



# MILITARY PHYSICIAN

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## Military Physician

### Quarterly

Official Organ of the Section of Military Physicians at the Polish Medical Society

Oficjalny Organ Sekcji Lekarzy Wojskowych Polskiego Towarzystwa Lekarskiego

Scientific Journal of the Military Institute of Medicine

Pismo Naukowe Wojskowego Instytutu Medycznego

Published since 3 January 1920

Number of points assigned by the Polish Ministry of Science and Higher Education (MNiSW) – 6

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The journal is financed by the Military Medical Chamber

Translation, proofreading and DTP of the English version by Skrivanek Sp. z o.o.

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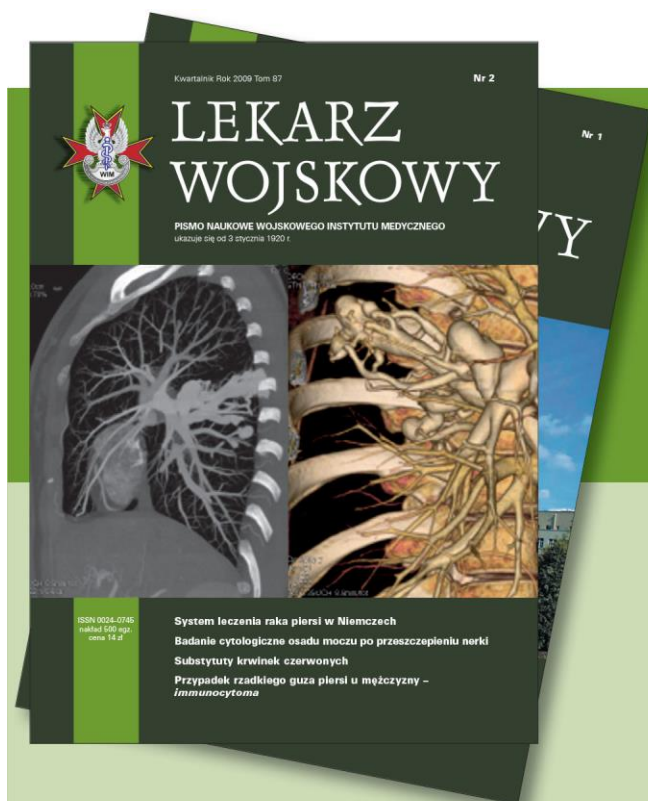
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# Analysis of environmental risk factors and health problems among PMC OIR Kuwait personnel

Analiza zagrożeń środowiskowych oraz problemów zdrowotnych personelu PKW OIR Kuwejt

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2 Head of the Department of Epidemiology and Tropical Medicine of the Military Institute of Medicine in Warsaw

**Abstract.** The article presents the characteristics of environmental risk factors and health problems in the personnel of the Polish Military Contingent deployed under Operation Inherent Resolve in Kuwait. The retrospective analysis was based on epidemiology databases (GIDEON, ProMED-mail) and the medical records of soldiers and employees of the Polish Ministry of National Defence (n = 120-130) who performed mandated tasks during four 6-month rotations of the contingents between 2016 and 2018. The intensity indexes of PMC OIR Kuwait were 43–46 cases / 100 patients / month. The most common health problems in the analysed group included upper respiratory tract infections, acute gastrointestinal disorders, dermatoses, and musculoskeletal injuries either sustained on duty or resulting from sports activities. Health problems occurring in PMC personnel were connected with the effects of environmental conditions and neglecting of health prophylaxis rules.

**Keywords:** Kuwait, Polish Military Contingent, health problems

**Streszczenie.** Cel. W pracy przedstawiono charakterystykę zagrożeń środowiskowych oraz problemów zdrowotnych personelu Polskiego Kontyngentu Wojskowego podczas Operacji Inherent Resolve w Kuwejcie. Materiał i metody.

Analiza retrospektywna została oparta na epidemiologicznych bazach danych (GIDEON, ProMED-mail) oraz dokumentacji medycznej żołnierzy i pracowników resortu obrony narodowej (n = 120–130) wykonujących zadania mandatowe w czterech 6-miesięcznych zmianach rotacyjnych kontyngentów w latach 2016–2018. Wyniki. Wskaźniki natężenia zachorowań personelu PKW OIR Kuwejt wynosiły 43–46 przypadków/100 pacjentów/miesiąc. Do najczęściej zgłaszanych problemów zdrowotnych należały stany zapalne górnych dróg oddechowych, ostre nieżyty żołądkowo-jelitowe, zmiany skórne i urazy narządu ruchu doznane podczas uprawiania zajęć sportowych oraz wykonywania obowiązków służbowych. Wnioski. Zachorowania personelu PKW były związane z działaniem czynników środowiskowych oraz nieprzestrzeganiem zasad profilaktyki zdrowotnej.

**Słowa kluczowe:** Kuwejt, Polski Kontyngent Wojskowy, problemy zdrowotne

Delivered: 4/12/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 9-14

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## Introduction

The Polish Military Contingent (PMC) was formed by a decision of the President of the Republic of Poland on a motion of the Prime Minister (under the act on principles of use or stay of the Armed Forces of the Republic of Poland beyond the state's borders) as a part of

Operation Inherent Resolve (OIR) on the Arabian Peninsula, in Kuwait, Iraq and Qatar. The main forces of PMC OIR (comprising approx. 120-130 soldiers and other military personnel) were located in Kuwait, where they performed the mandated tasks from the middle of 2016 to the middle of 2018 as part of 4 shift rotations. PMC OIR in Kuwait was operationally subordinated to

the commander of Central Command of the USA, whereas in the aspect of national leadership it was subordinated to the Minister of National Defence of the Republic of Poland through the Operational Commander of Service Branches of the Armed Forces [1]. The aim of the paper is to present the environmental hazards and health problems in the personnel of PMC OIR in Kuwait who served in the tropical climate of the Arabian Peninsula.

### Material and methods

The retrospective analysis was based on epidemiological databases (GIDEON, ProMED-mail) and the medical documentation of soldiers and employees of the Ministry of National Defence (n = 120-130) treated in a medical bay of the PMC in Kuwait (Al Jaber military base), performing mandated tasks in four six-month shift rotations in the years 2016-2018.

### Environmental conditions of Kuwait

Kuwait is a low-lying, desert country with a surface area of 17,818 square kilometres, occupying the northern-eastern part of the Arabian Peninsula (borders Iraq - 242 km and Saudi Arabia - 222 km), characterised by a dry continental tropical climate on the coast (499 km of shoreline by the Persian Gulf) and an extremely dry climate in the hinterlands. The annual sunshine hours exceed 3000 (10 hours per day between June and August). The maximum temperature varies from 18°C in January to 45°C in August (at its most extreme >50°C), the minimum temperature varies from 7°C (at its most extreme -4°C, frosts from December to March in the hinterlands) to 29°C. In the period between November and April there are episodes of torrential rain with daily precipitation occasionally exceeding 50-150 mm (annual precipitation of 100-200 mm). Strong winds blow for 9 months a year, including the most turbulent (lasting for 40 days) shamal, which is accompanied by rust-red dust storms with twisters. Groundwater resources are limited, predominantly brackish. Demand for fresh water, which has increased by a factor of 50 since the 1960s, is covered by seawater desalination plants and, to a low degree, by deep wells in oases. All (100%) of the population has access to potable water free of contaminants, all urban households (98% of the inhabitants) are connected to sewage collectors [2].

### Food-borne diseases

Cholera is the largest health hazard for inhabitants of Kuwait, especially for the population of expatriates residing in the country. Since 2015, a sudden increase in the number of cases of cholera, a disease belonging to a group of especially hazardous illnesses, has been

observed in Iraq, a country bordering Kuwait (1000 cases of the disease confirmed in 17 of the 18 provinces). Infections brought by Iraqi refugees are reported in Kuwait, Bahrain and Oman [3]. In relation to the above, vaccinations against cholera with an oral vaccine available in Poland were included in the vaccination schedule of PMC OIR Kuwait for all personnel.

A survey of the population carried out in 2015 in Kuwait among patients with acute diarrhoea (n=2584) indicated infections by *Clostridium difficile* among 0.62% of the subjects, *Salmonella spp.* among 0.39% and *Campylobacter spp.* among 0.23% [4]. 356 cases of salmonellosis were reported in 2017 among the inhabitants [5]. Other screening tests found cases of *Salmonella typhi* (typhoid fever) and HAV (hepatitis A), mostly among economic migrants [6].

Food-borne zoonotic infections are also reported in Kuwait. In 2016, cases of brucellosis (*Brucella melitensis*) were discovered among people after the ingestion of unpasteurized dairy animal products [7]. In 2017, 446 cases of brucellosis were reported [8].

Other surveys carried out among livestock within the territory of Kuwait in 2015 found cases of ascariasis and strongyloidiasis, mainly among horses, cattle and camels. The possibility of the infection spreading to humans was announced, especially in the environment of breeders and people selling animal products.

The available literature provides no reports on the topic of screening tests aimed at cases of infections by oval and flat helminths among the population of Kuwait. Finally, surveys aimed at cases of infections with enteric protozoans revealed cases of *Cryptosporidium parvum*, *Blastocystis hominis* and *Giardia intestinalis*, mainly among children [9].

### Respiratory system diseases

Cosmopolitan infections of the upper and lower respiratory tracts are the most common respiratory system diseases among the local population, caused by adenoviruses, coronaviruses, rhinoviruses and influenza viruses [10, 11]. In 2013-2018, sporadic cases of MERS (Middle East respiratory syndrome) were observed within the territory of Kuwait: 2 cases in 2013 [12], 1 in 2014 (death) [13], 1 in 2015 (death), 1 in 2016 (a traveller took the disease from Kuwait to Thailand) [15], 1 in 2018 (a traveller took the disease from Kuwait to South Korea) [16]. The source of infection is direct contact with animals (camels) or their excrement or secretions, or ingestion of meat that was not thermally processed and originating from infected animals. 748 cases of tuberculosis were also reported in Kuwait in 2015. The sources of infection are often economic migrants from Muslim countries (Pakistan, Bangladesh) [17].

### Transmissible diseases

Malaria is not endemic within the territory of Kuwait. Sporadic cases of the disease are brought by economic migrants. Similarly, visceral leishmaniasis is not endemic in Kuwait; sporadic cases are brought by migrants. Cutaneous leishmaniasis is sporadic among both native and migrant populations [18].

### Other diseases

It was estimated in 2016 that 0.44% of the population were carriers of HCV. There is no up-to-date data on HBV cases. The most recent data from 2011 indicated 766 cases of hepatitis B among the population [6]. The number of HIV carriers is estimated to be 0.12% of the adult population (including 73% who are 15-49 years old, 90% who are heterosexual, 3% who are homosexual, 7% who inject drugs, 0% of vertical infections and infections through blood transfusion) [20].

### Conclusions

The most commonly reported medical conditions among the personnel of PMC OIR Kuwait were airway inflammation, acute gastroenteritis, skin lesions and musculoskeletal injuries sustained while practising sports and performing duties (fig. 1-2, tab. 1-2).

The infection rate of the most common illnesses among the personnel of PMC OIR Kuwait in the period Jan-Dec 2017 was 43 cases / 100 patients / month.

The most commonly reported health problems were:

- respiratory system diseases: 14 / 100 patients / month
- musculoskeletal diseases: 12 / 100 patients / month
- gastrointestinal diseases: 4 / 100 patients / month
- skin diseases: 3 / 100 patients / month.

The infection rate of illnesses among the personnel of PMC OIR Kuwait in the period Jan-Jun 2018 was 46 cases / 100 patients / month. The highest morbidity rate concerned the following systems or organs:

- musculoskeletal diseases: 15 / 100 patients / month
- respiratory system diseases: 8 / 100 patients / month
- skin diseases: 8 / 100 patients / month
- gastrointestinal diseases: 5 / 100 patients / month

### Immunoprophylaxis in PMC OIR Kuwait

Assignments of soldiers and employees of RON who were not subject to a cycle of basic preventive vaccination within the country according to the applicable schedule before departure to the area of the operation were a significant problem observed in PMC OIR Kuwait.

It should be underlined that the task of PMC's healthcare service was to administrate supplementary doses and booster injections when the term for administration was within the period of serving outside the borders of the country. The area of military operations is not a place intended for the introduction of basic immunoprophylaxis, as this is a task of the military unit in Poland which prepares the contingent for foreign service. Over 60 vaccinations / 100 patients / month were administered during the four six-month rotating shifts of PMC in 2016-2018.

### Remarks on chemoprophylaxis in PMC OIR Kuwait

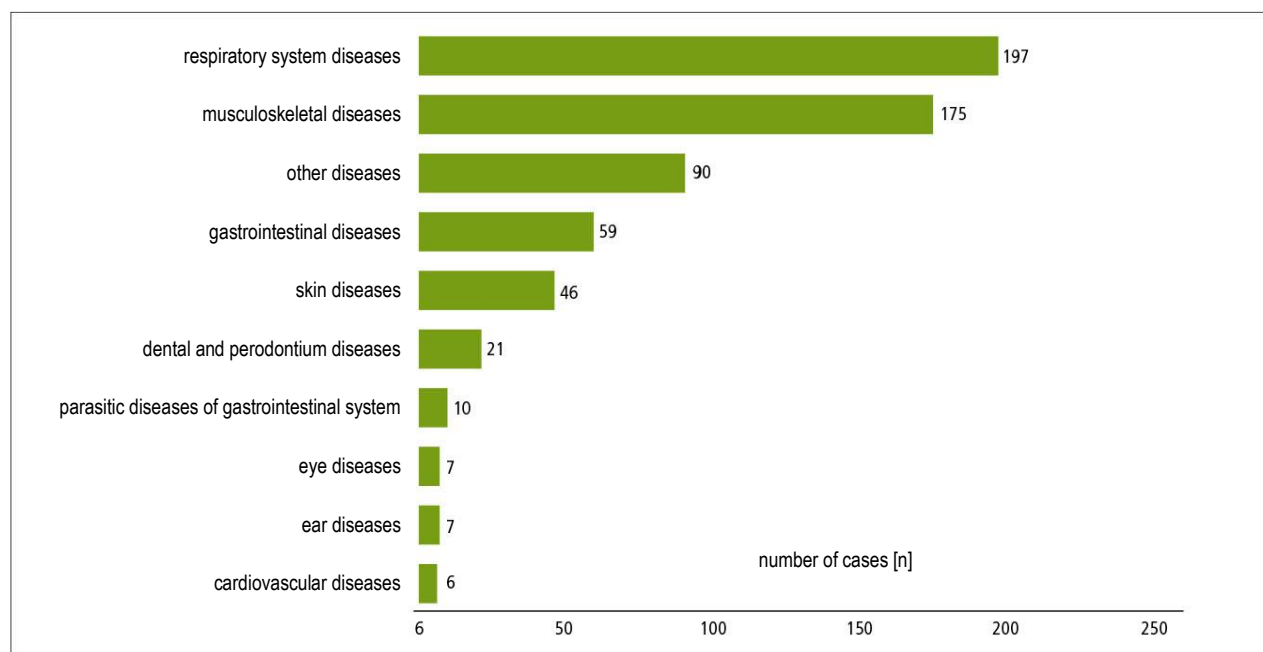
The majority of the personnel assigned for foreign service received booster doses of typhoid fever and tetanus in Poland every 10 years, while vaccine preparations TT administered in Poland in accordance with the guidelines of the manufacturer (Biomed Kraków) should be administered every 3-5 years.

Chickenpox vaccinations should be administered in Poland, without exceptions, before departure to an area of military operations due to potential post-vaccination adverse effects (appearance of abortive symptoms of the disease; in PMC OIR Kuwait there was no possibility of developing a septic isolator).

Measles/mumps/rubella vaccinations should be administered in Poland without exception before departure to an area of operations due to post-vaccination adverse effects (teratogenic effects on a foetus already in the first trimester of pregnancy; women must take a pregnancy test before the vaccination).

### Conclusions

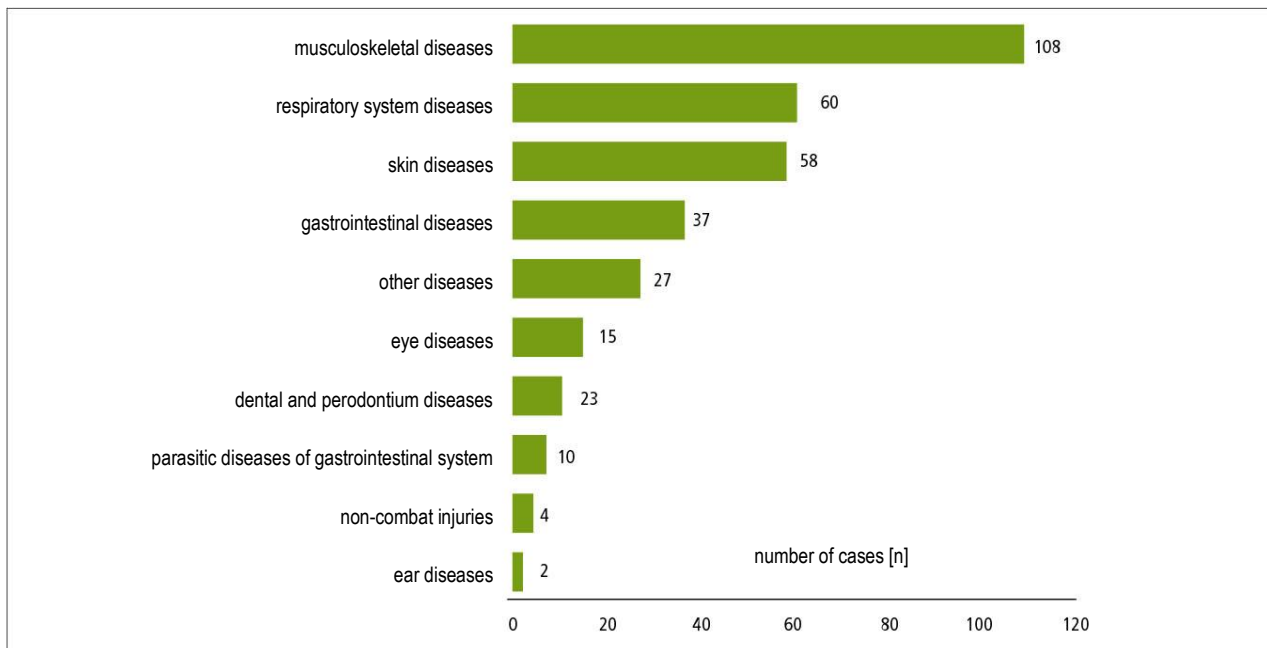
A retrospective analysis found morbidity of the personnel of PMC OIR Kuwait related to the influence of environmental conditions and a lack of observance of the principles of prophylaxis. Thanks to the introduction of new table overviews in the EpiNATO reports (tab. 1-2), regarding morbidity of the PMC personnel it is currently possible to carry out analyses of the health of soldiers and other personnel of the Ministry of National Defence and evaluate current demands in the scope of medical protection (drugs, vaccines) on a monthly and annual basis, similarly to the U.S. Armed Forces Health Surveillance [21].



**Figure 1.** Morbidity in PMC OIR Kuwait personnel for the period January–December 2017  
**Rycina 1.** Zachorowalność personelu PKW OIR Kuwejt w okresie I–XII.2017 r.

**Table 1. Morbidity in PMC OIR Kuwait personnel for the period January–December 2017**  
**Tabela 1. Zachorowalność personelu PKW OIR Kuwejt w okresie I–XII.2017 r.**

code disease/month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	total
<b>A</b> respiratory system diseases	18	3	13	16	2	10	4	16	23	22	32	38	197
<b>B</b> cardiovascular diseases	-	-	-	4	2	-	-	-	-	-	-	-	6
<b>C</b> gastrointestinal diseases	1	2	4	9	4	9	2	5	2	6	11	4	59
<b>D</b> dental and perodontium diseases	-	-	3	5	7	-	3	-	-	-	-	3	21
<b>E</b> musculoskeletal diseases	2	7	21	38	19	19	10	17	8	19	15	-	175
<b>F</b> skin diseases	3	2	8	18	-	-	5	4	2	4	-	-	46
<b>G</b> nervous system diseases	-	-	-	-	-	-	-	-	2	1	-	-	3
<b>H</b> genitourinary diseases	-	-	-	-	-	-	1	-	-	-	3	-	4
<b>I</b> eye diseases	-	-	-	-	-	-	2	2	-	1	2	-	7
<b>J</b> ear diseases	-	-	1	-	-	-	2	2	1	1	-	-	7
<b>K</b> mental disorders	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>L 1</b> infectious diseases of gastrointestinal tract	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>L 2</b> other infectious diseases	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>M 1</b> parasitic diseases of gastrointestinal tract	-	-	-	-	5	5	-	-	-	-	-	-	10
<b>M 2</b> other parasitic diseases	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>N</b> combat injuries	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>O</b> non-combat injuries	-	-	-	-	-	-	1	3	-	-	-	1	5
<b>P</b> other diseases not classified above	2	2	6	-	3	5	5	12	7	6	9	21	78
<b>total</b>	<b>26</b>	<b>16</b>	<b>56</b>	<b>90</b>	<b>42</b>	<b>48</b>	<b>35</b>	<b>61</b>	<b>45</b>	<b>60</b>	<b>72</b>	<b>67</b>	<b>618</b>
<b>R</b> other prophylactic measures, medical advice	26	16	57	55	-	-	-	1	-	-	-	-	155
<b>S</b> vaccinations	53	79	63	38	18	1	93	85	19	55	338	44	886



**Figure 1.** Morbidity in PMC OIR Kuwait personnel for the period January–June 2018

**Rycina 2.** Zachorowalność personelu PKW OIR Kuwejt w okresie I–VI.2018 r.

**Table 2.** Morbidity in PMC OIR Kuwait personnel for the period January–June 2018

**Tabela 2.** Zachorowalność personelu PKW OIR Kuwejt w okresie I–VI.2018 r.

code	disease/month	I	II	III	IV	V	VI	total
A	respiratory system diseases	13	4	7	14	16	6	60
B	cardiovascular diseases	-	-	-	-	-	-	-
C	gastrointestinal diseases	1	5	5	10	9	7	37
D	dental and perodontium diseases	3	1	2	2	1	1	10
E	musculoskeletal diseases	17	26	20	18	18	9	108
F	skin diseases	9	11	13	11	14	-	58
G	nervous system diseases	-	-	-	-	-	-	-
H	genitourinary diseases	-	-	-	-	-	1	1
I	eye diseases	1	2	6	4	1	1	15
J	ear diseases	-	-	-	-	-	2	2
K	mental disorders	-	-	-	-	-	-	-
L 1	infectious diseases of gastrointestinal tract	-	-	-	-	-	-	-
L 2	other infectious diseases	-	-	-	-	-	-	-
M 1	parasitic diseases of gastrointestinal tract	-	-	-	-	-	7	7
M 2	other parasitic diseases	-	-	-	-	-	-	-
N	combat injuries	-	-	-	-	-	-	-
O	non-combat injuries	1	-	-	-	-	3	4
P	other diseases not classified above	11	1	2	-	4	8	26
	<b>total</b>	<b>56</b>	<b>50</b>	<b>55</b>	<b>59</b>	<b>63</b>	<b>45</b>	<b>328</b>
R	other prophylactic measures, medical advice	-	-	-	-	-	-	-
S	vaccinations	21	44	106	150	58	119	498

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# Reception of live classical music by patients of a military psychiatric ward

Recepcja żywej muzyki klasycznej przez pacjentów wojskowego oddziału psychiatrycznego

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**Abstract.** While seeking new ways to activate patients in a military psychiatric ward, periodic concerts of classical music were arranged in collaboration with a local elementary music school. The goal of the paper is to examine the impressions made by live classical music in patients of the therapeutic-and-rehabilitation part of the ward. After the concerts the patients were requested to complete a 4-question survey on their status, feelings, reflections and suggestions referring to their experience listening to the music. 53 patients (79.9% of the total number of the concert audience) responded to the survey. All respondents – both service members and civilians – unanimously accepted this form of afternoon activity. They stated that the music had had a relaxing effect on them, cheering them up, and provoking reflection and spurring them into action. The patients emphasized the power of music performed by the young artists and favouring, or even elevating for the audience, the nature of the live concerts at the hospital. The conclusions were: (1) classical music concerts performed by pupils of the elementary music school are warmly appreciated by service members and civilian patients of the military hospital, and (2) the positive reception of classical music concerts at the hospital promotes listening to that kind of music as a medium supporting medical treatment.

