dynamic magnetic resonance imaging (MRI) of the cervical spine and further supportive tests lead to the diagnosis of Hirayama disease. To our knowledge, this is the first description of such a case in Poland.
Key words: dynamic MRI, Hirayama disease, monomelic amyotrophy

Streszczenie. W artykule przedstawiono przypadek 18-letniego mężczyzny z postępującym od około 1,5 roku odsiebnym niedowładem kończyny górnej z zanikiem mięśni ręki i przedramienia po stronie prawej, u którego na podstawie obrazu klinicznego i wyniku dynamicznego badania rezonansu magnetycznego odcinka szyjnego kręgosłupa oraz innych badań pomocniczych rozpoznano chorobę Hirayamy. Według naszej wiedzy jest to pierwszy w Polsce opis takiego przypadku.
Słowa kluczowe: choroba Hirayamy, monomeliczny zanik mięśni, dynamiczny MRI

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Introduction

Hirayama disease (HD) is a very rare type of cervical myelopathy. Typical symptoms include one-sided, progressive paresis of an upper limb, with hand and forearm muscle atrophy. It primarily affects young men.

The etiopathogenesis is not fully clear, the most widely accepted theory describes the disproportionate growth of the bone part of the spinal canal and the dural sac in puberty. This results in ischemic damage to the cells of the anterior horn, stemming from repeated microinjuries during bending movements of the cervical spine.

The diagnosis is based on the clinical image and supplementary scans: dynamic magnetic resonance imaging (MRI) of the cervical spine, and neurophysiological tests: electroneurography (ENG) and electromyography (EMG). Early diagnosis is very important due to the possibilities of conservative treatment slowing down the progress of the disease.

Case study

A male patient, aged 18, with no significant medical history from childhood, apart from asthma, was admitted to the Department of Neurology of the 7th Hospital of the Navy in Gdańsk for diagnostics of distal paresis of the right upper limb accompanied by the atrophy of the muscles of the hand and forearm. The symptoms were preceded by a sensation of "muscle stiffness" in the limb when exposed to cold. In the last weeks before the hospitalization he had begun regular gym workouts and noticed the increasing disability of the limb. He denied having any cervical spine or upper-limb injury. The family interview into neuromuscular diseases was negative.

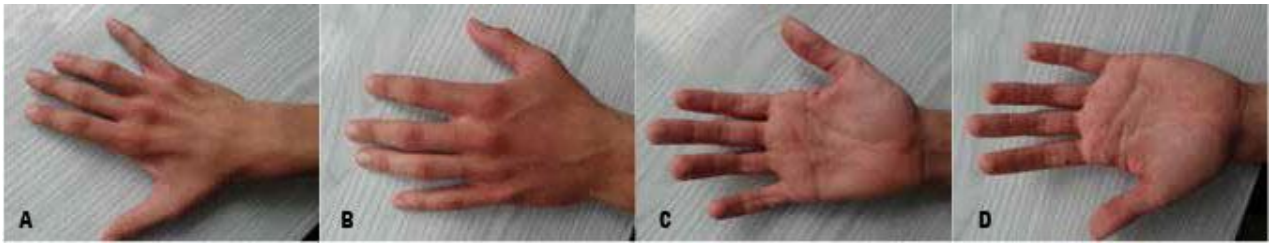

Figure 1. Dorsal surface of the right (**A**) and left (**B**) hand. Palm of the right (**C**) and left (**D**) hand. Muscular atrophy in the right hand (**A** and **C**).
Rycina 1. Powierzchnia grzbietowa prawej (**A**) i lewej (**B**) ręki. Powierzchnia dłoniowa prawej (**C**) i lewej (**D**) ręki. Zanik mięśnia ręki prawej (**A** i **C**).

The neurological examination showed the following abnormalities: weakening and atrophy of the muscles of the right hand, most visible in the muscles innervated from the C7-Th1 level (Fig. 1A – D.), less intense atrophy of the muscles of the right forearm, but with no damage to the brachoradialis (Fig. 2.), postural hand tremor with prevalence of the right side, intensifying when the fingers are stretched, bilaterally brisk tendon reflexes, right-convex thoracic scoliosis, winged right scapula, and bilaterally excessive movement range in the carpal, metacarpophalangeal and interphalangeal articulations. No pathological pyramidal symptoms, sensation disorders, cranial nerve disorders or sphincter dysfunction were observed. The results of the laboratory test were as follows: in CBC a slight increase of eosinophil count (8.3%, N: <3%) and an increased IgE titre (136 IU/mL N: <100). Other laboratory tests, including: coagulation profile, ESR, CRP, kidney and liver function tests and virological tests (HBV, HCV, HIV) gave normal results. No antibodies against *Borrelia burgdorferi* or antiganglioside antibodies were detected. The cerebrospinal fluid tests, including the test for oligoclonal bands, also gave normal results.

Figure 2. A minor muscular atrophy in the right forearm with the spared brachioradial muscle. *Oblique amyotrophy*.

Rycina 2. Niewielki zanik mięśni przedramienia prawego z zaoszczędzeniem mięśnia ramienno-promieniowego. *Oblique amyotrophy*.

The neurophysiological examination revealed the traits of intensive neurogenic damage to the first interosseous muscle in the right hand, both of chronic (reinnercation) and active character (denervation). Single fibrillations were observed in both bicepses brachii and the first interosseous muscle on the left side. However, no fasciculation was observed, neither in the clinical examination nor in the EMG. The evaluation of sensory conduction in ENG showed no abnormalities.

X-ray of the cervical spine did not reveal any significant abnormalities apart from the reduction of the physiological cervical lordosis. The X-ray image of the chest, right glenohumeral joint and both arms showed they were within normal limits. Similarly to the X-ray, the MRI of the cervical spine in the neutral position (Fig. 3A.) showed a reduction of the physiological cervical lordosis with no signs of compression of the spinal cord or intramedullary foci. The dynamic MRI of the cervical spine in flexion (Fig. 3B.) revealed the following abnormalities: anterior translocation of the cord by the dura, the reduction of the anterior reservoir at the level of C5, C6, C7 vertebral bodies and broadening of the epidural space on the dorsal side visible after the contrast enhancement in the T1 sequence. No unambiguous intramedullary foci were observed. The patient was discharged home with a suspicion of Hirayama disease with the recommendation to use a soft cervical collar. 6 months following the hospitalization,

the patient arrived for a check-up visit. His neurological condition – muscle strength and scope of atrophy – had not changed. The diagnosis of HD was confirmed and the recommendation to use the soft cervical collar was maintained for the period of the following 3 years (period of predicted progression of the disease).

Discussion

Hirayama disease, also described in the literature as juvenile asymmetric segmental spinal muscular atrophy, monomelic amyotrophy or asymmetric muscular atrophy, is a very rare form of cervical myelopathy first described in 1959 by a Japanese researcher, K. Hirayama [1-3]. It appears mainly in the countries of the Far East, Indochina and India. Out of 400 cases described so far, few come from Europe and the USA [4-6]. The disease affects mainly young men. The morbidity rate in men is 7–17 times greater than in women [7,8]. The typical age of onset is 15–20 years [5]. The beginning is deceitful, with a gradually progressing course of a typically mild nature. After 2–5 years from the first symptoms, the progress of the disease becomes self-limited, but the established neurological deficit does not subside [5,7,9]. The clinical image of Hirayama disease consists of: gradually progressing weakening and atrophy of the thenar, hypothenar, and interosseous muscles of the hand, flexors and extensors of the wrist and fingers, with characteristic saving of the brachoradialis, which gives the effect of an "oblique" atrophy of the muscles of the upper limb. The upper limbs are affected asymmetrically. The prevalence of the symptoms on the right side is much more frequent (3:1) regardless of whether the right hand is dominant or not [5,6,10]. The bilateral form of the disease with asymmetry is much less frequent, and there are only several cases (<10%) in which the upper limbs are affected bilaterally and symmetrically [11]. The typical symptoms include muscle weakening, intensifying after exposure to cold, and postural hand tremor, visible especially when the fingers are stretched, known as minipolymyoclonus [7,6,9,11]. Sometimes autonomic symptoms such as hyperhidrosis and thermoregulation disorders in the affected limb may occur [11]. No sensation disorders, weakened tendon reflexes, traits of cranial nerve or pyramidal pathway damage, or sphincter disorders have been observed. The results of the cerebrospinal fluid examination is usually normal.

Hirayama disease was first considered a mild form of degenerative motor neuron disease, but was finally isolated from neurodegenerative diseases. However, its etiopathogenesis remains unknown. Due to cases of the disease within the same family and the predilection to occur in South-East Asia, research is conducted into environmental and genetic factors

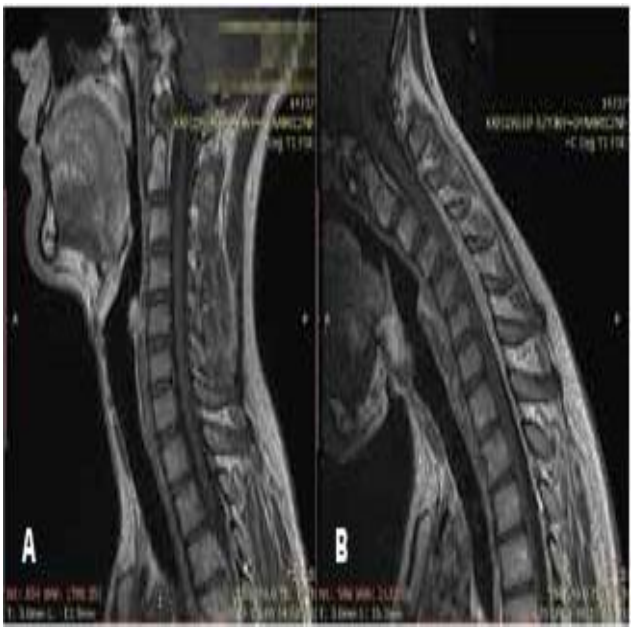

Figure 3. MRI (T1) of the cervical spine in the neutral position. **A.** Reduction of the physiological cervical lordosis with no signs of compression of the spinal cord or intramedullary foci. **B.** MRI (T1) of the cervical spine in flexion: anterior translocation of the cord, reduction of the anterior reservoir at the level of C5, C6, and C7 vertebral bodies and broadening of the epidural space on the dorsal side, visible following contrast enhancement.

Rycina 3. MRI (T1) kręgosłupa szyjnego w pozycji neutralnej. **A.** Zniesienie fizjologicznej lordozy szyjnej bez cech impresji rdzenia kręgowego i ognisk śródrdzeniowych. **B.** MRI (T1) kręgosłupa szyjnego w zgięciu: widoczne przesunięcie rdzenia ku przodowi, zniesienie przedniej rezerwy płynowej na poziomie trzonów C5, C6 i C7 oraz poszerzenie przestrzeni nadtwardówkowej po stronie grzbietowej ze wzmocnieniem pokontrastowym.

(*KIAA1377* and *C5orf42* genes) [12]. Among the hypotheses explaining the mechanism underlying the disease, the most probable is the theory of disproportionate growth of the bone part of the spine and the content of the spinal canal, mainly the dural sac in puberty. The delayed growth of the dural sac in relation to the skeleton leads to its insufficient length, which is visible in bending movements of the cervical spine. The dural sac is tensed and its posterior wall moves forwards, pushing on the spinal cord. The anterior surface of the spinal cord is pressed on the vertebral bodies located in front of it. As a result, the spinal artery is pressed and secondary ischemia occurs, especially in the anterior horn area. Furthermore, the epidural space on the dorsal side is extended, and the venous plexuses in it are excessively filled [5,13]. An alternative theory as to etiopathogenesis of HD involves incorrect structure of the dural sac (disordered structure of flexible fibers, which leads to lower flexibility during bending of the cervical spine) [14]. Additionally, due to frequent

concomitance of atopic diseases with HD and increased IgE titre, an inflammatory source of the disease (atopic myelitis) cannot be excluded [15,16]. The scarce autopsies conducted showed a reduction of the anterio-posterior dimension of the cervical spinal cord and asymmetric, probably ischemic lesions located in the anterior horn of the spinal cord, especially in segments C7 and C8 [17,18]. The most important lesions involved neuronal loss without cytoplasmic inclusions, slight astrogliosis, no macrophage infiltration and abnormal proliferation of blood vessels. The results of the autopsy is similar to spinal ischemic damage in the course of syphilis (*téphromalacie antérieure*) [3]. The diagnostics are based on clinical examination, dynamic MRI of the cervical spine, neurophysiological tests: ENG and EMG, and exclusion of other diseases with similar clinical manifestations. Of the scan types, dynamic MRI of the cervical spine is the most important, its sensitivity in Hirayama disease is estimated at 87% [19,20]. It shows separation of the meninx from the posterior border of the spinal cord, extension of the epidural space and reduction of the anterior fluid space surrounding the cervical spine, with the effect of spinal cord "flattening" caused by the compression of its anterior surface. After the administration of a contrasting agent, an enhancement of extended epidural space (filled venous plexuses) in the T1 sequence is visible [11,21]. In patients with an advanced stage of the disease, MRI in the neutral position reveals, apart from non-specific lesions such as the reduction of cervical lordosis, an asymmetric atrophy of the superior segments of the cervical cord and hyperintense intramedullary foci in the T2 sequence on this level [11,22]. The aforementioned lesions are located in the same places as ischemic and atrophic lesions in the autopsy examination [5] and are visible most clearly at the beginning of the disease. In older patients with Hirayama disease, after the progression of the disease stops, the characteristic shift of the posterior wall of the dura to the front does not appear. The significant role in the diagnostics of Hirayama disease is played by neurophysiological tests: ENG and EMG. They show the traits of neurogenic muscle damage, especially those innervated from the C7–Th1 level [11,23]. No sensation abnormalities in the neurographic parameters are detected. Differential diagnosis takes into consideration syringomyelia, intramedullary tumors, spinal disc herniation with secondary compressive myelopathy, spinal muscle atrophy, especially Kugelberg-Welander disease, hereditary motor neuropathy (CMT2D/dSMA-V), amyotrophic lateral sclerosis and multifocal motor neuropathy [21,24].

Hirayama disease is treated mainly with conservative therapy. Apart from physical rehabilitation, it is recommended to use a soft collar limiting the bending movements of the cervical spine for the period of the anticipated disease progression (3-4 years). It has been proved that this shortens the progression period (1.8 ± 1.1 years) in comparison to those patients who do not use the preventive collar (3.2 ±22 years) [6]. There are also single reports about the positive effects of neurosurgical treatment. The surgical methods used in Hirayama disease include: anterior stabilization of the cervical vertebrae and posterior decompression with the use of laminectomy and dural plasty. The surgical treatment should be reserved for those cases in which the symptoms progress in spite of the conservative therapy [5]. Therapeutic options for Hirayama disease involve also cosmetic surgery procedures with subcutaneous filling of the spaces after hand muscle atrophy with adipose tissue [6,24]. Although Hirayama disease has a mild character and its progress stops within 2–5 years from onset, early diagnosis is extremely important as it enables the early implementation of conservative therapy and therefore prevents the formation of a permanent neurological deficit and major disability.

Summary

The diagnosis of Hirayama disease in the described patient was based on several clinical data: typical age of the onset, the distribution of the paresis and atrophy, slow intensification of the symptoms and an atopic disease in the medical history. The image from the MRI of cervical spine was also typical of Hirayama disease and the lack of intramedullary foci or traits of spinal cord atrophy corresponds to a relatively mild intensity of the symptoms. The stationary neurological condition at the 6-month observation point may be related to the early implementation of the most recommended conservative treatment.

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Emergency pharmacology in tactical environments, based on the TCCC guidelines

Farmakologia stanów nagłych wykorzystywana w środowisku taktycznym na bazie standardu TCCC

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Abstract. Pharmacological treatment under combat conditions entails many difficulties and limitations conditioned by the specificity of the tactical situation. The differences are mainly due to pressure and the variety of environments in which the soldiers may be located. The treatment regimen of casualties depends on the possibilities available in the danger zone. The Tactical Combat Casualty Care (TCCC) guidelines distinguish three zones of operation. The first zone, with direct fire contact: Care Under Fire (CUF), the TCCC recommends self-treatment and possibly the continuation of fighting. Due to the dynamics of action, there is no possibility for pharmacological treatment. On the other hand, in a relatively safe zone: Tactical Field Care (TFC), after taking the combat initiative and ensuring the cessation of fire, as well as during follow-up activities, which include medical evacuation (TACEVAC/MEDEVAC), advanced pharmacological treatment is recommended to combat the negative effects of injuries, starting with fluid therapy for the treatment of shock through analgesic treatment to the application of antibiotics.
Key words: TCCC, tactical operation zone, pharmacotherapy on the battlefield

Streszczenie. Stosowanie farmakoterapii w warunkach bojowych niesie za sobą wiele ograniczeń uwarunkowanych trudnościami i specyfiką sytuacji taktycznej. Odmienności wynikają przede wszystkim z presji i różnorodności środowiska, w którym przebywa żołnierz. Schemat leczenia poszkodowanych zależy od możliwości, jakie określają strefy zagrożenia. W schemacie postępowania Tactical Combat Casualty Care (TCCC) wyróżnia się trzy strefy działania. W strefie pierwszej, bezpośredniego kontaktu ogniowego – *care under fire* (CUF), zasady postępowania TCCC zalecają „samoleczenie" oraz w miarę możliwości kontynuację walki. Ze względu na dynamikę działań we wspomnianej strefie nie ma możliwości stosowania środków farmakologicznych. Z kolei w strefie względnie bezpiecznej – *tactical field care* (TFC), po przejęciu inicjatywy bojowej i ustaniu kontaktu ogniowego, jak również podczas dalszych działań, w skład których wchodzi ewakuacja medyczna (TACEVAC/MEDEVAC), zaleca się stosowanie zaawansowanego leczenia farmakologicznego, które niweluje negatywne skutki wystąpienia obrażeń ciała, zaczynając od płynoterapii w celu ograniczenia narastającego wstrząsu, poprzez leczenie przeciwbólowe, aż do wprowadzenia antybiotykoterapii.
Słowa kluczowe: TCCC, strefa działań taktycznych, farmakoterapia na polu walki

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Figure 1. Care under fire (CUF)

Rycina 1. Pomoc pod ostrzałem (źródło: Marcin Zieliński)

Figure 2. Tactical field care (TFC)

Rycina 2. Taktyczna pomoc polowa (źródło: Marcin Zieliński)

"What an injured soldier should do or what his companions should do for him, what should be done by a paramedic or medical team leader if a soldier has an amputated limb or an open chest wound, in combat, dust, heat or snow – this simple procedure can make the difference between life and death..." – Lt. Co; Douglas Lindsey MD [1].

Introduction

The contemporary battlefield is ruled by strict procedures guiding medical aid for casualties, which also apply to pharmacotherapy. The Tactical Combat Casualty Care (TCCC) guidelines distinguish three main zones for this type of activity: Care Under Fire (CUF), where there is direct contact with the enemy and weapon fire, Tactical Field Care (TFC), a relatively safe zone where there is no open weapon fire but danger still exists (the medical procedure scheme was simplified down to the most important points), and Tactical Evacuation (TACEVAC), when it is possible to introduce more advanced medical procedures, including the administration of pharmacological preparations filling the blood vessels. Additionally, the maintenance of the thermal and analgesic comfort of the casualty and body hemostasis is recommended.

Care Under Fire (CUF)

In the CUF zone (Fig. 1), there is no time for advanced medical procedures, such as drug or infusion fluid administration. The casualty needs to self-heal, and, if possible, continue fighting [2]. During periods of danger, the situation is usually very dynamic so great stress is laid on self-treatment with the primary aim of preventing hemorrhages; only after the direct danger is eliminated may a wider scope of help, with advanced treatment techniques, be applied.

After managing the tactical situation, the rescuers may then attempt to eliminate the conditions that put the life of the casualty at risk. Medical aid is provided within the second zone, known as Tactical Field Care (TFC), which gradually becomes Tactical Evacuation (TACEVAC) and Medical Evacuation (MEDEVAC).

Tactical field care (TFC)

In the TFC zone (Fig. 2), the first important step is the tactical casualty assessment (TPA), securing and staunching all visible bleeding areas, managing chest injuries, clearing airways and eliminating pain.

Fluid therapy in hemorrhages, use of tranexamic acid (TXA)

Under combat conditions, apart from fulfilling specific tasks, the priority for injury management is to staunch hemorrhages and ensure hemostasis, other medical procedures being considered less important. More than half of battlefield deaths are related to massive bleeding, according to the research conducted in 2008 by J. F. Kelly et al., showing that at least 51% of the deaths of American soldiers taking part in combat operations in Iraq and Afghanistan in the years 2003-2006 was caused by uncontrolled bleeding from the limbs [3].