**Key words:** military psychiatric ward, music therapy

**Streszczenie.** Poszukując nowych form aktywizacji pacjentów wojskowego oddziału psychiatrycznego, we współpracy z dyrekcją podstawowej szkoły muzycznej zorganizowano cykliczne koncerty muzyki klasycznej. Celem pracy było zbadanie recepcji żywej muzyki klasycznej przez pacjentów terapeutyczno-rehabilitacyjnej części oddziału. Metoda i wyniki. Po koncertach proszono pacjentów o wypełnienie 4-pytaniowej ankiety dotyczącej ich statusu, uczuć, refleksji i sugestii towarzyszących słuchaniu muzyki. Odpowiedziały na nią 53 (79,9%) osoby z ogółu słuchaczy koncertów. Wszyscy respondenci – żołnierze i cywile – jednomyślnie akceptowali tę popołudniową formę zajęć. Stwierdzali, że muzyka działała na nich relaksująco, podnosiła na duchu, pobudzała do refleksji, stymulowała do działania. Akcentowano siłę muzyki wykonywanej przez młodych artystów oraz wyróżniający, wręcz nobilitujący słuchaczy charakter koncertów żywej muzyki w klinice. Wnioski. (1) Koncerty muzyki klasycznej w wykonaniu uczniów podstawowej szkoły muzycznej przyjmowane są z uznaniem przez żołnierzy i cywilnych pacjentów szpitala wojskowego. (2) Pozytywny odbiór szpitalnych koncertów muzyki klasycznej promuje słuchanie tej muzyki jako medium wspomagające leczenie medyczne.

**Słowa kluczowe:** muzykoterapia, wojskowy oddział psychiatryczny

Delivered: 12/09/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97 (1): 15-18

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## Introduction

In April 2017, with a view to providing new forms of leisure activity for patients, and in collaboration with the head teachers of Juliusz Zarębski Elementary Music School No. 3 in Warsaw, an experimental series of concerts was initiated at the Department of Psychiatry, Combat Stress and Psychotraumatology. Since then, four performances within the "Four seasons in music" cycle have been organised at the hospital, and on Christmas Eve 2017 there was a carol concert for the employees and friends of the hospital.

The present hospital and music school are located on the site of the Battle of Grochów, where on 23 - 25 February 1831 a total of 6800 Polish and 9400 Russian soldiers lost their lives, as part of the November Uprising [1-4]. Stanisław Wyspiański based his play, "Warszawianka", around the events associated with this battle, including the famous character of the mute Old Combatant at Grochowski Palace, where the music school is presently located [5, 6].

## Aim of the study

The aim of the study was to assess how patients of the Department of Psychiatry, Combat Stress and Psychotraumatology received live classical music, as performed by pupils of the music school, peers of the patients' children and grandchildren.

## Method

The concerts were performed as part of afternoon music therapy sessions. They usually comprised 10 pieces for the piano, violin, cello, flute and accordion, performed by pupils from grades one to seven, with accompaniment by the teachers or in ensembles. Approximately 30 pupils were involved in each concert, coordinated and presented by the deputy head teacher of the music school. An introduction, referring to the site's history, was given by the host of the event. At the end of each concert, the young artists and their teachers received letters of appreciation signed by the head of the Military Institute of Medicine or the Department of Psychiatry, Combat Stress and Psychotraumatology, flowers and - when possible - small gifts thematically linked to the army. A collective picture was also taken. On the day each concert, the patients were asked to complete a four-question questionnaire:

- Are you a civilian or a soldier?
- How do you assess the concert?
- What thoughts and feelings did the music arouse in you?

- What are your suggestions regarding the music therapy sessions at the hospital?

## Results

On average, 68 patients from the therapeutic and rehabilitation section of the Daily Psychiatric Ward participated in the concerts. Of these, 53 (79.9%) responded to the survey questions (11 soldiers and 42 civilians). All respondents expressed positive opinions regarding the idea of organising concerts at the hospital, as demonstrated by scores of 6 using a school grading system, or 10 on a 10-level scale. A selection of the responses in the form of mini-reviews is presented below.

### Concert assessments provided by soldiers

A 38-year-old male combatant: "I liked the concert, as its organisation and the engagement of the teachers was at the highest level. Beautiful music. I enjoyed listening to the music performed by the pupils and their teachers. One could relax, and also follow closely the talented children. Yes, the music generally calmed me down and helped to experience deeply the presented works of art. It is a beautiful initiative. I think concerts like this should be organised here more often. It could help patients considerably."

A 43-year-old male: "Beautiful moments that helped me escape from the colourless everyday routine. They helped me to stop thinking about the purpose of my stay here, and what brought me to the hospital. Nostalgic, reflective music. The most impressive was the performance by the youngest musicians, who visibly suffered stage fright and stress, but also showed great engagement, joy and determination in achieving their goals. Reduced stress and getting carried away by the music helped me look inside myself, and to see something that had floated away, became forgotten. As a result, I realised what I had lost, and what is worth living for."

A 38-year-old male, combatant: "A very high level of performance and skills presented by the musicians, considering their young age. Calmness, a cheerful mood. One can use music to modify one's mood, according to current needs (to calm down or increase concentration while studying, to relax, such as with physical exercise). Continue this cooperation with the music school and organise concerts for patients, if possible."

A 35-year-old male: "It was beautiful! I got goose bumps. Concerts like this should be organised more often. I am even now motivated to send my daughters to music school. I can see it gives a lot."



**Figure 1–2.** Scenes from concerts at the Clinic of Psychiatry, Combat Stress and Psycho-Traumatology of the Military Institute of Medicine

**Rycina 1–2.** Sceny z koncertów w Klinice Psychiatrii, Stresu Bojowego i Psychotraumatologii WIM

A 38-year-old male combatant: "I like this type of music a lot. In the past I used to play the clarinet and piano. I played classical music, which I enjoy a lot. Calmness, reflection, regret, crying, pondering the past. Positive emotions triggered by the children's talent, and the engagement of their teachers. Gratitude. Music can considerably affect mood; it calms one down, or sometimes boosts energy. Such events are necessary and useful."

A 40-year-old male soldier: "The concert was at a high level. It was nice to hear live music, the sound of real instruments. The children showed class. I liked the last piece the most. Delight. Admiration for the performers. It was nice to escape from the everyday hospital routine. More concerts like this one."

### Opinions about the concerts expressed by civilians

A 47-year-old female: "I enjoyed the concert a lot. I like classical music, I like the sound of the accordion, which seems to be a forgotten instrument. It is a nice break in the hospital routine. Music has a therapeutic and calming effect on me. Nostalgia, relaxation, calmness. I missed my daughter, who at that age often participated in concerts and performances. In watching the children performing I felt as if I were at a concert by my own daughter. I used to enjoy them very much, and I was very proud of her."

A 65-year-old female: "The concert was a very nice surprise for me. The level of music presented by such young artists was very high, in my lay opinion. The choice of repertoire was another pleasant surprise. I appreciated the short introductions before each performance. A real cherry on the top of the cake was the very interesting opening of the concert by the Professor. I went to the concert with a need for good music. I left fully satisfied, as if after a feast where only delicacies were

served. Yesterday was especially difficult for me, and the concert offered a great remedy and was soothing. The sight of such young artists, already acting and playing in such a professional manner, was a source of real pleasure for me. I am very happy that I could come to the concert. Many thanks to all involved. Live music cannot be replaced by any therapy with recorded music. For me, weekly meetings would be ideal - if not with a group of artists, then at least solo recitals."

A 72-year-old female: "Wonderful, professional, held at a high level. The youths were very well prepared. The music calmed me down, helped to escape the reality, slow my breathing and racing thoughts. I would like to use this form of therapy more frequently, and I intend to continue it both outside and at home, listening to music that is right for me. I will also start meditation again. They are needed and necessary."

A 43-year-old female: "I liked the fact that children were performing. I was touched, moved. I became calm and thoughtful. My childhood memories came back. I was thinking about my brother who went to music school. A beautiful concert."

A 57-year-old male: "A very nice experience, as I never went to concerts like this one. I live in a small town, so there was no option. Pleasant to the ear and for the eye. I was very moved and pleased. I liked the accordion and the violin the most."

A 53-year-old female: "I enjoyed the concert, the atmosphere was great, the children played beautifully. It calmed me down, transported me to a different world, away from troubles. I would like such concerts to be more frequent."

A 43-year-old male: "As I have daughters at a similar age, I find all children performances enjoyable, moving and warm. Happiness, admiration, emotions, the feeling of calm, joy and relaxation. More concerts like this!"

A 55-year-old male: "Excellent concert, great, young artists, who performed their music beautifully. The concert was very moving, and will surely not be forgotten. The music was very moving, especially as it was performed by such young people. It was a very touching experience. Please organise more concerts like this one."

A 44-year-old female: "A very pleasant and valuable cultural event. "Music soothes the savage beast", and thanks to live music you can reflect on life, improve your mood and simply feel the joy. It was a very good idea and I hope the concerts will be regular, offering patients pleasure and calm."

A 24-year-old female: "It was very enjoyable. The time in the hospital was diversified. It was elegant. I felt flattered. The children played like young virtuosos. It was moving. The music was ok. It could last a little bit longer. I would come again to a concert like that."

A 34-year-old female: "I was sceptical at first, but the event was very enjoyable. It was like a private concert. I felt like a VIP. I found the youngest children the most touching."

A 62-year-old female: "I enjoyed the concert. I admired the talented children. The music was pleasant. I liked the accordion pieces the most, as I like the instrument itself. Calm, a slightly improved mood."

## Discussion

In answering the question about the feelings that the concert aroused, all the respondents emphasised the "therapeutic" properties of music, such as calming, relaxing, soothing, mood improving and energy boosting. They declared that the music stimulated self-reflection, thinking about their lives, and the need to change undesirable behaviour. The respondents underlined the force of live music, performed on "real" instruments by the music school pupils at the age of their own children, which helped to overcome their sceptical approach to classical music, often considered "incomprehensible" by a lay audience.

The concerts at the hospital, due to their form and numerous performers, were treated by the patients as unique events that distinguished, or even ennobled the listeners ("I felt like a VIP at a private concert"). Organisation of the concerts was facilitated by the close locations of the hospital and school, and by the similar needs of both institutions: for the school the goal was to prepare pupils for public performances in a friendly environment, close to the school buildings, and in the case of the hospital the aim was to offer patients cultural events in their leisure time, to break the routine of hospital life. Since the pupils can meet with foreign mission veterans hospitalised at the Department of

Psychiatry, Combat Stress and Psychotraumatology, and learn about the history and spirit of the place (genius loci), the concerts for patients can be treated as educational and artistic experiences for the pupils.

Numerous evidence-based studies confirm the usefulness of listening to classical music as a form of recreation and a universal *vehiculum therapiae* for various chronic diseases. Therefore, music therapy in the form of systematic, programmed therapeutic sessions is considered to be a therapeutic procedure in American military hospital healthcare [9].

## Conclusions

- Classical music concerts performed by the pupils of the elementary music school are appreciated by the soldiers and civilian patients of the military hospital.
- The positive reception of classical music concerts at the hospital may encourage patients to listen to this kind of music as a medium supporting the medical treatment.

## Acknowledgement

We would like to thank Ms Grażyna Radkowska MA, headmistress of Juliusz Zarębski Elementary Music School No. 3 and Mr Maciej Kandefer MA for organising and conducting the concerts. We would also like to thank all the teachers for preparing the pupils for the performance.

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# Causes of delay in the management of patients with acute ischaemic stroke

Przyczyny opóźnień postępowania w ostrym udarze niedokrwiennym mózgu

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**Abstract.** Acute ischemic stroke is a life threatening emergency in which reperfusion treatment should be administered as fast as possible after stroke onset. The aim of this study was to identify delays in acute stroke management based on a prospective register of patients hospitalized in a single care centre. Between 01/04/2014 and 01/06/2014 and between 01/02/2015 and 01/04/2015 we analysed the pre-hospital in-hospital delays related to 46 patients, including 24 consecutive subjects who received intravenous thrombolysis. Key time measurements were made before (n=24) and after (n=22) the streamline intervention, which included introduction of stroke alert procedures and continuous personnel education. The main causes of delay were late stroke recognition and transfer to the hospital, late neurologic consultation at the emergency department, and waiting for patient transfer to the CT room, taking blood samples, and analysis of laboratory tests and CT scan description. On introducing the streamlining measures to patients who received thrombolysis, the median door-to-needle (DTN) time decreased from 128 to 93 minutes, and the proportion of patients with DTN <60 minutes increased from 33% to 50%. This improvement was also achieved in shorter door-to-CT time (48 vs 37 minutes), door-to-neurologic consultation (15 vs 7 minutes), door-to-lab sampling (24 vs 13 minutes), CT description (40 vs 25 minutes), and laboratory results (55 vs 27 minutes). Our study proved the usefulness of continuous delay time monitoring, their analysis and streamlining measures undertaken to enhance the effectiveness of management of stroke patients.

**Key words:** door-to-needle time, in-hospital delays, stroke, thrombolytic therapy

**Streszczenie.** Udar niedokrwienny mózgu jest stanem zagrożenia życia, w którym leczenie reperfuzyjne powinno zostać rozpoczęte jak najszybciej. Celem pracy było określenie przyczyn opóźnień w postępowaniu w udarze mózgu na podstawie prospektywnego rejestru chorych hospitalizowanych w pojedynczym ośrodku w okresach: 1.04–1.06.2014 oraz 1.02–01.04.2015 r. Analizą objęto opóźnienia przed i wczesnoszpitalne u 46 chorych, włączając 24 kolejnych chorych leczonych trombolitycznie. Wykonano analizę przed (n=24) oraz po wdrożeniu działań usprawniających (n=22), obejmujących wprowadzenie procedury alertu udarowego oraz cyklu szkoleń. Najważniejszymi przyczynami opóźnienia postępowania były: zbyt późne rozpoznanie objawów udaru i przetransportowanie chorych do szpitala, opóźniona konsultacja neurologiczna na SOR, a także oczekiwanie na transport chorego do pracowni TK, pobranie próbek krwi i opracowanie badań laboratoryjnych oraz opis badania TK. Po wdrożeniu działań usprawniających wśród chorych leczonych trombolitycznie mediana DTN uległa skróceniu ze 128 do 93 minut, zwiększył się odsetek chorych z DTN <60 minut z 33% do 50%, opóźnienie od przyjazdu na SOR do wykonania TK skróciło się z 48 do 37 minut, do konsultacji neurologicznej z 15 do 7 minut, do pobrania badań laboratoryjnych z 24 do 13 minut oraz opisu TK i opracowania badań laboratoryjnych z odpowiednio 40 do 25 minut i 55 do 27 minut. Badanie potwierdziło przydatność stałego monitorowania okresów opóźnień, ich analizy oraz podjętych działań usprawniających dla poprawy efektywności postępowania medycznego u chorych z udarem mózgu.

**Słowa kluczowe:** udar mózgu, leczenie trombolityczne, opóźnienia w postępowaniu wczesnoszpitalnym, czas do rozpoczęcia leczenia

Delivered: 28/06/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 19-25

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## Introduction

Cerebral stroke is the second most frequent cause of death, and the principal cause of disability in the adult population. The basic therapeutic strategy for the treatment of ischaemic cerebral stroke (ICS) is recanalisation of the closed or critically occluded intracranial vessel, and reperfusion of this area. The most effective therapies include thrombolytic treatment with a recombinant tissue plasminogen activator (rtPA), which is used in a narrow therapeutic window of up to 4.5 hours from onset, and - recently - mechanical thrombectomy in the therapeutic window of up to 6 h (in exceptional cases, up to 12-24 h). The time from stroke onset to treatment initiation is often too long to apply effective reperfusion treatment. In many cases patients delay the call for medical assistance, or the necessary diagnostic tests are not completed before the expiration of the therapeutic window. It is estimated that over half of the patients with cerebral stroke arrive at hospital Accident and Emergency departments (A&Es) after the therapeutic window has closed, and 25% do not receive thrombolytic treatment due to delays in the hospital. Despite the fact that rtPA has been used increasingly often in Poland over the past few years, only 11% of patients with ICS receive thrombolytic treatment. This rate is lower than in Germany (approximately 25%) or the Czech Republic (20%), for example [1]. The effectiveness of rtPA depends on time, and the treatment is the most effective if started within 90 minutes from the onset. However, even at reference stroke units (SU) it can be achieved in one in ten patients. The main obstacle to reducing the delays is low social awareness of the fact that stroke is an acute condition that requires immediate contact with medical emergency services, and coordinated pre-hospital and in-hospital activities in the so-called "chain of survival". A patient with a suspected stroke should be put on a diagnostic fast-track so that confirmation of the diagnosis is followed quickly by reperfusion treatment, on average within 1 hour from arrival at the hospital (door-to-needle time – DTN), and preferably under 30 minutes from arrival. Streamlining of the process allows the number of patients receiving thrombolytic treatment to be increased and improvements in the treatment outcomes by reducing the delays in therapy. In order to improve treatment effectiveness, American scientific associations (AHA/ASA) in 2013 developed guidelines regarding the times for the individual steps in the medical management of patients at the (ER)/A&E in patients with suspected stroke [2]. The delay from arrival at the hospital to:

- first assessment by the ER/A&E doctor (door-to-medical doctor - DTMD) should not exceed 10 minutes;

- consultation with a neurologist (door-to-neurology consult - DTNC) should be  $\leq$  15 minutes;
- computed tomography examination (CT) (door-to-CT - DTCT) should be  $\leq$  25 minutes;
- receiving the result of the CT examination should be  $\leq$  45 minutes;
- initiation of thrombolytic treatment DTN should be  $\leq$  60 minutes.

Exact times and causes of delays are not systematically monitored or analysed in Poland. The aim of the study was to examine the delays in the pre-hospital and in-hospital management of patients with cerebral stroke hospitalised in a single centre, and to introduce streamlining measures to improve the effectiveness of early treatment.

## Material and Methods

The prospective analysis comprised anonymised data regarding the length of the pre-hospital and in-hospital delays in 25 patients (including 12 consecutive patients receiving thrombolytic therapy) hospitalised at the Department of Neurology of the Military Institute of Medicine in Warsaw due to suspected cerebral stroke between 01/04/2014 and 01/06/2014 (group I), and in 25 patients (including 12 individuals receiving thrombolytic therapy) hospitalised between 01/02/2015 and 01/04/2015 (group II). All the patients received routine diagnostics and ICS treatment. The analysis did not comprise patients treated with mechanical thrombectomy, reporting to A&E with symptoms persisting for over 12 hours, or with unknown disease onset. The collected data were introduced into the QUICK international stroke registry, whose aim is to reduce delays in the management of patients with ICS, and analysed externally, with treatment centre blinding [3]. The project involved measurements of delays at every stage of the ICS treatment process (pre-hospital management, diagnostics at the A&E, and specialised care at the Stroke Unit), identification of the main delays, and the introduction of corrective actions in order to reduce the diagnostic and therapeutic pathway in pre-hospital and early hospital treatment of patients with cerebral stroke.

The assessment included the time between the onset of the disease and the call for medical assistance (onset-to-call - OTC), and the time between the onset and arrival at the hospital (onset-to-door - OTD). As the OTC data were established in only 11 patients (5 individuals in group I and 6 individuals in group II), OTC was not further analysed. The evaluation of delays in early in-hospital treatment included the time between arrival at the hospital and:

- taking medical decisions for patients who did not receive thrombolytic treatment (door-to-medical decision - DTMD),
- collection of blood samples (door-to-lab-sampling - DTLS) and receiving lab test results (door-to-lab results - DTLR) and CT description (CT-to-results - CTTR), as well as determination of DTCT, DTNC and DTN.

Based on the evaluation of data in group I (initial assessment), the main delays were identified, streamlining measurements were introduced to reduce them, and a follow-up analysis of the delays was conducted in group II (final assessment). All the numerical data were presented as medians, interquartile range (IQR), and the range between the minimum and maximum lengths of delay. Due to the descriptive nature of this pilot analysis and the limited size and heterogeneity of the patient group, no tests were conducted to determine statistically significant differences in delays between the two studied groups.