Activities related to combatting intensifying hypovolemic shock should commence as quickly as possible. Those who are injured and still conscious (A/V in the AVPU scale, with present peripheral pulse) should take liquids orally. There are no guidelines concerning the type of the liquid, therefore water is considered the best and at the same time the easiest to find. It must be remembered, though, that oral administration of liquids is strongly counterindicated in the event of digestive system injuries [4]. If the casualty is unconscious (U in the AVPU scale) with centralized circulation and disappearing pulse on the radial artery, an IV or IO should be made immediately to infuse liquids. If the casualty is in decompensated shock with no peripheral pulse due to a large blood loss, has multiple amputations or a penetrating wound

of the chest has been detected, it is recommended to administer a large-molecule HES preparation - 670/075 hydroxyethyl starch suspended in lactate Ringer solution (Scientific Committee of Tactical Combat Casualty Care recommends 500 mL of Hextend preparation). If no significant improvement in the life parameters is achieved within 30 minutes, a fluid bolus may be repeated, but without exceeding the total volume of 1,000 mL Unfortunately HES solutions have a confirmed negative influence on homeostasis. Research shows a significant increase in the frequency of bleeding and factor VIII coagulation disorders if large volumes of solutions with an average molecular mass of over 450 kD are administered. However, the Ringer solution as the carrier after the elimination of starch from the organism does not leave an excess of chlorine and sodium [5–7].

It is advisable to administer one dose of 1 g of tranexamic acid (TXA, Fig. 3.]) in 100 mL of 0.9% saline (NaCl) or Ringer fluid, no later than 3 hours after the injury [6,7]. TXA is a synthetic amino acid with antihemorrhagic properties. Its mechanism of action consists of the direct inhibition of plasma plasminogen activators and at the same time partial inhibition of tissue plasminogen activators, which leads to inhibition of transformation of plasminogen into plasmin. TXA is a weak plasmin inhibitor that does not bind to plasma proteins, and as a free amino acid it rapidly penetrates the tissues. It can penetrate through the blood-brain barrier and into the synovial fluid. It is excreted within 12 hours from administration, with 90% in an unchanged form, by means of glomerular filtration and hence maintaining its antifibrinolytic activity.

This medicine is approved for use pursuant to the directive of Under-Secretary of Health, Department of Defence of the Republic of Poland of 4 November 2011 only in medical facilities and for people participating in special operations [6].

Analgesia under tactical conditions

In TCCC, analgesic procedures should be introduced as quickly as possible, as pain is a significant factor limiting the functioning of a soldier. However, the safety of the operation (its success) and the safety of the casualty have to be taken into consideration. Before administering analgesics, it may be necessary to disarm the casualty if this has not been done before, although this depends on the type of chosen painkiller. The assessment may be done using the AVPU consciousness scale. If the casualty is conscious and capable of further combat activities, and the tactical situation changes, it is recommended to administer analgesics from non-steroidal anti-inflammatory drugs and from COX-1 inhibitors. These drugs are administered in the form of bilayer tablets every 8 hours (Tylenol 650 mg) or as a single dose (Mobic 15 mg 1x/d), available in the personal combat

Figure 3. Tranexamic acid (source: Marcin Zieliński)

Rycina 3. Kwas traneksamowy (źródło: Marcin Zieliński)

pill packs. In the case of a casualty person who is not capable of continuing combat, who has consciousness disorders due to a head injury or major body injuries and increasing levels of shock, it is recommended to disarm them and administer opioid analgesics. When using drugs from this group, the administration of naloxone as an agonist in the event of respiratory depression should be considered. In the tactical environment, morphine, fentanyl lollipops and, increasingly often, ketamine are administered [6].

Morphine

Morphine is a strong analgesic drug, a phenantrene derivative present in opium. It is administered in 5 mg doses in *i.v., i.o.* or *i.m.,* or in a 10 mg (American version [Fig. 4]) or 20 mg (Polish version) dose, in an auto-syringe.

Figure 4. Morphine (source: Marcin Zieliński)

Rycina 4. Morfina (źródło: Marcin Zieliński)

Acting on the central nervous system (CNS) it exhibits strong analgesic and tranquilizing properties, has a depressive effect on the respiration and cough centers in the medulla and causes strong miosis, even in darkness. In intramuscular administration the effect begins to be visible after 15 minutes, while in an intravenous injection it takes only 2–3 minutes (the maximal effect is achieved after about 30 minutes, which is related to the slow penetration through the brain-blood barrier). Slow penetration is important in those casualties having multi-organ injuries and

wounds covering major surface areas of the body, and it is used for its rapid painkilling effect. The risk of apnea after administration of this opioid requires securing airway patency [6, 8]. The site of intramuscular injection of the drug should be far from the injury, especially if it is accompanied by a major hemorrhage.

Fentanyl

The recommendations of the Committee on Tactical Combat Casualty Care (CO TCCC) stipulate that 800 µg of fentanyl in the form of a lollipop (oral transmucosal fentanyl citrate – OTFC) may be administered [Fig. 5]). It is a strong synthetic analgesic drug belonging to the class of opioids, a µ-opioid receptor antagonist. Its effect is about 100 times stronger than that of morphine (0.1 mg of fentanyl corresponds to about 10 mg of morphine) due to better lipofilicity and solubility in fats and quicker penetration though the blood-brain barrier. The degree of analgesia depends on the dose and the plasma concentration. Intravenous administration of 2 mL (0.1 mg) of fentanyl ensures successful analgesia for 10–20 minutes. The analgesia is sufficient for multi-organ injuries incurred during tactical operations. Fentanyl enables the alleviation of pain without any influence on the circulatory system, it has no depressive effect on the heart muscle and does not cause histamine release, which is very important for the stabilization of life functions. When administered intravenously, it starts to work after about two minutes and the duration of action is rather short, which at only thirty minutes is not desirable in the case of delays in evacuation from the tactical operation area. Administered intramuscularly, the drug starts to work after about 10–15 minutes with the effect lasting for 1–2 hours. The administration to the mouth mucosa also ensures quick absorption. Its bioavailability is estimated at 65% of the total dose. 50% of the dose is absorbed from the mucosa and 50% is swallowed, with 30% of the swallowed dose also reaching the blood. The duration of action of fentanyl then lasts about one hour; therefore it is the route of administration recommended in the TCCC guidelines [6,8]. It should be remembered that, as an opioid drug, it has a direct impact on the CNS, causing consciousness disorders. This means that the casualty has to be disarmed quickly. The application of large doses increases the real risk of respiratory center depression and requires additional measures aimed at ensuring patency of the airways and administration of naloxane (from opioid antagonists).

Ketamine

Ketamine is a quick effect analgesic drug, a derivative of phenocyclidine with a structure similar to hallucinogens. In tactical environments, the doses used are 20 mg intravenously or intraosseously (Fig. 6), 50-100 mg intramuscularly or 50 mg with a nasal atomizer device (NAD) [Fig. 7]) until the pain subsides or nystagmus appears. The drug has a weak effect on the pharyngeal reflexes, which protects the casualty from secondary airway obstruction. Contrary to opioids, it does not cause respiratory center depression but it accelerates the heart rate, increases arterial pressure and cardiac oxygen consumption. This, in turn, may be dangerous in the case of uncontrolled bleeding. Hemodynamic changes related to ketamine are a consequence of increased serum catecholamine concentration caused by the stimulation of the parasympathetic system in the CNS. Ketamine, as a **µ**-opioid receptor antagonist, brings a painkilling effect, while as an **s**-receptor antagonist it has a strong dysphoric activity.

Figure 5. OTFC 800 µg Fentanyl lollipop (source: Marcin Zieliński)

Rycina 5. Fentanyl OTFC 800 µg – lizak z fentanylem (źródło: Marcin Zieliński)

It causes dissociative anesthesia and has an amnesic effect as well as local anesthetic effect. It has a direct impact on the psychophysical condition of the casualty, therefore they must be disarmed. Another effect, which may be harmful in head injuries, is the increased cerebral blood supply and the consequent increase of intracranial and intraocular pressure. As ketamine increases intraocular pressure it is absolutely counterindicated in penetrating eye wounds of traumatic brain injuries (TBI) which is a common type of battlefield injury with mortality reaching 31% [3,9].

It should be remembered that, after each administration of analgesics, the evaluation of the casualty's parameters should be repeated. For morphine or ketamine administered intravenously or intraosseously, the evaluation should be repeated every 10–15 minutes. If pain persists, another dose of the drug may be given. Table 1 presents the specification of the analgesic drugs used in TCCC.

Antibiotics

Early antibiotic therapy is a crucial treatment factor limiting further complications in casualties with open wounds exposed to contamination. On the TFC stage, it is recommended that the casualty should take 400 mg of moxifloxacin as a pill from the personal combat

Figure 6. Ketamine (source: Marcin Zieliński)

Rycina 6. Ketamina (źródło: Marcin Zieliński)

Figure 7. LMA MAD nasal, needle-free intranasal drug delivery (source: Marek Dąbrowski)

Rycina 7. Atomizer donosowy służący podaży ketaminy (*nasal atomizer device* – NAD) (źródło: Marek Dąbrowski)

pill pack. 400 mg of moxifloxacin should be taken orally in the first hour after the injury so that the bacteria cannot colonize the contaminated wound and proliferate excessively in it. Moxifloxacin is a fourth-generation synthetic chemotherapeutic antibacterial agent with a broad spectra of activity, belonging to the fluoroquinolone group [4,10].

Tactical evacuation care (TACEVAC)

Tactical evacuation is a process of moving a casualty to a place where specialist help may be administered. The phase consists in preparation of the casualty for transport to a medical point or field hospital and performing emergency medicine procedures during the transport process itself. Emergency procedures should be continued for each phase of medical evacuation and be finished with the final management of the injuries in hospital conditions. The scope of medical help given increases for each subsequent phase of medical evacuation, which is related to the greater number of medical staff and greater access to drugs and medical equipment. At the beginning of the medical evacuation, the rescue procedures should be introduced or continued by adding further elements. If no pharmacological agents have been administered, they should be used as recommended after the evaluation of the casualty's condition. The evacuation of the casualty most often involves the use of land vehicles or air transport.

Medical activities during TACEVAC are performed according to the Advanced Life Support (ALS), Prehospital Trauma Life Support for Military Medic (PHTLS) and Advanced Trauma Life Support (ATLS) levels. Furthermore, the rescue procedures and pharmacotherapy of acute conditions is extended with further analgosedation and further intravenous/intraosseous infusions of colloid and crystalloid fluids enriched with blood-based products, if available. In order to achieve an intensified analgesic effect, and in the case of nausea or vomiting, prometazine is administered, 25 mg every 6 hours in intravenous/intraosseous infusions or intramuscular injections. This has antiallergic, tranquilizing and antiemetic effects. Prometazine hydrochloride is a H_1 receptor antagonist. By binding with these receptors, it prevents the appearance of allergic symptoms induced by overreleased histamine.

In the case of the casualties who are still in shock, further fluid therapy is recommended in order to maintain systolic blood pressure over 80-90 mm Hg. Blood pressure is often an unachievable parameter to measure due to external conditions, such as the noise of a working helicopter rotor or noise inside the medical evacuation vehicle. In such cases, radial artery pulse is the decisive factor. Of the recommended colloid preparations, 500 ml of Hextend should be administered. If the shock symptoms persist, the fluid bolus can be repeated after 30 minutes, although the total volume should not exceed 1000 ml. Intensive fluid therapy brings the risk of acid-base and ion balance disorders, as crystalloid fluids bear a substantial ionic load of chlorine and sodium. The problem can be solved by the administration of plasma products and packed red blood cells (PRBC) in the proportion 2:1. If there is no possibility of this type of treatment, fresh whole blood may be used [5,7,10].

Antibiotics in TACEVAC

If the casualty did not take the oral 400 mg moxifloxacin pill from his personal combat pill pack in the TFC zone, he should take it in TACEVAC conditions.

If due to injuries, shock or consciousness disorders, the casualty has no possibility of taking the recommended moxifloxacin 400, 2 g of cefotetane (from macrolides) should be administered as a slow intravenous infusion intramuscularly, every 12 hours. Also ertapenem 1 g (administered intravenously or intraosseously once a day) is recommended. Ertapenem is a β-Lactam antibiotic with a broad spectrum of activity, inhibiting the biosynthesis of bacterial cell walls, which makes bacteria proliferation impossible. All these drugs are aimed at limiting the infection in the contaminated wound and systemic infection [3,6,10].

Table 1. Various pain-killers listed in TCCC
Tabela 1. Zróżnicowanie środków przeciwbólowych używanych w TCCC

Type of drug	Mobic (meloxicam)	Morphine	Fentanyl OTFC	Ketamine	Tylenol
Route of administration, dose	*p.o.* pill **15 mg**/d	*i.v.*, *i.o.* bolus **5 mg;** after 10 min, if there is no effect, next **5 mg** or auto-syringe **20 mg** or **10 mg** *i.m.*	*p.o.* lollipop (mouth mucosa) 800 µg	*i.v.*, *i.o.* **20 mg** *i.m.* **50–100 mg** NAD **50 mg**	*p.o.* pill **650 mg** every 8 h
Indications	Injury pain of medium intensity	Medium or strong injury pain, sedation	Analgesia, strong injury pain	Sedation, pain of medium intensity	Injury pain of medium intensity
Adverse effects	Allergy to the drug	Apnea, consciousness disorders, blood pressure drop	Apnea, consciousness disorders	Increased intraocular pressure	Allergy to the drug

The time related to casualty care should be sufficient for a full examination during the evacuation (MEDEVAC or CASEVAC) to hospital, injury management point of forward surgical team (FST). However, transporting the casualty to a hospital remains the priority [11].

Conclusions

The pharmacology in emergencies under combat conditions based on TCCC guidelines is one of the most important elements in the whole treatment process for casualties of contemporary military conflicts. War experiences from the past resulted in the introduction of appropriate procedures related to urgent analgosedation and infusions. The experience acquired from all stages of treatment of casualties is the result of many years of research on changes in shock pathophysiology and the consequences of multi-organ injuries. The continuing progress in military medicine significantly increases the chances of saving people injured in the hostilities of the contemporary war theatre.

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Evacuation techniques during different phases of the tactical environment

Techniki ewakuacji poszkodowanego w poszczególnych fazach prowadzenia działań w środowisku taktycznym

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Abstract. Combat operations and the implementation of high-risk tasks can generate a high number of dead and wounded soldiers. Taking steps to minimize losses during combat tasks is treated as a priority. The evacuation of casualties from the battlefield depends on the current tactical situation, the changing environment, and the available forces and means. Moving the wounded from the CUF (Care Under Fire) area to TFC (Tactical Field Care) takes place at various levels, resulting from the knowledge and tactical training of the soldiers and the availability of emergency equipment. Rapid and safe evacuation of casualties from the danger zone to the medical care zone enables the use of procedures that significantly increase the battlefield survival rate.
Keywords: TCCC, evacuation, MEDEVAC

Streszczenie. Działanie w warunkach bojowych i realizacja zadań związanych z dużym ryzykiem może prowadzić do dużych strat sanitarnych. Priorytetem jest podjęcie czynności mających na celu wykonanie zadania bojowego przy jednoczesnym zminimalizowaniu strat własnych. Ewakuacja poszkodowanych z pola walki jest uzależniona od aktualnej sytuacji taktycznej, zmieniającego się środowiska oraz dostępnych sił i środków. Przemieszczanie rannego ze strefy CUF (*care under fire)* do TFC *[tactical field care)* odbywa się na różnych poziomach zaawansowania, wynikających z wiedzy i taktycznego wyszkolenia żołnierzy oraz dostępności sprzętu ewakuacyjnego. Szybka i bezpieczna ewakuacja poszkodowanego ze strefy zagrożenia do strefy opieki medycznej umożliwia zastosowanie procedur zwiększających prawdopodobieństwo przeżycia na polu walki.
słowa kluczowe: TCCC, ewakuacja, MEDEVAC

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Introduction

Medical evacuation under tactical conditions involves a sequence of changing events and circumstances, posing a range of challenges and problems to the rescuer.

The evacuation of casualties from the danger zone is a great burden on the combat unit and its difficulty varies, depending on the available forces, resources and type of terrain. The success of the evacuation process depends partly on the changing tactical situation (quick reaction to danger and moving casualties from the danger zone behind the shield or directly to the TFC zone) [1].

Rescue activities must be dynamic and at the same time safe for the casualty; therefore the technique chosen should take into consideration the distances to be covered and the current condition of the person who needs help.

While operating in difficult environmental and tactical conditions that may impede the evacuation,

Figure 1. Casualty evacuation from a CUF area; the casualty is dragged by a single rescuer (source: Mikołaj Wegnerowicz/KWP Poznań)

Rycina 1. Ewakuacja poszkodowanego z CUF techniką ciągnięcia przez jednego ratownika (źródło: Mikołaj Wegnerowicz/KWP Poznań)

Figure 2. Casualty evacuation from a CUF area; the casualty is dragged by two rescuers (source: Tactical Medical Solutions)

Rycina 2. Ewakuacja poszkodowanego z CUF techniką ciągnięcia przez dwóch ratowników (źródło: Tactical Medical Solutions)

light and sound discipline must be observed. Light discipline includes restrictions stemming from the ban on using light sources (especially white light) in conditions of darkness related to the time of the day while helping the casualty in a CUF area [2]. Sound discipline involves minimizing the volume of the voice in verbal communication with the casualty or between the rescue team members in the danger zone. If sound discipline is not required, a casualty classified as V on the AVPU scale should be given loud orders from behind cover, commanding his self-evacuation to a safe place [3]. Using the remote access methodology (RAM) to assess the condition of the injured involves giving voice commands or using optical devices without the need to increase risk by approaching the casualty.

Maintaining light and sound discipline is aimed at masking the current location of the casualty on the battlefield and preventing the enemy from finding it.

The availability of advanced evacuation equipment during tactical activities is usually restricted to the minimum, especially in situations where no vehicles are used and the soldiers carry additional munitions and combat assets at the expense of evacuation equipment. In such circumstances, the easiest evacuation methods are used (no equipment, based on the strength of the muscles – carrying or dragging the casualty [Fig. 1. and 2.]). The activities are aimed at limiting the scope of the medical procedures and, consequently, at shortening the time of stay in the CUF area, according to the rule "good medicine may make bad tactics" [4].

Care under fire (CUF)

In the CUF area, the most frequent techniques are man-carries, if the casualty, due to his condition, cannot evacuate himself from the danger zone and hide behind cover. In the danger zone, the tactical situation does not allow rescuers to use evacuation devices. Buddy carries and simple, multifunctional tapes and lanyards are used. Special systems built into the soldier's clothes or tactical vest (tapes and grips) are also used to facilitate evacuation. Such solutions enable quick evacuation of the casualty to a safe place with the use of simple dragging techniques. Training in simulated conditions before activities in the tactical environment should prepare the soldier physically and increase his knowledge of possible emergencies during combat operations.

The evacuation of the casualty is usually highly problematic. The weight of the casualty together with the rescuer's equipment means the rescuer needs to undertake substantial physical effort. Evacuation is always indicated when the casualty is unable to move to the safety zone without help. A ballistic trauma to the lower limbs or the pelvis leads to a loss of mobility

Figure 3. Casualty evacuation from a CUF area using the “fireman’s carry” (source: Mikołaj Wegnerowicz/KWP Poznań)

Rycina 3. Ewakuacja poszkodowanego ze strefy CUF „chwytem strażackim” (źródło: Mikołaj Wegnerowicz/KWP Poznań)

and the need to remain in one place, it also causes consciousness disorders which do not allow the casualty to make rational decisions concerning evacuation from the danger zone. The choice of rescue technique depends not just on the tactical situation but also on the physical strength of the rescuer, the weight of the casualty and the terrain to be covered (distance and type of surface). During a man-carry evacuation of an unconscious person, it is extremely difficult to hold and control the limp body as it requires a lot of energy and concentration from the rescuer. Quick evacuation involves the risk of extending the injuries, loosening of tourniquets or causing an airway obstruction. However, leaving the casualty in the danger zone may bring a much greater risk of losing health or life.

Fireman's carry

Moving an unconscious person may require the use of both of the rescuer's arms in order to stabilize the body of the casualty in a fuller way. This involves the risk of slower reaction in the case of danger. Among the different man-carry techniques, one of the most popular and often used is the fireman's carry (fig. 3). The lift is performed by one person and the weight of the casualty is moved to the muscles of the back and shoulders of the rescuer, which are most resistant to anoxia. In order not to weaken the fire capacity of the unit, the rescuer may use handguns during evacuation. A rapid visual assessment of the casualty (body weight, amount of equipment) in comparison to the potential physical abilities of the rescuer leads to the decision whether this technique is a good choice.

Turtle carry

The "turtle" is an evacuation technique in which the casualty is transported on the soldier's back. The problematic part is lifting the casualty from the ground, especially if they have consciousness disorders or if their muscles are flaccid. The rescuer should lay the casualty on one side and then lie down in an identical position, so that his back is close to the casualty's chest. By holding the casualty's hand to the rescuer's chest and turning to a prone position, the rescuer drags the casualty onto his back. Any equipment carried on the back of the tactical vest of the rescuer makes the application of the technique more difficult and may cause problems during the rescue activities. Another difficulty is the complete inability of the rescuer to use a weapon in order to protect himself.

Rautek grip

Another technique is dragging the casualty with one grip point. One example is the Rautek grip, which can be used by a single rescuer. Starting from a position behind the casualty, a grip on the forearm allows the rescuer to hold the body in a safe and firm way, enabling the casualty to be dragged relatively long distances. However, success depends on the rescuer's equipment – a lot of equipment on the front side of the tactical vest makes the technique more difficult to use. Another option involves two rescuers, when a grip deep under the armpits should be considered (fig. 4 and 5).

With some modification, the casualty may be lifted and transported by more rescuers, e.g. by four people (fig. 6).