## Results

The study involved 46 patients (24 in group I and 22 in group II). Four patients with haemorrhagic stroke confirmed in the diagnostic procedure were excluded from the analysis. The median age of the patients included in the analysis was 72.5 years (IQR: 62–79), 55% of the patients were females, most patients were incapacitated at admission to the A&E (60% of patients received >3 points on the modified Rankin scale, the median neurological testing result was a NIHSS [National Institute of Health Stroke Scale] score of 11, with IQR of 6–16). A total of 24 patients received thrombolytic treatment (52% of all patients), 12 in each of the analysed groups. The principal cause for not receiving rtPA was the transfer of patients to the A&E outside the appropriate therapeutic window (7/12, 58% in group I and 4/10, 40% in group II). Most of the 5 patients from group I and 6 patients from group II who were brought to A&E in time for thrombolytic treatment (OTD ≤ 4.5 h), but were not qualified for it, demonstrated serious medical contraindications for rtPA (4/5 in group I and 4/6 in group II); in the case of the remaining 3 patients from both groups, the necessary diagnostic procedures were not completed in time to enable the treatment.

The median onset-to-door (OTD) time in the initial assessment was 99 minutes, 30% patients arrived at A&E outside the therapeutic window for the rtPA treatment (Tab. 1). Based on the analysis of the data from all the patients in group I and those receiving thrombolytic therapy (Tab. 2), the principal causes for delays were identified. They included: late arrival of patients at the hospital (30% patients arrived after the

270–568 minute limit), delayed neurological consultation at the A&E (DTNC 31 minutes, IQR 6–53 minutes), waiting time for transportation to the CT laboratory (DTCT 56 minutes, IQR 31–90 minutes, with a wide range of 16–144 minutes) and for the results of the CT examination (CTTR 44 minutes, IQR 25–50 minutes, range of 15–94 minutes), as well as waiting time for blood collection (DTLS 30 minutes, IQR 13–57 minutes) and for the results of laboratory tests (median of 50 minutes, IQR 30–65 minutes).

The corrective plan included: ongoing reporting and analysis of the delay indicators, hiring a neurologist dedicated to A&E on week days, immediate informing the on-call A&E neurologist and the stroke team about the arrival of a patient with suspected cerebral stroke in the therapeutic window for potential thrombolytic treatment (stroke alert), and assigning the highest priority to further actions by immediate collection and delivery of blood samples to the diagnostic laboratory, urgent performance of the laboratory tests necessary for qualification of the patient for reperfusion treatment, and urgent ordering, performance and presentation of the results of a brain CT. These measures also included streamlining of the process, cyclic training for the stroke team and the A&E personnel on the management of patients with ICS, and meetings with medical emergency teams regarding identification of stroke symptoms and the need for fast transportation of patients with suspected stroke to the hospital. The training for the stroke team focused on a fast neurological assessment at the A&E, elimination of the standard waiting for the biochemical test results, discussing the length of delays, and analysis of errors.

Between September 2014 and January 2015 all the listed procedures were implemented, and two training sessions at the A&E and one training for the medical emergency team were conducted. The final analysis revealed that at the pre-hospital stage the median OTD delay did not change significantly (median of 99 vs 102 minutes), but the rate of patients admitted to the A&E within the therapeutic window for rtPA increased from 70% to 81%. The time to neurological consultation was reduced (from 31 to 25 minutes), especially in patients admitted to the A&E within OTD ≤ 4.5 h (from 15 to 7 minutes), with a visible reduction in deviations in the management of individual patients (IQR 4–44 to 4–21 minutes). Regarding the availability of laboratory test results, the following improved: the delay in blood sample collection at the A&E (from 30 to 15 minutes), especially in patients receiving thrombolytic treatment (from 24 to 13 minutes), and in processing of the tests (from 55 to 27 minutes), although the time to sending the samples to the laboratory did not change significantly (from 15 to 13 minutes) in the total group of patients.

**Table 1. Pre-hospital and in-hospital delays in all subjects: baseline (Group I) and follow-up assessments (Group II)**  
**Tabela 1. Okresy opóźnień w postępowaniu przedszpitalnym oraz wczesnoszpitalnym u wszystkich chorych w ocenie wyjściowej (grupa I) oraz końcowej (grupa II)**

Delay	Group I	Min-max	Group II	Min-max
• Cases	24		22	
Thrombolytic treatment n (%)	12 (50)	–	12 (55)	–
OTD <i>median (IQR) min.*</i>	99 (48-230)	25-568	102 (58-181)	25-360
OTD ≤ 4.5 h n (%)**	17 (70)		18 (81)	
OTT	180 (79)	110-410	157 (110-200)	90-300
DTNC	31 (6-53)	1-177	25 (11-41)	1-85
DTLS	30 (13-57)	5-90	15 (6-30)	2-110
BSTL	15 (9-25)	1-42	13 (5-20)	3-38
Processing of laboratory tests	50 (30-65)	5-110	30 (18-37)	5-75
DTCT	56 (31-90)	16-144	47 (33-65)	17-180
CTTR	44 (25-50)	15-94	30 (19-30)	12-45
CTRMD	25 (15-31)	5-90	10 (5-15)	1-40
DTMD	120 (109-154)	50-224	87 (70-120)	57-240

\* The data are presented as median and interquartile range, or \*\* number and percentage of cases  
 OTD – onset-to-door, OTN – onset-to-neurologist, OTT – onset-to-treatment, DTNC – door-to-neurology consult, DTCT – door-to-CT, DTLS – door-to-lab sampling, DTMD – door-to-medical decision, DTN – door-to-needle, BSTL – blood samples-to-lab, BSR-LR – blood samples received – lab results, CTTR – CT-to-results, CTRMD – CT-results-to-medical decision

**Table 2. Pre-hospital and in-hospital delays in thrombolysis patients: baseline (group I) and follow-up assessments (group II)**  
**Tabela 2. Okresy opóźnień w postępowaniu przedszpitalnym oraz wczesnoszpitalnym u chorych leczonych trombolitycznie w ocenie wyjściowej (grupa I) oraz końcowej (grupa II)**

Delay	Group I	Min-max	Group II	Min-max
• Cases	12		12	
OTD <i>median (IQR) min.*</i>	60 (44-140)	25-358	58 (32-84)	25-195
OTT	180 (168-215)	90-268	167 (110-200)	90-300
DTNC	15 (4-44)	1-136	7 (4-21)	1-35
DTLS	24 (16-36)	5-60	13 (5-16)	2-30
BSTL	5 (5-10)	1-30	5 (5-10)	3-30
Processing of laboratory tests	55 (39-65)	5-110	27 (18-34)	5-45
DTCT	48 (34-59)	16-105	37 (28-47)	17-70
CTTR	40 (23-45)	15-94	25 (15-30)	5-60
DTN	128 (56-149)	45-180	93 (39-105)	25-198
DTN ≤ 60 minutes n (%)**	4 (33)		6 (50)	
CTTN	30 (21-46)	5-60	30 (20-30)	15-120
Time from neurological assessment to rtPA treatment	85 (55-124)	10-160	75 (60-90)	55-190
Time from medical decision to rtPA treatment	8 (11-18)	5-42	5 (5-10)	1-30

\* The data are presented as median and interquartile range, or \*\* number and percentage of cases  
 OTD – onset-to-door, OTN – onset-to-neurologist, OTT – onset-to-treatment, DTNC – door-to-neurology consult, DTCT – door-to-CT, DTLS – door-to-lab sampling, DTLR – door-to-lab results, DTMD – door-to-medical decision, DTN – door-to-needle, BSTL – blood samples-to-lab, BSR-LR – blood samples received – lab results, CTTR – CT-to-results, CTRMD – CT-results-to-medical decision

Regarding the imaging diagnostics, a general reduction in the DTCT (from 56 to 47 minutes) was obtained, and the time of waiting for the CT results was shortened (from 44 to 30 minutes). In patients within the therapeutic window for rtPA treatment, the DTCT time was even shorter, and was reduced from 48 to 37 minutes. The median waiting time for initiation of treatment at the Stroke Unit for patients who did not receive thrombolytic therapy and the DTN time decreased by 23 and 35 minutes (OTT from 180 to 157 minutes, and DTN from 128 to 93 minutes). Patients were significantly more often (increase from 17% to 41%) qualified for rtPA therapy on the basis of the CT test result alone, without waiting for the results of all the laboratory tests (following the AHA/ASA guidelines). Due to these improvements, the rate of patients receiving thrombolytic therapy for DTN  $\leq$  60 minutes increased from 33% to 50%, and for DTN  $\leq$  30 minutes from 0% to 17%. The introduced streamlining measures and reduction of delays were not associated with an increased rate of misdiagnosis (which in both analyses was 0%). The undertaken actions also resulted in an increased rate of all the ICS patients receiving thrombolytic treatment in the Department of Neurology of the Military Institute of Medicine from 8% in 2014 to 12% in 2015.

## Discussion

The present study confirmed that constant monitoring of the delay times and the introduced streamlining measures improve the effectiveness of the diagnostic and therapeutic management of patients with cerebral stroke. The implemented measures, especially at admission, resulted in positive outcomes, even if their scope was still limited. Constant monitoring of the diagnostic and therapeutic process in ICS patients at the A&E and SU, involving a specialised stroke team and trained A&E personnel, minimised the delays of the early in-hospital period, resulting in the implementation of thrombolytic treatment 35 minutes earlier, for example. The reduction in the interquartile range also indicates smaller differences regarding the diagnostic and therapeutic process, and more uniform management of individual patients.

The time from the onset of stroke symptoms to treatment initiation comprises two phases: the first from the disease onset to admission of the patient (OTD), and the second from hospital admission to initiation of thrombolytic treatment (DTN). While the first phase frequently depends on the patient's situation, circumstances of stroke onset, and transportation to the hospital, and is only partially modifiable through widespread education of the population and training of

the emergency services, the responsibility for the second phase is held directly by the medical personnel providing patient care in the hospital [4].

The presented study concentrated on the reduction of in-hospital delays. The time to process CT examinations alone was significantly improved by 15 minutes. The DTCT median was reduced by 11 minutes, i.e. by over 20%. Also blood sample collection after arrival at the hospital and processing of the laboratory tests (especially in the group of patients receiving thrombolytic therapy) took less time. The waiting time for test results could be further reduced by pre-notification of the hospital, and sample collection already during transportation of the patient, or in the CT laboratory, as well as by using fast tests with the use of a bedside analyser (e.g. for INR). Using INR analyser helps to reduce the delay by approximately 30 minutes, compared to the waiting time for the results from the hospital laboratory [5]. These elements of patient management can be improved by more effective coordination between the medical emergency team, A&E and stroke team, the CT laboratory and the stroke unit.

The time to rtPA therapy is the most important modifiable factor affecting the prognosis in ICS. The rtPA treatment should be initiated as soon as possible, even considering the recommended 4.5-hour therapeutic window. The metaanalyses of studies demonstrated a constant reduction in the effectiveness of rtPA treatment for the odds ratio (OR) for restoring full function. The OR was established at 2.8 within the first 90 minutes from disease onset, 1.55 within 90-180 minutes, to 1.4 for 4.5 hours [6]. Even a minor reduction in the DTN time by a few minutes is reflected in higher effectiveness of the thrombolytic therapy. Studies of pharmacoeconomic effectiveness of thrombolytic therapy demonstrated that, on a social scale, each minute saved between the onset and initiation of treatment translates into an average of two days of life in health. This benefit is observed in all stroke patients receiving thrombolytic treatment. Each 15 minutes saved corresponds to one additional month of life without incapacity, and reduced by approximately 5% the risk of in-hospital mortality, as well as 4% increase in the chances for independent mobility [7]. The data are significant, as they indicate that in the best centres the elimination of even minor delays is reflected in a visible benefit for patients. The time to initiation of treatment also affects the therapeutic effectiveness of mechanical thrombectomy, as demonstrated in the metaanalysis of studies with the use of stent retrievers, where each hour passed from disease onset reduced the chances of functional independence by 16% [8]. The door-to-needle time is of great importance in intracerebral haemorrhage due to anticoagulation treatment, in which early normalisation of coagulation parameters and intensive

treatment of high arterial blood pressure improve the prognosis.

The rates of thrombolytic therapy reflect the quality of care in a given centre, or functionality of the regional and national system of care over patients with stroke. Currently, approximately 170 stroke units/subunits are available in Poland. The frequency of thrombolytic treatment procedures performed is increasing considerably: 6,520 procedures were carried out in 2015, and 7,570 in 2016 (an increase by 16.1%). This is primarily due to the higher number of SUs, and the extended therapeutic window for rtPA treatment. The improved efficiency of SUs contributes to this increase to a lesser degree, as only approximately 30 units demonstrate thrombolytic therapy rates of over 10%.

It is estimated that over half of the delays in the management of stroke patients occur at the pre-hospital stage. They include too late diagnosis of the symptoms of stroke and delayed call for medical services by patients or their caregivers. Surveys conducted in Poland revealed that less than 50% of adult individuals can correctly identify the symptoms of stroke [9]. However, the effectiveness of campaigns in the mass media is not clear. A metaanalysis of 15 studies demonstrated a beneficial effect of social information campaigns promoting the knowledge of stroke symptoms, the necessity to contact medical services early and the use of one alert phone number; however, the obtained effect was not universal, and was achieved in different populations (e.g. one of the studies demonstrated that such interventions are only effective in women) [10]. In other analyses the improvement was found only in the knowledge of stroke symptoms or the FAST mnemonic describing the main symptoms of stroke (F – face, A – arm, S – speech, T – time), but not the immediate call for medical services [11, 12]. Contacting the primary care physician first instead of calling the emergency medical services, or taking the patient to hospital by car, significantly prolong the time to initiation of proper treatment, and adversely affects the prognosis. It has been demonstrated that calling the medical emergency team, and a fast, direct transfer by ambulance to the nearest hospital with a SU, doubles the chances of arriving at the hospital within 3 hours from disease onset, and of early CT examination followed by initiation of thrombolytic treatment [13].

The effectiveness of pre-hospital management is also affected by preliminary triage by the dispatcher accepting the call, and application of the standard management protocol and stroke scales by the emergency service teams. The communication between the medical emergency team and A&E or SU is very important (prenotification), as it allows the hospital to prepare for admission of the patient, to avoid delays due to

administrative procedures, and to inform the stroke team early. This can reduce the in-hospital delays (DTN, DTCT) by up to 25%, and doubles the patient's chances of receiving rtPA treatment [14, 15]. In the presented study, prenotification was not used due to the lack of formalised communication channels between the medical emergency team and stroke unit. The current (2018) guidelines for medical emergency teams and medical dispatchers include this option, and prenotification should be obligatory. A direct transport of the patient by the emergency team to the CT/RM laboratory or a vascular laboratory is an important element in reducing in-hospital delays. There, the patient receives simultaneous diagnostic procedures, blood draws, neurological examination and rtPA treatment. This is considered standard protocol in model SUs in Western Europe, and helps to achieve a mean DTN time of under 25 minutes [16].

Many individual procedures, often bearing no financial consequences, can help to reduce in-hospital delays. Each of them can be of key importance in the improvement of the organisation of care for stroke patients in the conditions specific for a particular centre. In the USA, national-level information and educational campaigns, as well as gradual modification of the organisational model of hospital and pre-hospital care over patients with cerebral stroke has resulted in a higher availability and effectiveness of rtPA treatment [17]. A study involving 1500 centres that implemented 10 preselected practices associated with the reduction of delays in the management of ICS patients revealed a significant reduction of median DTN from 77 to 67 minutes, and increased the percentage of patients receiving thrombolytic therapy within  $\leq 60$  minutes, from 29% in 2010 to 53% in 2013. Presently, experienced SU are expected to obtain DTN  $\leq 30$  minutes in most patients receiving thrombolytic treatment.

The design of the presented study has certain limitations, including the small size of the patient group and variability of the causes of delays and the actions undertaken. The aim of the project was to improve the treatment process in ICS patients with a minimal use of hospital resources, and the limited number of subjects (25 patients per analysis) was still sufficient to identify the gaps and introduce improvements. The project was not designed for statistical analysis at the hospital level. Further actions should include introducing prenotification of the stroke team, notifying the laboratory, and performing blood draw before the patient arrives at the hospital, transporting the patients directly to the CT laboratory, without visiting the A&E, and starting the thrombolytic therapy already in the radiology laboratory. Also important is the obligatory monitoring of delay duration, systematic implementation of good practices,

and organising interdisciplinary meetings, as they help to maintain consistency in management and delay reduction. Since 2017, following the analysis of the collected data, the Department of Neurology of the Military Institute of Medicine introduced obligatory monitoring of the duration of delays, which is periodically analysed. The diagnostic and therapeutic pathway is regularly improved in order to reduce potential delays. Presently (2017), at the Department of Neurology of the Military Institute of Medicine, 18% of patients receive reperfusion therapy (rtPA and mechanical thrombectomy), median DTN is 58 minutes, 55% of patients receive thrombolytic therapy  $\leq 45$  minutes, including 25% patients with DTN  $\leq 30$  minutes (unpublished data). Further streamlining of the procedures is expected to reduce delays further.

## Conclusions

The principal delays in the management of patients with acute ischemic stroke included:

- too late recognition of the symptoms of stroke and transportation of patients to the hospital,
- delayed neurological consultation at A&E,
- waiting time for transfer to the CT laboratory, for blood collection and processing of the laboratory tests, and for CT results.

Our study proved the usefulness of continuous monitoring of delay times, their analysis and streamlining measures undertaken to enhance the effectiveness of management of stroke patients admitted to the hospital.

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# Fibrinogen as an acute phase protein after total hip replacement

Fibrynogen jako białko ostrej fazy po protezoplastyce stawu biodrowego

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**Abstract.** The aim of this study was to analyse the changes in fibrinogen concentration in patients who underwent total hip arthroplasty. In this prospective study 30 patients (18 females) with a mean age of 70 years (range, 45–86 years) suffering from idiopathic hip osteoarthritis and qualified for elective surgery were analysed. Fibrinogen levels were established immunoenzymatically prior to the surgery, 6 hours after the procedure, and on days 2, 4 and 6 after surgery. None of the patients demonstrated any symptoms of venous thromboembolism during the hospital stay. The mean fibrinogen concentration was 366 mg/dl before the surgery, decreasing to 311 mg/dl 6 hours after the procedure, then increasing to 827 mg/dl on POD 4. Increased baseline fibrinogen values (>400 mg/dl) were found in 20% of the patients. After elective total hip arthroplasty, fibrinogen acts like an acute phase protein.

**Key words:** fibrinogen, total hip arthroplasty, venous thromboembolism

**Streszczenie.** Celem pracy była analiza zmian stężenia fibrynogenu u pacjentów po totalnej protezoplastyce stawu biodrowego (TPB). Prospektywnym badaniem objęto 30 chorych (18 kobiet) w średnim wieku 70 lat (zakres: 45–86 lat) z idiopatyczną chorobą zwyrodnieniową stawu biodrowego, zakwalifikowanych do planowej operacji. Chorym immunoenzymatycznie oznaczano stężenia fibrynogenu przed zabiegiem operacyjnym, po 6 godzinach od zakończenia operacji oraz w 2., 4. i 6. dobie po operacji. Żaden z chorych nie demonstrował objawów żyłnej choroby zakrzepowo-zatorowej podczas hospitalizacji. Średnie stężenie fibrynogenu wynosiło 366 mg/dl przed zabiegiem, ulegało zmniejszeniu do 311 mg/dl w 6 godzin po zabiegu, potem wzrastało, ze szczytem wynoszącym 827 mg/dl w 4. dobie po zabiegu. Zwiększone wyjściowe stężenia fibrynogenu (>400 mg/dl) stwierdzono u 20% chorych. Po planowej TPB fibrynogen zachowuje się jak białko ostrej fazy.

**Słowa kluczowe:** endoprotezoplastyka stawu biodrowego, fibrynogen, żylna choroba zakrzepowo-zatorowa

Delivered: 16/08/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 26-29

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## Introduction

Due to ischaemia, reduced perfusion and increased inflammatory reaction, total hip arthroplasty (THA) leads to increased activity of the coagulation system and fibrinolysis [1]. Ischaemia is caused primarily by blood loss, a risk inevitably associated with orthopaedic surgery. Due to acute blood loss, plasma fibrinogen concentration (the same as concentrations of other

coagulation cascade proteins) is reduced, which may further increase the blood loss, and delay homeostasis [2]. This is supported by observations in patients undergoing cardiac and vascular surgeries, as well as spinal procedures in adolescents (idiopathic scoliosis); in this group of patients, reduced plasma fibrinogen concentrations were the critical risk factor for blood loss and the need of transfusion [3-7]. There are various methods of reducing haemorrhage in the surgical field,

and limiting the quantity of blood products transfused in the post-operative period. One of them is prophylactic transfusion of fibrinogen concentrate during the perioperative period [2]. However, increased fibrinogen concentration is associated with a higher risk of thromboembolic complications [8], including pulmonary embolism [9].

### Aim of the study

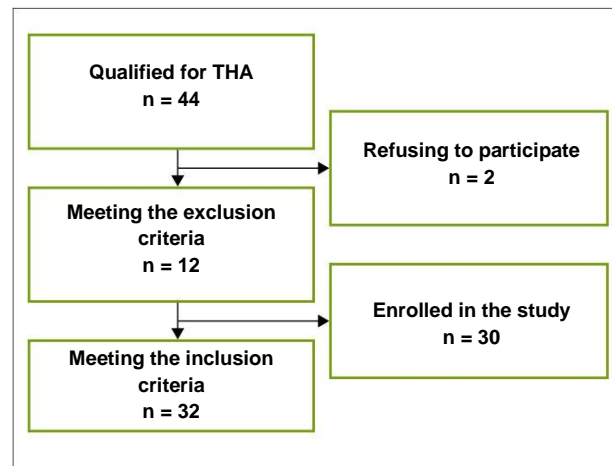
The aim of the study was to analyse the changes in fibrinogen concentrations observed in patients after elective total hip arthroplasty due to idiopathic hip osteoarthritis during the 6 days following the procedure.

### Material and methods

The study was approved by the Bioethics Committee of the Military Institute of Medicine, and was conducted in compliance with the Declaration of Helsinki. Each patient hospitalised at the Orthopaedic Ward of the Department of Traumatology and Orthopaedics, Military Institute of Medicine, qualified for total hip arthroplasty due to idiopathic hip osteoarthritis, was invited to participate in the study, provided they did not meet the exclusion criteria, such as:

- non-idiopathic hip osteoarthritis,
- venous thromboembolism or
- antithrombotic treatment,
- coagulopathy,
- infections,
- renal insufficiency, defined as creatinine clearance of < 50 ml/min.

All the study subjects provided a written informed consent to participate in the project. Blood draws to determine fibrinogen concentrations were performed as part of standard monitoring of coagulation parameters (before the procedure), together with blood draws for peripheral blood count (6 h following the procedure and 4 days after the surgery), and on days 2 and 6 post-surgery (only for this assay). Venous blood samples were collected from the peripheral vessels in 5 ml tubes with citrate. Apart from the blood draw 6 hours after the surgery, the samples were collected at fixed hours (8:00 am). Fibrinogen concentration was determined by immunoenzymatic test using the ACL TOP 500 CTS testing system (Beckman Coulter, Brea, CA, USA). All the patients were operated on by the same team of surgeons using the posterolateral approach, implantation of uncemented prostheses, and without the use of tranexamic acid in the postoperative period. Prophylactically, all patients received enoxaparin (40 mg 1 x 1 subcutaneously from the day of the surgery) to prevent venous thromboembolism, in compliance with the guidelines [10].



**Figure 1.** Study flow chart  
**Rycina 1.** Diagram przebiegu badania

**Table 1. Demographic and laboratory characteristics of the study group**

**Tabela 1. Dane demograficzne i laboratoryjne grupy badanej**

Parameter	Value in the study group (n = 30)
Age (range) [years]	72 (95% CI: 68.0-75.8)
Females [human]	18
Mean BMI (95% CI) [kg/m <sup>2</sup> ]	30 (28.4-31.8)
ASA (range)	II (I-III)
Hgb concentration before surgery (95% CI) [g/dl]	13.8 (95% CI: 13.3-14.3)
Hgb concentration 2 days post-surgery (95% CI) [g/dl]	10.5 (95% CI: 9.9-11.1)
Blood transfusions	Absent
Thromboembolic complications	

The following patient data were introduced to the database: age, body mass index (BMI), sex, American Society of Anaesthesiologists (ASA) score for the assessment of perioperative risk, blood transfusions, haemoglobin (Hgb) concentrations before and 2 days after the procedure, and thromboembolic complications. The study was observational and did not require any modifications to the treatment. The statistical analysis was conducted using MedCalc 18.5 (MedCalc Software bvba, Ostend, Belgium). Normality of distribution was examined with the use of the Kolmogorov-Smirnov test. The continuous variables with normal distribution were presented as a mean with a 95% confidence interval, a minimum and a maximum. If the distribution was abnormal, the variables were transformed logarithmically, and their normality was re-examined. The means following logarithmic transformation were compared using t-Student's test for correlated variables. The Mann-Whitney test was used to compare medians. A p value of <0.05 was considered statistically significant.

**Table 2. Fibrinogen concentrations (mg/dl) before and at 6 hours, 2, 4 and 6 days after total hip replacement**  
**Tabela 2. Stężenia fibrynogenu (mg/dl) przed oraz 6 godzin, 2, 4 i 6 dni po zabiegu endoprotezoplastyki stawu biodrowego**

Time	Before the procedure	After the procedure			
		6 hours	2 days	4 days	6 days
Mean	344.8	266.9	598.8	758.9	693
95% CI	315.4-376.9	244.8-290.9	543.9-659.2	698.8-824.1	629.4-763.0
minimum	218	178	242	514	448
maximum	541	465	912	1327	1145

## Results

Between February and April 2018, 44 patients qualified for total hip arthroplasty in the study were hospitalised. The final analysis included the data of 30 patients. The flow of patients in the study is presented in Figure 1. The demographic and laboratory data are presented in Table 1. None of the patients demonstrated any symptoms of venous thromboembolism during their stay in the hospital or in the 6 weeks of follow-up after the procedure. The changes of fibrinogen concentrations are presented in Table 2. Increased baseline fibrinogen concentration (above the laboratory limit of 400 mg/dl) was observed in 20% of patients. Mean fibrinogen concentrations were higher compared to the baseline at 6 hours after the surgery, and on days 2, 4 and 6 following the procedure (in all the cases  $p < 0.0001$ ). Fibrinogen concentrations in all the patients on days 4 and 6 following the THA were above the laboratory limit.

## Discussion

In all the patients significantly increased fibrinogen concentrations were observed between days 2 and 6 following THA. Reduced concentrations were found only on the day of the procedure, which is probably due to the blood loss and increased coagulation processes immediately after the surgery.

A total of 20% of patients demonstrated increased fibrinogen concentrations before the procedure. It is probably a manifestation of the inflammatory component of hip osteoarthritis, or the effect of comorbidities [11]: increased fibrinogen concentration was observed in obese patients [12], tobacco smokers [13], and patients abusing alcohol [14]; it also increases with age [15]. Reduced concentrations are observed in young patients and individuals who practise sports [14, 16].

Although increased fibrinogen concentration is one of the three components of Virchow's triad, we did not observe an increased frequency of venous thromboembolism in the study population. This observation is confirmed by the study by Paramo et al.

[17]. It is probably due to increased fibrinolysis that occurs simultaneously with the activation of the coagulation system [1].

Our study had certain limitations. The analysis involved a relatively small group of patients, and it did not include factors potentially affecting fibrinogen concentration. It is important that patients qualified to THA should not have any inflammatory conditions, and their comorbidities should be well-controlled. In addition, the perioperative risk in the majority of patients was limited (ASA I and II). The presented project is a pilot study, but the increased fibrinogen concentrations found throughout the study period corresponded to the observations by Olsner et al. [18], who analysed the acute phase reactions in patients following total hip arthroplasty. The planned further analyses of other components of the coagulation system, complementing the presented results, will increase the understanding of the problems associated with surgical treatment of patients with degenerative lesions of the large joints. This will contribute to increased safety for patients, and to improved treatment outcomes.

## Conclusions

- Fibrinogen acts as an acute phase protein: its concentration increases after a total hip arthroplasty.
- The fibrinogen concentration decreases on the day of the surgery (6 hours after the procedure).
- Fibrinogen levels were increased from day 2 to day 6 post THA, with maximum concentrations on day 4 following the procedure.

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# Paranasal sinus and nasal cavity fungus balls among patients of the Otolaryngology Department at the Military Institute of Medicine between 2000 and 2017

Kule grzybicze zatok przynosowych i jam nosa u chorych Kliniki Otolaryngologii Wojskowego Instytutu Medycznego w latach 2000–2017

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**Abstract.** A qualitative and quantitative analysis was made of cases of paranasal sinus and nasal cavity fungus balls in patients of the Otolaryngology Department of the Military Institute of Medicine in Warsaw between 2000 and 2017. The study group comprised 101 patients treated for fungus balls in the years 2000–2017. During that period 3 of the patients were treated twice, thus a total of 104 operative treatments were analysed. Patient records, location and symmetry of lesions, type of treatment and special accompanying factors were analysed retrospectively. In 80 cases the fungus balls affected a single maxillary sinus, in 10 the sphenoid sinus, in 3 the anterior ethmoidal sinus and in 1 the nasal cavity. Isolated fungus balls did not affect the posterior ethmoidal sinus and the frontal sinus. Concomitance of fungus balls were found in several paranasal sinuses, in the maxillary sinus and the nasal cavity and cases of bilateral occurrence. All patients underwent surgical treatment, of which 78.8% was FESS, without an anti-fungal drug cover. In 102 cases, the etiological factor of the fungus balls were fungi of the genus *Aspergillus* and in two other cases the genus *Candida*. The fungus balls, most often caused by members of the genus *Aspergillus*, occurred mostly unilaterally in the maxillary sinus. FESS is an effective and safe method of treatment.

**Key words:** FESS, fungus, fungus ball, sinusitis

**Streszczenie.** Cel pracy. Jakościowa i ilościowa analiza przypadków kul grzybiczych nosa i zatok przynosowych u chorych Kliniki Otolaryngologii WIM w Warszawie w latach 2000–2017. Materiał i metody. Grupa badana to 101 chorych leczonych z powodu guza grzybiczego w latach 2000–2017. Troje pacjentów poddano w tym czasie leczeniu dwukrotnie, tym samym analizowano 104 interwencje zabiegowe. Retrospektywnej ocenie poddano dane metrykalne chorych, lokalizację i symetrię zmian, typ przeprowadzonej interwencji oraz czynniki szczególne towarzyszące chorobie. Wyniki. 80 przypadków kul grzybiczych dotyczyło jednostronnie zatoki szczękowej, 10 – zatoki klinowej, 3 – sitowia przedniego i 1 – jamy nosowej. Izolowane kule grzybicze nie występowały w komórkach sitowia tylnego i w zatoce czołowej. Stwierdzono współwystępowanie guzów grzybiczych w kilku zatokach przynosowych, w zatoce szczękowej i jamie nosa oraz przypadki obustronnego ich występowania. Wszyscy chorzy poddani zostali leczeniu operacyjnemu bez osłony leków przeciwgrzybiczych. 78,8% interwencji zabiegowych stanowiła procedura FESS. W 102 przypadkach czynnikiem etiologicznym kuli grzybiczej były grzyby z rodzaju *Aspergillus*, w kolejnych dwóch *Candida*. Wnioski. Kule grzybicze występują najczęściej jednostronnie i zajmują zatokę szczękową. Związane są zwykle z zakażeniem kropidlakiem. FESS jest skuteczną i bezpieczną metodą leczenia chorych.

**Słowa kluczowe:** zapalenie zatok przynosowych, grzyb, kula grzybicza, FESS

Delivered: 13/11/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 30-34

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## Introduction

Inflammatory diseases of the nasal mucosa and paranasal sinuses affect a large and constantly increasing number of people. It is estimated that 13% of the population develop them [1]. Due to the widespread presence of fungi in the environment, the fungal aetiology of these diseases should not be neglected.

Fungal infections of the nasal cavity and paranasal sinuses can take various forms, from saprophytic colonisation to inflammatory invasion. The criterion that distinguishes the invasive forms from the non-invasive ones is penetration of the hyphae into the mucosal membrane and blood vessels of the paranasal sinuses, confirmed by a histopathological examination. The clinical manifestation of the disease is determined primarily by the immunological status of the patient. Thus the rare occurrence of invasive forms in immunocompetent patients. However, the incidence of non-invasive fungal rhinitis and paranasal sinusitis is increasing. They include asymptomatic colonisation, allergic fungal inflammation of the nasal mucosa and paranasal sinuses, and fungus balls (mycetomas).

In 1997, deShazo et al. presented clinical and pathomorphological criteria for the diagnosis of a fungus ball of the nose and paranasal sinuses [2]. They include:

- Heterogeneous opacification in the sinus lumen or nasal cavity, visible in imaging tests, usually associated with internal calcifications,
- intraoperative identification of clay-like or mucopurulent material in the nose or a paranasal sinus,
- presence of dense fungal hyphae agglomeration, not penetrating the nasosinusal mucosa,
- signs of non-specific chronic inflammation in a pathomorphological examination of the samples of nasosinusal mucosa (no evidence of dominant eosinophilia, granulocytes or presence of allergic mucin),
- absence of fungal invasion into the mucosal membrane, blood vessels and bones in a microscopic examination.

According to the published data, in approximately 12% of patients undergoing nasosinusal surgery at least one form of fungal sinusitis is diagnosed post-operatively [3]. Fungus balls are found in 3.7% of all the patients receiving these procedures [4], and in approximately 13 - 28.5% of patients operated on due to isolated maxillary sinusitis [5].

## Aim of the study

The aim of the study was a quantitative and qualitative analysis of fungus balls in the nasal cavity and paranasal

sinuses in patients of the Department of Otolaryngology, Military Institute of Medicine in Warsaw in the years 2000-2017.

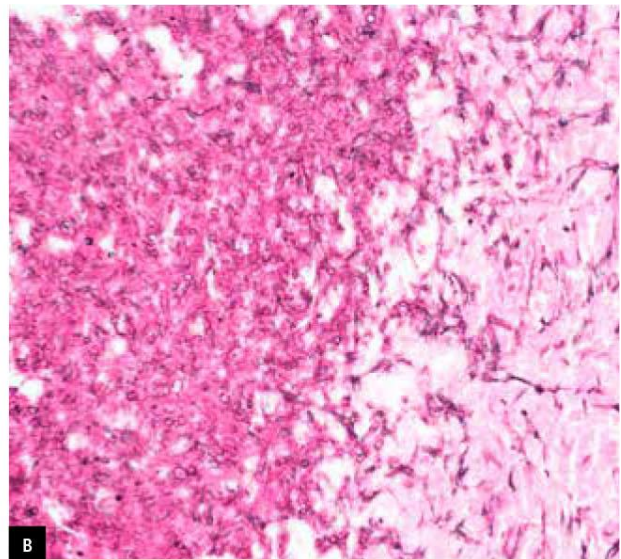
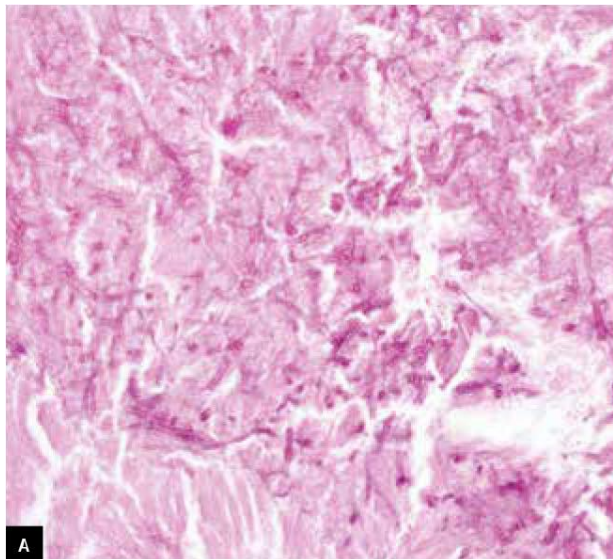
## Material and methods

From January 2000 to December 2017, fungus balls of the nasal cavity and paranasal sinuses were diagnosed and treated in 101 patients. In this group, 3 patients required two surgeries, so the analysis comprised 104 interventions in 101 patients. The studied group included 65 female and 36 male patients. The mean age of the patients was 53 years, with an age range from 27 to 87 years. The study was retrospective. The analysed data were derived from the medical histories of patients at the Department of Otolaryngology, and from the internal databases of the Pathomorphology Division of the Military Institute of Medicine. The diagnosis of fungus ball was established based on deShazo's criteria listed above [2]. For better visualisation of the hyphae, the intraoperative material was stained with hematoxylin and eosin (Fig. 1A), and with GMS Eosin (Fig. 1B). The analysis involved patient records, location and symmetry of the lesion, type of surgical intervention, and specific accompanying factors.

## Results

In the majority of patients the lesions were located in a single paranasal sinus. It was predominantly the maxillary sinus – 80 cases (77%), followed by the sphenoid sinus – 10 cases (9.6%), the anterior ethmoidal sinus – 3 cases (2.9%), and the nasal cavity – 1 case (1%). In the studied group of patients fungus balls were not found in the posterior ethmoid or in the frontal sinus. However, cases of the concurrent presence of fungus balls in several paranasal sinuses, or in the maxillary sinus and the nasal cavity was observed. In three cases bilateral fungal agglomerations were found (Tab. 1).

The imaging tests (X-ray or CT of the paranasal sinuses) revealed opacifications in the sinus lumen, suggestive of fungal infection. None of the patients presented with symptoms indicating an invasive form of infection. All subjects received surgical treatment without antifungal medication. In eighty-two cases (78.8%) functional endoscopic sinus surgery (FESS) was performed. Fifteen patients (14.4%) received a Caldwell-Luc operation. In three cases (2.9%) the initial FESS procedure was extended to provide access to the maxillary sinus using Caldwell-Luc surgery. Two Denker's procedures and two polypectomies of the nasal cavities was also performed. 2).



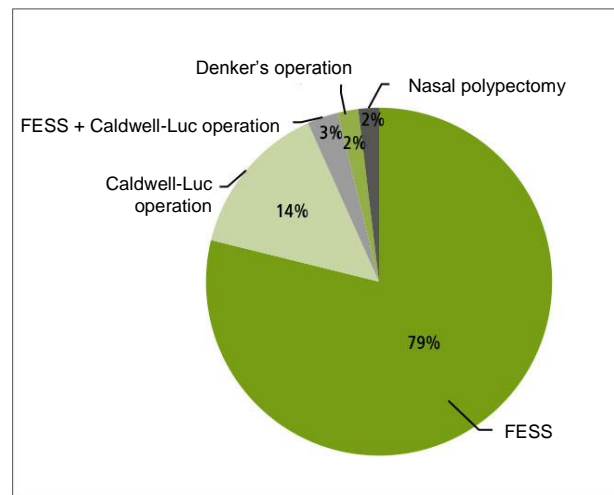
**Figure 1.** Histopathologic examination demonstrating hyphae masses in hematoxylin & eosin stains (A) and in the GMS Eosin method (B)

**Rycina 1.** Badanie histopatologiczne z masami grzybnii w barwieniu hematoksyliną i eozyną (A) i metodą GMS Eosin (B)

**Table 1. Location of paranasal sinus and nose fungus balls (counter – contralateral)**  
**Tabela 1. Lokalizacja kul grzybiczych zatok przynosowych i nosa (kontra – kontralateralnie)**

Location of lesion / number of cases	Unilateral lesions		Bilateral lesions
	Sin	Dex	
Maxillary sinus / 81	30	50	(versus: M) 1
Anterior ethmoid sinus / 3	1	2	0
Posterior ethmoid sinus / 0	0	0	0
Frontal sinus / 0	0	0	0
Sphenoid sinus / 10	8	2	0
Nasal cavity / 2	1	0	(versus: N) 1
Maxillary sinus + anterior ethmoid sinus / 2	1	0	(versus: M+P) 1
Maxillary sinus + anterior ethmoid sinus + posterior ethmoid sinus / 1	1	0	0
Maxillary sinus + nasal cavity / 5	2	3	0

In the final phase of the procedure, the paranasal sinuses and the nasal cavity were rinsed profusely with an 0.9% NaCl solution. No cases of fungal tissue invasion were found. The histopathological examination revealed *Aspergillus* fungi in 102 cases (98.1%), and in the remaining 2 were *Candida* species. None of the patients developed complications other than those typical for FESS. They usually included minor haemorrhage from the nasal cavities in the early post-operative period. In three patients who required second surgery, the secondary lesion was located in the same site in the



**Figure 2.** Types of performed operations  
**Rycina 2.** Rodzaje przeprowadzonych operacji

maxillary sinus. One patient in this group had chronic glomerular nephritis, while the other patients did not demonstrate any chronic diseases. The cause of the second surgery in 2 cases was persisting pain in the affected sinus area; the interval between the procedures was 7 months in the first case, and 3 years in the second. In the third patient, operated 2 months following the first procedure, the surgery was indicated due to nasal adhesions. They probably developed as a result of infection with methicillin-sensitive *Streptococcus aureus*, which occurred directly after the first

operation. The scopes of the primary and secondary procedures were identical.

Four patients (3.9%) also had a history of oncological conditions. One patient had a fungus ball and inverted papilloma at the operated site (right and left nasal cavities), two other patients had distant neoplasms (multiple myeloma in remission, extraperitoneal liposarcoma with renal metastases), and in one patient, based on the head MR test results, a diffused neoplastic disease was suspected, with metastatic lesions in the brain and cerebellum. Nasal polyps were found during twenty-one interventions (20%), and dental material was found in pathomorphological examination only in five patients (4.9%).

## Discussion

Fungal rhinosinusitis is a serious clinical problem, with various manifestations. In the past nasosinus fungal balls were considered a rarely occurring condition. With the widespread use of computed tomography and endoscopic procedures on paranasal sinuses, the diagnosis of the disease has increased [6, 7]. It usually affects elderly patients, aged 64 on average [8], predominantly females [4, 7, 8-10], as confirmed by our analysis.

Dense agglomerations of hyphae are usually found unilaterally in the maxillary sinus [6, 8, 11], less often in the sphenoid sinus, and occasionally in the frontal sinus. They may also occur in some paranasal sinuses, unilaterally or bilaterally [12]. Sometimes they are found in the nasal cavities. The predisposing factors for fungus balls in the paranasal sinuses are still unknown. Dental treatment complicated by the introduction of the dental filling into the sinus lumen [13] was considered to be one, but numerous studies question the relationship [12, 14]. The concurrence of nasal polyps and fungus balls is also unclear. In these cases the occurrence of polyps can be primary, or they may develop as an inflammatory reaction to the fungal infection. However, the number of patients with concurrent fungus ball and nasal polyps is considerably higher than the incidence of nasal polyps in the general population (10% vs 2%) [14, 15].

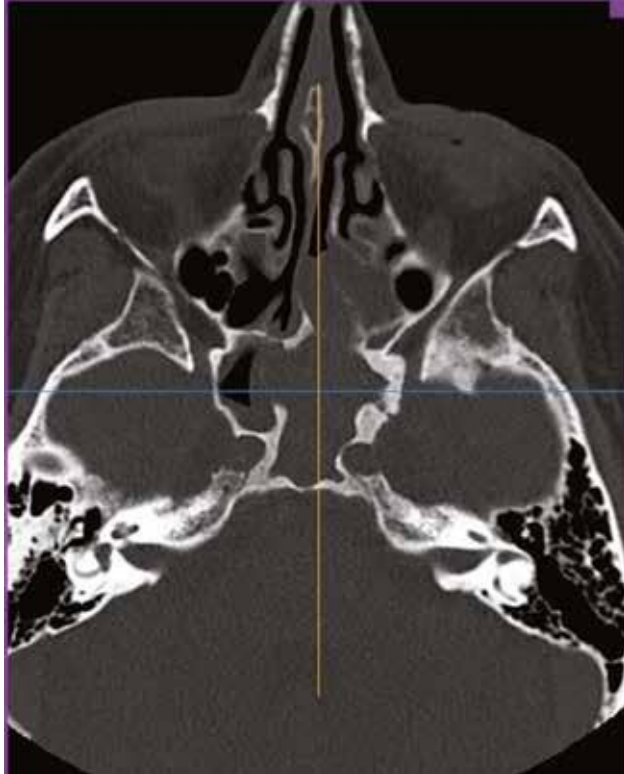
The symptoms of fungus balls are non-specific, and usually do not differ from those reported by patients with chronic paranasal sinusitis of different aetiologies. Typically patients complain about recurrent unilateral symptoms, including mucopurulent discharge, post-nasal drip, pain or distension in the affected sinus area, nasal bleeding or cacosmia. On the other hand, in a large percentage of patients (13.2 - 20%) the infection is asymptomatic [6]. Invasion of the sphenoid sinus, and distending growth of the fungus ball may result in neurological symptoms due to compression of the

regional nerves (nerves III, IV, VI, V1, V2 and the optic nerve) [10].