Figure 4. CUF area casualty evacuation using underarm grip (source: Maciej Sip)

Rycina 4. Ewakuacja poszkodowanego z CUF za pomocą chwytu pod pachami (źródło: Maciej Sip)

Figure 5. Casualty evacuation with two rescuers using the Rautek grip (source: Maciej Sip)

Rycina 5. Wykorzystanie chwytu Rauteka w ewakuacji prowadzanej przez dwóch ratowników (źródło: Maciej Sip)

Tapes and lanyards

Simple equipment in the form of a long rope with a karabiner at one end forms an alternative to man-carry techniques. The rope is thrown from behind the cover towards a conscious soldier, who fastens the karabiner to his equipment, such as the evacuation grip on his vest, which makes it possible for the rescuers to drag him closer. Tapes, lanyards and ropes have many applications in evacuation activities and may be used in various configurations.

Figure 6. Casualty evacuation with four rescuers (source: Tactical Medical Solutions)

Rycina 6. Ewakuacja poszkodowanego prowadzona przez czterech ratowników (źródło: Tactical Medical Solutions)

Dragon handle

A dragon handle is a set of tapes with two hand grips on one end and a karabiner on the other. Its advantages include good resistance to load and lightness. When packed it takes little space. During an evacuation process it is possible to constantly observe the combat area and, if need be, to fire. Depending on the force available, the evacuation may be performed by one or two people. A short distance from the casualty allows the rescuer to observe him and communicate with him.

Rat strap

The rat strap set (fig. 7) uses a similar rope technique as described in the dragon handle technique above, only the length of the rope itself being different. One of the ends may be thrown to the casualty from behind cover so that he can fasten it to his equipment. During the evacuation, the fastened part (known as the rat tail) is combined with the belt (part of the equipment) so both hands remain free. The fastening has a quick release mechanism to be used in the case of danger.

Hasty harness

This is a long, straight belt with ends combined to form a loop, very resistant and multifunctional. The skilled positioning of the belt on the body of the casualty and around him allows the rescuer to lift the casualty from the ground even if he is unconscious and the muscles are flaccid.

Figure 7. Using a Rat Strap Belt (source: Mikołaj Wegnerowicz/KWP Poznań)

Rycina 7. Zastosowanie taśmy *rat strap* (źródło: Mikołaj Wegnerowicz/ KWP Poznań)

High threat extraction kit

The High threat extraction kit is designed for members of assault teams and contains all the tools necessary for quick and efficient performance of rescue procedures in the CUF area. The time of use and efficiency of the products in the kit is a key factor for successful evacuation from the direct danger zone. The equipment has been designed as an "extension to the human body" in extreme conditions. Immediate evacuation of the casualty is a significant factor in survival and completion of the combat operation. The kit consists of dragon handle and rat strap tapes, a long hasty harness tape, a set of karabiners, a combat tourniquet and a chemical light.

Figure 8. Evacuation by ground vehicle (source: Marek Dąbrowski)

Rycina 8. Ewakuacja z pojazdu (źródło: Marek Dąbrowski)

Vehicular evacuation

If a vehicle has been immobilized and there is a need to evacuate the wounded driver or other members of its crew, the activities required depend on many conditions: tactical situation, vehicle position (on its wheels, on its side, on its roof), access to the inside and fire. All these will influence the decision as to which technique should be used to extract the casualty and the number of rescuers needed. Taking all these factors into account, the recommended method is to drag the casualty out of the vehicle and then to evacuate the casualty to a safe place. If the situation allows it, the evacuation may be performed by two rescuers. After approaching the vehicle, one of the rescuers kneels down in parallel to the doorstep of the vehicle, facing its front, while the other stands next to him. The task of the first rescuer is to free the legs of the casualty (free the feet from the clutch, accelerator and brake pedals/levers) and then drag them towards his arms until he can grip him under his armpits. At the same time, the other rescuer uses the Rautek grip to

Figure 9. Phantom litter (source: Tactical Medical Solutions)

Rycina 9. Nosze płachtowe *phantom* (źródło: Tactical Medical Solutions)

lift the casualty from the seat towards the outside of the vehicle (fig. 8). When both rescuers report readiness, the command to leave is given and they move away in a safe direction.

If the aim of the evacuation is to move the casualty to another vehicle, the proceedings are identical only in reverse order – the person holding the trunk of the casualty enters the vehicle first, going backwards and dragging the body of the casualty inside. If this technique cannot be used, it should be modified, so that the time the rescuers have to remain in the CUF area is not prolonged.

Tactical field care (TFC)

Activities in the TFC area involve performing rescue procedures in a relatively safe zone, without fire contact [5]. The tactical situation enables the use of ready-made evacuation platforms. As there is no direct contact with the enemy in this area, it is possible to examine the casualty, manage his wounds and prepare him for tactical evacuation. There are many ready-made evacuation systems available, and the choice of equipment for a given unit depends mainly on their tasks and the environment in which they must be performed. The equipment has been designed to take little space after packing, making it more practical for transport.

Phantom litter

This litter is sewn from a durable and abrasion-proof material, with a structure which can be folded down to very small dimensions so it can be easily transported under the vest or fastened below the backpack. The surface of the litter freely covers the body of the soldier, while the many handles on the edges enable transport by dragging or lifting, depending on the available force.

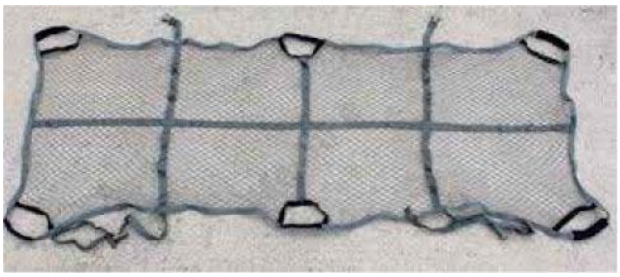

Figure 10. Individual Tactical Net Litter (source: www.medline.pl)

Rycina 10. Osobiste nosze taktyczne (źródło: www.medline.pl)

Apart from the lateral grips, the litter also features a belt at the chest level of the casualty, which may serve for securing the limp arms or the weapon of the casualty. The adequate number of grips ensures ease of transport both for the casualty and the rescuers, in various configurations of available forces. An additional advantage of the phantom litter is its multifunctionality: while it can be used for evacuation it may also serve as a case for personal equipment. The double layer of the material creates an empty space into which the personal equipment of the soldier may be packed. By pulling the belt in the middle of the litter, it can be closed in order to secure the equipment (fig. 9).

Individual Tactical Net Litter

The tactical net litter is small and light so it can be treated as an element of the personal equipment of each soldier (Fig. 10.). It is made of a durable polypropylene net, able to bear loads of up to 920 kg. It is stored in a closed package integrated with the tactical vest, on the reverse side. It is drawn from the package with the use of tapes. There is one tape on the top and two tapes at the bottom of the package. The net covers the whole body of the casualty and the package fixed to the vest ensures additional stability. Evacuation may be performed using dragging or lifting techniques. The number of grips enables the evacuation to involve up to six rescuers. A second version of the Tactical Net Litter may be transported as a separate package fastened to the rescuer's bag or equipment by karabiner. Apart from evacuation purposes, the manufacturer suggests an alternative function as a universal survival tool. In survival situations it may be used as a hammock, an element

Figure 11. Foxtrot litter (source: Tactical Medical Solutions)

Rycina 11. Zastososowanie noszy *foxtrot* (źródło: Tactical Medical Solutions)

of camouflage, a fishing net or the skeleton of a shelter.

Foxtrot

The foxtrot-type rolled litter is made of artificial textile and equipped with handles, stabilization belts and a long tape for dragging on the ground (fig. 11.). The litter is stored rolled (as a cylinder) inside a case, therefore taking very little space as well as being light and practical. With the foxtrot litter, the casualty may be evacuated both in the lying and sitting positions. Five pairs of belts with Velcro fittings or classical metal studs or clasps prevent the body from moving or sliding from the litter. The belts are located at the level of the chest, pelvis, knees (each leg separately) and the distal part of the lower legs. The leg belts may be also used for securing a long weapon, which should be positioned between the legs of the casualty. The casualty may be lifted thanks to the handles on either side of the litter or dragged/slid on the ground with the use of a handle or the long tape at the head end. The structure and elasticity of the material of the foxtrot litter does not always enable safe transport in rocky areas. The energy from contact with rocks sticking out of the ground is transmitted to the body of the casualty, which causes discomfort or may result in further injuries.

Tallon

The tallon litter is a typical example of a multi-task evacuation platform used for transporting a casualty. It can be carried by the rescuers or transported in a vehicle (fig. 12.). They form part of the standard equipment for combat vehicles in the Polish Military Contingent in Afghanistan.

Figure 12. Tallon litter (source: Maciej Sip)

Rycina 12. Nosze *tallon* (źródło: Maciej Sip)

A metal structure covered with a resistant net with a high bearing capacity (>500 kg). Both ends of the litter have ergonomic, foldable handles for comfortable evacuation by two to four rescuers. The bottom part of the litter is equipped with four supports that allow the litter to stand on the ground and which also form a universal fastening for vehicles, evacuation helicopters and airplanes. Thanks to this, the litter may be attached to the special fastenings on board Black Hawk helicopters while the handles allow its stable transport in AC-130 Hercules airplanes. The structure of the tallon litter includes six hooks for the assembly of medical equipment, such as for intravenous infusions. The litter has also two belts for the stabilization of the casualty. It can be folded to a quarter of its full dimensions and packed into a case, thanks to which it may be transported by one soldier.

Spinal board

A spinal board is rarely used on the battlefield. It is made of plastic resistant to abrasion and damage. It has fixed belts for the stabilization of the casualty as well as two stabilizers and two belts to immobilize his head in the horizontal position. The hard structure of the board protects the casualty from secondary damage to the backbone when stabilized in the horizontal position. The handles around the board allow the rescuers to hold it firmly and transport the casualty safely. The durable structure of the board makes it appropriate for any conditions: flat, mountainous or urban. It is compatible with MEDEVAC/CASEVAC evacuation equipment.

Table 1. 9-linear Medevac Report
Tabela 1. Dziewięcioliniowy meldunek MEDEVAC

Line/ linia	request	meldunek
1.	Location at HLS	miejsce odbioru
2.	Radio frequency, call sign and suffix	częstotliwość, sygnał wywoławczy miejsca odbioru
3.	Number of patients by precedence: A – urgent (up to 1 hr) B – priority (up to 4 hrs) C – routine (up to 24 hrs)	liczba poszkodowanych po priorytetach: A – pilny (do 1 h) B – priorytetowy (do 4 h) C – rutynowy (do 24 h)
4.	Special equipment required: A – none B – hoist C – extraction equipment D – ventilator	wyposażenie specjalne: A – brak B – podwieszenie C – wyciągarka D – respirator
5.	Number of patients by type: L – litter A – walking E – escorted (child)	liczba pacjentów wg typów: L – (+ #) na noszach A – (+ #) siedzący E – (+ #) eskorta (np. dziecko)
6.	Security at HLS: N – no enemy P – possible enemy E – enemy in area X – armed escort required	ochrona miejsca podjęcia/ lądowania: N – brak przeciwnika P – możliwość obecności przeciwnika E – przeciwnik w rejonie X – wymagana eskorta
7.	HLS marking method: A – panels B – signal pyrotechnic C – signal smoke (color) D – none E – other	sposób oznakowania lądowiska: A – panel (symbol) B – sygnał pirotechniczny C – sygnał dymny (kolor) D – brak E – inne
8.	Number and nationality status: A – ISAF/coalition forces B – ISAF/coalition civilian C – non ISAF/coalition security forces D – non ISAF/coalition civilian E – opposing forces/ detainee F – child G – embedded interpreter H – civilians from ISAF/CF	liczba i narodowość pacjentów: A – żołnierz ISAF/koalicji B – cywil ISAF/koalicji C – funkcjonariusz sił spoza ISAF D – cywil spoza ISAF/koalicji E – wróg/aresztowany F – dziecko G – tłumacz H – cywil raniony przez ISAF/ koalicję
9.	HLS terrain/obstacles	teren lądowiska/przeszkody terenowe

Table 2. MIST – supplement to MEDEVAC Report
Tabela 2. MIST – uzupełnienie meldunku MEDEVAC

M	Mechanism of injury (and time if known)	mechanizm urazu (czas, jeśli znamy)
I	Injury or illness sustained	uraz lub dolegliwość zastana
S	Symptoms and vital signs A – airway B – breathing rate C – pulse rate D – conscious/unconscious E – other signs	objawy i parametry życiowe A – drożność dróg oddechowych B – liczba oddechów C – tętno D – przytomność/brak E – inne
T	Treatment given (TQ and time, morphine)	wdrożone leczenie (np. staza i czas aplikacji, morfina)

Tactical evacuation (TE)

Battlefield rescue activities are aimed at the safe evacuation of the casualty from the danger zone and then rapid transport with MEDEVAC/CASEVAC to the field hospital, and further to higher-level medical facilities for the continuation of the treatment [6]. Medical procedures implemented at this stage of evacuation in a vehicle, such as an armored personal carrier (APC), medical evacuation vehicle, and MEDEVAC or CASEVAC vehicle are based on standards close to Advanced Life Support (ALS) and Advanced Trauma Life Support (ATLS) [7].

All medical interventions performed by evacuation teams are subordinate to the current tactical situation. Tactical evacuation in the Enduring Freedom/ISAF (International Security Assistance Force) operation in Afghanistan is conducted mainly in the form of airlift by helicopter. This is due to the high intensity of kinetic activities in the airspace, as well as the type of the terrain and large distances between the places of action and dislocation [6]. The transport time by air to a second level hospital does not exceed one hour (usually no more than 15-20 minutes from the injury). The MEDEVAC/CASEVAC procedure is preceded by submission of a 9-liner report to the Tactical Operation Center (TOC). The coordinates of the extraction area are given, and information about the number, nationality, condition of the casualty, activity of the enemy and pick-up area markings is transmitted with the use of a letter code. Table 1). The 9-liner report is supplemented with a MIST report, describing the mechanism and nature of the injuries, the casualty's condition (ABCDE scheme) and administered treatment (Table 2).

The waiting time before the MEDEVAC/CASEVAC vehicles arrive should be used for the assessment of the effect of the medical procedures applied so far. A casualty should be examined in detail using the MARCHE protocol (intended for the TFC phase). MARCHE is the acronym of: massive hemorrhages, airway and respiratory management, circulation,

hypothermia, head and eye injuries. One aspect which should be monitored very closely is the body temperature of the casualty, as it has a great influence on the blood coagulation processes. A 1°C loss of body temperature results in a 10% decrease in the ability to form a clot [8,9]. TCCC guidelines recommend using hypothermia prevention kits in the tactical environment. The hypothermia prevention and management kit (HPMK) should consist of an impermeable sleeping bag, a thermal blanket (maintaining approx. 53 °C for 8 h) and a head cover. Earplugs in the kit are aimed at protecting the casualty from excessive noise, increasing transport/evacuation comfort [2]. The method of extraction from the combat zone is dependent on available evacuation platforms or rope techniques, as well as the tactical situation and opportunities for airlift evacuation. In such severe conditions, one should remember to protect the eyes and vital organs of the casualty, by use of safety goggles or a ballistic vest [10].

Conclusions

If heavily wounded casualties remain on the battlefield, the chances of their survival decrease radically. The implementation of simple examination schemes, such as Tactical Patient Assessment (TPA) or the more advanced MARCHE protocol, depending on the tactical situation, is aimed at the identification of hemorrhages and securing life parameters. The evacuation of the casualty from the danger zone and transporting him to a field hospital is a crucial factor increasing the probability of survival.

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Cushing's disease: cardiovascular and metabolic complications of chronic hypercortisolemia

Choroba Cushinga: powikłania kardiologiczne i metaboliczne przewlekłej hiperkortyzolemii

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Abstract. Cushing's disease (CD) is the most common cause of ACTH-dependent hypercortisolemia. Excessive and uncontrolled cortisol concentration leads to characteristic clinical symptoms of Cushing's syndrome accompanied by cardiovascular and metabolic complications, such as: hypertension, cardiac abnormalities, coagulation disorders, abnormal metabolic parameters, and especially glucose homeostasis alterations (pre-diabetes and diabetes) and hyperlipidemia. This article presents the pathogenesis of such complications, as well as the principles of causal and symptomatic treatment of cardiovascular complications, and analyzes their influence on the further prognosis in patients in remission of CD.
Key words: Cushing's disease, diabetes, cortisol, hypertension, cardiovascular risk

Streszczenie. Choroba Cushinga jest najczęstszą przyczyną ACTH-zależnej hiperkortyzolemii. Nadmierne i wymykające się spod kontroli mechanizmów regulacyjnych stężenie kortyzolu prowadzi do charakterystycznych objawów klinicznych zespołu Cushinga, ale także do powikłań sercowo-naczyniowych i metabolicznych, takich jak nadciśnienie tętnicze, uszkodzenie mięśnia sercowego i zaburzenia krzepnięcia, oraz nieprawidłowych parametrów metabolicznych, a zwłaszcza zaburzeń gospodarki węglowodanowej (stan przedcukrzycowy oraz cukrzyca) i hiperlipidemii. W prezentowanej pracy omówiono aspekty patogenetyczne oraz zasady leczenia przyczynowego i objawowego powikłań sercowo-naczyniowych oraz metabolicznych hiperkortyzolemii, a także przeanalizowano jego wpływ na poprawę rokowania u pacjentów w remisji choroby Cushinga.
Słowa kluczowe: choroba Cushinga, cukrzyca, kortyzol, nadciśnienie, ryzyko sercowo-naczyniowe

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Introduction

Cushing's disease is a condition of hypercortisolemia caused by an excessive secretion of adrenocorticotropic hormone (ACTH) by an adenoma of the pituitary gland. Typical clinical symptoms include: reddening of the face, "moon face", easy bruising, wide red striae of the skin on the abdomen and fat humps on the neck and trunk. Also muscle atrophies, especially of lower limbs, are common. The symptoms are complemented with complications, such as arterial hypertension, carbohydrate management disorders (including diabetes), complications related to thromboembolism and lowered bone density. If not treated, or treated inefficiently, the disease significantly increases mortality in comparison to the general population [1–3].

In about 95% of cases, the cause of this rare disease (with morbidity of 1–3 people/million/year) is ACTH-secreting adenoma of the anterior lobe of the pituitary gland. Less than 5% of cases are caused by hyperplasia of corticotropic cells of this gland [2].

Although corticotropic pituitary adenoma are histologically benign, their secreting activity leads to serious complications, especially cardiovascular and metabolic ones, which significantly reduce life expectancy and lower life comfort [2–5].

The aim of this paper is to present current views on the cardiovascular and metabolic complications of Cushing's disease and current therapeutic recommendations in the field.

Pituitary-adrenal axis in a healthy organism

Cortisol is the basic human glucocorticoid. It is produced in the adrenal cortex under the influence of corticotropin (ACTH) secreted by the anterior lobe of the pituitary gland. It is necessary for maintaining correct blood pressure and maintaining (together with aldosterone) the water-electrolyte balance. Cortisol participates in maintaining protein, fat and carbohydrate homeostasis. It is also a crucial element of the correct response of the human body to stressful situations.

The biological activity of cortisol is mediated by specific receptors located in the cytoplasm and cell nucleus. Cortisol works also as a ligand for aldosterone receptors and, especially in the case of hyperalderosteronism, it may have a biological effect typical of mineralocorticoids. Normal concentration and availability of cortisol, depending on the demands of the body, is possible thanks to a special enzyme: 11-β-hydroxysteroid dehydrogenase 2 (11P-HSD2). This catalyzes the metabolic transformations of active cortisol into inactive cortisone, protecting the tissues and organs from the harmful effect of excessive amounts of cortisol. An isoform of this enzyme, 11β-HSD1, is extremely active in the liver and visceral adipose tissue and, in the case of need, catalyzes the reaction of transformation of cortisone into metabolically active cortisol.

The metabolic effect of cortisole on the carbohydrate metabolism is antagonistic to the effect of insulin. Cortisol stimulates gluconeogenesis (activates phosphoenolpyruvate carboxykinase), which prevents the development of hypoglycemia. At the same time, it inhibits insulin-dependent uptake and use of glucose by peripheral tissues, especially in the liver and skeletal muscles (increased insulin resistance). The stimulation of lypolysis and proteolysis leads to increased access of fatty acids and amino acids which may become substrates for hepatic gluconeogenesis.

Impact of hypercortisolemia on the cardiovascular system

Inadequate to the organism's needs, the production of cortisole in Cushing's disease leads to cardiovascular and metabolic complications. It is known that untreated Cushing's disease causes a significant (even fourfold) increase of mortality rate in comparison to the general population [2,4,6,7]. The shortened life expectancy of the patients is related to the complications, while death is usually caused by myocardial infarction or cerebral stroke. Efficient surgical treatment leading to a remission of hypercortisolemia improves the functioning of the cardiovascular system but does not remove fully any earlier damage to the organs and cardiovascular complications [4,7,8].

Arterial hypertension

It is estimated that as many as 80% of hypercortisolemia patients suffer from arterial hypertension [2,4,6]. This fact has been confirmed in our publication concerning complications related to Cushing's disease [3]. It is interesting that no dependency between the duration of hypercortisolemia and the incidence of arterial hypertension has been detected. On the other hand, we have confirmed the relationship between higher Body Mass Index (BMI) values and the risk of arterial hypertension, which is present also in the general population [2,3].