During a pre-operative endoscopic examination, in over half of the patients (52%) no abnormalities were found [16], and in the remaining cases the picture did not differ from that typical for inflammation of the nose and paranasal sinuses. Computed tomography is the gold standard in imaging diagnostics of the paranasal sinuses [17, 18]. In patients with a fungus ball in the paranasal sinuses, a CT scan usually reveals partial or complete heterogeneous opacification of the affected sinus, with internal calcifications, or metallic spots present, frequently with sclerosis of the sinus walls (Fig. 3). In 4-17% of cases the destruction of the regional bones is observed, which may imitate the presence of neoplastic tumour [16]. In patients with a suspected fungus ball in the sphenoid sinus or in several sinuses, involving destruction of the regional bones, an MRI of the paranasal sinuses is recommended, in order to assess the orbital and cerebral structures [19]. In nearly 100% of cases the fungus balls are caused by *Aspergillus* fungi, the remaining few cases are due to *Candida* fungi. In the studied group of patients the rate was 104:2 cases.

The final diagnosis was based on intraoperative material collection and performing relevant stains for visualisation of the hyphae. Pathomorphological examination of samples of the removed fungus ball helps to identify the main fungal families. Histopathological testing of the samples of nasosinus mucosa enables assessment of fungal invasion into the regional structures. Another sample should also be collected from the nose or the paranasal sinus, in order to start a culture of the media typical for fungi, although growth is obtained in only 23-50% of cases [1]. This is the only method that allows the identification of the genus and subgenus of the fungus, and introduce proper antifungal treatment for invasive infection. In the studied group of patients there were no patients with suspected invasive fungal infection, so no cultures from the collected material were started. Mechanical removal of the hyphae from the nose and paranasal sinuses is sufficient for complete recovery of patients. The FESS procedure, and a profuse rinsing of the surgical site with saline solution has become a standard procedure in this group of patients [6, 16, 20], due to the high effectiveness and the limited risk of serious intraoperative complications. It should be noted that cases of death following endoscopic removal of a fungus ball from the sphenoid sinus were reported. The deaths were due to haemorrhagic and ischaemic strokes within a month of the surgery [4]. Paranasal sinus surgeries by external approach, such as Caldwell-Luc or Denker's operation, are reserved for atypical cases of fungus balls. In the study group these procedures were

conducted in patients with concurrent destruction of the medial or anterior and medial wall of the maxillary sinus.



**Figure 3.** Computer tomography – fungus ball in left sphenoid sinus

**Rycina 3.** Tomografia komputerowa – kula grzybicza w lewej zatoce klinowej

The destruction was due to the distending growth of the fungal ball, which suggested a neoplastic nature of the lesion, while a wide sinus opening allowed complete removal of the hyphae. Most (87%) procedures of this type were conducted in the years 2000-2007, when endoscopic surgery of paranasal sinuses was not a standard treatment at our hospital.

## Conclusions

Fungus balls in the paranasal sinuses and nasal cavities usually affect one of the maxillary sinuses, and result from the localised growth of *Aspergillus* hyphae. They are usually found in females over 50 years old. Complete removal of the fungus hyphae using an endoscopic method is a safe and effective treatment method, and does not require a complementary general systemic antifungal therapy.

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# Combat casualties of the Polish Military Contingent in Afghanistan

Straty ogólne i sanitarne Polskiego Kontyngentu Wojskowego w Afganistanie

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**Abstract.** Estimating the quantity of combat casualties is the main principle for medical support plan development during combat operations. The aim of this study was to analyse the mortality and the number of combat injuries of the Polish Military Contingent (PMC) in Afghanistan from 2007 to 2014. Medical, tactical, engineering, EOD and technical reports were analysed, as well as communications available on the official website of the Ministry of National Defence ([isaf.wp.mil.pl](http://isaf.wp.mil.pl)) and [www.wojsko-polskie.pl](http://www.wojsko-polskie.pl) from 2007 to 2015. Forty-five PMC soldiers were killed in action (KIA) or died of wounds (DOW) in combat. The mortality rate was 0.16%. During combat operations, 869 soldiers were wounded (3.0% of total number of PMC). The dead / injured ratio was 5.2%. 361 soldiers were severely injured. Most of the deaths (KIA – 69%) were due to multiple organ injuries caused by IED. Higher mortality was reported in the summer months. An in-depth analysis of the loss structure is required.

**Key words:** combat casualties, improvised explosive device, mortality, Polish Military Contingent in Afghanistan

**Streszczenie.** Wstęp. Szacowanie wielkości strat sanitarnych jest podstawą do opracowania planu zabezpieczenia medycznego działań wojennych. Celem niniejszej pracy jest analiza śmiertelności oraz liczby obrażeń u żołnierzy PKW w Afganistanie w latach 2007–2014. Materiał i metody. Przeanalizowano raporty medyczne, taktyczne, inżynierskie, saperskie i techniczne oraz komunikaty dostępne na oficjalnej stronie internetowej Ministerstwa Obrony Narodowej ([www.isaf.wp.mil.pl](http://www.isaf.wp.mil.pl)) oraz strony [www.wojsko-polskie.pl](http://www.wojsko-polskie.pl) z lat 2007–2015. Wyniki. W wyniku działań wojennych życie straciło 45 polskich żołnierzy PKW Afganistan. Wskaźnik śmiertelności wyniósł 0,16%. W przebiegu działań bojowych rannych zostało 869 żołnierzy (3,0% stanu osobowego kontyngentu). Współczynnik poległych/rannych wyniósł 5,2%.

Ciężko rannych zostało 361 żołnierzy. Wnioski. Znacząca część ofiar (69,0%) zginęła w wyniku obrażeń wielonarządowych spowodowanych improwizowanymi ładunkami wybuchowymi (*improvised explosive device* – IED). Większą śmiertelność odnotowano w miesiącach letnich. Konieczne są dogłębne analizy struktury strat.

**Słowa kluczowe:** śmiertelność, straty sanitarne, improwizowany ładunek wybuchowy, Polski Kontyngent Wojskowy w Afganistanie

Delivered: 18/09/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 35-40

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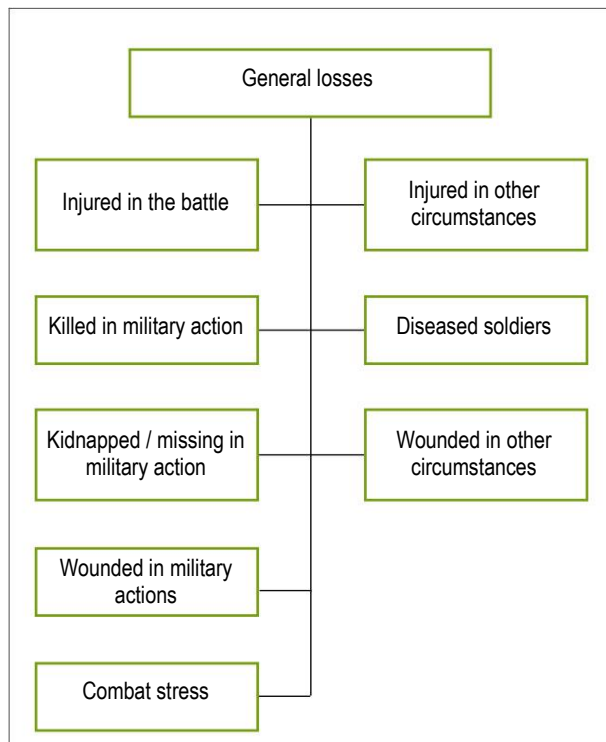
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## Introduction

Since 25/04/2007, the Polish Armed Forces (PAF) have participated in military operations in Afghanistan as part of the International Security Assistance Force (ISAF). Initially, Polish soldiers were present in the Paktika province, and then from November 2008 the Polish

Military Contingent (PMC) was responsible for the Ghazni province [1]. The principal goal of the PMC in Afghanistan was to create conditions that would favour the development of a democratic state, mainly by ensuring the safety of the local population and strengthening the administrative structures [1].



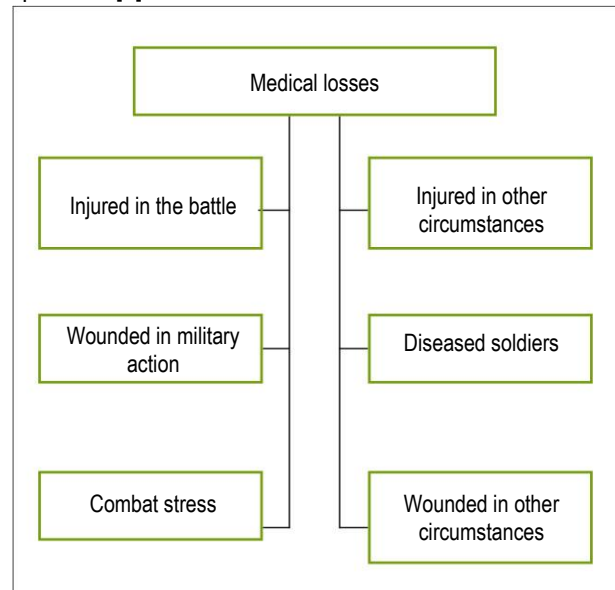
**Figure 1.** Categories of battle casualties (based on reference 3)

**Rycina 1.** Podział strat ogólnych (na podstawie 3. pozycji piśmiennictwa)

From 2009 (i.e. the 4th rotation of the PMC) until the end of the 14th rotation, the PMC included a Medical Support Group (MSG), the Polish Field Hospital. The medical team (usually incomplete) comprised 10 physicians, 11 nurses, 8 paramedics, 5 technicians, medical analysts, medical junior officers and 5 orderlies and drivers [2]. The military medical personnel and resources were to address combat casualties in the Polish forces and allied armies, as well as to offer medical assistance to Afghan citizens whenever possible. Medical casualties, a group of general casualties, included soldiers injured in combat, cases of combat stress, non-combat casualties, soldiers injured in other circumstances, and soldiers with diseases [3] (Figs. 1-2).

Development of the medical support plan for military operations is based on the prognosis of medical casualties. The analysis of the size, structure and dynamics of medical casualties allows one to optimise the medical assistance, and to identify the critical elements affecting the survival of casualties. The size of the general losses, including medical ones, is determined by the type of operation, the quantity and quality of the weapons used, the environmental conditions, the training

the soldiers have received, and the dynamics of the operation [3].



**Figure 2.** Categories of medical casualties (based on reference 3)

**Rycina 2.** Podział strat sanitarnych (na podstawie 3. pozycji piśmiennictwa)

The aim of this study is to analyse the mortality rates of PMC soldiers in Afghanistan in years 2007-2014 using a retrospective description study.

## Material and Methods

The analysis involved communications available at the official website of the Polish Ministry of Defence ([www.isaf.wp.mil.pl](http://www.isaf.wp.mil.pl)) and the [www.wojsko-polskie.pl](http://www.wojsko-polskie.pl) website in the years 2007–2015.

Apart from the generally available published data and Internet data, the article was based on medical, tactical, engineering, EOD and technical reports. The materials were obtained with the permission from the Operational Chief of the Armed Forces, and the Head of the Military Healthcare Department to use medical studies.

## Data analysis

Deaths were listed according to causes, including:

- improvised explosive device (IED),
- small arms fire,
- rocket-propelled grenade,
- traffic accidents,
- diseases.

In the case of contact with IED, the type of vehicle which soldiers were using was determined:

- MRAP (mine resistant ambush protected),

- Rosomak WAV (wheeled armoured vehicle),
- HMMWV (high-mobility multipurpose wheeled vehicle),
- Other [2].

### Calculations

Mortality is a term that designates both the phenomenon and its frequency in a given area, at a given time interval. It is associated with mortality indicator (rate or index), which is the frequency of deaths in a given population, recorded in a given area, over a given time interval.

The fatal casualty rate (mortality) is calculated using the formula:

$$\text{mortality} = \frac{\text{number of fatal casualties}}{\text{size of contingent}} \times 100\%.$$

The rate of deaths to casualties (fatal casualties/injured rate) is derived from the formula:

$$\text{percentage of fatal casualties / injured} = \frac{\text{number of fatal casualties}}{\text{number of the injured}} \times 100\%.$$

To discuss the correlation between the medical casualties and intensity of military action, the deaths were classified according to the date and cause.

### Statistical analysis

The statistical analysis was conducted using MedCalc 18.5 (MedCalc Software, Ostend, Belgium). The frequency of phenomena was compared using a modified chi2 test. A p-value of <0.05 was considered statistically significant.

### Results

Following the decision of the President of the Republic of Poland, 2600 Polish soldiers served in Afghanistan at the same time, and 400 soldiers remained in reserve in Poland in the peak period [4]. In total, 28,000 soldiers served in the PMC, 22,000 patrols were performed, and 500 military combats took place [5]. 869 soldiers were injured [4].

### Deaths

The first death was recorded on 14/08/2007 [6], and the last one on 16/09/2014 [7]. As a result of military combat 45 Polish soldiers lost their lives. Among the deceased were 39 junior officers, 4 officers, and 2 members of civilian personnel. The number of deaths, classified according to the PMC rotations, are presented in Table 1. The mortality rate for the PMC in Afghanistan was 0.16%.

Most combat casualties resulted from an IED explosion (31 out of 45 fatal casualties, 695,  $p = 0.01$ ). The analysis of deaths due to IED explosion revealed that 11 fatal casualties were in MRAP vehicles, 8 were in Rosomak WAV, 7 were in HMMWV, and 5 were in other vehicles. Other causes of death included: small arms fire (9 fatal casualties [20%]), disease (3 deaths [6%]), one person died due to a rocket-propelled grenade, and one due to a traffic accident. Mortality appears to correlate with the intensity of military operations, both on the side of the allied forces, and their opponent. Most deaths were reported in the summer months (27 out of 45 deaths, 60%,  $p = 0.005$ ).

### Medical casualties

During combat operations 869 out of 28,000 soldiers present at the military theatre were injured (3.0% of the contingent). The fatal casualty/injured rate was 5.2%. 361 soldiers were severely injured.

### Discussion

As previously mentioned, the general and medical losses are presented through their number, structure and dynamics of occurrence [3]. This study focuses on the problem of irreversible and medical losses, to a lesser degree analysing the structure and dynamics.

A detailed analysis of the structure of losses will be presented in further studies. The PMC in Afghanistan was the largest military contingent in the history of peacekeeping missions with the participation of the Polish Army. The mortality rate for the PMC in Afghanistan was 0.16%. The analysis of the dynamics of changes should involve correlation of medical casualties with the available data describing the activity of the opponent, and the strategic goals of our own troops.

Initially (since 2002) approximately 100 logisticians, EOD specialists, and special forces soldiers served in Afghanistan. Before the planned return of the PMC from Iraq in September 2006, the preparation for a significant reinforcement and modification of the PMC in Afghanistan was officially announced. On 25 April 2007, the contingent started the 1st rotation, comprising approximately 1000 soldiers, including 750 soldiers in the Polish Combat Group (PCG), operating in the Ghazni, Paktika and Paktija provinces. At the same time, the contingent received newly purchased Rosomak WAVs [8]. Initially, the actions of the PCG troops were mainly defensive and humanitarian, which was partially due to the significant dispersal of the PMC across Afghanistan. During the first rotation 2 soldiers died.

**Table 1. Combat casualties of the Polish Military Contingent in Afghanistan**  
**Tabela 1. Wybrane straty ogólne i sanitarne PKW Afganistan**

PMC rotation	Period	Number	Casualties	Seriously injured (n)	Fatal casualties (n)	Mortality (%)
1	2007	1200	36	11	2	0.09
2	2007/2008	1200	26	9	3	0.26
3	2008	1500	21	7	4	0.26
4	2008/2009	1600	42	11	1	0.07
5	2009	2000	112	76	6	0.25
6	2009/2010	2000	96	26	2	0.05
7	2010	2600	143	108	6	0.23
8	2010/2011	2600	48	27	2	0.07
9	2011	2600	125	25	5	0.15
10	2011/2012	2500	68	11	7	0.24
11	2012	2500	53	20	0	0
12	2012/2013	1800	49	15	3	0.11
13	2013	1600	44	14	3	0.12
14	2013/2014	1000	3	1	0	0
15	2014	360	3	0	1	0.28

During the 2nd rotation, winter 2007-2008, few combat operations were conducted, with the exception of the last two months, when a rebel offensive started. Three Polish soldiers were killed in this rotation. Similarly to the previous one, the 2nd rotation did not involve any decisive operations against the enemy.

Operations against the enemy started during the 3rd rotation; however, they still did not result in taking the initiative in the controlled area. This was due to the remodelling of the PMC at the end of the 3rd and beginning of the 4th rotation, which consisted in concentrating the majority of Polish forces in the Ghazni province, increasing the contingent to 1600 people, creating the Independent Air Group, providing the troops with 32 Cougar MRAP vehicles (instead of the previously used HMMWV) and increasing the number of Rosomak WAVs to approximately 50 vehicles. Further rotations, from the 4th to the 14th, were responsible for the Ghazni province.

The 4th rotation, winter 2008/2009, had limited losses, probably due to the retreat of the rebel forces to hiding places where they prepared for the spring offensive, and interrupting the elections. During the 4th rotation one Polish soldier was killed.

The 5th rotation started on 29/04/2009, and included a number of combined operations, resulting in the destruction of the opponent's live forces and weapons,

as well as in regaining control over part of the province; however, at the price of 6 soldiers killed [9].

The 6th rotation was in winter, i.e. the period of reduced activity of the rebels. Two Polish soldiers lost their lives [10].

On 27/04/2010 the 7th rotation of the PMC began [11], with 2600 Polish soldiers in the military theatre, and approximately 400 in reserve in Poland. Due to the incoming spring and the rebel offensive, the PMC again began advance measures, initially consisting in the intensive destruction of the enemy's arsenal, and arresting Taliban fighters [12]. Such operations took place every week during the 7th rotation. It triggered a strong reaction from the Taliban, in the form of more frequent and increasingly effective attacks on the patrols and bases of the coalition. As the combat intensified, the 7th rotation was the most difficult one (6 Polish soldiers died, and approximately 143 were injured).

The 8th rotation (from 28/10/2010) was supported by the 800-soldier strong Task Force, Iron Rakkasans, from the 101 Airborne Division, and 30 MAxxPro MRAP vehicles from the USA Army [13]. This facilitated further arrests of rebel leaders. In this period a relatively low mortality rate was observed among PMC soldiers (2 deaths).

On 20/04/2011 the 9th rotation of the PMC started. The combat in most cases involved precision attacks with

well-identified aims, conducted by small groups of soldiers, including Special Forces Group [14]. Five Polish soldiers were killed during this period.

The 10th rotation was reduced to 2,500 soldiers. In that period Polish soldiers began transferring responsibility for the Ghazni province to Afghans, despite the Taliban's efforts to interrupt the process [15]. On 21/12/2011 the bloodiest attack in the PMC history took place: the explosion of an IED under a MRAP vehicle, in which 5 soldiers died simultaneously [16, 17]. Soldiers of the 10th rotation of the PMC in Afghanistan conducted 4,500 kinetic operations (activities involving manoeuvres including equipment, people and troops, with simultaneous engagement of combat forces and resources, such as artillery, mechanised infantry and armoured troops, or air forces, in order to achieve a direct goal in offensive and defensive actions), and over 7,200 non-kinetic operations (these include affecting the attitudes of people in the operational area, achieved by non-military forces and measures) [18]. Apart from the attack mentioned above, two other soldiers of the PMC lost their lives.

In the summer of 2012, the allied armies in Ghazni (including the 11th PMC rotation) began another offensive against the rebels. It was one of two rotations without any deaths due to combat or non-combat causes [17, 19].

During the 12th rotation, started on 24/10/2012, and reduced by approx. 700 soldiers, three soldiers died. The same number of deaths took place during the 13th rotation.

During the 14th rotation, on 27/10/2014, Polish operations in the Ghazni province were officially concluded, and the remaining contingent was moved to the Bagram base. During this rotation, the Polish Army did not suffer fatal losses.

The final and 15th rotation of the PMC ISAF began on 05/06/2014. It was a logistic operation, concentrated on securing and transporting the remaining equipment and accessories from Bagram. During this rotation the last death of a soldier due to combat operation was reported [20].

A total of 869 soldiers were injured in combat, and the fatal casualty / injury rate was 5.2%. This supports the observation that along the development of military and medical techniques, the ratio of fatal casualties to the injured decreases. For comparison, during World War I the ratio was 1 fatal casualty to 10 injured soldiers (10%), and during the World War II the ratio was 1 fatal casualties to 28 injured soldiers (3.6%) [21-23].

Our study has certain limitations. Unfortunately, we cannot compare the data on mortality and the percentage of injured soldiers with the data regarding the American and allied forces. This is partly due to the limited access

to the data, and the fact that the American army and other coalition forces operated in different regions of Afghanistan, where the activity of the enemy varied. Another limitation consists in the fact that no in-depth analysis of the structure of the medical casualties was conducted, as it would require detailed data regarding individual cases of fatal casualties and their circumstances.

## Conclusions

The analysis of the available data regarding the PMC in Afghanistan demonstrated that the mortality index was comparable to that of the allied forces, i.e. 0.16%. The majority of victims died as a result of IED explosions, which appeared to be an inexpensive and, unfortunately, effective weapon of the enemy. Further detailed studies on the structure of medical losses and their possible reduction in further military operations are necessary. The number of explosions and mortality index increased together with the number of combat activities performed.

## Funding

National Centre of Research and Development project no. DOBR-BIO4/022/13149/2013 "Improvement of safety and protection of deployed soldiers in the military medical and technical area (acronym AFGAN)".

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# Diagnostics and orthopaedic treatment of the consequences of renal cancer, as illustrated by a clinical case

Diagnostyka i leczenie ortopedyczne następstw raka nerki na przykładzie przypadku klinicznego

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**Abstract.** A 51-year-old female, physically and professionally active, suffered a pathological fracture of the right humerus, after which diagnosis and treatment were implemented. Metastases were found in vertebrae C 6–7, Th 1–12, L 1–5, S 1–2, the right humerus, left humerus, right hip bone, left femur, with a probable primary focus in the left kidney. There were pathological fractures of Th3, Th10, and both the right and left humeruses. The patient was treated surgically: right humerus – open repositioning and fixing with an LCP plate and screws with bone substitute material and with tissue material for histopathological examination, left humerus – excision of the tumour focus around the pathological fracture of the left humerus with an LCP plate and screw fixing filled with bone cement. Left kidney tumour excision – primary focus. Vertebroplasty of vertebrae L1, L4, L5. The histopathological examination revealed an undetermined Renal Cell Carcinoma, though a translocation RCC was suspected. She was treated with radiotherapy of the metastase foci and immunomodulator – Sunitinib. The patient was treated conservatively due to secondary anaemia, pain syndromes and muscular contractures. Metastases in the lungs, liver and spleen were revealed. She died a year after the diagnosis. Invasive treatment improved the patient's physical condition, restoring her life activity. It was not possible to stop the spread of cancer, which led to multi-organ failure and consequently to her death.

**Key words:** diagnosis, metastases, osteosynthesis, pathological fractures, renal cell cancer

**Streszczenie.** Kobieta lat 51, aktywna zawodowo i fizycznie, doznała patologicznego złamania trzonu kości ramiennej prawej, po którym wdrożono diagnostykę i leczenie. Stwierdzono przerzuty do kręgów od C6 do S2, kości ramiennej prawej, kości ramiennej lewej, kości biodrowej prawej, kości udowej lewej oraz prawdopodobnie ognisko pierwotne w nerce lewej. Wystąpiło złamanie patologiczne kręgów Th3, Th10, kości ramiennej prawej i kości ramiennej lewej. Chora leczona operacyjnie: kość ramienna prawa – otwarta repozycja i zespolenie płytą LCP oraz śrubami z wypełnieniem materiałem kościostępczym, pobranie materiału tkankowego do badania histopatologicznego, kość ramienna lewa – usunięcie ogniska nowotworowego w przebiegu złamania patologicznego z zespoleniem płytą LCP i śrubami, wypełnienie cementem kostnym. Usunięcie guza nerki lewej – ognisko pierwotne. Vertebroplastyka trzonów kręgów L1, L4, L5. Badanie histopatologiczne wykazało nieokreślony *renal cell carcinoma* z podejrzeniem typu translokacyjnego. Leczona radioterapią ognisk przerzutowych, immunomodulatorem (sunitinib), zachowawczo z powodu niedokrwistości wtórnej, zespołów bólowych, przykurczów. Wykazano ogniska przerzutowe do płuc, wątroby i śledziony. Zgon nastąpił w okresie roku od rozpoznania. Leczenie inwazyjne usprawniło pacjentkę, przywróciło do aktywności życiowej. Nie udało się zatrzymać rozsiewu nowotworu, co doprowadziło do niewydolności wielonarządowej i w konsekwencji do zgonu.

**Słowa kluczowe:** rak nerki, przerzuty, złamania patologiczne, diagnostyka, osteosynteza

Delivered: 17/09/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 41-49

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## Introduction

Primary kidney cancer differentiates towards the renal tubular epithelium. It is usually found in elderly patients, with the peak incidence observed in patients in their 60s and 70s. The disease affects men twice as often as women. The risk factors include: smoking tobacco, obesity, arterial hypertension, oestrogen therapy, long-term therapy with phenacetin and acetaminophen, exposure to asbestos, petroleum products and heavy metals, acquired renal cystic disease and hereditary factors [1, 2].

The characteristic biological feature of kidney cancer is the unpredictability of its clinical course. Distant metastases may be the first symptoms. Resection of individual metastases prolongs survival.

Distant metastases are found in approximately 25% of patients at the diagnosis of the primary tumour. They usually affect the lungs (55%) and bones (33%), followed by the liver, adrenal glands, brain and the other kidney. The five-year survival of patients with this disease is as follows: 1 year – 60-80%, 2 years – 40-70%, 3 years – 10-40%, 4 years – less than 5%. The prognosis is determined by the histological type of the cancer: papillary and chromophobe carcinomas have the best prognosis, in clear cell carcinoma it is uncertain, and sarcomatoid carcinomas and cancers of the connecting tubules are associated with the poorest prognosis [3].

There is a group of neoplasms, referred to as translocation renal cell carcinomas, in which the genes coding transcription factors TFE3 and TFEB, located on the loci of Xp11 and 6p11 chromosomes, are translocated. The tumours are found in young patients, predominantly women. The probable risk factor is chemotherapy received in childhood. Translocation tumours are very aggressive, and are associated with early invasion of the lymph nodes.

## Nature of metastases

Tumour cell dissemination to the bones is haematogenous. Cancer cells reach the bone tissue through the arteries, then penetrate the arteriovenous junctions and the venous plexus of the spinal dura mater (Batson venous plexus), extending along the entire vertebral column [4].

Metastases are most frequently located in the spine (69%), pelvis (41%) and femur (25%), which significantly increases the incidence of pathological fractures in these areas. Regarding the pathological fractures of the long bones, the most frequent are femoral fractures (proximal end 40-60%) and fractures of the humerus, and every infiltration of the cortical layer in the subtrochanteric region of the femur increases the risk of fracture. Radiotherapy is very important in the treatment of

neoplastic diseases, but it increases significantly the risk of fracture at the site of radiation, as it impairs osteogenesis after the treatment [5].

The mechanisms responsible for tumour growth in bones are complex and include stimulation of osteoclasts, osteoblasts and other ingredients of the bone microenvironment, triggered by the neoplasm. RCC metastases to bones are typically osteolytic, and are associated with bone destruction. It is believed that 71% of bone defects assessed based on the radiological tests are osteolytic, and the others are osteoblastic or mixed in nature [6].

## Imaging diagnostics

Differentiation of neoplastic bone lesions during a radiological examination involves tests that determine whether the lesion is single, considering the patient's age as the most important factor in the radiological diagnosis. The peak incidence of tumours and tumour-like lesions observed in the sixth decade of life includes fibrous dysplasia, fibrosarcoma, malignant histiocytic fibroma, chondrosarcoma, histiocytic lymphoma and multiple myeloma. The diagnostic plan includes conventional X-ray examination, then scintigraphy, and then if the lesion is located in the bone a computed tomography (CT) scan to determine the precise location and measurements; for soft tissues magnetic resonance imaging (MRI) is recommended. If the conventional X-ray image suggests a malignant tumour, it should be followed directly by a CT or MRI examination. CT is superior to MRI in the detection of erosions in the cortical layer and periosteal reactions, whereas when the cortical layer is destroyed by soft tissue masses, MRI is the test of choice to determine the scope of invasion [7].

Bone scintigraphy (radioisotope examination of the bones) is an indicator of the metabolic transformation of mineral compounds. In the majority of cases, bone scintigraphy does not allow differentiation between benign and malignant lesions, as in both the activity of osteoblasts is increased. However, it provides a good morphological and parametric assessment of the visible lesion [7].

Positron emission tomography allows the early detection and detailed analysis of the metabolic and biochemical activity, with anatomic details provided by a CT scan in a form that enables differentiation between the normal and pathological conditions. It is an excellent tool in the assessment of a metastatic disease [4].

## Surgical treatment

The therapy of pathological fractures and threatening fractures of long bones in the course of primary kidney cancer significantly improves the quality of life, and

allows patients with a neoplastic disease to perform daily activities. The success of surgical intervention is determined by early diagnostics of the metastatic process and, in the case of fracture, the choice of the most beneficial treatment method [13].

Surgical treatment of metastases and their sequelae includes numerous methods and techniques, selected for each patient individually. Stabilisation of the long bones involves the use of AO plates, screws and post-resection prostheses. These methods are supported by filling with bone cement or bone replacement material. Surgical treatment of pathological fractures helps to restore a satisfactory level of function early, and provides significant pain relief. The procedures are well-tolerated by patients emotionally [13].

### Radiotherapy

Radiotherapy is used mainly to alleviate pain. It controls the bone affected by metastasis, and prevents pathological lesions and compression of the spinal cord.

The pain associated with a bone metastasis is primarily determined by three factors. Firstly, the neoplastic cells disturb the physiological balance between osteoclasts and osteoblasts, affecting structural bone degradation. Secondly, neoplastic cells can attack the nerve root directly, or increase the expression of chemical mediators that stimulate nerve fibres, resulting in contractures of the surrounding skeletal muscles.

Moreover, ionising radiation can reduce the activation of osteoclasts, and eliminate the neoplastic cells. Therefore, the tumour size decreases, but the discomfort in the adjacent nerves does not subside. In addition, the reported alleviation of symptoms within 24 hours after the initial radiotherapy suggest that the fast improvement is due to the reduction of both inflammatory cells and the chemical mediators of pain [5, 6].

Three-dimensional conformal radiation therapy (3-DCRT) is currently considered a standard practice in the treatment of bone metastases. 3-DCRT enables the radiation beam to be adjusted to the target volume, reducing the dose received by the surrounding healthy tissue. Before the treatment, a computed tomography examination of the affected anatomic structure is performed. Using three-dimensional CT planning, the best adjusted treatment plan is developed. The aim is to provide the maximum dose to the target volume, and to minimise exposure to the healthy tissue. In vertebral metastases the radiation field should include the invaded vertebral bodies (and if necessary, the soft tissue tumour), and the spinal bodies below and above. Stereotactic body radiation therapy (SBRT) is an advanced method of treatment that provides a high dose to the metastatic bone with great precision, minimising the exposure of the surrounding critical structures,

primarily the spinal cord and cauda equina, but also of the lungs, oesophagus, kidneys, intestines and the adjacent vertebral bodies. In considering the heterogeneous prognosis in patients with bone metastases, researchers and clinicians are interested in identifying the group of individuals with oligometastatic disease (up to three metastatic lesions), who may achieve permanent pain control with SBRT.

SBRT is performed in spinal lesions. It allows a certain distance to be maintained between the targeted volume and the spinal cord, thus protecting the nerve structures from doses inducing radiculopathy and myelopathy. The SBRT treatment field includes only the neoplastic lesions: the anterior part of the invaded vertebral body, together with the posterior wall and the connecting pedicles with the bone metastases [5, 6].

Indications for SBRT include single metastasis, or oligometastatic disease with up to three vertebrae involved. The damage should not be more than 5 cm in diameter. Symptomatic spinal cord compression may be a contraindication for SBRT therapy. During the treatment effective immobilisation of the patient and meticulous quality control are essential. The dose and fractionation for SBRT are at present uncertain. A few fractionation schedules have been proposed: from a single fraction of 15-24 Gy, to multiple fractions delivering a total dose of 18-36 Gy. In general, in over 80% of patients, reduction of pain symptoms and local tumour control are reported, with very low (<0.5%) incidence of myelopathy. SBRT appears to be an advanced technique providing improved and permanent pain control, especially in re-treatment cases. Therapy with single fractions is effective and viable for alleviation of pain associated with bone metastases [5, 6].

### Pharmacotherapy

Sunitinib is an oral tyrosine kinase inhibitor (TKI) for a number of receptors, including types 1–3 of the vascular endothelial growth factor receptor (VEGFR), platelet-derived growth factor receptor (PDGFR), stem cell factor receptor (KIT), FMS-like tyrosine kinase 3 (Flt-3), colony stimulating factor receptor type 1 (CSF-1R), and glial cell line derived neurotrophic factor receptor (RET), or the substances that participate in angiogenesis and the diffusion of neoplastic lesions.

Denosumab is a fully human monoclonal antibody to the receptor activator of nuclear factor- $\kappa$ B (RANKL). RANKL is an integral mediator of osteoclast differentiation and function. Neoplastic cells produce various cytokines, such as parathormone-related protein, IL-6 and tumour necrosis factor  $\alpha$ , which promote resorption of bones in cultures. It has been demonstrated that expression of these factors to the bone microenvironment increases production of RANKL, due

## CASE REPORTS

to their effect on the surface of stromal osteoblasts. RANKL may also be produced directly by the neoplastic cells, and is a member of TNF family. It binds with its receptor (RANK) on the surface of precursors of osteoclasts, and in fully developed osteoclasts, stimulating their differentiation and activation. RANKL is inhibited by denosumab, which reduces the excessive osteoclastic activity stimulated by bone metastases. Common use of targeted therapies has revolutionised the therapy of metastatic renal cell carcinoma [5].

### Psychological functioning

Apart from somatic symptoms, patients also have to deal with the psychological consequences of the disease. The nature of diagnosis, and the perception of neoplastic disease are associated with very negative emotions. The patient's life becomes governed by the proposed treatment schedule. Patients cope with physical symptoms, weakness, pain, fear, anxiety and sadness. They are worried about the future of their families, contemplate the meaning of life and deal with spiritual problems. The disease requires reorganisation of the lifestyle of the family members. Introducing changes is associated with a significant emotional burden for patients and their families, which could be perceived as a crisis. The emotional reactions are determined by family relationships, disease dynamics, emotional support, financial situation and children's age [8].

### Case report

A 51-year-old woman, with higher education, professionally and physically active, reported recurrent pain symptoms in the lumbar spine. She regularly received periodic examinations. Abdominal ultrasound did not reveal any abnormalities.

The patient made a sudden internal rotation of the outstretched right arm, bent at the elbow, without resistance - it resulted in a pathological fracture of the right humeral shaft. The patient visited the hospital, where initial diagnostics were conducted, including X-ray examination of the right humerus and comparative X-ray of the left humerus, blood tests, and ultrasound examination of the abdomen, thyroid and breasts.

The tests revealed a fracture of the right humeral shaft at the cyst site, and a cyst in the proximal head of the left humerus.

Blood tests did not demonstrate any significant abnormalities:

- WBC 13 thousand/mm<sup>3</sup>,
- RBC 4.1 thousand/mm<sup>3</sup>,
- Hgb 12 g/dl,
- PLT 181 thousand/mm<sup>3</sup>,
- ESR 15 mm/h.



**Figure 1.** Pathological fracture of right humerus  
**Rycina 1.** Złamanie patologiczne kości ramiennej prawej

The ultrasound examination of the abdomen, thyroid and breasts did not reveal any abnormalities.

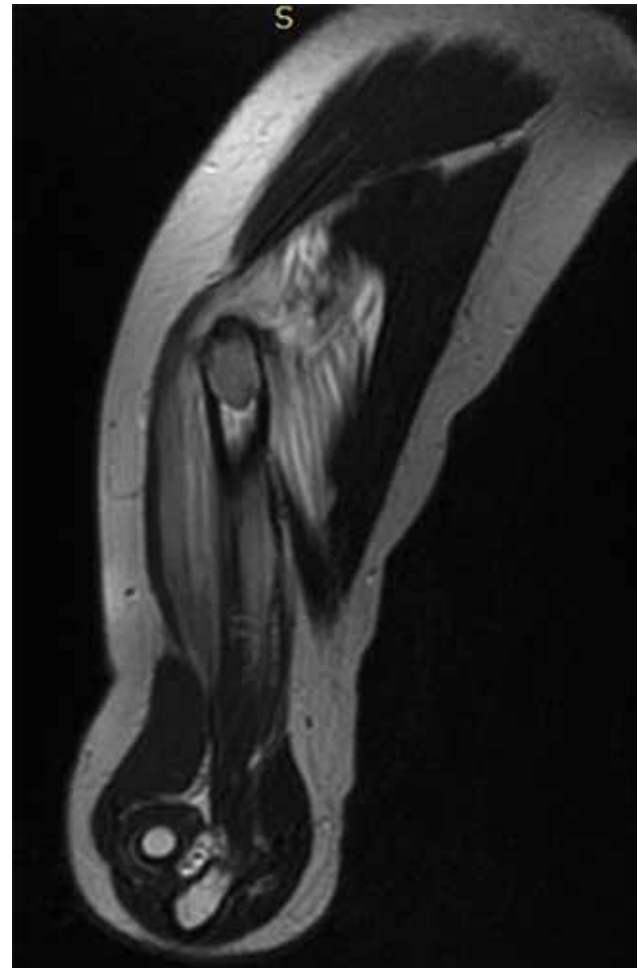
The CT scan of the fractured right humerus demonstrated a fracture of the right humeral shaft at approximately 1/2 of its length, with a lesion of 15×16×38 mm visible at this site, filling the medullary cavity, with a slight distension of the cavity and thinning of the cortical layer. The lesion's density was approximately 50-60 HU. No malignant periosteal reactions, signs of osteolysis, or lesions in soft tissues were observed. The picture suggested a non-malignant process, only the density of the lesion was not typical for a spontaneous bone cyst - which should be verified in an MRI test.

MRI test: at half of the right humerus a focal lesion of 32×14×17 mm was found, causing shaft distension - at this level a pathological fracture with an angular deformity was found, in the surrounding soft tissues signs of heterogeneous signs suggestive of a post-traumatic oedema or pathological infiltration. Below the described area of pathological fracture a focal lesion of 8×6 mm was observed, in the further 2/3 of the shaft. Both lesions were slightly heterogeneously enhanced after contrast administration. Together with the CT scan of the thoracic spine and the C/Th region, the lesions in the humerus were probably consistent with metastatic foci of limited vascularisation - for further diagnostics. Focal lytic lesions in vertebral bodies, with preserved body height.



**Figure 2.** Radiological examination of left arm, revealing metastasis in proximal metaphysis of the left humerus

**Rycina 2.** Badanie radiologiczne przeciwstawnej kończyny, ujawniające przerzut w przynasadzie bliższej kości ramiennej lewej



**Figure 3.** MRI image of pathological fracture of the right humerus

**Rycina 3.** Obraz MRI złamania patologicznego kości ramiennej prawej

The patient was qualified for surgical treatment. Open repositioning of the humerus was performed, with fixing with an LCP plate and screws, and application of bone substitute material in the bone cyst. The content of the cyst was sent for histopathological examination.

The test result suggested fibrous dysplasia, but it was not specific enough to confirm the final diagnosis.

Following a consultation in a more specialised centre, the diagnosis of malignant proliferation was established: *adenocarcinoma metastaticum*. The whole picture is consistent with metastasis of *carcinoma clarcellulare (eosinophilic variant)*.

Bone scintigraphy was performed. An increased uptake of tracer in the right humerus, left humerus, Th10 and left femur was observed.

A PET test was performed. A few metabolically active right axillary lymph nodes were demonstrated, and a metabolic focus of 16 mm in diameter in the parenchyma of the left kidney. Moreover, active metabolic foci were revealed in bones; having damaged the cortical layer they grew in a cauliflower pattern outside the bone: left humerus - 16×76 mm, Th3 body - 22×17 mm, Th10 body laterally on the left side, at the arch base - 22×17 mm and 18×15 mm. The Th12 body revealed an osteosclerotic outline of 8 mm in diameter, L1 body - 13×10 mm, L5 body - 15×14 mm, sacral bone on the left - 46×38 mm, left ilium at the sacroiliac joint - 33×30 mm, left femur of 9 mm in diameter.

Contrast-enhanced computed tomography of the thorax, abdomen and pelvis was performed. (...) Both kidneys were located typically, of normal size, without deposits and signs of stasis, with slightly ampullary renal pelvises. In the inferior medial part of the left kidney, following intravenous administration of contrast medium,



**Figure 4.** Postoperative image of open reposition and internal fixation of right humerus fracture in anteroposterior projection

**Rycina 4.** Obraz pooperacyjny otwartej repozycji i wewnętrznej stabilizacji złamania kości ramiennej prawej w projekcji przednio-tylnej

an area of lower density of 15 mm in diameter was found; it may have consisted of a proliferative lesion. The focus did not demonstrate enhancement typical for RCC. (...)

The observed proliferative lesion was considered the primary focus.

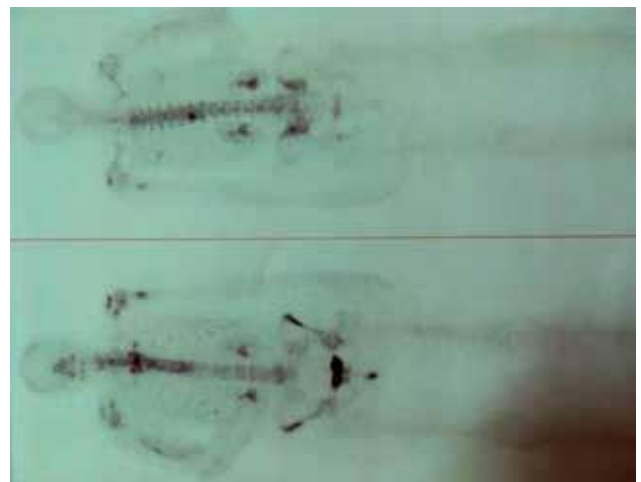
Considering the approximate number of metastases, the probable primary lesion, the lifestyle and personality of the patient, the following therapeutic goals were established: inhibition of the neoplastic diffusion, improvement of the quality of life, providing the patient with minimum independence, and prophylaxis of further fractures.



**Figure 5.** Postoperative image of open reposition and internal fixation of right humerus fracture in the lateral projection

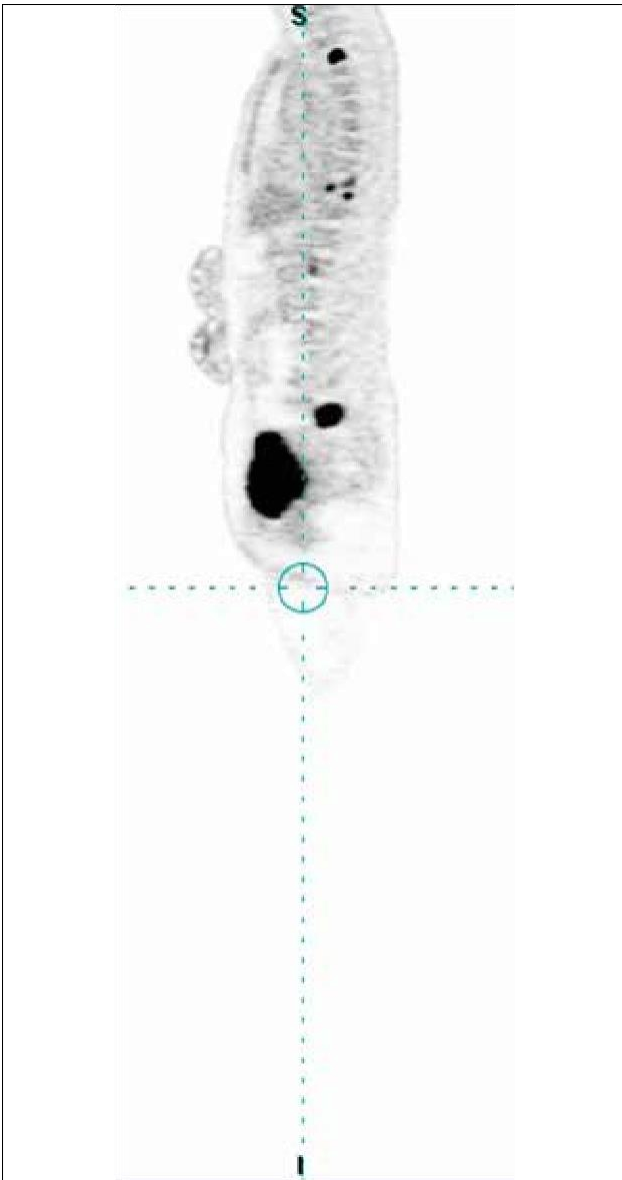
**Rycina 5.** Obraz pooperacyjny otwartej repozycji i wewnętrznej stabilizacji złamania kości ramiennej prawej w projekcji bocznej

Shortly after the diagnostic procedures, the patient extended the arm at the left humerus joint, with bending of the pronated forearm at the elbow joint, while closing a door. This resulted in a pathological fracture of the left humerus.