The pathogenesis of hypertension in Cushing's disease is complex. The disturbed day and night cycle of cortisole secretion, with inappropriately large production at night, leads to the disappearance of the night drop of arterial blood pressure, which can easily be demonstrated by 24-hour blood pressure monitoring. Arterial hypertension at night intensifies the damage to the organs and increases the risk of myocardial infarction and cerebral stoke at night or in the morning.

One of the mechanisms leading to such a significant incidence of arterial hypertension that is worth mentioning is the decrease of synthesis of nitrogen oxide (NO) and prostacyclin, which have vasodilating properties, as a result of which vasoconstrictors prevail. The concentration of plasmic endothelin-1, one of the strongest vasoconstricting agents, increases, as does the production rate of erythropoietin, which also causes constriction of the blood vessels [9,10].

An important role in the pathogenesis of arterial hypertension in Cushing's disease is attributed to cortisole-induced sensitization of the blood vessels to the pressor activity of catelochamines (especially noradrenaline), the activity of which is mediated by β-adregenic receptors. Also increased tension of the sympathetic nervous system, which is extremely intense in patients with sleep apnea, is not without meaning. A significant role in the pathogenesis of sleep apnea is played by the redistribution of adipose tissue in the course of hypercortisolemia, which causes its growth in the areas of abdomen, nape and base of the tongue. This makes breathing more

difficult both because of airway patency disorders during sleep and breathing mechanism disorders dependent on peritoneal obesity. Tissue hypoxia during sleep leads to the activation of the sympathetic nervous system and increase in peripheral resistance [10,12].

Abnormally large serum concentrations of cortisole exceed the binding capacity of the aforementioned enzyme 11β-HSD2, which catalyzes the transformation of cortisole into inactive cortisone. This leads to the appearance of the mineralocorticoid effect of cortisole, which has no important role in physiological conditions. The excess of cortisole activates mineralocorticod receptors, which leads to water and sodium retention and loss of potassium through the kidneys. The concentration of aldosterone and plasma renin activity fall. At the same time, the sensitivity to pressor activity of angiotensin II may be increased, which also results in the increase of arterial blood pressure [10,12,13].

Chronic hypercortisolemia in Cushing's disease disturbs the transmembrane transport of sodium and calcium, lowering the activity of Na-Ca exchanger in the myocytes of vessel walls. As a consequence, the intracellular supplies of calcium in the smooth myocytes build up, which leads to vasocontraction.

The treatment of arterial hypertension should be introduced at the diagnosis stage of Cushing's disease. Correct treatment improves the patient's life quality and decreases the risk of cardiovascular complications and pre- and perisurgical complications. While choosing medications it is important to take the pathogenesis of hypertension in the course of hypercortisolemia into consideration. Due to the intensified effect of cortisole on mineralocorticoid receptors and increased sensitivity to angiotensinogen II, the basic role should be played by angiotensin convertase inhibitors and angiotensinogen receptor blockers; also aldosterone receptor antagonists (spironolactone or eplerenone in commonly accepted doses may be used). Loop and thiazide diuretics should be used with utmost care because their administration may exacerbate hypokalaemia caused by the mineralocorticoid activity of excessive amounts of cortisole. However, difficulties in controlling arterial hypertension in Cushing's disease only by means of antihypertensive drugs are common.

As the best method of causal treatment is the removal of corticotropic pituitary tumor, it is of key significance to prepare the patient for surgery [1,2]. In the presurgical period or in the case of treatment failure, adrenal steroidogenesis, usually ketoconazole or metyrapone, may be administered. Thanks to cortisole production inhibition a rapid therapeutic effect is achieved, which enables the operation to be performed. The hypotensive effect has been achieved also with a new analogue of somatostatin, pasireotide and by administration of cabergoline (agonist of dopaminergic receptors present in some of corticotropic pituitary tumors).

After a successful transsphenoidal operation of the pituitary tumor, the control of arterial pressure usually becomes easier. It is possible to reduce both the number of drugs used and their doses, and in some cases even complete discontinuation of the treatment. In some cases arterial hypertension remains even after a successful operation, the most probable cause of this phenomenon is a pre-existing primary hypertension which was intensified by hypercortisolemia or established lesions in the blood vessels resulting from long-term hypercortisolemia.

Myocardial damage

Chronic hypercortisolemia in Cushing's disease leads to harmful overgrowth of the heart. As Cushing's disease is a rare disease, this aspect of the cardiological complications has not been sufficiently studied. Muiesan et al. documented an increase of thickness of the heart walls, increased weight of the left ventricle and disorders in its geometry. The paper described also the diastolic dysfunction and filling defect of the left ventricle without abnormalities in LV systolic function and ejection fraction [14]. On the other hand, Pereira et al. showed that the aforementioned disorders tend to disappear gradually in the hypercortisolemia remission period after successful surgical treatment [15]. The normalization concerned both the disappearance of left ventricle hypertrophy and the diastolic dysfunction. Interestingly, the improvement was independent of the disappearance of other abnormalities, such as arterial hypertension and hyperlipidemia [15].

Coagulation disorders

Chronic hypercortisolemia causes an inclination towards the major coagulation disorders present in Cushing's disease. This is related both to greater thrombotic susceptibility and impaired fibrinolysis. Van Zaane et al. showed a significant increase of factor VIII, factor IX and bon Willebrandt factor, as well as overproduction of thrombin [16]. The increase in thrombotic susceptibility leads to a greater risk of thromboembolic complications, especially in the perisurgical period. The risk of thromboembolism related to surgeries is estimated at 5.6%, while the risk of thromboembolic episodes not related to surgeries at about 2–2.5%. The risk grows with the increase of BMI [16]. The above observations force the application of thromboembolic prevention (low molecular weight heparins) in patients with Cushing's disease in the perisurgical period.

Additionally, a drop in the fibrinolytic activity of the plasma is observed. This is caused partly by the increased activity of plasminogen activator inhibitor 1 (PAI-1). Furthermore, Faggiano et al. stress the crucial role of serum taurin deficiency. Taurin is treated as a

protective agent, protecting the cardiovascular system from the detrimental effects of excesses of homocysteine, the prothrombotic role of which was discussed earlier by Terzolo et al. [17,18]. It also seems that hyperhomocysteinemia and taurin deficiency disappear after successful surgical treatment of Cushing's disease, so they may be treated as a potentially reversible element of increased thrombotic and cardiovascular risk in Cushing's disease [17,18].

Early atherosclerosis and carbohydrate metabolism disorders in the course of hypercortisolemia

The majority of patients with Cushing's disease have an increased BMI, although monstrous obesity is rare in this disease. This is related to redistribution of adipose tissue, the amount of which increases in the area of the nape and abdomen, but decreases in the limbs, which together with decreasing muscular mass prevents the development of monstrous obesity. In the majority of patients, BMI ranges from 25 to 32 kg/m^2 [3]. It seems that the crucial element is not the total amount of adipose tissue but the insulin resistance developing or intensifying due to chronic hypercortisolemia. Insulin resistance is visible mainly in the liver and skeletal muscles. The stimulation of gluconeogenesis in the liver fosters both fasting and postprandial hyperglycemia. Additionally, the lipolytic effect of an excess of cortisole leads to an increased concentration of free fatty acids and glycerol. This is intensified by the overproduction of triacylglycerides in the liver, which cannot be stored in the adipose tissue as the lipolysis is activated. This is how lipotoxicity develops, which also reduces the insulin sensitivity of the skeletal muscles. Growing hyperglycemia in the course of glucotoxicity leads finally to insulin secretion disorders, which again exacerbates carbohydrate metabolism disorders [19].

The aforementioned pathophysiological processes lead to prediabetes and diabetes. Our observations indicate that prediabetes or diabetes is present in 50% of Cushing's disease patients (prediabetes in 35%, diabetes in 15%) [3]. This is a result close to the 60% incidence of carbohydrate metabolism disorders indicated in the earlier work by Colao et al. [4].

Persistent inflammation and lipolysis in visceral adipose tissue depend both on the excess of cortisole and proinflammatory adipocytokines (resistin, visfatin, TNF-α, MCP-1, PAI-1). Together with hyperglycemia they cause visible changes in the limpid panel, which in Cushing's disease patients is characterized by atherogenic dyslipidemia (increased LDL faction, triglycerides and lipoproteins, and decreased HDL faction). As a result, atherosclerosis is accelerated and the risk of coronary heart disease and cerebral stroke increases. In the majority of Cushing's disease patients, the intima-media thickness (IMT) is increased, which is clear evidence for a general inclination to atherosclerotic processes. In their paper, Faggiano et al. showed an improvement, as far this index is concerned, within a year from a successful surgical treatment; however, the index still remained far from normal and significantly poorer than in the control group [7]. Other authors have formulated similar opinions [4].

Appropriate therapeutic processes in lipid disorders does not differ from recommendations for the general population and involves the administration of statins and fibrates and observing safety rules and counterindications typical of these drugs. The carbohydrate metabolism disorders must be appropriately balanced with diet, frequent glycemic self-control and antihyperglycemic drugs. The basic drug used in the treatment of diabetes secondary to hypercortisolemia is – as in Type 2 diabetes – metformin. Its usefulness is related to the documented improvement of insulin sensitivity, which is reduced in the course of Cushing's syndrome, and the beneficial influence on lipid parameters [19,20]. Its use also protects against excessive bodyweight gain [20]. If metformin does not give sufficient glycemic control, inhibitors of dipeptidyl peptidase 4 (DPPIV) or glucagon-like-peptide-1 (GLP-1) receptor agonists should be added. If the therapeutic effect still cannot be achieved, it is necessary to administer metformin together with basal insulin or intensive insulin therapy [19,20].

Summary

Chronic hypercortisolemia leads to cardiovascular and metabolic complications: abdominal obesity, arterial hypertension, heart hypertrophy and its diastolic dysfunction as well as carbohydrate metabolism disorders, atherogenic dyslipidemia and changes in the adipocytokine profile. The basis of the treatment might involve quick surgery of the ACTH-secreting pituitary tumor, which in the majority of cases leads to normalization of cortisol concentrations and remission of Cushing's disease. Some patients require preparation to surgical treatment with the use of adrenal steroidogenesis inhibitors, which facilitate the presurgical improvement of cardiovascular and metabolic parameters. If arterial hypertension is diagnosed, treatment is necessary, preferably with drugs influencing the renin-angiotensin-aldosterone complex: angiotensin convertase inhibitors, angiotensinogen receptor blockers or aldosterone antagonists.

Each patient with hypercortisolemia requires monitoring of the carbohydrate metabolism and correct treatment of its disorders. As hypercortisolemia increases thrombotic risk, especially in the perisurgical period, an appropriate preventive therapy is

necessary. Successful treatment of Cushing's disease leads to clinical improvement, decrease of body weight, better functioning of the cardiovascular system and better carbohydrate and lipid parameters; however, the increased cardiovascular risk tends to become chronic, at least in some patients.

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Comprehensive prevention and elimination of contamination caused by Bacillus anthracis – current capabilities

Kompleksowe zapobieganie skażeniom wywołanym przez Bacillus anthracis oraz ich likwidacja – aktualne możliwości

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Abstract. With the increasing phenomenon of global migration of humans and animals, it is important to focus attention on the problem of how to protect humanity and the economy both during natural outbreaks of highly contagious diseases and during deliberately spread ones – such as with the use of aerosols, e.g. *B. anthracis* spores. The United States of America experienced this type of situation on the smallest possible scale 13 years ago. The purpose of this paper is to discuss the infectious properties of *B. anthracis* and contemporary possibilities of comprehensive prevention and elimination of the consequences of an attack using *B. anthracis*.
Key words: anthrax, biological weapon, bioterrorism, epidemiology

Streszczenie. Wraz z narastającym od lat zjawiskiem globalnego przemieszczania się ludzi i zwierząt ważne jest skierowanie uwagi na problem, jak chronić ludzkość i gospodarkę zarówno w czasie naturalnych chorób wysoce zaraźliwych, jak i w czasie celowo rozsiewanych aerozolów, np. z przetrwalnikami *B. anthracis.* Takiej groźnej sytuacji w możliwie najmniejszym wymiarze doświadczyły USA 13 lat temu. Celem tego opracowania jest omówienie właściwości zakaźnych laseczek wąglika oraz współczesnych możliwości kompleksowego zapobiegania atakom z użyciem *B. anthracis* i likwidacji ich skutków.
Słowa kluczowe: wąglik, broń biologiczna, bioterorryzm, epidemiologia

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Introduction

Of the three major types of weapons of mass destruction: nuclear, chemical and biological, the last is the least known as humanity has fortunately the least experience with its application, although it still causes no less fear.

In the literature discussing biological weapon agents, the first place is unchangeably occupied by *Bacillus anthracis*, which causes a zoonotic disease known as anthrax. Thirteen years have passed since this weapon was last used by terrorists, during an event that took place a few days after the attack on the World Trade Center in New York. Unknown perpetrators mailed several letters filled with small doses of dried, powdered endospores of these bacteria.

Who could have predicted that, after so many years, the increasingly complicated political situation would result in us remembering that biological weapons, including anthrax, may be used as a tool for achieving the goals of terrorism?

The cold war ended 25 years ago, but occasionally events take place which are considered to be the beginning of a new one. If we bring together the acts of terrorism (especially the recent ones in Nigeria) and constant local wars in various parts of the world, including in Europe, then it reminds us that desperate extremists may still choose weapons of mass destruction.

In the last decades of the 20th century, some terrorists groups attempted to produce chemical and biological weapons, fortunately with primitive methods and only on a laboratory scale.

Features of *B. anthracis* and its transformation into a biological weapon

Anthrax is one of the oldest described animal diseases with zoonotic properties i.e. one which may be transmitted from an animal to a human. The infectious agent is the bacterium *B. anthracis*.

In aerobic conditions, these bacteria produce extremely resistant endospores. When cooled or dried they may maintain their vitality for hundreds of years.

The introduction of preventive vaccinations, modern procedures of handling dead animals and eradication programs significantly reduced the threat related to anthrax. Currently, cases of illness are very uncommon in people and relatively rare in animals. However, due to the properties of the endospores, these bacteria have long been considered to form the easiest biological weapon to produce [1]. Cultures of this microorganism are commonly available in microbiological laboratories, obtained from samples from animals that have died from or which were ill with anthrax. The bacteria may be easily proliferated, stored and processed, if need be. Therefore, anthrax is an optimal agent for bioterrorism [2,3]. In the 1980s Iraq attempted to culture it and produce a biological weapon in 2001; for this purpose it prepared a supply of endospores of *B. anthracis* [4]. In September 2001, such dried and powdered endospores were mailed to the USA, to the offices of two senators and several post offices, which caused 17 cases of infection and five deaths of inhalation anthrax [5]. The attacks initiated an increase in antibiological protection activities.

Research into use of anthrax as a weapon conducted in the 20th century by the world powers

In the second half of the 20th century, work was conducted on using anthrax as a biological weapon in the UK, the USA and the Soviet Union. In the 1990s, after the Iraqi offensive plan for the USA was discovered, research and implementation programs were commenced devoted to antibiological defense. These programs involved the development of field detectors, protection masks and vaccines immunizing against anthrax and other dangerous infectious diseases. Soon after the attacks on the WTC and the anthrax letters of 2001 in the USA, other countries also began to think seriously about the antibiological protection of civilians. They focused mainly on anthrax and smallpox, as these are diseases listed as threats against humanity.

In 1997, the budget for bioterrorism protection of the United States Department of Defense amounted to 137 million dollars. However, after 2001 the budget for preparation and reaction to bioterrorism increased by more than 40 times – up to 6 billion USD annually [6].

Several important arrangements were made in relation to the following issues:

- The problem of the protection of civilians being more difficult than the protection of the army,
- biological threats differing significantly from chemical threats and requiring other defensive preparations,
- acts of bioterrorism needing to be treated as the appearance of an infectious disease induced by germs dispersed on purpose,
- developments in biotechnology being an impulse for use of its achievements for both peaceful and terrorism-related applications,
- equilibrium between the possibilities of bioterrorism activities and protection not being achieved, either in relation to technical and biomedical solutions, funds for research, prevention and reaction, or general preparations for bioterrorism attacks,
- the threat of anthrax attack needing to be seen in the context of other biological threats,
- even the richest countries cannot afford to bear the preparatory costs (vaccines, drugs, diagnostics,

detectors etc.) for every possible biological factor which may be used by terrorists or terrorist organizations,
- the improbability that the intelligence services will be able to recognize and warn what type of attack is to take place,
- no being able to exclude that the rapid development of biotechnology will lead to replacing *B. anthracis* by another, genetically modified or artificially synthesized biological material,
- taking into consideration the unique physical and biological properties of anthrax bacteria and the knowledge gathered after the events of 2001, it may be assumed that in the future bioterrorists will be interested above all in the use of these bacteria.

Building on these assumptions and taking into consideration the wide spectrum of threats arising from the potential use of anthrax bacilli, one may attempt to analyze the preparatory works required to help prevent the majority of potential catastrophic and subcatastrophic events.

Specific medical undertakings

Due to the unique nature of *B. anthracis* as a weapon, and inhalation anthrax as a disease, it seems justified to work on specific medical undertakings. Among these, the most important problem is related to vaccines and antibiotics, as well as their administration to people on a mass scale. Vaccinations may be very efficient as far as inhalation anthrax is concerned. In the majority of cases, in order for the vaccines to be efficient, they must be administered before exposure to the infectious agent. In emergencies, such as after a surprise attack and its detection, people exposed to the infectious agent may be vaccinated, especially if there is a risk of another attack. However, in the case of a detected anthrax attack, the vaccine should be administered together with an efficient antibiotic. As *B. anthracis* is susceptible to antibiotics, antibiotics are included in the state anti-bioterrorism programs and stored. The storage of large supplies of antibiotics causes the problem of supply exchange and quick administration to the population (up to 48 hours after the attack). These difficult logistic operations require practice [7].

The most important condition for the efficient prevention of any disease, natural or deliberately induced, is the precise recognition of the infectious agent and subsequent determination of the size of the population under the threat of infection [8].

When the first case is diagnosed by an experienced clinician, as was the case of the anthrax letters in 2001 [9] or if many automatic systems detect an unusual type of microorganism, a laboratory confirmation of this infectious agent and its properties is necessary. Standard diagnostic procedures in this case involve a classic method of proliferation and determination of drug sensitivity to the detected bacteria.

After cases of anthrax have been diagnosed clinically and confirmed by isolating *B. anthracis*, the following cases will probably be diagnosed only on the basis of clinical symptoms, without waiting for laboratory confirmation.

Only a few countries have developed technologies for detection in air samples. In the USA, they function only in some cities, in government buildings and transport systems [10]. The systems are highly automated and detect the aerosol cloud long before the first symptoms appear in humans. This enables shortening the time between the exposure and the decision concerning preventive measures.

Public healthcare system

Public healthcare programs focus firstly on the prevention of disease, supervision, epidemiological analyses and promoting a healthy lifestyle, and secondly on the treatment of actual cases of infection. An important element in preparing to prevent any biological incidents in an efficient public healthcare system is the training of public healthcare personnel and laboratory personnel.

Since in the developed countries few physicians have had contact with inhalation anthrax patients, special emphasis should be put on training in the field of diagnosis, pathogenesis, treatment and prevention of this form of the disease.

The public healthcare system is organized and managed by the minister of health of a given country. The system includes laboratories at all levels of administration. In emergency situations they will be the basic source of knowledge and support, especially in the case of unusual outbreaks of diseases or newly emerging and detected acts of terrorism. State laboratories are equipped with reference sets, special reagents which may be supplied to laboratories of lower administration levels, and, in special cases, also to non-public laboratories.

Increase in the role of forensic experts and intelligence

The technological advancement and easy access to equipment and methods of production will allow terrorists to produce biological weapons increasingly easily. Research into acts of bioterrorism is very similar to the research conducted by epidemiologists during natural outbreaks of the disease, and also involves collecting and securing documentation for future judicial needs and increasing the supervision over sample registration.

In the USA, after the anthrax letters, measures were taken to improve the public health system and its legal foundations, and to intensify the training in

epidemiological investigation procedures. The purpose of the training was to give insight into the legal experience of the routine work of epidemiologists, familiarize them with legal vocabulary and operational procedures.

The role of the knowledge acquired by the intelligence services in differentiating between types of weapons of mass destruction, and the international exchange of experience in preventing terrorists from bioterrorism actions in the form of inducing infectious diseases in humans, animals or crops is constantly increasing.

Advancement in life sciences, development of a biotechnological basis

Basic research is the foundation of protective programs targeting natural or purposeful outbreaks and the expansion of diseases. The quick reaction of diagnosticians and the determination of the infectious agent of the disease forms the basis for preparation of the technical background for further proceedings. When the infectious agent has been determined and the cause identified, it is necessary to obtain epidemiological tools for the description of the situation and present the needs related to the treatment of victims, such as the rapid determination of the agent's sensitivity to antibiotics.

Immunologically specific vaccines are difficult to produce in a just-in-time mode [11]. Taking into consideration biological terrorism and natural pandemics, intensive research is conducted into modern vaccines based on nucleic acids. Other examples of important basic research into infectious diseases include studies into their pathogenesis, understanding of immune phenomena and other reactions of infected organisms, research into the environment and stability of the pathogens dispersed in it, decontamination, filtration of contaminated air and other physical protection methods.

International cooperation and exchange of information

Biological factors, and especially infectious agents, do not respect state borders; therefore, in the light of the quickness and commonness of people moving from place to place, no country or its inhabitants are fully safe. It is obvious that the legal restrictions in the field of public health and the professionalism and constant improvement of the intelligence community are developed in cooperation, including special training focused on this type of event.

Until now, terrorism attacks with the use of anthrax have been of limited scope, although potentially they could be a significant fragment of a larger epidemic. Dealing with large epidemics may require the experience of global public health organizations. WHO reports that every year 10 million people die of infectious diseases and 25 million of chronic diseases [12]. Diseases transmitted from domesticated animals (e.g. anthrax) and cultivated plants may cause the development of food-borne diseases in humans and significant economic losses.

International cooperation in relation to infectious diseases enables:

- limiting the consequences of naturally appearing diseases,
- decreasing the global probability of the purposeful induction of diseases,
- building important relations of cooperation with public health professionals all around the world,
- sharing information about potential biological threats and supporting regions less prepared for the activities of terrorist groups.

Informing, engaging and coordination of protective activities

Today the global functioning of the world is more complicated than 10–15 years ago. An important factor in the international relations is the use of new technologies which have influence on the economy and improving security.

Due to the complexity of the challenges related to detection of threats on all levels of prevention, the cooperation of professionals from the world of science, industry and NGOs will be necessary. Training of the population and management will be helpful here, as a well-prepared manager will help prevent panic and clear the environment after the attack.

Large metropolitan areas function like living creatures built of interconnected, dynamic and interdependent elements, and are also more difficult to defend in comparison to an army on the battlefield. That is why large metropolises are an attractive target for terrorists. Perfectly powdered endospores of *B. anthracis*, if dispersed efficiently in ideal meteorological conditions, may infect humans and animals over hundreds of square kilometers. In the critical period of two to seven days from the attack, thousands or even hundreds of thousands of people may develop various symptoms of the infection. Therefore, it is important to take into consideration various methods of reaction, including the well-organized global public health systems described above.

Attack detection, decision-making, supply and distribution of drugs [13]

In the USA, every city, region and the whole country has special plans to manage different risks, trained personnel, stored drugs and vaccines for use immediately after the event. The changes in the plans involve, among other things, moving the supplies of

antibiotics and vaccines and concentrating them in the attacked regions with the purpose of quick administration to the local population. The consequences of such decisions are very costly, so they should be made only when really needed.

In the case of anthrax, the medicines should be administered up to 48 hours after the attack. Although theoretically the management with these resources may seem easy, in reality it may be quite difficult. Typical detection systems require sample collection, delivery to a laboratory, analysis of the samples and (if possible) confirmation of the results, and finally a decision about the provision of stored medicines and their distribution. Automatic detection systems may significantly shorten this time, but are not widely accessible. If the data are credible, and especially if they come from many detectors, the decision about drug administration may be made quickly.

However, it may be very difficult to assess where precisely and to whom the medicines should be delivered first. There are no good methods for the rapid identification of the area where the population was exposed to the primary aerosol cloud. An easy method is to collect nose mucus samples from people who may have been exposed to the attack, test for the presence of endospores and treat all carriers before the symptoms develop. The standard procedure is the distribution of drugs in the area over which the aerosol passed, in accordance with the direction of the wind. If the city does not have supplies of drugs stored before the attack, their delivery may take 12–18 hours.

In the case of difficulties in drug distribution, civil volunteers, mailmen or military personnel may be used. If the method of distribution is planned, organized and repeatedly trained, it is possible to complete the distribution in 24–36 hours. If the attack has been performed in a city with a population of ten million, the scope of the distribution operation will be extremely large, and of long duration [14].

The efficiency of an attack will depend on the source, season of the year, used material and weather conditions. The time of post-exposure preventive actions after the emergence of first clinical symptoms of the disease is a significant challenge, a race between the terrorists and the public healthcare system.

Hospital treatment

Infecting people purposefully with a biological agent may cause great disturbance in the work of the hospitals (lack of free beds, ventilators, basic pharmaceutical supplies and, of course, a lack of personnel).

Inhalation anthrax is a disease which requires intensive medical care.

The strategy for increasing the medical care capacity of the hospitals may involve:

- earlier discharge of patients who have been stabilized,
- increasing hospital capacity by installing beds in non-hospital buildings (railway stations, schools or hotels),
- moving doctors and nurses from unaffected regions,
- introduction of a special communication system for quick exchange of information between managers, planners, laboratories and doctors.

In many countries, hospital are currently private enterprises, in others they belong to the state or local government. Both types of hospital use a typical chain of current supply and stocking. In both types, the management continues to try to lower treatment costs. In the USA, the preparation for such events is done according to the carbon concept, which means that each hospital should be ready to admit 500 selected adult patients and children who are severely ill or injured. On the scale of the country this amounts to one million hospital beds [15]. Medical rescue has developed communication systems aimed at mutual aid in transporting patients to the hospitals. Similar systems may be developed with the purpose of efficient help to the victims of larger terrorist attacks. They will include demographic information and data about the treatment capacities, analyses of the data of hospital facilities and their treatment capacities. With the use of the planning document "Bioterrorism Emergency Planning and Preparedness Questionnaire for Healthcare Facilities" [16], the US Agency for Healthcare Research and Quality has been conducting, since 2001, wide-ranging research and the gathering of knowledge in order to prepare hospitals and train medical teams for this type of event.

Informing people in the areas affected by civil disruption

It is extremely important to provide calming information to people who are not ill or exposed to a given harmful biological agent. After the Aum Shinrikyo attack in the Tokyo subway performed with the use of sarin, there were only 12 deaths but as many as 5,510 people went to hospitals – the majority of whom was anxious about the possibility of poisoning. Out of those, 17 people were in critical condition, 37 seriously ill, and 984 moderately ill.

After the attack with anthrax, anxiety may be heightened due to the long time between infection and the appearance of symptoms. The number of panicked people may be reduced thanks to properly conducted training and making the population aware of the threat, as well as planning and coordinated cooperation with the mass media.

It is also important that the people responsible for the preparation of the hospitals and the public health

systems should cooperate closely, and involve those doctors caring for the mental health of society.

Decontamination

Unlike bombs or chemical weapon attacks, in the case of release of endospores of *B. anthracis* it is very difficult to determine immediately who has been exposed and what area and which buildings have been contaminated.

As far as the size of the biological aerosol particles is concerned, we distinguish two types: small molecules (1-10 microns), moving with the wind, fluctuations of temperature and whirls of air, and larger molecules (>20 microns) which precipitate quickly along the route of dispersion. It is assumed that the primary aerosol of very small particles will behave in urban areas in a similar manner to water vapor and, depending on the sealing of buildings, slowly penetrate and sediment inside [17].

If the aerosol has been released inside a building, as was the case in 2001, the level of contamination will be much greater as not just the small particles but also the larger ones will sediment inside. The determination of who was exposed to the primary aerosol may be possible only after the first cases of illness appear, which may take several days or weeks.

The assessment of the efficiency of decontamination is a task that is very difficult to assess. Currently the laboratories have equipment capable of detecting gases or radiation in real-time, but there are no devices which could immediately detect which areas have been contaminated with living microorganisms, e.g. endospores of *B. anthracis*. The precipitated aerosol may contain endospores of various vitality, and it may include endospores exposed to sunlight UV and so no longer form a significant threat. The endospores may precipitate on covered surfaces and maintain their vitality, but remain in places where they do not pose a threat of inhalation. There may be endospores released in closed areas, precipitating on the people or various surfaces in the form of clusters. All this precipitated aerosol matter has to be removed and neutralized.

Sampling, analysis and decontamination of various objects requires significant and expensive effort [18,19]. The employees performing decontamination operations should be included in the most necessary human reserves. They must be vaccinated and understand the identification and decontamination processes. Those countries which are better prepared against bioterrorism will also have vaccinated military personnel, which may also be used for decontamination works.

Municipal services, public utility services and transport

In the event of biological contamination, the municipal authorities will have to make many difficult decisions, such as granting consent to leave a city, ordering people to stay at their place of residence or implementing quarantine procedures. In the case of many catastrophic events (earthquakes, floods, chemical incidents or military attack), the first, and often right, reaction of people is to leave the city. In the case of anthrax, issuing a decision that the inhabitants have to stay is a better solution. The primary aerosol hangs in the air for a long time, and the local population should be given preventive measures in the form of antibiotics.

Air medical services may, within a few days, transport the victims of an attack requiring immediate intensive care and further treatment to centers specializing in assistance in this type of danger. It may also be necessary to allow people from outside to enter the contaminated area in order to help their families or friends, or care for their houses and workplaces.

If the municipal services (gas, electricity and sanitary authorities) are to function well, staff with skills related to the maintenance and repair of the city infrastructure will be necessary. Only some of these works may be performed by untrained volunteers or auxiliary military personnel. In a similar way, trained fire fighters and paramedics will be necessary for emergencies.

Volunteering and coordination of NGOs

Almost every danger, no matter where it appears, attracts volunteers from other areas of the country or other countries. It is crucial to prepare them appropriately and equip them with protective equipment. The volunteers are not always disciplined enough and will have various levels of preparation to help. The work of the volunteers should be coordinated by competent authorities so that their good intentions do not become counterproductive. As far as volunteering is concerned, anthrax attacks are a special case, different from the majority of other dangers. Firstly, fewer volunteers may enroll because of the lack of knowledge about the danger, and secondly they would need specialized equipment and physical protection devices that they may not possess when going to an affected area.

A look into the future

In an emergency, there are always many unpredictable circumstances and events. In the case of an anthrax attack, the most important of those

include the efficacy of the drug distribution, especially for the inhabitants of large metropolises.

Another unpredictable factor is the duration of the conflict in which the biological weapon has been used – whether the attack will be the beginning of a military conflict, blitzkrieg, war of attrition and, in the case of terrorism, whether quick detention and punishment of the perpetrators will be possible.

As far as anti-anthrax preventive actions of the public health system are concerned, immunization is much more beneficial than administration of antibiotics after the attack. Although in theory it is possible to vaccinate the whole adult population, no country, including the USA, has a vaccine approved for use in children. The question 'will we have such a vaccine in the future?' remains open.

Another problem is the assessment of safety after the decontamination works in an area contaminated with anthrax endospores. Will a normal restaurant in the city be as safe as before the attack? Maybe vaccination of all the inhabitants and people visiting the city will be necessary, together with constant monitoring of the contamination of the municipal environment? [20]. As yet, we have no clear answers to these questions.

In the past, research and training focused on the manners of drug distribution and building disinfection.

Currently, the organization of activities aimed at the liquidation of the consequences of an attack should be performed according to the scenario accepted by the attacked community and including various activities united into one procedural doctrine. While preparing for the Normandy invasion during the Second World War, Dwight Eisenhower said: "Plans are nothing; planning is everything". In his opinion, plans are static documents, while the active process of planning forces us to take into consideration all dynamically changing factors which may be known before, and developing the plans in a way which enables decision-making and altering them as the situation unravels. No country has been attacked with a widely dispersed aerosol of virulent endospores of *B. anthracis.* Because of that and of the impossibility of predicting even the probability of such an attack, the approach to the danger must take into account the special properties of the endospores and be built on a well-organized and functioning public health sector.

We are living in a time of increasingly cruel terrorism and the situation may change in an unpredictable way. After the anthrax letter attack of 2001, many focused on the possibility that these attacks may be repeated. A year later, some of the researchers concentrated on the SARS epidemic, and a short time later on the possibility of a flu pandemic, while today the Ebola virus in Africa is causing many problems.

The perception of the threat differs significantly between countries or even regions of the world. Not every population of a city or country sees the threat of anthrax attack as serious enough to store vaccines and drugs, or even have the required laboratory diagnostic capacity for this particular germ.

However, due to the intensifying phenomenon of global movement of people and animals, it is necessary to focus also on planning how to protect people and the economy both during natural outbreaks of highly infectious diseases and during purposefully dispersed aerosols with endospores of *B. anthracis*, as was experienced by the USA, though on the smallest possible scale.

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Hyperbaric oxygen therapy as a method of treatment in chosen neurological and psychiatric disorders. Research review

Hiperbaryczna terapia tlenowa – możliwe zastosowania w wybranych zaburzeniach z pogranicza neurologii i psychiatrii. Przegląd badań

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Abstract. Since the beginning of use of hyperbaric oxygen therapy there has been an interest in the possibilities of treating CNS disorders with this method. During the last few years, results have been published of research into the effectiveness of hyperbaric oxygen therapy in mild traumatic brain injuries, and some reports on its use as part of PTSD treatment. The aim of this paper was to summarize the results of the available research on hyperbaric oxygen treatment of the above-mentioned disorders. The reference material available in scientific databases was analyzed, although so far the results of hyperbaric oxygen therapy use in the described disorders are incoherent. More research is necessary on the treatment of mild traumatic brain injuries and posttraumatic stress disorder with hyperbaric oxygen therapy.
Key words: hyperbaric oxygen therapy, stroke, traumatic brain injury, postconcussive syndrome, posttraumatic stress disorder

Streszczenie. Wstęp: Zainteresowanie możliwościami wykorzystania hiperbarycznej terapii tlenowej w leczeniu chorób OUN pojawiło się już na początku jej stosowania. W ostatnich latach zaczęto prowadzić badania w zakresie skuteczności tej metody w terapii łagodnych urazów mózgu i opublikowano pojedyncze doniesienia o jej zastosowaniu w leczeniu zespołu stresu pourazowego. Cel: Celem pracy było podsumowanie wyników badań w zakresie skuteczności hiperbarycznej terapii tlenowej w leczeniu wymienionych powyżej zaburzeń. Metoda: Przeanalizowano piśmiennictwo dostępne w naukowych bazach danych. Wyniki: Jak dotąd nie uzyskano jednoznacznych wyników dotyczących stosowania terapii hiperbarycznej w leczeniu chorób OUN oraz objawów stresu pourazowego. Wnioski: Potrzebne są dalsze badania nad zastosowaniem tej metody w leczeniu łagodnych urazów mózgu oraz zaburzeń stresowych pourazowych.
Słowa kluczowe: hiperbaryczna terapia tlenowa, udar mózgu, uraz mózgu, zespół pourazowy, zespół stresu pourazowego

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Introduction

Hyperbaric oxygen therapy (HBOT) is a treatment method where the patient inhales pure oxygen at a pressure higher than local atmospheric pressure in a specially designed pressure chamber. The minimum pressure used should be 1.4 atm (absolute atmospheric pressure) [1].

The treatment is based on increasing the partial pressure of oxygen in the tissues, improving blood

flow in hypo-oxygenated tissues as well as reducing edema and hindering bacterial growth [1].

On the basis of the recommendations of the European Committee for Hyperbaric Medicine (ECHM), the Polish National Health Fund (NFZ) recommends hyperbaric treatment in the following cases:

- decompression sickness,
- carbon monoxide poisoning,
- air embolism,
- idiopathic sudden hearing loss, deafness after an acoustic injury,
- burns,
- necrotizing soft tissue infections
- hard-to-heal wounds and tissue infections
- post-injury acute soft tissue ischemia,
- post-radiation tissue damage.

ECHM mentions other therapeutic uses of HBOT, such as for the treatment of cerebral stroke, although the agreement of specialists is lacking in this issue [2-4].

The interest in the possibilities of hyperbaric therapy for CNS disorders, being the consequences of widely understood brain damage, have appeared already in the first years of its application. It has been assumed that it allows the supply of more oxygen to hypo-oxygenated areas of the cerebral tissue. The phenomenon may have a beneficial impact on the treatment of disease processes caused by ischemia, edema or apoptosis, such as cerebral stroke, post-injury brain damage, subarachnoid hemorrhage or radiation encephalopathy.

HBOT in CNS disorder therapy

The data related to the use of HBOT in the treatment of neurological diseases refer mainly to cerebral strokes and brain injuries of various etiologies [5-7]. The available literature contains various opinions on the efficacy of HBOT as well as doubts as to the methodology of the research so far conducted.

HBOT in cerebral stroke therapy

Theoretical assumptions

In a stroke focus, the blood supply is completely cut off, which causes the immediate death of nerve cells. Around the dead focus is an area with significantly lowered blood flow, called the penumbra. Nerve cells in this area remain alive for a longer period of time but may die due to persistent ischemia. Hyperbaric oxygen therapy is aimed at restoring blood circulation in the penumbra in order to save those cells which remain alive [7].

Results of research into application of HBOT in cerebral strokes

In the available literature reviews, the authors emphasize that the majority of the studies were conducted without control groups or specific inclusion criteria [5,7]. Op-pel et al. mention only two studies with control groups, which are described below [5].

Anderson et al. administered HBOT in a group of 39 patients with ischemic stroke. However, the study was finished earlier as better results were obtained among the participants of the control group and because of difficulties in observing study protocol conditions. The patients breathed pure oxygen at 1.5 atm for fifteen 60 minute sessions, taking place every 8 hours. The study was conducted using a double-blind method and with placebo (pressurized air) [8].

The results obtained by Nighoghossian and Trouillas in a group of 34 post-stroke patients did not show any significant difference between the groups as to the treatment results. The study was conducted with a control group and placebo. The treatment was administered in the form of 100% oxygen at a pressure of 1.5 atm during ten 40-minute sessions [9].

Whelan and Helms mention another study with a randomized control group and placebo, but again no statistically significant results were obtained. In this study, Rusyniak et al. used two 60-minute sessions at pressures of 1.14 and 2.5 atm (100% O2) [10].

Recently, Efrati et al. published results suggesting the beneficial influence of hyperbaric oxygen therapy in stroke patients. The study population consisted of 74 patients, 15 of whom were excluded from the study. The patients were randomly assigned to the study and control groups. They underwent forty 90-minute sessions during a two month period (5 times a week), with 100% O_2 at a pressure of 2 atm being applied. A significant improvement was observed in the study group after HBOT. After two months, the control group was also included in the hyperbaric therapy and a clinical improvement was observed. The clinical improvement in both groups correlated to the SPECT images [11].

HBOT in traumatic brain injuries

Theoretical assumption about the use of HBOT in the therapy of traumatic brain injuries.

In traumatic brain injuries (TBI), cerebral cells are primarily damaged due to the influence of various forces. The primary damage leads to secondary damage through the edema of cerebral tissue, ischemia and cell metabolism disorders leading to biochemical, cytotoxic changes. HBOT treatment is based on the assumption that reducing the edema, ischemia and cytotoxic disorders will reduce the potential risk of secondary injuries [7].

Results of research into the application of HBOT in traumatic brain injuries.

In the literature reviews published so far, all authors refer to four seminal works [6-8] in which HBOT was used in study groups and a standard treatment was applied in the control groups.

- Holbach et al. studied 99 patients in post-injury coma, using 60-minute sessions at a pressure of 1.5 atm [6-8].
- Artru et al. studied 60 patients in post-injury coma, the patients undergoing ten 60-minute sessions at a pressure of 2.5 atm [12].
- Rockswold et al. administered therapy to 168 patients with brain injuries, 60-minute sessions were conducted every 8 hours for two weeks, at a pressure of 1.5 atm [13].
- Ren et al. studied a group of 55 patients with major brain injuries, applying 30–40 sessions lasting 40–60 minutes at a pressure of 2.5 atm [14].

The general conclusions from the analysis of the aforementioned research suggest that the application of HBOT in TBI therapy may reduce the mortality in TBI patients. Bennett et al. indicate a trend which, although statistically insignificant, suggests HBOT as a supplementary therapy [6]. At the same time, some authors criticize the methodology because no placebo was used, for example [5,6].

Newer studies on HBOT in trauma brain injuries allow us to make more optimistic conclusions. Lin et al. in a study on a group of 44 patients observed a significant improvement of Glasgow Outcome Scale and Glasgow Coma Scale results after the application of HBOT in the study group (twenty 90-minute sessions, pressure: 2 atm) [15]. Rockswold et al. divided 69 patients with severe brain injury into three groups:

- treated with hyperbaric therapy (60 minutes, 1.5 atm),
- treated with normobaric therapy (100% O_2, 1 ATA),
- control group.

The sessions took place every 24 hours for three consecutive days. The best results were obtained in the HBOT group patients. Positive results were observed also in the normobaric group patients, but they were not as good in the HBOT group [16].

New HBOT application possibilities

Hyperbaric therapy in the treatment of mTBI and PTSD

Some authors suggest that HBOT in patients with mild traumatic brain injury may lead to greater improvement [6]. The newest data is related to research into the use of HBOT in the treatment of post-concussive syndromes.

Post-concussive syndrome (PCS), described also as mild traumatic brain injury (mTBI), is a set of symptoms appearing as a consequence of mild brain damage. It usually includes headaches, dizziness, mood swings and cognitive function disorders. The symptoms may appear directly after the injury or be delayed. The mechanism of their emergence may be related to damage at the cellular levels, which is visible as cell activity disorders in specific parts of the brain diagnosed by SPECT, PET and fMRI [17]. However, an emotional component as a reaction to the injury cannot be excluded.