**Figure 6.** Image of bone scintigraphy

**Rycina 6.** Obraz scyntygrafii kości



**Figure 7.** PET scan image  
**Rycina 7.** Obraz badania PET

The patient was admitted urgently to the hospital. After preparation, the tumour was resected, and the humerus was fixed with a Philos plate and screws, including filling the bone deficit with of bone cement.

A few days later, a simultaneous removal of the primary tumour, carried out by a team of urologists, and vertebroplasty of vertebrae L1, L4 and L5 that were at risk of fracture, conducted by a team of neurosurgeons.

The material collected from the primary focus for histopathological examination revealed the final histopathological diagnosis: *renal cell carcinoma, unclassified*. The translocation type of the renal cell carcinoma could not be determined.



**Figure 8.** Radiographic image of pathological fracture of proximal metaphysis of left humerus in two projections  
**Rycina 8.** Obraz radiologiczny złamania patologicznego przynasady bliższej kości ramiennej lewej w dwóch projekcjach



**Figure 9.** Image showing fixations of both upper limbs demonstrated by CT examination  
**Rycina 9.** Obraz przedstawiający zespolenia obu kończyn górnych wykazany przy badaniu TK

The patient was qualified for a cycle of stereotactic radiation therapy of the metastasis to the right humerus, of the metastasis to the left femur, of the Th2-Th5 thoracic spine, and of the metastases to the sacral bone and the left ilium.

In the post-operative period, the patient underwent passive exercises of the upper limb joints. She also regularly exercised at the swimming pool, involving

movements in all joints, with water resistance, in a vertical position.

The following pharmacotherapy was administered:

- Sutent (sunitinib) – antineoplastic protein kinase inhibitor, in a cycle of 1 tablet daily for 4 weeks / 2-week interval
- Denosumab – 120 mg *i.m.* every month
- Fentanyl 50 µg/h – 1 plaster every 3 days
- Sevredol (morphine) – 1 tablet as needed
- Amitriptyline – 10 mg in the morning + 10 mg at noon + 25 mg in the evening
- Clexane (enoxaparin sodium) – 40 ml 1×1 *s.c.*
- Ketonal (ketoprofen) 100 – 2×1 tablet
- Polprazol (omeprazole) – 20 mg 1×1 tablet

Following the initiation of combined therapy, the patient was hospitalised due to secondary anaemia - Hb 7.5 mg/dl - induced by a 3-week gynaecological bleeding. Three units of PRBC were transfused.

Radiologically - MRI of the pelvis and L-S spine were performed every 4 months; no growing lesions were found.

The patient reported increasing nausea, hair greying, hair loss, and a gradual loss of body weight. The wound healing processes were normal.

The orthopaedic consequences of the treatment included a significantly limited movement of the cervical and lumbar spine, and pain syndromes originating in the spinal cord, left sacral plexus, bones and muscles, resulting in a limping gait. The post-operative sequel was pain-induced limited mobility of the humerus joints.

No further pathological fractures occurred during the treatment. During the therapy with Sutent, the patient's general performance improved. She moved independently in the area close to her home, drove a car short distances, and was a passenger for long distances. The patient exercised at the swimming pool. She did not work professionally, but could continue her research work. The patient was highly motivated to continue the treatment. She died 13 months after the first fracture.

A post-mortem examination was not performed, as the patient did not meet the criteria for obligatory autopsy.

### Discussion

In a case of RCC treated in China, classified as T1N0M0, with the size of 3×3.5 cm, following surgical removal of the focus, a good response was observed after CRT 50 Gy in 20 fractions for the post-operative RCC.

In an 11-year-old patient, who received a right nephrectomy, a large, well-defined, brown, soft tumour of 13.7×11.0×8.0 cm was found, almost completely substituting the normal renal parenchyma. The neoplasm was classified as a translocation renal cell carcinoma

[10]. In an American study conducted in Minnesota, out of 2651 patients studied, 182 (6.9%) were qualified as M1 RCC. The tumour was much larger in the patients with M1 RCC than in those with M0 RCC. Only 1 out of 629 patients (0.2%) with a tumour of < 3 cm was qualified as M1 RCC; the tumour was 2.5 cm [11].

One of the methods of treatment is placing a cement filling with 2 g of methotrexate in the bone deficit. This therapy also enables performing daily activities, and has no adverse effects of the general systemic or local function that are characteristic of intravenous therapy with antimetabolic medications [12].

### Discussion

The applied treatment was effective, as it improved the patient's performance, increased her activity, and allowed her to participate in family life. The neoplastic diffusion was not stopped, which led to multi-organ failure, resulting in death.

### Conclusion

Effective treatment of patients with diffused neoplastic disease with bone metastases requires a consolidated, interdisciplinary approach. Diffused neoplastic disease with such a small primary focus is rare. Close collaboration between an orthopaedist, radiologist and oncologist, personal care and patient's motivation, together with family support, are necessary conditions for proper treatment, which is associated with multiple inconveniences and high costs. The treatment must be adjusted individually, after consideration is given to the life expectancy and general status of each patient. The treatment goals are reduction of pain and restoring functionality for the expected survival time [13].

### Acknowledgements

We would like to express our gratitude to Dr Andrzej Ziętek from the Department of Orthopaedics and Traumatology of the Motor Organs, Medical University of Gdańsk, and Ms Julia Kowalski for the editorial support.

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# Mental health problems in the most recent generation of American veterans

## Problemy zdrowia psychicznego najmłodszego pokolenia weteranów amerykańskich

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**Abstract.** Wartime activities determine the threats to a soldier's life and health. To prepare soldiers for new forms of warfare, one should understand the challenges the soldier must face in the midst of battle and after returning home. Between 2001 and 2015, 1.2 million American soldiers returning from Iraq and Afghanistan used the health care services of the Department of Veterans' Affairs. An analysis of the resulting medical interventions makes possible the long term evaluation of the effects of war, some of which appear only after the soldier returns to civilian life. This study analyses the research on the mental health problems of soldiers who have returned from Afghanistan and Iraq. Veterans report mental health problems reluctantly; they try to solve the problems connected with their return from war on their own. Many cases of traumatic brain injury and post-traumatic stress are left undiagnosed, while the use of pain relievers and other drugs increases. As a result, veterans may seek help only many months or even years after leaving the military. The sudden increase in the appearance of complex mental health problems among this new generation of veterans necessitated changes in the US healthcare structure and in specialized medical training to meet this new challenge.

**Key words:** addiction, health care, Iraq and Afghanistan Veterans, PTSD

**Streszczenie.** Zagrożenia dla życia i zdrowia żołnierzy zależą od charakteru działań wojennych. Aby przygotować żołnierzy do nowych form walki, należy poznać wyzwania, z jakimi będą się spotykać zarówno w trakcie działań bojowych, jak i po powrocie z wojny. W okresie od 2001 do 2015 r. 1,2 miliona żołnierzy amerykańskich, którzy brali udział w walkach w Iraku i Afganistanie, skorzystało ze specjalistycznej służby zdrowia Departamentu do Spraw Weteranów (Veteran Affairs – VA). Analiza przeprowadzanych interwencji medycznych umożliwia ocenę długotrwałych skutków działań wojennych, z których część może się ujawnić dopiero po powrocie żołnierzy do życia cywilnego. W pracy przedstawiono zakresy badań dotyczących problemów zdrowia psychicznego żołnierzy po powrocie z Afganistanu i Iraku. Weterani niechętnie zgłaszają się na badania zdrowia psychicznego, a ewentualne problemy związane z powrotem z wojny starają się rozwiązać we własnym zakresie. Wiele przypadków stresu pourazowego i urazów mózgu pozostaje niezdiagnozowanych, zwiększa się za to spożycie środków przeciwbólowych i odurzających. Dlatego też weterani często zgłaszają się po pomoc wiele miesięcy, a nawet lat po powrocie z wojska. Gwałtowne zwiększenie częstości występowania skomplikowanych problemów psychicznych wśród nowej generacji weteranów spowodowało konieczność zmian struktury lecznictwa USA i specjalistycznego przygotowania środowiska medycznego do nowych wyzwań.

**Słowa kluczowe:** weterani – Irak i Afganistan, zespół stresu pourazowego, uzależnienia, służba zdrowia

Delivered: 27/09/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 50-55

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Every war brings new experiences. The sooner they are examined and understood, the more effective are the measures that can be introduced to prevent wartime losses. Therefore, the experience of the allied armies in Iraq and Afghanistan after 2002 is thoroughly analysed and discussed. The specific health issues of the returning soldiers require constant modifications of the veteran

healthcare system, as the military operations, instead of dying out, take new and dangerous forms. Therefore, the threats associated with modern warfare should be determined with particular care [1, 2].

The experience of Polish Army soldiers deployed abroad differs from that of American soldiers; however, the general impressions after the return from combat are

similar. Studies conducted in the coalition countries, such as Great Britain and Poland, analyse selected groups of soldiers, whereas Americans included in their research most soldiers participating in military operations. Therefore, an analysis of the American data is important for planning of the healthcare system for all the soldiers of the coalition forces. Most of the information used in this study is derived from the analyses of the Department of Veterans Affairs (VA) from years 2001-2005, published in 2017, and from discussions regarding the needs of mental healthcare for the new generation of American veterans [3-6].

Many associate war with fascinating achievements in military technology and new methods of armed combat. For soldiers returning from Iraq, however, it is a story that is difficult to tell, and even more difficult to live with.

Young Americans join the army for various reasons. Patriotism, the need to achieve something important, a lack of ideas for life, running away from home or the need for a change... Regardless of the immediate cause of this decision, it is often supported by a calculation related to the future: a chance to gain the financial resources to start a family, to learn a profession, to organise one's life or to achieve a broadly understood sense of manhood. Young women want to be equal to men, demonstrate their skills, and develop their own identity in extreme situations [1, 7].

American society remembers well the injustice suffered by the Vietnam veterans as the blame for the war was placed on those who fought it. This time the discussion about war and its social assessment do not affect the appreciation of soldiers, respect for them and interest in their well-being. Numerous scientific studies examine the effects of wartime activities of the health and lives of soldiers. The results of these studies are immediately considered in healthcare policies, so that physicians and therapists can be ready for the emerging needs of the returning soldiers [2, 3, 8].

Colonel Tom Burke MD from the US Department of Defense, who was responsible for the military programme of mental health protection, declared that war changes everyone who participates in it. Therefore, all the future plans made by soldiers are radically changed after they return from war. A painful discrepancy between expectations and reality is visible in many aspects. One of them is coming back home, others are health-related [9].

Young people who go to military training, and then to war, recently graduated from school, still lived with their parents, or were planning to start a family. They came back from war to a changed environment. Their friends and loved ones are in different relationships, have modified their life plans, and often also place of residence. The work the soldier was counting on is no

longer available, due to economic crisis. The profession learnt in the army has no counterpart in civilian world. Every employer asks for certificates and diplomas, and the army does not issue any [9].

For months before the return the soldier was feeling close to the people around him, those who protected him from danger. He listened to his superiors, whom he trusted with his life, the greatest gift that had to be protected at all times. The soldier saw how easily this gift could be taken away. Now he does not know how to talk about it. He feels like a stranger among those who were in Iraq or Afghanistan. He cannot return to the war zone, but is afraid to stay at home [10, 11]. The soldier has been taught to be self-sufficient, talk little, and always be ready to act. There's no room in his life for disease or malaise, and there is definitely no room for moral or existential dilemmas. These were the rules in combat, and they still apply at home. Soldiers do not go for treatment. In the case of physical pain they are more likely to seek assistance than if the pain is psychological, when they never turn to healthcare institutions. Only a crisis, or an intervention by the family or loved ones, may motivate a soldier to make a doctor's appointment, or seek therapy. Even then they resistant treatment, as it usually consists in talking about emotions and problems [8, 12]. According to the official data of the Office of Public Health in the Department of Veterans Affairs, in the period from 1 October 2001 to 30 June 2015, nearly 2 million veterans who participated in military operations in Iraq and Afghanistan gained the right to use VA healthcare services. Among them 1.2 million sought help in VA facilities, and this group has been studied the most.

It is worth noting that veterans of the wars in Iraq and Afghanistan constitute 10% of all the veterans treated by the VA healthcare system. To differentiate between the most recent generation of veterans from those other ones, OEF/OIF/OND acronym is often used, from Operation Enduring Freedom, Operation Iraqi Freedom, and Operation New Dawn. Of these, 88% of them are men, and 12% are women. The two most numerous age groups are those born in the years 1980–1989 (48%), and in the years 1970–1979 (25%) [3].

The most commonly observed among the VA patients in this most recent generation of veterans are musculoskeletal disorders, mental health conditions and general difficulty in assessing health status at the moment of examination (this includes respiratory, thoracic, head and neck symptoms). These are followed by gastrointestinal disorders. The rate of diagnosed cases of musculoskeletal disorders in the analysed period was 62%, for 58% for mental health conditions, 51% for nervous system disorders, and 59% for problems difficult to diagnose (the total index is higher than 100%, as various health problems may be

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concurrent) [3]. Among the mental health issues, post-traumatic stress disorder (PTSD) is the most frequently observed, and was found in over 393,000 cases. This diagnosis is followed by non-psychotic depressive disorders (over 321,000), neurosis (over 309,000), and affective disorders (over 203,000). After mood disorders, the patients usually tend to abuse psychoactive substances: alcoholism was diagnosed in over 92,000 patients, and addiction to psychoactive substances in approximately 54,000 of veterans. Abuse (without addition) of these substances was found in approximately 73,000 veterans. New phenomena include a growing number of additions to drugs, especially to opiates. The rates of fatal accidents due to medication overdose have also increased [12, 13].

The results of studies on the health of OEF/OIF/OND soldiers impact the evaluation and modifications in the VA healthcare system. Studies by Hoge et al. from the Walter Reed Army Institute of Research provided the first and most frequently cited data regarding mental health problems in soldiers deployed to Iraq. Serious mental problems were observed in 30% of soldiers examined 3 and 4 months after their return from Iraq. It is generally believed that healthcare and soldier preparation for combat in this war were significantly better than in the past. This explains the fact the more casualties in Iraq survive, but also more soldiers require intensive and long-term therapy after returning home. Brain injuries are specific for this war. For the past few years, all employees of VA healthcare had to have participate in a special training on the diagnosis and treatment of patients with brain injuries [1, 8].

It is estimated that 25% cases of traumatic brain injuries (TBI) remain undiagnosed, as the condition may be undetectable with the use of present brain testing methods. Imaging studies may not reveal injuries that consist in the breaking of microscopic neural connections in the brain. Every concussion involving loss of consciousness can result in TBI. The first symptoms quickly subside, and it is not until a few months after a veteran returns home that the family starts to worry about personality changes in their son or husband. The changes usually include memory issues, concentration disorders and problems with decision making. The veteran gets tired easily, shows discouragement and increased irritability. He may also demonstrate aggressive behaviour, which when combined with alcohol abuse poses a serious problem. Patients with TBI have the impression that everything around them is happening too fast. Their perception is limited [8].

Many patients with TBI do not understand their situation. They feel that something wrong is happening, but cannot identify the problem. It appears that TBI increases the predisposition to alcohol and narcotic

abuse. This further complicates establishing the right diagnosis, as the symptoms of TBI and addiction to psychoactive substances largely overlap. Moreover, some symptoms are caused independently by anxiety disorders, dissociative disorders, depression or PTSD associated with injuries [2, 3]. Studies indicate that one in five veterans returning from deployment demonstrate symptoms of PTSD. However, in soldiers who were wounded and lost consciousness, the number of diagnosed PTSD cases increases to 40% [1, 10]. PTSD may be caused by a life threat or a traumatic experience for which a person was not ready at the given moment. The sense of safety is destroyed in one second, and the intensity of the experience and the following events makes it impossible for normal cognitive processes to embrace and comprehend the situation. All that remains is a pure, live fear of the unnamed. Individuals with PTSD have problems with memory, sleep and emotion control. They often isolate themselves from their environment and avoid situations that could trigger "the demons hiding in their bodies". Many patients with PTSD symptoms do not understand their emotions and behaviour, and think that they are losing their minds. Families often exacerbate the problem by demonstrating a lack of patience and demanding that the veteran recovers and starts acting in a normal way.

The situation is worse for women. General healthcare personnel often do not ask if a woman served in the army, and patients do not mention it on their own. Women are rarely diagnosed with PTSD, and more often with depression or anxiety disorders [8, 14].

Bomb explosion triggers both physical and mental changes to the central nervous system. It may cause brain injury, as well as destroy the sense of safety. Therefore, PTSD symptoms are difficult to distinguish from signs of TBI. It is believed that the only differentiating symptom is the severe headache present in TBI. Patients suffering from PTSD and TBI often seek refuge from negative emotions in narcotics. It appears that the principal factor increasing the risk of addiction to psychoactive substances is the belief that they actually help to solve mental problems. In reality, alcohol and other chemical substances that lead to addiction only increase the scale of the problems [12, 13].

In women, the most frequent cause of PTSD, depression and other mood disorders are injuries due to sexual violence. It has been reported that 15% of women serving in the army were exposed to various forms of harassment and sexual attacks. Men can also be victims of sexual violence. The rate of sexual abuse of men is much lower, and the highest values reported in studies are 1%. However, considering the fact that the ratio of men to women in the army is approximately ten to one, the absolute numbers regarding victims of sexual

violence appear to be of the same order of magnitude for men and women. This information is very important for planning of specialist psychological and psychiatric assistance for the victims of traumatic events [15].

Until recently a man who had been a victim of sexual violence in the army had limited options in looking for help. Admission that a sexual act took place, even if it was a rape, could be interpreted as participation in a homosexual act, for which the victim could be discharged from the army. Ever since gay and lesbian soldiers can serve in the armed forces with the same rights as heterosexual ones, all cases of sexual violence, regardless of the victim's sexual orientation cannot be hidden under the threat of expulsion. However, victims are often still reluctant or unable to report cases of sexual violence to their superiors [15].

The most common reaction to mental problems in the army is abuse of psychoactive substances. Drawing from the experience after the war in Vietnam, when the number of drug addictions increased dramatically, the Department of Defense introduced a zero-tolerance rule for illegal narcotics, such as opiates, cocaine or amphetamine. Urine drug tests significantly reduced the use of illegal substances in the army, and it is believed that the problem applies to merely 3% of soldiers. However, the use of prescription analgesics and psychoactive substances is on the rise. In the group of veterans seeking help in VA facilities the rate of individuals with alcohol problem is much higher, up to 10%, and the percentage of soldiers abusing psychoactive substances increased to 5% [12, 13, 16]. Due to the internalised principle that a soldier always needs to be self-sufficient, veterans are unwilling to seek help in mental healthcare facilities. They are afraid that consulting a therapist or psychiatrist may put their military career in jeopardy. In addition, many mental problems are undetected or neglected by the healthcare system. For instance, it has been observed that in a group of over 56,000 veterans, 12% admitted to alcohol abuse, but only 0.2% were referred to therapy. Out of this small group only 29 veterans received treatment within 90 days [12, 13]. Studies comparing the conditions of healthcare for veterans and non-veterans revealed that, on average, veterans come for help some 4 years later, and achieve abstinence 7 years later than non-veterans. This is associated with the dominant belief that soldiers should cope with problems on their own, as well as with the historically grounded reluctant attitude of the healthcare system to soldiers addicted to psychoactive substances [12, 13, 16]. Therefore, special programmes are being introduced to reduce the stigmatising effect the diagnosis of dependency and mental disorder may have on veterans' motivation to seek assistance. One of them is Battlemid, and it makes use of the behaviours the

soldiers are trained to use to overcome problems in combat. The programme is based on the assumption that if soldiers could manage during war, they are capable of solving the problems they have brought back from the war. To deal with mental problems, veterans must make use of the options offered by the modern VA healthcare system [17].

All the above issues overlap with a phenomenon that moves American society the most, namely a much higher suicide rate among soldiers returning from Iraq than in the general population. According to some sources the number of suicides among veterans is over twice the rate among young people who are not veterans. Journalists quote the information from the VA source that the number of suicides has already exceeded the number of soldiers killed in the battle. Suicides are often associated with addiction to psychoactive substances, including medications [1, 6].

The highest suicide rate is observed in the groups that are most exposed to chronic stress. These include gays and lesbians. The latest changes in the official status of homosexual people in the army will surely result in a change in behaviour, including reduced incidence of violent behaviours in the military environment. However, it is too early for general conclusions and analyses. Training of mental resistance to stress is a prevention measure for the various forms of mobbing, indicating a change required in military culture [15, 18].

Many reviews were conducted with selected groups of veterans and their families to understand the scale of the problems faced by the soldiers returning from Iraq and Afghanistan. These conversations help to learn about the problems that proved elusive in previous tests. The most frequently mentioned issue is resentment towards the family and the fact they do not understand, do not wait, and have no patience, while soldiers cannot come to terms with themselves. Veterans do not know how to talk about the war. Everybody asks about their impressions from Iraq, but it is impossible to describe the atrocities of war to someone who did not experience them. Veterans want to be left alone. They cannot find a place for themselves in the world that abandoned them. They demonstrate difficulties with emotion control, frequent bursts of anger, and exaggerated reactions to every unexpected sound. They are afraid of any item lying on the ground before them. They are afraid of stepping onto the lawn, as they remember there might be a bomb. Veterans often fall ill. If they work, they need to take time off to see the doctor. They drink and smoke a lot, they have trouble with sleeping, and their families suffer, which often leads to divorce [8, 9].