During the research into the efficiency of HBOT in the reduction of post-injury symptoms (in mTBI), the researchers drew attention to post-traumatic stress disorders (PTSD) as a disorder occurring as a consequence of exposure to a traumatic situation constituting a threat to life or physical integrity. In PET, SPECT and fMRI scans, the presence of organic lesions in the brain (in the hippocampus, amygdalae, visual and prefrontal cortex) was observed in PTSD patients although a physical injury is not the sole condition for the development of this syndrome as a psychological injury is sufficient for its emergence [18]. The mentioned organic lesions and the similarity of symptoms in mTBI and PTSD described by Harch [19] may be a theoretical basis for applying HBOT in the treatment of PTSD.

Effects of HBOT in the treatment of mTBI and PTSD

In recent years, several case studies were published devoted to the beneficial influence of HBOT in the treatment of mTBI and PTSD. Harch et al. describe a case of a veteran with symptoms of PTSD and PCS. HBOT brought about alleviation of the symptoms of both disorders and an improvement in the SPECT image [20]. Wright et al. used hyperbaric therapy in two military pilots with symptoms of mTBI. In the paper, they indicate a clear improvement of the patients' cognitive functions [21].

Very recently, studies on groups of patients with mTBI and PTSD have been conducted. Harch et al. studied a group of 16 soldiers with PCS and PTSD. They applied forty 60-minute sessions at a pressure of 1.5 atm. The study had no control group. After hyperbaric therapy, an improvement in cognitive functions measured by neuropsychological tests (for example Stroop test, attention tests), symptom of fear and depression, and life quality (measured with questionnaires) were observed. Also the SPECT results were improved [22].

Another study was conducted by Wolf et al. on a group of 50 soldiers with mTBI. The trial was double-blind, the patients were divided into two groups: the study group (HBOT, 30 sessions, 2.4 atm) and control group (placebo, 1.3 ATA, atmospheric oxygen). The evaluation made with PCL-M and Post-Concussion Assessment and Cognitive Testing ImPaCT did not indicate any influence of HBOT on the condition of the study participants [23].

Current research trends

The latest studies concern mTBI treatment with hyperbaric oxygen therapy. The US Department of Defense commenced a project on the use of HBOT in the treatment of chronic mTBI symptoms, consisting of 5 single- and multi-center studies. The studies have been designed as double-blind. Various pressure ranges and oxygen concentrations are to be administered in order to verify the most appropriate doses. The number of sessions in the studies ranges from 30 to 40. One of the studies is to be conducted on healthy people in order to create a reference group (normalization) [24]. The aforementioned study by Wolf et al. forms part of this project [23].

Conclusions

On the basis of the available literature, it can be concluded that no unambiguous results were obtained in the studies into the application of HBOT in the treatment of CNS disorders. The most recent research focuses on the use of HBOT in the treatment of mTBI and PTSD, but the results published so far do not give any clear answers to the question related to the efficacy of the therapy in these disorders. Therefore, further research on the influence of HBOT on patients with the symptoms of mTBI and PTSB is necessary.

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Hearing protectors – new solutions

Ochronniki słuchu – nowe rozwiązania

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Abstract. Soldiers during their military service are repeatedly exposed to noise. Especially dangerous to their health is the impulse noise produced during the firing of a weapon. The standard hearing protectors they use help reduce the level of dangerous noise; however, these protectors can also degrade hearing and the understanding of useful sounds, like commands issued during weapon firing exercises. In such situations, the solution is the use of hearing protectors containing electronic circuits which support oral communication or special acoustic filters which transmit speech sounds. This paper presents a description of the new solutions of such protectors specifying particular models from different manufacturers.
Key words: hearing protectors, noise

Streszczenie. Żołnierze w trakcie służby wojskowej są wielokrotnie eksponowani na hałas, w tym szczególnie niebezpieczny dla zdrowia hałas impulsowy wytwarzany podczas wystrzałów. Stosowane przez żołnierzy standardowe ochronniki słuchu pozwalają na obniżenie poziomu niebezpiecznych dźwięków, ale jednocześnie pogarszają słyszenie i rozumienie dźwięków użytecznych, np. komend wydawanych podczas ćwiczeń. W takich sytuacjach rozwiązaniem jest stosowanie ochronników słuchu zawierających układy elektroniczne, wspomagające m.in. komunikację słowną, lub specjalne filtry akustyczne przenoszące dźwięki mowy. W pracy przedstawiono opis nowych rozwiązań takich ochronników z wyróżnieniem konkretnych modeli różnych producentów.
Słowa kluczowe: ochronniki słuchu, hałas

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Introduction

Noise is a significant risk factor for the health of soldiers, and may be produced, for example, by vehicles used during combat operations. However the most frequent noise source in military service is impulse noise produced when firing various types of firearms. The peak level of C-weighted noise during military exercises may exceed 170 dB [1]. This type of noise is extremely dangerous as it may lead to hearing disorders after short-term exposure, even a single shot. Very often, the only way to protect soldiers from the negative impact of noise is the use of hearing protectors. Research shows that in the case of small caliber weapons (e.g. handguns or rifles), hearing protectors can sufficiently reduce the exposure to impulse noise [2]. Unfortunately, the standard and most frequently used hearing protectors not only dampen the noise but also impede normal hearing capacity in relation to speech and warning signals. The latter is very important as it is important to be able to receive and react to orders from the commander. In order to ensure suitable hearing protection with simultaneous good hearing of speech and warning signals, manufacturers are continuously developing and launching new designs of hearing protectors.

Types of hearing protectors

Hearing protectors may be divided into anti-noise earplugs and earmuffs, although they may also be classified into passive protectors without electronic

circuits and active protectors equipped with electronic circuits. The development of hearing protectors involves both of these groups, as new solutions appear both in passive anti-noise earplugs equipped with acoustic filters and anti-noise earmuffs with various types of electronic circuits.

Hearing protectors with electronic circuits

Hearing protectors reduce undesirable noise but also limit the reception of useful stimuli, such as speech. The task of ensuring verbal communication while wearing hearing protectors may be achieved by electronic circuits built into the protectors. Electronic circuits may also support the reduction of low-frequency noises.

One of the solutions used in hearing protectors is the transmission of sound through the protectors via a route consisting of a microphone (located outside), an amplifier and a speaker inside the protector [3]. The amplification of the transmitted sounds by the electronic route depends on the noise level of the environment, which leads to increasing sound-dampening properties with increases in the noise outside. This solution, called level-dependent, is used most often in an impulse noise environment, such as the use of firearms. The protectors guarantee hearing protection during the sound of the shot while ensuring communication with the environment at all other times. Some examples of level-dependent earmuffs available on the market include: Elvex Impulse Com-655 [4], Bilsom / Howard Leight Impact Sport [5], Walker Alpha Muffs [6], MSA Suprime Pro-X [7] and Radians Hunters Ears [8]. There are also earplugs available, for example Variphone AEP-1 [9] and Etymotic Research BlastPLG EB-15 [10], as shown in Figure 1.

Another type of hearing protector with electronic circuits includes those equipped with radio communication systems [3]. This type of protector uses a radio signal for communication between several users, and may be done via an additional, external radio to which the protector is linked, or via a built-in radio in the earmuffs. This method of communication is used, for example, by Peltor Lite-Com [11], as shown in Figure 2.

Another hearing protector technology using electronic circuits is active noise reduction [3]. This is based on mutual compensation of sound waves by shifting their phase by 180°. The circuit in the protector generates a counterphase signal in relation to the noise signal, and the interference of these signals leads to noise reduction. Such a solution is efficient for low-frequency noise, so it can be successfully applied to protect helicopter pilots, for example. Products with active noise reduction include earmuffs by a French company, TechnoFirst NoiseMaster [12], and American-made earplugs, Aegisound DANR T3E [13]. Active noise reduction technology may be used in headphones, which contrary to hearing protectors have low passive protection levels. The solution may also be used in situations featuring typical low-frequency noise. An example of this type of product is the Bose QuietComfort 15 headphones (Fig. 3) [14].

Figure 1. Etymotic Research BlastPLG EB-15 level-dependent ear-plugs

Rycina 1. Wkładki przeciwhałasowe z regulowanym tłumieniem Etymotic Research BlastPLG EB-15

Figure 2. Peltor Lite-Com ear-muffs with electrical radio input

Rycina 2. Nauszniki przeciwhałasowe z komunikacją radiową Peltor Lite-Com

Hearing protectors may use two or even three of the above mentioned technologies together. Earmuffs Peltor ComTac XP (Fig. 4) [15] and earplugs TEA Invisio X50 Digital Ears [16] are level-dependent protectors with radio communication. Radio communication and active noise reduction are combined in the Silynx Maximus [17] system equipped with anti-noise earplugs and Racal Acoustics RA5000 RAPTOR HEADSET [18] with anti-noise earmuffs. A solution combining all three described technologies is the QuietPro system (Fig. 5) [19]. Additionally, the system warns if the plugs are fitted incorrectly so that the user can reinsert them. The radio communication with another QuietPro user is unusual, as the speech signal is collected from the external acoustic meatus with a microphone located inside the earplug, not with a microphone located near the mouth of the speaker.

Figure 3. Bose QuietComfort 15 active noise reduction headphones

Rycina 3. Słuchawki z aktywną redukcją hałasu Bose QuietComfort 15

Figure 4. Peltor ComTac XP level-dependent ear-muffs with electrical radio input

Rycina 4. Nauszniki przeciwhałasowe z komunikacją radiową i regulowanym tłumieniem Peltor ComTac XP

Thanks to this, the user's speech signal is not corrupted by the surrounding noise to such an extent and therefore is clearer for the recipient of the verbal message. As standard, the system has foam earplugs, but work on customized earplugs have also been conducted [20].

Passive hearing protectors

Improvements in verbal communication quality is not always achieved by electrical circuits. An alternative method is to use various types of acoustic filter in passive hearing protectors (without electronic circuits), which may increase the communication possibilities while the protectors are being worn. Acoustic filters are most often introduced to customized anti-noise earplugs [21], the manufacturers of such earplugs offering filters with various dampening capacities for use in the earplugs, depending on the noise levels.

Such a solution is available with the Variphone [22], Sonomax [23] and dB Blocker [24] earplugs. An upgrade to this solution involves flat-attenuation filter protectors, as standard protectors have lower attenuation capacities for frequencies in the 125–1000 Hz band than in the 2000–8000 Hz band. Thanks to the flat-attenuation filter, the timbre of the sound heard by the user is not distorted. The following flat-attenuation filter earplugs are available on the market: Etymotic Research ER-9, ER-15, ER-25 [25] and ER-20 [26], as shown in Figure 6.

Another type of passive protector with acoustic filters is the level-dependent earplug and earmuff [21]. The filter works in a way that low levels of sound are dampened weakly and the attenuation capacity grows together with sound intensity. Passive level-dependent

Figure 5. QuietPro system

Rycina 5. System QuietPro

earplugs are often used in military situations for attenuating impulse noise. For example: EAR Combat Arms (Fig. 7.) [27] and Variphone Stopgun [28]. A civil counterpart of the EAR Combat Arms are EAR Arc earplugs. The passive level-dependent earmuffs 3M Ultra 9000 (Fig. 8) [29] with acoustic filters located in ear cups are available on the market.

Another new solution used in passive hearing protectors are earplugs assembled on pressure springs, which also work as a resonance chamber. An

Figure 6. Etymotic Research ER-20 ear-plugs with acoustic filter

Rycina 6. Wkładki przeciwhałasowe z filtrem akustycznym Etymotic Research ER-20

Figure 7. EAR Combat Arms ear-plugs with acoustic filter

Rycina 7. Wkładki przeciwhałasowe z filtrem akustycznym EAR Combat Arms

example of this solution is the SensGard ZEM [30] earplug. The use of a resonance chamber with an impedance lower than the impedance of EAM means the majority of the acoustic energy from the external source is transmitted to the chamber and not to the EAM.

Research into hearing protectors

Although hearing protectors incorporate advanced technologies, studies into their improvement are still being conducted. One of the directions of research in this field is the improvement of noise exposure

Figure 8. 3M Ultra 9000 ear-muffs with acoustic filter

Rycina 8. Nauszniki przeciwhałasowe z filtrem akustycznym 3M Ultra 9000

reduction with simultaneous improvement of speech or alarm signal reception quality in the communication channel, including the development of new control algorithms. An example of a solution increasing the communication possibilities is a control system structure including active a noise reduction adaptation circuit [31]. The adaptation system control is divided into octave bands in the range from 125 Hz to 8 kHz, which leads to a significant improvements in speech understandability.

Another solution is an algorithm improving the audibility of warning signals in hearing protectors [32]. The system detects the alarm signal and "allows it to pass".

Still another example of a mechanism supporting the reception of desired sounds in a noisy environment is the prototype of a headset with a digital signal compressing system designed both to attenuate noise and detect speech signals present in an industrial noise background [33].

Another prototypical solution for hearing protectors with electronic circuits are earplugs with active noise reduction achieved thanks to an adaptation system which changes the working parameters depending on the noise levels in the environment [34].

Research is also being conducted into the application of genetic algorithms in active noise reduction earmuffs [35]. Genetic algorithms enable the adjustment of the frequency of NOTCH filters, which reduce noise in chosen frequency bands.

The application of wireless transmission of speech signals during the use of anti-noise earplugs may also be classified as a new solution in hearing protection. In order to achieve this, prototypical anti-noise earplugs

were equipped with a microphone located in the EAM of the user and a wireless module which transmits the signal collected by the microphone to another user of the earplugs [36].

A frequent problem with earplugs is their correct placement in the external auditory meatus. They are not inserted deeply enough as they are produced from easily expandable materials. An attempt to solve this problem was made with prototype earplugs with pumped ends, expanding in the EAM, which gave a better match to the ear canal shape [21].

Summary

New solutions in hearing protection help protect the hearing from the harmful effect of noise while still allowing communication with other people without the need to take the protectors off. This is extremely important during range training, where the soldier has to hear commands or other useful signals. The implementation of this type of hearing protector in the Polish Army may improve the health of the soldiers and their safety during military service.

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Lt. Col. Antoni Tomasz Aleksander Jurasz, professor of medicine (1882–1961) – surgeon, scientist, community worker and patriot – part II

Podpułkownik profesor medycyny Antoni Tomasz Aleksander Jurasz (1882–1961) – chirurg, naukowiec, społecznik i patriota – część II

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Abstract. Lieutenant-colonel Antoni Tomasz Aleksander Jurasz, professor of medicine (1882–1961) was an outstanding man – a surgeon, a scientist and a community worker. Born in Prussia to a Polish father and English mother, he dedicated all his skills to Poland, the motherland of his father Antoni Stanisław Jurasz, once it regained its independence in 1918. He continued his work for Poland despite the outbreak of the Second World War. The purpose of this series of five articles is to present the cause-and-effect analysis of his development, work and achievements.
Key words: Antoni Tomasz Aleksander Jurasz

Streszczenie. Ppłk prof. med. Antoni Tomasz Aleksander Jurasz (1882–1961) był nietuzinkowym człowiekiem: chirurgiem, naukowcem i społecznikiem. Urodził się w Rzeszy Niemieckiej z ojca Polaka i matki Angielki, ale wszystkie swoje umiejętności ofiarował Polsce, ojczyźnie swojego ojca, Antoniego Stanisława Jurasza, po odzyskaniu przez nią niepodległości w 1918 roku. Realizacji tego celu nie przerwał nawet wybuch II wojny światowej. Celem niniejszego – pięcioczęściowego – opracowania jest przedstawienie przyczynowo-skutkowej analizy rozwoju bohatera, jego twórczości i dorobku całego życia.
Słowa kluczowe: Antoni Tomasz Aleksander Jurasz

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Introduction

The aim of this series of articles dedicated to Lieutenant-colonel Antoni Tomasz Aleksander Jurasz, MD (1882-1961) is not only to present his contribution to Polish and international surgery, Polish society and Poland after it regained independence in 1918, but also to analyze the mechanisms through which his parents and teachers formed his character, as well as the circumstances which allowed him to generate such impressive and multi-faceted achievements during a long and rich life.

Jurasz, a professor of medicine, was the creator of the Poznań school of surgery (also known as "Jurasz's school of surgery"), the Polish Medical Faculty at the University of Edinburgh, the Chirurgia Clinica Polonica, a buoyant Academic Sports Association in Poznań, and an active branch of the Polish Red Cross in the Wielkopolskie region. With the Second World War still not finished, Jurasz was already organizing the necessary equipment for Polish hospitals, with the restoration of the Polish health care system in mind. Unfortunately, this was not appraised later by the Polish communist authorities. Forced to emigrate, Antoni Tomasz Aleksander Jurasz eventually died in New York.

The first part of this work is dedicated to his family and school environment, the second part discusses his professional life before the outbreak of the Second World War, the third tells of the events of 1939 and the creation of the Polish Medical Faculty at the University of Edinburgh, the fourth is devoted to his post-war life and the fifth sums up his life and scientific accomplishments.

Part II. Professional career, scientific and educational accomplishments

Heidelberg and London

In 1906, after graduating from the medical faculty of the University of Heidelberg, Antoni Tomasz Jurasz left to serve an apprenticeship at the German hospital in London, where he worked in the surgery and gynecology clinics [1,2]. Less than a year later, in 1907, he returned to the University of Heidelberg, to the department of physiopathology led by the professors Arnold and Ernst [1] and the Internal Medicine Clinic of Ludolf von Krehl (1861-1937), a pathologist interested in psychosomatic diseases [3]. His work and research resulted in the defense of his doctoral thesis entitled: "*Beitrag zur Kenntnis der Dermoide und Teratome des Backenbindegewebes, besonders der retrorektal gelegenen"* (An insight into dermoid cysts and teratomae of connective tissue, especially in retrorectal locations) [5] which took place on 12 November 1907. From the defense till the spring of 1908 he worked as a volunteer assistant at the Pathological Anatomy Department of his parent university and then he was employed as a second ship's doctor on an ocean liner owned by a German company and fulfilled his dreams from the times of the studies: to see the world.

He travelled for a year and a half, then returned to Heidelberg and again spent two years in the German hospital in London [6], where he mastered his skills in surgery and gynecology, assisting Doctor Michels. He chose London because he wanted to specialize in gynecology, inspired by the personality of Professor von Rosthorn from the University of Heidelberg, who suggested such a condition to him. However, when the professor died Jurasz chose not to continue gynecology and to instead specialize in surgery [2].

Königsberg and Leipzig

In February 1910, benefitting from his father's contacts, who was appointed head of the laryngology department of the University of Lviv, he began a surgical apprenticeship in Königsberg [2] as a volunteer assistant at the side of Professor Erich Lexer (1867-1946), a disciple of that prominent surgeon, Ernst von Bergmann (1836-1907) [6]. He admired the surgical skills of Professor Lexer but observed that the routines used by the professor often led to permanent disfiguring of the patients; however, Lexer did not pay attention to this. Under Lexer, Jurasz observed the first cosmetic surgeries in Europe and unsuccessful attempts at transplanting a knee joint from a dead person. Lexer was moved to the University of Weimar, and his position was given to Professor Erwin Payr (1871-1946). Antoni Tomasz Jurasz was fascinated by the human attitude of this professor, both towards the staff and patients. Payr had acquired his surgical skills under the famous Carl Nicoladoni (1847-1902) and his life motto was Terence's *nihil humanum mihi alienum* (I am a human being, I consider nothing that is human to be alien to me). He was the first European surgeon to use ozone as a disinfectant [3]. In his educational and clinical work he was characterized by the systematic approach and logic of his surgical procedures, which were obligatory to his assistants. He was very lenient to his patients, he claimed that "a complaining patient is always right" [8]. In his diaries, Antoni Tomasz Jurasz describes his apprenticeship under Payr in Königsberg: "the arrangements in Professor Payr's clinic brought to each of us great satisfaction from being a doctor. I recall the studies under his supervision and his personal engagement in my education with utmost gratitude to this day, the more because what he taught us was not - and is still not - present in any textbooks" [8]. On 1 October 1911 Payr left Königsberg to transfer to the university surgical clinic in Leipzig, taking Antoni Tomasz Jurasz with him as a volunteer assistant. In the meantime, in the winter of 1912/13, the German Red Cross sent Jurasz to Constantinople to the Balkan War [2]. There, Jurasz contacted Ludwig Rehn (1849-1930), a pioneer in cardiac surgery) [9]. In November 1913, he returned to the University of Leipzig and till the summer of the next year he gave lectures on fractures and dislocations (*über Frakturen und Luxationen)* and their handling (über *Verbandlehre)* [3]. Thanks to his fluent command of foreign languages, acquired at home, he presented the scientific work of the Payr's team on anesthesiological complications and abdominal surgery [3] at conferences in Germany, the UK and the USA. For example, in 1914, on a conference of surgeons in New York, he presented a paper entitled "*Das Ulcus ventriculi und duodeni*" ("Ulcers of the stomach and duodenum") [10]. While in the USA, he also widened his knowledge on surgical techniques and procedures by visiting the best hospitals [3].

First World War and Frankfurt

On 7 August 1914, Jurasz, as a senior physician *(Oberarzt I.L.I.* of *Sanit. Kompanie Nr. 2 IV A.K.* in Magdeburg) left with the army of General Alexandr von Kluck (1846-1934) and travelled to the region of the Marne, and after the defeat of the Germans he was sent to the eastern front, assigned to *Feld-Lag. Nr 10 IV A.K,* where he held the function of ordering surgeon. At the end of 1914, he was moved to Zastrow Corps in Mława. There, he fell ill with dysentery and returned to the hospital in Heidelberg. He was sent to Frankfurt am Main to recover [11] and during his stay there, in 1915, he took part in a competition for the main physician and head of surgical department of *Marienkrankenhaus* (St. Mary's Hospital). Having good recommendations from Michels in London and Payr in Leipzig, he won the competition at the age of 33 and worked there till 1920 [2]. His election caused many protests in the German

medical environment, as young physicians were sent to the front. The protests came to the ears of General Gallwitz in the Ministry of Defence in Berlin, but he maintained the results of the competition and decided that Antoni Tomasz Jurasz would fulfil the duties in the hospital for the full duration of his convalescence [9]. In his *Memoirs*, Jurasz says [8]: "As could be predicted, my health did not improve until the last day of the war in 1918." However, in the application to the Admission Committee for resident officers at D.O.K, he describes the situation differently: "... after I recovered, I was deemed capable of service and not only for garrison service, and on 4.11.1915 I was moved to 'Vereinslazarett Marienkrankenhaus, Res. Lag. IV 18 A.K. in Frankfurt am Main. I served there to my demobilization on 18 October 1918. In Frankfurt I was appointed to the position of 'Stabsarzt' [staff physician – author's note] and in 1917 or 1918 (the exact date is uncertain) 'beratender Chirurg [consultant surgeon – author's note] at 18 A. K" [11]. In 1919, after several years of work in *Marienkrankenhaus,* he was appointed titular professor by the Senate of the University of Frankfurt [10].

Municipal Hospital in Poznań

In the spring of 1920, a competition was held at the Municipal Hospital in Poznań for the position of main physician of the surgical department, where a large clinic (100 beds and out-patient clinic) for the students of the University of Poznań was being organized. Antoni Tomasz Jurasz also entered the contest. It is worth mentioning that the year before his father, Antoni Stanisław Jurasz, who was from Poznań and a professor of the University of Heidelberg, became the head of the department of laryngology at the University of Lviv. Out of six candidates in the competition, Antoni Tomasz Jurasz was chosen. Jurasz had German nationality and although the decision about the contest winner was made on 7 May 1920, he was not aware of this until 18 August when he arrived in Poznań concerning private matters. It was later discovered that the German censorship authorities had confiscated the correspondence from the Municipal Office of Poznań sent to his address in Frankfurt. As a result, Jurasz took the position of the main physician of the Municipal Hospital in Poznań as late as October [2]. As the main physician he wanted to equip his department with the latest medical technologies, but this was not understood by the authorities of Poznań which tried to explain that there were no funds due to the costs related to the restoration of Poland. This resulted in many conflicts. Therefore, in January 1923, Jurasz resigned from the position of main physician of the surgical department in the Municipal Hospital in Poznań [12].

University of Poznań and Transfiguration Hospital

In 1920, with the beginning of reconstruction of Polish universities following Poland regaining its independence, Jurasz received the proposal that he become the head of the department of surgery of the University of Warsaw. He refused; however, on 22 September 1920, at the age of 38, he became the head of the Department of Surgery of the University of Poznań, where worked until 1947, with a break during the Second World War. Furthermore, on 1 October 1920, he was granted the title of specialist surgery professor by the Chief of State and was appointed the head of the Surgery Clinic of the Municipal Hospital in Poznań [13]. At the University of Poznań, he was dean of the Medical Faculty in the years 1925–1927 and prorector in the years 1930–1931 [14]. Until 1923, the newly founded Department of Surgery of the University of Poznań had clinical and educational support in the shape of the Municipal Hospital in Poznań since Jurasz was the main physician there. After resigning from this function, he organized a modern clinical and educational background for the Department of Surgery (100 beds) in the Transfiguration convent hospital of the Sisters of Saint Elisabeth in Poznań, and became the director there. The clinic was recognized by the International Congress of Surgeons in Warsaw in 1932 as being one of the best in Poland [6]. It had a large research base in the form of laboratories (for chemistry, hematology, histopathology, bacteriology, metabolism, X-ray and culture of neoplastic cells) and an experimental surgery room. Jurasz also established a museum of medicine in the department, and in January 1927 he finished the construction of an amphitheater type lecture hall for 120 people. In the following year he organized the archive and the library and in the years 1929–30 created a modern motor rehabilitation unit [15]. After 1930 he helped develop urological surgery along with Jan Schlingmann PhD, a talented student of Ferdinand Schligmann. In the developed clinical base, he also created the Radium Institute and cooperated with Professor Stanford Cadet from Westminster Hospital School in London [17], as well as a laboratory for culture of neoplastic tissues for research into oncology. Apart from radiotherapy, he introduced radical surgical treatment with conservative therapies. In the years 1920–1939 he participated in almost all national and international congresses of surgeons organized in Poland. In this period he published about 20 scientific papers in English, French, German and Polish. The topics covered by these works is wide, and are related to esophageal surgery, treatment of cardiac injuries, indirect cardiac massage, diseases of the thyroid gland, treatment of cholelithiatis, Graves' disease, purulent peritonitis, cancers and diseases of the esophagus [15]. His original scientific works include: *O*

nowym sposobie operacyjnym tzw. cardiospasmus (1925), in which he describes an own version of the Heller myotomy in achalasia, *Contribution on Operative Treatment of Graves' Disease* (1929), where he discusses the results and conclusions from his pioneer research into surgical treatment of hyperthyroidism, *Behandlung der Pankreascysten* (1931), in which he writes about a new method of joining pancreatic cysts with the stomach. In his works *Postępowanie w ropnem rozlanem zapaleniu otrzewnej pochodzenia wyrostkowego* (1931) and *Zapalenie otrzewnej pochodzenia wyrostkowego* (1939) he broached the problem of purulent peritonitis caused by appendicitis and presented a new surgical procedure in which the exudate and purulent content are removed by precision suction and drying [5]. He also described reconstruction surgeries of the urinary bladder and the stomach, and a mobile kidney [3].

Of the many operations performed in Poznań, one is worth mentioning due to its historical aspects. On 13 May 1926, General Sosnkowski was brought to the hospital with a gunshot wound, following his attempt to commit suicide after Piłsudski's May Coup. The surgical intervention by Jurasz saved the general's life. It is also worth mentioning that General Józef Haller was a patient of the Transfiguration Hospital [18]. Later, in the spring of 1943 he was invited to be a guest of Jurasz while he was working as the dean of the Polish Medical Faculty of the University of Edinburgh [19]. The position of the dean of the Medical Faculty of the University of Poznań, which he held in the years 1925–1927, was related with various administrative functions, therefore Jurasz was present at the opening of the New Baths (*Nowe Łazienki*) of Zakład Zdrojowy in Krynica-Zdrój in September 1926 [20].

Work with students

As the head and lecturer of the Department of Surgery of the University of Poznań, Professor Jurasz "laid special stress on professional skills and moral qualifications. In recognition of this good influence on the young generation, the Senate elected him to be supervisor of the Association of Medicine Students" (of the University of Poznań – author's note) [21]. He repeatedly reminded his students that the health of the patient is of the utmost importance. He claimed that surgery is an exact science, but saw a relation between the *soma* and the *psyche* of the patient [8]. He warned the trainees against the temptation of financial benefits and considered civil liability insurance for physicians as a sign of the presence of semi-skilled and irresponsible doctors, and a method of earning money by insurers and patients. He saw a disharmony between the advancement of civilization and the fall of human morality. He did not hide from his students that they may suffer painful defeats which could not be avoided despite their grounded knowledge and good surgical skills, but he consoled them with the joy brought by keeping alive a patient with a poor prognosis [8]. At the end of his life, he wrote: "I was very happy when during my lectures I saw that my words got across to the youth. I had clinical lectures every day – they were so important to me that I treated them as a pleasure, a day without a lecture was not a nice day" [8].

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Contribution of Polish Jews as military physicians in the creation and development of the Garrison Hospital in Żary

Wkład polskich żydów – lekarzy wojskowych – w powstanie i rozwój Szpitala Garnizonowego w Żarach

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Abstract. In October 2014 we celebrate the 70th anniversary of establishing the 105th Military Hospital with Outpatient Clinic in Żary. It was formed in 1944 in Kock as the 8th Field Mobile Surgical Hospital of the 2nd Polish Army and followed the action at the front from Kock to Ruszów. In 1946, it arrived in the city of Żary, where it remains stationed to this day. Polish Jews as military physicians largely contributed to its development. From among 13 commandants of the hospital, 4 have been Jewish. They are an example for all military physicians.
Key words: military hospital, Żary, Jews, Sorau

Streszczenie. W październiku 2014 r. obchodzono 70. rocznicę powstania 105. Szpitala Wojskowego z Przychodnią w Żarach. Został on sformowany w 1944 r. w Kocku jako 8. Polowy Ruchomy Szpital Chirurgiczny w składzie II Armii Wojska Polskiego. Przeszedł cały szlak bojowy od Kocka do Ruszowa. W 1946 r. przybył do miasta Żary, gdzie stacjonuje do dziś. Polscy Żydzi – lekarze wojskowi – w dużej mierze przyczynili się do jego rozwoju. Szpitalem dowodziło 13 komendantów, w tym aż czterech polskich Żydów. Są oni przykładem dla wszystkich lekarzy wojskowych.
Słowa kluczowe: szpital wojskowy, Żary, Żydzi, Sorau

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The Second World War, as well as taking its toll among millions of people around the world, brought about a painful lack of medical staff. Many doctors died during the hostilities on all fronts, in mass liquidation actions (Katyń, Palmiry etc.) as well as in ghettos, concentration camps and labor camps. At the same time, hundreds of thousands of sick and wounded people needed professional treatment and healthcare, and the army required medical assistance in the battles aimed at the final defeat of Hitler's Germany. A still underestimated role in this field was played by those Jewish doctors who managed to survive the holocaust and, despite tragic experiences that often included the deaths of their kin and poor physical condition and exhausted organism, enrolled in the Polish Army to become the seed of military healthcare. To a great extent, it was they who bore the burden or organization and development of military field hospitals of the First and Second Polish Army. This publication aims to present silhouettes of the founders of one such hospital, the Garrison Hospital in Żary, which still exists today and is the oldest and one of the best medical centers of Ziemia Lubuska.

Żary and its history

Żary is a city located at 15°9’ E and 51°38’ N, and is the capital of Terra Sarove region situated between two tributaries of the Oder River: the Bóbr and the Nysa Łużycka. The name comes from the Zara tribe which inhabited the area, also known as the Sara in a Latinized form, or Zaro, Zarow, Soravia, or Soraw. The German name of Sorau appeared as late as 1689. According to German chroniclers, the name was related to burning grass or a meadow on acidic soil (in Sorbian). The first post-war name of the town, "Żóraw" also stems from Slavic-Sorbian etymological origins, later changed to the present name. The first known

owner of Żary was Ulryk Dewin (the Silesian version of the surname is Dziewin). In the 13th century, power over the region was in the hands of the Piast princes: Henry I the Bearded, Henry II the Pious, Henry III the White and Henry IV Probus. It is assumed that the town of Żary was founded in 1260 by Albrecht Devin under Magdeburg rights. Its owners took advantage of beneficial political conditions and especially the constant succession wars in Germany and Poland, encouraging their rulers to issue increasing numbers of privileges concerning autonomic rule over their fief. In this way, by the end of 14th century the fief of Sarove was gradually transformed into a state known as Żary (German Freie Standesherrschaft Sorau), which coincided with the childless death of Bolko II the Small (1368), the last Piast prince to rule over the area.

The relationship of the present-day Żary with the past can be clearly seen in the coat of arms of the town, which remains practically unchanged since 1653. It consists of fields with the coats of arms of the dynasties ruling over the city: Pack (red deer), Biberstein (red antlers with 5 branches) and Promitz (a silver arrow with two silver stars). It is a form of tribute to the contributions made by these houses to the construction and development of the town [7,9].

Battle trail of 8th Mobile Surgical Field Hospital and formation of the Garrison Hospital in Żary

Żary is now part of the territory of the Lubuskie province and is famous throughout the region because for seventy years it has been the location of 105th Kresy Medical Hospital with Public Out-Patient Clinic and Division in Żagań, with seventeen modern units and the only helicopter service in the region. The beginnings of the hospital date back to 1944 when the 8th Mobile Surgical Field Hospital in Kock was formed. It was established by the order of the Commander-in-Chief of Polish Armed Forces no. 8 of 20 August 1944, together with the other hospitals in the region of Czemierniki-Kock-Siedlce. The 3rd Field Evacuation Point (PEP in Russian) commanded by Major Leon Gecow MD organized thirteen hospitals in the area, including two in Kock. During the formation of the hospital, extreme difficulties were encountered concerning supplies of medical equipment, drugs and food. Also qualified medical staff, especially experienced physicians, were scarce. Despite all that, the hospital had to change its location several times while still in organization due to the dynamic situation at the front. On 17 January 1944, the hospital left the comfortable Jabłonowski Palace in Kock and moved to the mansion in Leszczyna (district of Garwolin). Subsequently, by Order of the Day no. 15 of 18 January 1945, it transferred all the remaining patients to the 12th Mobile Field Surgical Hospital, and departed for a new location – the town of Koło on the Warta River. During its month stay in Koło, the hospital was still held in a state of constant readiness, concurrently filling staff shortages and encouraging a cooperative spirit among the entire personnel. On 18 January 1945, the 8th Mobile Field Surgical Hospital moved to Złotów (German: Flatow) near Bydgoszcz. This maneuver was connected to the preparation of the 2nd Polish Army within the framework of the 1st Ukrainian Front and 1st Polish Army within the framework of the 1st Belarusian Front, for the Battle of Berlin. Złotów was then a large hospital in which all public buildings (schools, offices, and inns) were used by the medical personnel of the 1st Polish Army and the Red Army. The 8th Mobile Field Surgical Hospital was sent as support for the field hospital of the 1st Polish Army commanded by Col. Dokuczajew. Then, on 28 March 1945 it moved to Oleśnica (German: Oels), and after two days they moved to Skarszyn (German: Sauerbrunn) due to the concentration of the units of the 2nd Polish Army as protection for the siege of Wrocław fortress (German: Festung Breslau) in the second echelon of the Soviet Army. As part of the medical support for the army while crossing the Lusatian Neisse, the 8th Mobile Field Surgical Hospital arrived at the hospital base in Ruszów (German: Rauscha) on 14 April 1945. There, it was located in tents and huts previously inhabited by forced laborers taken to Germany. The number of wounded soldiers being treated there reached a peak of 1,000 in a normally 100-bed hospital.

The provision of medical service while crossing the Lusatian Neisse is deemed to have been the most spectacular success of the 8th Mobile Field Surgical Hospital. All the more it should be emphasized that no sooner had the operation begun than the hospital began moving to a new location and, virtually on the fly, stepping straight into action on a scale ten times greater than the capacity it was designed to handle. The enormous number of severely injured soldiers whose lives were saved or had their suffering relieved in the last moments of their lives is the most notable success the hospital has ever achieved.

In the middle of August 1945 the hospital again changed its location, moving to Iława (German: Halbau, earlier Ilwa, now: Iłowa). On 22 September 1945, under Daily Order no. 131, the 8th Mobile Field Surgical Hospital was transformed into the Garrison Hospital in Iława, for 100 beds, according to military unit description no. 24/24. In this way the battle history of the field hospital ended and that of a stationary hospital, known informally as Garrison Hospital no. 8, began to function.

The tenth and last change of location of the facility took place on 15 May 1946 when it transferred to Żary (German: Sorau, now: Żary) and was located in the buildings of the former German psychiatric hospital (Psychiatric Hospital of Brandenburg, German:

Brandenburgische Landesirrenanstalt). It was the end of a journey for an exhausted veteran. Since then, for seventy years, the hospital has always been associated with Żary [1,8,10].

Jewish physicians, Polish Army officers – commanders of the hospital

This was the beginning of the history of the Garrison Hospital in Żary, which was later given other names: 105th Military Garrison Hospital (1951), 105th Military Hospital with Out-patient Clinic (1981), 105th Military Hospital with Public Out-patient Clinic (1999). Today the name has been supplemented with the name "Kresy" to take the form: 105th Kresy Military Hospital with Public Out-patient Clinic. The whole gigantic work connected with the creation and development of the hospital was performed by the eminent medical staff. 70 years have passed and few people in the town remember the names of the people who formed this famous medical facility, respected throughout the whole region. When analyzing the available documents it is easy to see that a great role was played by Jewish physicians. It is enough to mention that four out of first six commanders were Jews.

The first commander and the founder of the 8th Mobile Field Surgical Hospital, which later became the 105th Military Hospital in Żary, was Lt. Karol Rumeld MD, a very interesting and a colorful character. He was born on 8th April 1899 in Lasek (district of Nowy Targ) to a family of Jewish intelligentsia, Herman and Antonina nee Herzman. He had his secondary education in the years 1909–1917 at St. Ann's School in Kraków, and then began studies at the Medical Faculty of the Jagiellonian University. When Poland regained its independence after 123 years of occupation, he found himself in the Polish Army. During the Polish-Soviet war, he served as a junior physician - an officer cadet in District Hospital no. 5 and the POW Camp in Badów. During the Battle of Warsaw, he served in the 4th Watch Battalion in Warsaw. After the end of the war, he was demobilized, returned to the university and in 1925 obtained the diploma of doctor of medical science. He participated in several exercises of the military reserve and in 1925 was promoted to the rank of second lieutenant of the reserve. In 1932, he was promoted again, to the rank of lieutenant.

In 1939, he was mobilized in the position of junior surgeon in Field Hospital no. 252 organized by the Reserve Staff of the 2nd District Hospital. After the defeat of the September campaign, he managed to avoid imprisonment and began working in the Maternity Hospital in Stary Sambor. From 1942, he worked in Warsaw, where he participated actively in the left wing conspiracy as "Dr. Kazimierz" and was the deputy of the Sanitary Division of the People's Army (Polish: Armia Ludowa). On 14 August 1944 he enrolled in the Polish Army as a volunteer. In the middle of October 1944, he was given the task of organizing the 8th Mobile Surgical Field Hospital in Kock. Thanks to his personal engagement and extensive military and medical experience, he managed to build the framework of a well-functioning field hospital despite major difficulties in the supply of basic equipment and the lack of qualified staff. In recognition of his achievements, he was promoted to the rank of major by the Order of the Commander-in-Chief of Polish Armed Forces no. 98 of 22 December 1944. On 15 February 1945 he passed command over the hospital to his successor. In the following years, Dr. K. Rumeld held various positions, including Head of Healthcare of Military Command District no. 4. In 1948 he was moved to the reserve at the rank of lieutenant colonel. In 1953, he obtained a second degree of specialization in gynecology and obstetrics and worked in civil healthcare. For many years, he was the head of Municipal Hospital no. 8 in Warsaw. He died on 11 July 1979 and was buried in the Powązki Military Cemetery in Warsaw, in sector C35/7/2 [1,4].

Figure 1. Dr. Karol Rumeld (1899–1979) (with permission of M. Rumeld)
Rycina 1. Dr Karol Rumeld (1899–1979) (za zgodą M. Rumelda)

The next commander, Lt. Mieczysław Mel MD, came from a relatively poor Jewish family in Sieradz. His father, Jakub Maurucy, was from a merchant family while his mother, Estera was the daughter of a farmer. They had three sons: Mieczysława (born 1909), Dawid (born 1912) and Bernard (born 1915). In 1928 the future commander graduated from the

Municipal School in Sieradz but failed to matriculate for medical studies. The cause was not related to poor grades but the so-called *numerus clausus*, the rule regulating the number of medicine students from ethnic minorities on the basis of the size of the given minority in society. In order to become a doctor, Mel went abroad where, in great poverty, he studied the mysteries of medicine. He obtained his diploma on 12 July 1938 at the Medical Faculty of the Victor Emmanuel III University in Naples. He did his post-graduate apprenticeship in Naples and then returned to the family town of Sieradz, and worked there in the Municipal Hospital as a volunteer to validate his diploma. After the outbreak of war, he was in the Soviet occupation zone and worked near Łuck as the head of a rural medical region. In June 1941 he was deported to Qamashi in Uzbekistan, where he worked as a physician in local healthcare facilities. On 30 July 1944 he enrolled in the Polish Army as a volunteer and was directed to the sanitary service in the 2nd Polish Army. First he served as the head of the laboratory of the 24th Field Infection Hospital, then as the commander of the 25th Field Infection Hospital, and from 6 May 1945 he commanded the 8th Mobile Field Surgical Hospital in Ruszów. It was a period of very intense work for this facility, as despite the end of the hostilities, casualties were still being taken there in numbers far greater than the capacities of the hospital. Only the great engagement and dedication of the whole staff enabled the correct functioning of the facility, and the personal example of a commander who never avoided hard work and supported his colleagues was not without meaning. In the first half of August 1945, Lt. M. Mel moved his hospital to Iłowa where, on 29 August 1945, he passed the command to his successor, Cpt. Maksymilian Mościsker MD. After the war, Dr. M. Mel returned to Sieradz where he became the head of the Healthcare of the Communications School for Officers. He worked also on the internal medicine unit of a civil hospital. Unfortunately, he was unable to enjoy the post-war stability for long as he fell ill with lung cancer and died on 14 September 1954. He was buried in the Powązki Military Cemetery [1,11].

The new commander was born on 18 October 1902 to a Jewish family with patriotic traditions. His father, Samuel, wanted his son Maksymilian to become a doctor, but it was not easy due to *numerus clausus.* Even very good final results from the secondary school examinations could not ensure study at the chosen faculty if the percentage of the Jewish ethnic minority in the university was higher than the percentage of the Jewish population in the whole of society. A relatively successful way of avoiding these types of barrier was to study abroad and then return and validate the diploma. Of course, it involved large expenses and sacrifice for the whole family, as well as requiring a good command of foreign languages. Maksymilian Mościsker began his medical studies at the Medical Faculty of the Charles University in Prague and then moved to the Jagiellonian University and obtained his medical diploma in 1935. After the outbreak of the Second World War he escaped to the eastern parts of Poland in fear of persecution from the German occupants. The direction of his escape was also related to his leftist attitudes, very popular among middle class intelligentsia in this period. After the outbreak of German-Soviet war, he was incorporated into Red Army and in 1944 transferred to the Polish Army. On 28 1945 he took command of the 8th Mobile Field Surgical Hospital, then located in Iłowa. He held the position for a short time but is remembered in the history for aiding its transformation into the Garrison Hospital with 100 beds, which took place on 22 September 1945. A month later he passed the command to his successor. In his later professional life, Dr. M. Mościsker was the Head of Healthcare in the Sapper Regiment in Gorzów, and his career was

Figure 2. Lt Dr Mieczysław Mel (1909 –1954) (with permission of M. Gajdzińska)

Rycina 2. Por. dr Mieczysław Mel (1909–1954) (za zgodą M. Gajdzińskiej)

crowned with the position of the deputy commander of the Polyclinic of the Central Clinical Hospital of the Military Medical Academy in Warsaw, for which he assumed in the rank of colonel. He was discharged in 1964. He died on 31 December 1982 and was buried in the Powązki Military Cemetery in Warsaw, in sector F/14/11 [1].

Bronisław Seyda is one of the most interesting characters in the whole history of the hospital. He was born on 27 July 1912 in magical Lviv, to a family of Polish Jews – Marek Seide and Erna nee Sperling (he assumed the spelling "Seyda" later). His father was the owner of a small printing house, which gave him financial means adequate for securing the education of his children. His son, Bronisław, was a talented and hard-working man, graduating from the General School and 4th National School in Lviv, where he obtained his secondary school diploma. In 1937, he finished his medical studies at the University of Naples and during the Soviet occupation he was employed in the 1st Soviet Hospital in Lviv. After the city was captured by the Germans, he worked as an epidemiologist. From 1943, he had to hide due to his Jewish origin. On 20 September 1944, the future commander of the hospital was mobilized as a junior physician of the 23rd Regiment of Light Artillery, first as officer without rank but being quickly promoted to captain. He took part in the whole combat trail of his unit, following the activities of the 1st Polish Army. In March 1946, he became a senior physician in the 18th Infantry Regiment and about two months later the commander of the Garrison Hospital in Żary, which had just arrived in the town. During the two years of hard service, Captain B. Seyda MD formed stable foundations for a stationary military medical facility. Under extremely difficult conditions, he managed the equipment, resources and staff entrusted to him in a brilliant way, ensuring good living conditions. The hospital under his supervision consisted of four well-functioning wards, and a farm that was organized to ensure a food supply. The commander considered constant education and learning new skills as being very important, therefore a Medical Scientific Circle was established for his staff. It was he who built the foundations and set the directions of the development of the hospital. To his successor, he left a well-functioning military medical facility with a well-integrated team of doctors and nurses. He left the position of commander on 26 May 1948. In the following years he commanded several other military hospitals (Łódź, Wałcz, and Szczecin), and then, at the rank of colonel, he was appointed the President of the Main Military Medical Committee of the 109th Military Hospital in Szczecin. On 10 October 1967, he was discharged. He became famous as the head of the Department of History of Medicine at the Medical Academy in Szczecin and the author of over one hundred publications in several languages. His greatest work is entitled "Dzieje medycyny w zarysie" [An outline of the history of medicine], which was a textbook for several generations of doctors. Col. Bronisław Seyda MD, PhD died on 3 July 2008 and was buried in the cemetery in Szczecin [1,3].

Jewish doctors managing hospital units

Apart from the commanders, other Jewish surnames may be found among people with other managerial functions, especially the heads of the units. As early as in 1945, Unit I is administered by Lt./Maj. Chaim Scharage MD, and Cpt. Abram Abraham Ratinow MD was a physician in Unit II. In September 1945, when the 8th Mobile Field Surgical Hospital was transformed into the Garrison Hospital in Iława, all management posts (commander and three unit heads) were occupied by Polish Jews:

- commander: Cpt. Maksymilian Mościsker MD,
- head of the surgical unit: Cpt. Arnold Sinkower MD,
- head of the general unit: Cpt. Salomon Riegelhaupt MD,
- head of the unit of dermatology and sexually-transmitted diseases: Cpt. Bernard Kohane (soon promoted to the rank of major).

The first head of the surgical unit, Dr. Chaim Scharage, was born on 12 December 1887 in Winniki near Lviv, to a family of a civil servant, Bernard and Debora nee Szrencel vel Birbach. They were financially comfortable so Chaim received an education without problems despite having three siblings. In the years 1904–1910, he attended the General School in Winniki and then attended the Franz Joseph I School in Lviv, although graduation was delayed due to the outbreak of the First World War. He was mobilized in 1916 to the Imperial-Royal Army, a year later he graduated from the Jägendorf Infantry Officer School and, as a lieutenant, he was sent to the 24th Infantry Regiment. After the end of the hostilities and graduation, he moved to Prague to study at the Medical Faculty of the Charles University (1920–1923). In 1923 he managed to transfer to the university of his dreams: John Casimir University in Lviv, where he finished his studies. He received his diploma of doctor of medicine on 29 October 1927. When the Second World War broke out he found himself in the Soviet occupation zone and worked at the 2nd Municipal Hospital in Lviv until Germany attacked the USSR. The German occupation brought about the nightmare of the ghetto, where he still used his medical knowledge to help people in the clinic for Jews at 103 Zamarstynowska Street. On 20 September 1944 he was mobilized to Evacuation Hospital no. 69 in Chełm Lubelski as the head of the surgical unit. On 16 November 1944 he was moved to the 8th Mobile Field Surgical Hospital and took part in its whole battle history as the head of the surgery department. It was him that bore the greatest burden

in the period of highest intensity in fighting by the 2nd Polish Army in the area of the Lusitian Neisse and Budziszyn. On 16 July 1945, the then Major Chaim Scharage was replaced by Cpt. Arnold Sinkower MD, and transferred to Kraków where for a few months he worked as a surgeon in District no. 5. On 1 June 1946, he became the head of the Department of Surgery in District Hospital no. 5 with the rank of lieutenant colonel. He fulfilled this function until 15 February 1951. It is worth mentioning that he was the doctor who was the last to fight for the life of the heroic doctor of the soldiers on Westerplatte, recipient of the War Order of Virtuti Militari, Maj. Mieczysław Słaby. Unfortunately, his efforts proved to be in vain, and one of the "Lions of Westerplatte" died in his presence on 15 March 1948. From June 1948, Scharage worked at the Penitentiary Hospital in Kraków, on Montelupich Street. It is probable that it was this function that led to his decision to move to the Ministry of Public Security where, as a colonel, he became the head of the 5th Department. He was discharged from professional military service on 21 December 1957. With a second degree of specialization in surgery and neurosurgery, he was a skilled doctor and a respected man. Col. Józef Szarage MD (known as Chaim Scharage until 12 October 1946) died on 1 March 1967 and was buried in the Jewish Cemetery in Warsaw, 7/3/11 quarter [1,6].

Another Jewish physician in the management of the hospital was Bernard Kohane, both on 6 October 1902 in Kraków to the family of Aron and Ella nee Haubenstock. In 1928, he graduated from the Medical Faculty of the Jagiellonian University in Kraków. Later, he worked as a volunteer at the St. Lazarus Hospital. During the September campaign of 1939 he participated in the defense of Przemyśl. Then, like the majority of the Jewish population, he attempted to escape to the east with all his family. The family finally settled in the Soviet occupation zone and lived in Tarnopol, the former capital of the province. From 14 June 1941, Dr. Kohane was a member of the medical committee of the Red Army. After the outbreak of the German-Soviet war, he commanded Evacuation Hospital no. 1768 in Połtawa, and from the summer of 1942 on he worked there in the rehabilitation ward. On 25 October 1942, the hospital was evacuated to Szua. There, Kohane's wife, Maria, joined the hospital staff as an X-ray technician. In March 1945, after numerous petitions, they managed to move from the Red Army to the Polish Army, which was their wish. In September 1945, Kohane, still as an officer without rank but soon promoted to major, became the Head of the Unit of Dermatology and Sexually-Transmitted Diseases in the Garrison Hospital in Iłwa, and in May 1946 he moved with the whole facility to Żary. Maj. Kohane did enormous work, as it should be remembered that the war brought about an avalanche of patients with venereal diseases, which together with low hygiene level in the everyday life of the soldiers had terrible results. The Garrison Hospital in Żary also employed his wife Maria Kohane, by then a sergeant major, as an X-ray technician in the Medical Radiology Department. At the end of 1951, Maj. Kohane was moved to District Hospital no. 4. In the following years, he was the deputy of the Head of Healthcare in the Śląskie Military District, and was promoted first to lieutenant colonel and then to colonel. In 1962, he retired, but still remained professionally active, working in several civil healthcare facilities in Wrocław. Col. Bernard Kohane MD died on 23 October 1989 and was buried in the Jewish cemetery at Lotnicza Street in Wrocław [1,2,12].

Salomon Riegelhaupt is another Jew holding a managerial function in the medical facility in Iłowa and Żary. He was born in 1900 in Krościenko nad Dunajcem, as a son of Samuel and Ida. In 1927, he graduated from the Medical Faculty of the Jagiellonian University in Kraków, and worked as a practitioner in his family town. This idyllic period ended with the outbreak of the Second World War, which brought with it a great personal tragedy - the Germans murdered his wife at the concentration camp in Treblinka. In September 1945, he took the command of the General Unit of the Garrison Hospital in Iłowa, which, on 7 June 1946 was transformed into the General and Infectious Unit. It should be remembered that these were times when basic things such as beds, sheets, clothes, drugs and medical equipment were scarce. Work in such conditions was a great challenge, but which was successfully taken up by Dr. S. Riegelhaupt, promoted to the rank major on 10 June 1946. A silent and calm man with the stigma of sadness imprinted on his face by the dramatic events of the holocaust, was respected and liked by his colleagues, including the commander, Cpt. B. Seyda MD, who chose him to be the deputy commander while he was away travelling. On 13 March 1946, he was appointed Chief of the Officer Court of Honor, which clearly confirms his position among the whole staff of the facility. Unfortunately, the difficult war experiences destroyed the psyche and the cardiovascular system of Dr. Riegelhaupt who, on 12 January 1947, had a major cardiac infarction and soon died in "his" hospital. Transported with military honors to the railway station in Żary, he took his last journey to Kraków and there, according to the will of the family, was buried in the Jewish Cemetery at 55 Miodowa Street [1,2].

Another Jewish physician in command of the Surgical Unit of the Garrison Hospital in Iłowa and Żary, Cpt. Dr. Arnold Sinkower, had more luck in life. He was born on 15 September 1912 in Przemyśl, where he graduated from the Juliusz Słowacki School. It was to him that Maj. Dr. Chaim Scharage delegated the command of the unit. This new head remained in this function for only three months, although it must be

said that they were exhausting times as the number of casualties being admitted exceeded the number of beds by a factor of ten. Work in such extreme conditions required both great experience and the dedication of the whole medical staff. Undoubtedly, Dr. A. Sinkower succeeded in the task entrusted to him and contributed to saving the life and health of many Polish soldiers. In the 1950s, he emigrated to Germany and his further fortunes are unknown [1].

Jewish employees of the hospital not holding managerial positions

Apart from the physicians who managed the 8th Mobile Surgical Field Hospital and Garrison Hospitals in Iłowa and Żary, there were several Jewish physicians who worked there in normal positions, including Lt. Benon Rost, Cpt. Adam Abraham Ratinow, Lt. Anna Gecow PhD, and Lt. Jakub Rezuk. They reinforced the facility during the period of the greatest intensity of hostilities related to crossing the Lusatian Neisse and the transport of the casualties from this operation. Without any doubt, the most interesting person out of those was Dr. Anna Gecow. She was born on 3 January 1911 in Łódź, as the daughter of Łazarz Zylberszac. Because of *numerus clausus,* she had to travel abroad and in the years 1929–1932 she studied at the Medical Faculty of the Charles University in Prague before continuing at the University on Zurich, until in 1935 she defended her doctoral thesis. In 1936 she participated in the Spanish Civil War with the republicans as an ambulance physician in the Ascaso Anarquist Unit on the Aragon front. After the German and Soviet invasions of Poland, she remained in the Soviet occupation zone and held an out-patient clinic in Poczajów (near Krzemieniec). She was also a member of a military medical committee. Her husband, Leon Gecow, was mobilized to the Red Army and when the Germans invaded the USSR, he retreated to the east while his wife stayed in the terrain occupied by the Third Reich. In December 1941 she was put in the ghetto in Radom, and a year later she became a forced worker in the munitions factory in Pionki. On 16 June 1944 she ran away with the help of Dr. Helena Wolf and joined the People's Army in the Kielce region. On 26 October 1944, she found her husband who, with the rank of major, commanded Field Evacuation Point no. 3 (called PEP no. 3 in Russian) in Czemierniki near Kock. There, she became a member of a medical committee, first as an officer without rank, but soon as a lieutenant. On 5 February 1945 she was sent to reinforce the 8th Mobile Field Surgical Hospital in Ruszów, where she worked during the bloodiest fighting on the Lusatian Neisse. After the end of the war, she worked with children in a Pediatrics Clinic in the Military Hospital in Warsaw. Discharged in 1948, she found a job at the Children's Hospital in Litewska Street in Warsaw. On 26 July 1949 she was arrested by the Security Service (a day before the same happened to her husband, Col. Leon Gecow, who was then a delegate of the Ministry of Defence in the Ministry of Health and Polish Red Cross) in relation to the case of Herman and Noel Field, accused of espionage by the NKVD (they were friends of Dr. Anna from her stay in the Switzerland). She was repeatedly interrogated in the famous torture room in the Mokotów district in Warsaw, including by the notorious Lt. Col. Józef Światło (Izaak Fleischfarb), and after four years she was sentenced to six years imprisonment "for Trotskyism". Her husband, Col. Leon Gecow died in prison on 30 April 1952, officially due to pulmonary tuberculosis; however it was suspected that he might have been killed during tortures and coercion of testimonies, or may have committed suicide. Thanks to the "great gift of amnesty" she left the prison in September 1953 and began work in Municipal Hospital no. 3 in Warsaw as a deputy head of the Poliomyelitis Department (transformed later to the Neuroinfection Unit), and then as its head. After the events of March 1968, she left Poland and lived first in Switzerland and then in France, where she died on 25 July 1985. She was a very interesting person, with a rich and ambiguous biography. For her service in the Polish Army, she was awarded the Bronze Cross of Merit.

Apart from physicians, there also other people of Jewish origin in the medical staff of the Garrison Hospital in Żary, including Sgt. Maj. Maria Kohane – a radiology technician, and Eleonora Mendelson – an operation theatre nurse of the Surgical Unit [1, 5, 13].

Conclusions

Without doubt, the greatest influence on the creation and development of the 8th Mobile Field Surgical Hospital, and then the Garrison Hospitals in Iłowa and Żary, was exerted by the doctors who held managing positions. They organized the work of the whole facility, made key decisions, their knowledge and experience were decisive factors affecting the life and health of the patients. Working under extremely difficult conditions and facing a lack of basic resources (food, clothes, equipment, and drugs), they managed to create a well-functioning medical facility which passed the test in the conditions of warfare, especially while the army was crossing the Lusatian Neisse when it dealt with casualties in numbers exceeding the capacity of the 100-bed hospital tenfold. It should be stressed that out of first six commanders, four were Jews. Jewish doctors also worked as the heads of the majority of the units. They were wonderful professionals and real humanists, which can be seen in the fact that they helped German patients with no hate or anger, although they suffered a lot from the descendants of Bismarck. Almost all Polish Jews lost

their families during the occupation and helping the nation who caused their great suffering certainly testifies to their magnanimity and wonderful understanding of medical ethics. It was also a successful attempt at regaining some stability and returning to a normal life, and the majority coped with that. However, the psychological burden was too much for the heart of one of them, Maj. Salomon Riegelhaupt MD.

In Żary, almost nobody is aware of the role of Polish Jews in the creation and development of the 105th Kresy Military Hospital with Public Outpatient Clinic and Division in Żagań, known throughout the whole region. That is why it is worth describing the silhouettes of at least those people managing the facility, who had the greatest influence on the work of the hospital. At the same time, it is a way of contradicting the false, negative, anti-Semitic stereotypes according to which Polish Jews used their intelligence and resourcefulness only in the investigative division of the communist Security Services (UB). The officers of the military hospital in Żary are a strong proof against this. There is a group of mean and vile people in every nation, they were present also among Poles (confidantes of the Gestapo or *szmalcownicy,* people who blackmailed hiding Jews), Jews, Russians, Ukrainians, etc., but the majority of the people behaved justly. A loud example is the history of a brave doctor, Lt. Anna Gecow. She was arrested on the basis of false accusations and interrogated by Lt. Col. Józef Światło – another Jew, which clearly illustrates the fight between good and evil, regardless of nationality.

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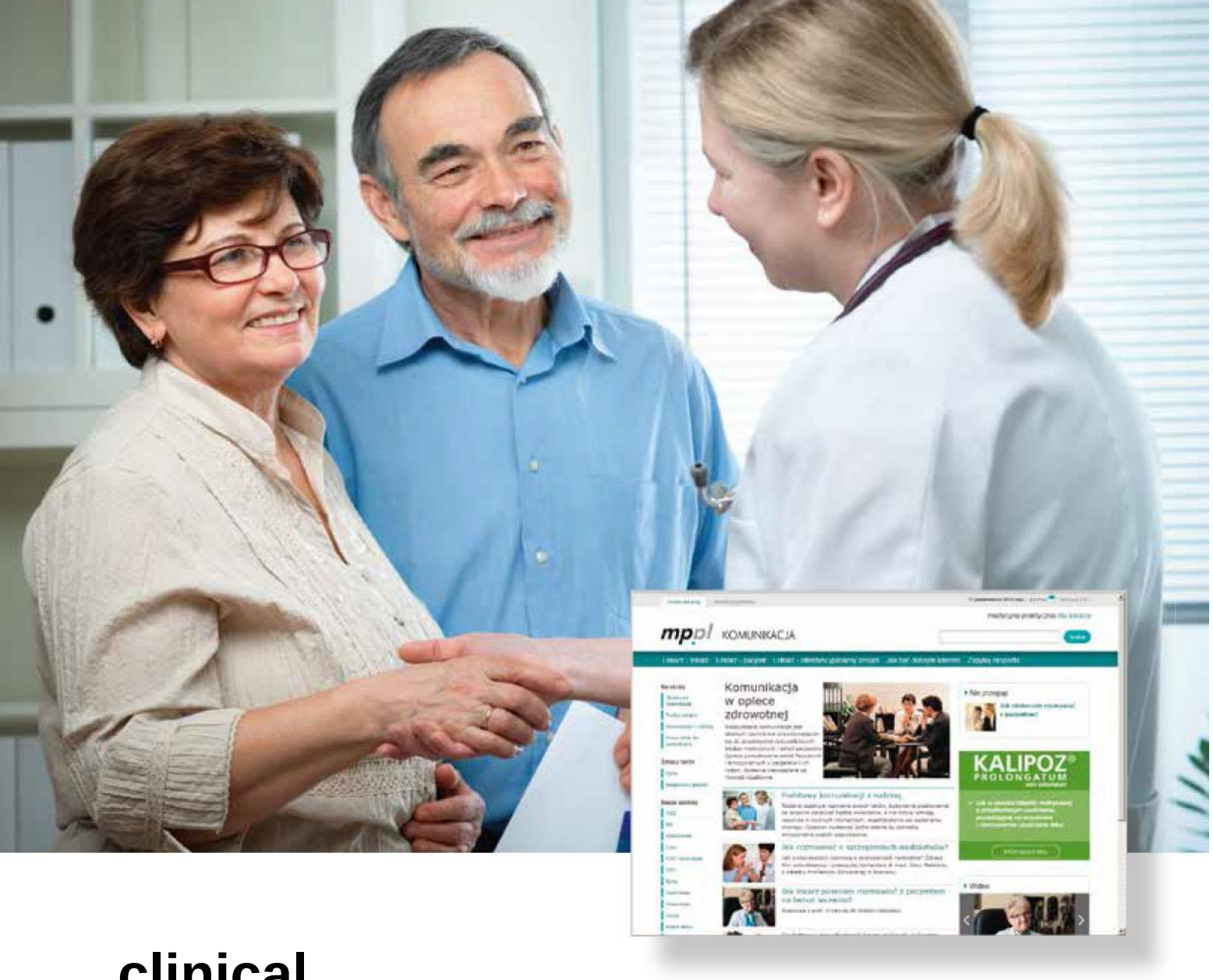

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