What can help veterans? First and foremost, they need to be prepared for life after the war [3, 9, 12]. Just as military training was required before the mission,

training for civilian life is also necessary. For a way of life that will never be the same. Soldiers must understand the price they pay for surviving the war. They need to understand that the problems they are experiencing after their return from Iraq may be symptoms of TBI or PTSD. Families of veterans should receive the same information, to be able to recognise and deal with the difficulties occurring after the return of their loved one. Moreover, special therapy and services will be required. Many veterans will need activities to train memory and concentration. They will require a change of lifestyle, to eliminate abuse of alcohol or other narcotics [9, 19]. The healthcare system must be prepared for providing adequate mental support in dealing with depression and suicidal thoughts.

Multiple government and non-government institutions in the USA specialise in helping veterans to find jobs and cope with financial problems. Veterans expect from society that the changes in their personality and health will not be a curse, that the experience of war will predispose them to play a unique and positive role in social life [8, 14].

One of the reasons young people enrol in the army is the warranty of a good financial situation for themselves and their families. Unfortunately, physical and mental war injuries often result in a change of plans. Instead of securing a good future for themselves, many young people cannot find a suitable job after leaving the army, and have to rely on social welfare. Therefore, accurate diagnosis is of great importance, as it determines the monthly payment veterans receive to compensate for the lost physical and professional aptitude.

The relationship between the diagnosis and the size of monthly payment may explain the difference between PTSD diagnoses in the American army, and in the Polish Armed Forces. In the American army the rate is significantly higher [3, 14, 20]. The difficulty and complexity of life after deployment in Iraq and Afghanistan, reluctance to seek psychiatric assistance, impaired emotion control and the associated family problems, issues at work, or even breaking the law prompt the VA healthcare system to form integrated specialist teams, in which social workers play a special role. A social worker in VA is a clinician who can establish a psychiatric diagnosis and conduct therapies for mental disorders. Many of them lead multidisciplinary teams of specialists working with individual veterans who have a range of various needs. The same social worker must know how to help the veteran's family, how to prepare the veteran for finding a suitable job and accommodation, and applying for the due financial reimbursement. This multifunctionality requires training. Therefore, many schools offering courses in social care

introduce a special discipline to prepare students for work with soldiers and veterans [8].

Apart from training for specialists, new training for soldiers is being introduced, to prepare them for the changing conditions of war and life after the army. According to a plan published in the recent years, over a million soldiers of the American Army will receive special training to resist stress and safety threats. The training is based on the principles of cognitive therapy and coping with negative emotions. Many officers ask themselves if this treatment of soldiers will not weaken their combat spirit, but everyone realises that a change is required so that soldiers can enjoy their lives after returning from war. Millions of dollars have been spent to change the military culture: instead of drinking with colleagues, soldiers will learn how to talk about their feelings and emotions. And this is not war - it is a revolution [2, 11, 29].

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# Development of a modern biological defence system for the Polish Armed Forces according to NATO requirements

Budowanie nowoczesnego systemu obrony przed bronią biologiczną Sił Zbrojnych RP zgodnego z wymaganiami NATO

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**Abstract.** This paper discusses the genesis of the biodefense system of the Polish Armed Forces, created according to the NATO standards.

Special attention has been given to the cooperation (initiated in 1994) between the Military Institute of Hygiene and Epidemiology (MIHE) and the U.S. military research institutions responsible for chemical and biological defence, including the Edgewood Research Development and Engineering Center and many others. The collaboration resulted in the acquisition of significant knowledge and experience. The personnel of MIHE has been trained in the USA to detect and identify biological agents, several scientific conferences have been organized, and a number of joint field and laboratory exercises covering biological agent detection and identification have been conducted (e.g. at Dugway Proving Ground, USA). Thanks to the collaboration, the first Biosafety Level-3 (BSL 3) laboratory was established in Poland and a network has been formed of military Biological Reconnaissance Teams, operating throughout Poland. Moreover, a special reconnaissance unit was created, designated for overseas missions (taking part in Operation Iraqi Freedom).

The Biological Threats Identification and Countermeasure Centre of the MIHE has become a part of the international network (such as the NATO laboratory network, US DoD-GEIS, EBLN, EVD-LabNet) responsible for the monitoring and identification of biological agents.

**Key words:** biodefense system, NATO, Polish-American cooperation, Polish Armed Forces

**Streszczenie.** W artykule omówiono genezę utworzenia systemu obrony Sił Zbrojnych RP przed bioterroryzmem i bronią biologiczną, zgodnego ze standardami NATO, ze szczególnym uwzględnieniem znaczenia rozpoczętej w 1994 r. współpracy między Wojskowym Instytutem Higieny i Epidemiologii (WIHiE) a wojskowymi i naukowymi placówkami w USA odpowiedzialnymi za obronę przed bronią chemiczną i biologiczną, takimi jak Edgewood Research Development and Engineering Center.

W wyniku tej współpracy zdobyto niezbędną wiedzę i doświadczenie, m.in. przeszkolono pracowników WIHiE w USA w zakresie wykrywania czynników biologicznych, organizowano konferencje naukowe oraz brano udział w ćwiczeniach poligonowych i laboratoryjnych nad wykrywaniem czynników biologicznych (m.in. Dugway Proving Ground, USA). Dzięki podjętej współpracy utworzono pierwsze w Polsce laboratorium III stopnia hermetyczności (BSL 3), a także utworzono Zespoły Rozpoznania Biologicznego działające na obszarze Polski. Ponadto utworzono jednostkę rozpoznawczą do działania poza granicami kraju, która uczestniczyła w operacji Iraqi Freedom. Ośrodek Diagnostyki i Zwalczania Zagrożeń Biologicznych WIHiE został włączony do międzynarodowych systemów monitorowania i wykrywania czynników biologicznych (sieć laboratoriów NATO, US DoD-GEIS, EBLN, EVD-LabNet).

**Słowa kluczowe:** system obrony przed bronią biologiczną, Siły Zbrojne RP, NATO, współpraca polsko-amerykańska

Delivered: 18/10/2018

Approved for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97 (1): 56-64

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March 2019 marks the 20th anniversary of Poland's accession to the North Atlantic Treaty Organization (NATO). This historic change in the geostrategic position of Poland caused a change in the defence doctrine, as well as significant changes in the structure and equipment of the Polish Armed Forces (PAF), including within the scope of defence from weapons of mass destruction, and the specific category of biological weapons. The issue is also a significant component of the defensive doctrine of NATO, which is taken into account in many documents, including AMedP-6(C): "The nations of NATO remain highly vulnerable to the strategic, tactical, and terrorist use of biological weapons. As the military and economic gaps between nations grow, and as some less advantaged nations seek a balance of power, there may be a tendency by these nations to overcome their disadvantage by choosing weapons of mass destruction that can be produced easily and cheaply" [1]. Poland as a member state of NATO was obliged to adjust PAF to the standards of the organization (including doctrines and standardization agreements, known as STANAG).

This paper presents actions undertaken in order to organize a modern system of defence from biological weapons in PAF, compliant with above mentioned standards. Those actions included use of new techniques for the detection and identification of biological pathogens which could be implemented in the field thanks to technological progress. Some of the facts are accounts by people who had the honour of actively participating in the process.

The first initiatives to establish cooperation with NATO countries in the scope of modification of biological defence system started in 1994 as a part of the "Partnership for Peace" program. It should be underlined that the early initiative of cooperation was started by the military scientific institutes of USA and Poland, despite the initial passive and sometimes even unfavourable attitude on the part of their superiors, including those from the General Staff of the Polish Army. Soon, however, the attitude of the superiors changed dramatically.

The first contacts as part of the "Partnership for Peace" program were established in Autumn 1994 by representatives of U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground. Establishing contact with the Veterinary Research Centre of the Military Institute of Hygiene and Epidemiology in Puławy (MIHE) resulted in a visit by an American delegation consisting of: Peter J. Stopa PhD and Richard Smardzewski PhD in December the same year, who acquainted themselves with the research issues of the Institute and the equipment and qualifications of the staff at the centre. The effect of the visit was a declaration of

cooperation and invitation to a scientific conference in Edgewood in 1995 dedicated to biological defence. A delegation from MIHE (Prof. J. Mierzejewski and Col. M. Bartoszcze, PhD) took an active part in the conference, during which Prof. Mierzejewski gave a lecture on the role of Gen. Kazimierz Sosnowski in establishing a ban on bacteriological weapons as part of the 1925 Geneva Protocol. The lecture was met with interest and the delegation of MIHE was welcomed warmly. The American hosts ensured that the delegation met a renowned epidemiologist, Donald A. Henderson, PhD, who on behalf of WHO directed actions leading to the complete eradication of smallpox in the world [2]. During that period, the development of cooperation was also supported by the American Liaison Mission, and especially its head, Colonel Gren R. Tanner, who along with his deputy, Lieutenant Colonel Thomas C. Kurasiewicz, visited MIHE twice (the first visit of the mission took place in May 1996). As a result of the cooperation, a group of officers of the Veterinary Service of the Polish Military (Col. A. Skoczek, PhD, Col. E. Niedoba, PhD and Col. M. Bartoszcze, PhD) visited American bases in Vicenza (Italy) and Ramstein (Germany), familiarizing themselves with the defence of the US military in respect of the safety of food supplied from the base directly to forces located in various parts of the world.

During another visit of the commander of MIHE, Col. Prof. K. Chomiczewski, and the deputy of Col. M. Bartoszcze, PhD to a conference in Edgewood in November 1996, the results were presented of research into the faster detection of anthrax spores with a luminometric method, a method which allowed detection of spores within 15 minutes [3]. Due to the very short analysis time, the report was met with high interest. During the visit, the MIHE delegation was received by the commander of U.S. Army Chemical Biological Defense Command, Major-General George E. Friel. During the talks, the general declared large interest in cooperation with Poland, and spoke with great affection about Poland and Poles, the common history and national heroes. General Friel approved the plans of cooperation with MIHE presented to him by Peter Stopa, PhD. During the visit, the American hosts allowed us to see five of the most important research institutes of the U.S. Armed Forces: U.S. Army Medical Research Institute of Infectious Diseases in Fort Detrick (fig. 1), Walter Reed Army Institute of Research, Armed Forces Radiobiology Research Institute, Armed Forces Institute of Pathology and Medical Research Institute of Chemical Defense. During the visit, George Farnini, PhD, responsible for international cooperation in the Centre in Aberdeen, familiarized us with the draft of the official agreement developed by the American party, which enabled strict

cooperation between our centres and an exchange of information. On the following day, Dr Famini presented the draft in our presence to the deputy of Polish military attaché in Washington with a request to send the draft of the agreement through diplomatic channels to the Ministry of National Defense. Our attaché showed genuine interest in the initiative.

Despite certain obstacles which we eventually overcame, the document known as "Information Exchange Annex IEA-96-PO-1556, US-Poland Master Information Exchange Agreement Concerning Technologies for the Detection and Analysis of Biological Materials" was concluded on 13 December 1996 in the Ministry of National Defence by Anita Jones, PhD - National Defence and Engineering Research Director in the Office of Under-secretary of Logistics and Technology of the Defence of USA, and Col. Prof. Bogusław Smólski, PhD, Eng, Head of the Department of Development and Implementation of the National Ministry of Defence (fig. 2). During this event, MIHE was represented by the head of the institute, Col. Prof. Krzysztof Chomiczewski, PhD, and his deputy, Col. M. Bartoszcze, PhD. Together with the entire delegation and employees of Defence Cooperation Office of the American Embassy, Anita Jones, PhD also paid a visit to MIHE, interested in the activity of the institute in the field of biological defence and promised a great measure of assistance in development of cooperation in the field. It should be underlined that it was the first agreement between the military research institutes of Poland and USA. It was extended on 21 May 2004 as Information Exchange Annex IEA-A-03-PL-1688 US-Poland Master Information Exchange Agreement Concerning Technologies for Biological Defense (signed by the head of ECBC, James Zarzycki, and head of MIHE - Col. Prof. Marek Janiak).

Signing of the document greenlit a number of valuable initiatives, which allowed the organisation and development of modern elements of the biological defence system, and the effects of their implementation were soon clear. As early as 19–22 May 1997 in Warsaw, in cooperation with the Centre in Edgewood, MIHE organised the NATO Advanced Research Workshops on fast methods of environmental monitoring for the presence of harmful biological factors. The coordinator of the conference was the NATO Scientific Committee in Brussels, NATO represented by Peter J. Stopa, PhD and Poland represented by Col. Prof. Krzysztof Chomiczewski and Col. Michał Bartoszcze, PhD.



**Figure 1.** MIHE delegation in US Army Medical Research Institute of Infectious Diseases at Fort Detrick. Director of USAMRIID, Col. David R. Franz, PhD – second from the right (Maryland, USA, 1996)

**Rycina 1.** Wizyta delegacji WIHiE w Medycznym Instytucie Badawczym Chorób Zakaźnych Armii Amerykańskiej w Fort Detrick. Drugi od prawej stoi komendant Instytutu, płk dr David R. Franz (Maryland, USA, 1996 r.)



**Figure 2.** Signing of IEA-96-PO-1556 annex to the Information Exchange Agreement between the USA and Poland concerning technologies for the detection and identification of biological materials (Warsaw, 1996)

**Rycina 2.** Podpisanie w MON aneksu IEA-96-PO-1556 do porozumienia o wymianie informacji między USA i Polską, dotyczącego wymiany informacji o technologiach do wykrywania i identyfikacji materiału biologicznego (Warszawa, 1996 r.)

A total of 52 people participated in the workshops, including 40 foreign scientists (USA, Canada, Germany, France, Netherlands, Austria, UK, Romania, Russia, Ukraine, and Czech Republic). 55 scientific contributions were presented and 3 panel discussions took place. All contributions were published in a monograph published by a worldwide scientific publishing house [4]. These were the first NATO scientific workshops in Poland concerning military healthcare. They were positively evaluated by the participants due to the opportunity to learn about the most recent global diagnostics technologies, participate in discussions and establish direct contacts with renowned scientists of NATO member states.



**Figure 3.** MIHE delegation during exercises at the Dugway Proving Ground (Utah, USA, 1998)

**Rycina 3.** Wizyta delegacji WIHiE na ćwiczeniach na poligonie Dugway (Utah, USA, 1998 r.)

MIHE officers were honoured by invitation to the “Joint Field Trials 5” exercises at the testing ground in Dugway, Utah, which was proof of American interest in further cooperation (fig. 3). There were two exercises with the aim of perfecting the systems and methods of detection and identification of militarily significant biological pathogens. Col. Chomiczewski and Col. Bartoszcze participated in the first exercise on September 1998. It was the first visit by Polish officers in the history of that large testing ground. The goal of the six day long exercise was perfecting the methods of early detection of biological aerosols.

Col. Bartoszcze, along with a team comprising A. Bielawska, MSc. and U. Szymajda, MSc from the Centre in Puławy, participated in the second exercise, a three week long laboratory test “Joint Field Trials 5 - Laboratory Test”, which took place on January 1999. Our team won the recognition of the organisers of the exercises, who assessed their level of preparation and qualifications as very high. Poles were the only foreign team invited to the exercises. It is worth noting that during the next annual visits of MIHE’s delegation the American hosts allowed us to participate in interesting meetings and also visit other scientific centres and military units. It is worth mentioning a passionate meeting with Professor Ken Alibek in 1999 who, as Col. Kenatjan Alibekow, PhD, was one of most renowned Soviet experts on the production of biological weapons and a deputy head of the “Biopreparat” combine, which supervised institutes and plants manufacturing biological weapons. In 1992, he arrived in USA and, having passed appropriate procedures, became a valued American specialist in the field of biological defence. A sign of the



**Figure 4.** The doctoral Oath of Peter J. Stopa PhD in MIHE (Warsaw, 1999)

**Rycina 4.** Dr Peter J. Stopa składa przysięgę doktorską w WIHiE (Warszawa, 1999 r.)

highest trust and good cooperation was the May 2001 visit by Col. Chomiczewski and Col. Bartoszcze to an extraordinary unit of the Marine Corps, specialising in counteracting threats posed by weapons of mass destruction (e.g. responsible for security at the White House) and an opportunity to observe a demonstration by the special forces.

Other effects of formal strengthening of Polish-American cooperation in the field of biological defence were: annual international scientific conferences organised in Puławy, financing of annual scholarships for 6 employees of the centre in Puławy by DARPA (Defense Advanced Research Project Agency), who in the Molecular Biology Institute of Scranton University (Pennsylvania) were able to learn pathogen identification methods which utilised the most modern methods of molecular biology, submission of doctoral thesis in MIHE by a scientific employee of the U.S. Army (fig. 4) or the significant financial aid of the US Defense Department in equipping the first BSL-3 laboratory in Poland (Biosafety Level-3 according to WHO, and European Containment Level 3 according to the current EU nomenclature) in the Biological Threats Identification and Countermeasure Centre (former Veterinary Research Institute) of MIHE in Puławy (fig. 5).



**Figure 5.** Opening ceremony of containment level 3 laboratory (BSL-3) at the Biological Threats Identification and Countermeasure Centre in Puławy. The ribbon is cut by Ms. Betty Dent (deputy director of Office of Defence Cooperation of US Embassy in Warsaw), next to her stands Prof. Vito Del Vecchio (Scranton University), Peter J. Stopa PhD stands in the middle (Puławy, 2002)

**Rycina 5.** Otwarcie laboratorium III stopnia hermetyczności w Ośrodku Diagnostyki i Zwalczania Zagrożeń Biologicznych w Puławach. Wstęgę przecina Pani Betty Dent – zastępca dyrektora Biura Współpracy Obronnej Ambasady USA, obok prof. Vito del Vecchio z Uniwersytetu w Scranton, w środku dr Peter J. Stopa (Puławy, 2002 r.)

The long road of Poland to NATO, which began in 1992, ended in 1999. On 17 February 1999, the Sejm and then the Senate adopted an act on the ratification of the North Atlantic Treaty, which was signed on the following day by the President. On 26 February, President A. Kwaśniewski signed the act of accession of Republic of Poland to the Treaty, countersigned by the Prime Minister. On 12 March 1999, in Independence, Missouri, the Polish Minister of Foreign Affairs, Prof. B. Geremek handed the document to the US Secretary of State, M. Albright. In that moment the Republic of Poland became formally a member of the North Atlantic Treaty Organization [5].

Since the accession of Poland to NATO in 1999 the representatives of Military Institute of Hygiene and Epidemiology have actively participated in the Human Factors and Medicine Panel of the NATO Science and Technology Organisation (STO) (Prof. M. Haniak), the NATO Bio-Medical Advisory Committee (BioMedAC) (Prof. M. Janiak, Col. J. Kocik, PhD, Lt. Col. A. Michalski, PhD), the NATO Chemical Biological, Radiological and Nuclear Medical Working Group (CBRN Med Working Group - Col. O. Antkowiak, PhD), Task Force of the HFM Panel on the biomedical effects of ionizing radiation (Prof. M. Janiak, E. Nowosielska, PhD.), group 005 HFM (Prof. M. Bartoszcze), Task Force of the HM Panel on defence from the influence of 3 KHz - 300 GHz electromagnetic fields, COMEDS Working Group on

Hygiene, Food Technology and Veterinary Service (Prof. J. Bertrandt, Prof. M. Bartoszcze) and COMEDS Working Group on Military Healthcare (Col. J. Kocik, PhD., Lt. Col. A. Michalski, PhD).

The next NATO Advanced Research Workshops were organised in Warsaw in November 2000 - "Implementation of Legally Binding Measures to Strengthen the Biological and Toxin Weapon Convention" (directors Col. Prof. Krzysztof Chomiczewski and Col. Henri Garrigue, PhD from the NATO Headquarters).

The participation of MIHE representatives in different NATO bodies contributed to the development of new STANAGs, where the implementation reinforces the potential and interoperability of the alliance's forces. Col. J. Kocik, PhD conducted training in the NATO Advanced Research Institute on the Protocol to Biological Weapons Convention, and the other representatives of the Institute (Col. M. Niemcewicz, Lt. Col. A. Michalski) conducted lectures for NATO on the biological factors of biological security and on biological weaponry (Biological Warfare Defence Awareness Course) in the NATO School in Oberammergau (Germany). In 2000, MIHE participated as the sole Polish research institute in the NATO-SIBCRA laboratory tests (Sampling Identification of Biological, Chemical, and Radiological Agents) which lasted for several years and verified the capacity for identification of coded samples. Intra-laboratory comparative tests were a great opportunity to perfect and review diagnostic capacity for the identification of reference material of biological weaponry agents which were not available every day. It should be emphasized that the above mentioned initiatives and experience proved to be invaluable in 2001 during the anthrax attacks in USA and the appearance of the same type of threats in many other countries, including Poland. The role of MIHE, and the knowledge and experience acquired before, proved to be crucial in defending the Polish Armed Forces and the country from the threat.

The participation of representatives of the institute (Lt. Col. R. Gryko, PhD) in 2002 at the NATO summit in Prague, where the Biological Response Team was presented, met with great interest and recognition of the participants, and should be mentioned among the more important initiatives implemented in the period. The NATO Summit in Prague was significant for NATO and spurred the development of the defence capacity against weapons of mass destruction, and in particular biological defence. Between 2003 and 2009, Prof. Krzysztof Chomiczewski was appointed as the sole representative of Poland to the position of biological weaponry expert of the Civil Protection Committee NATO).

Sessions of Working Group - WG FHTAV NATO organised by MIHE in Warsaw (Prof. J. Bertrandt, Prof.

M. Bartoszcze) were a matter of prestige, during which a number of documents essential for the security of food supplied to the armies were approved. This event was also an important element for the promotion of the Polish Armed Forces and Poland within NATO circles.

Further NATO advanced technology workshops organized by MIHE were also successful (Col. J. Kocik, Col. Prof. M. Janiak), organised in 2003 in Warsaw and called "Preparedness Against Bioterrorism and Re-Emerging Infectious Diseases", and contributed greatly to the understanding of modern biological threats and the development of effective methods of detecting and counteracting the threats.

The establishment of Biological Identification Teams in 2001 was an achievement that strictly related to the development of a biological defence system. The foundations of the system and the first concept for establishing such systems were developed by a team from the Military Institute of Hygiene and Epidemiology (the main proponents were Col. K. Chomiszewski and Col. M. Bartoszcze), and such a proposal was officially submitted to the Head of Healthcare of the Polish Military at the end of December 1999. The initiative was received favourably by Brig. Gen. A. Trybusz, but organisational and financial obstacles did not allow the implementation of the initiative the following year. As late as January 2001, the first two BITs were established at MIHE (in Warsaw and Puławy) and on 2 April of 2001 the BITs commenced operations in all Provincial Sanitary-Epidemiological Stations, established by the order of a representative of the Ministry of National Defence in the field of Departmental Health Care - Head of Military Healthcare of 27 March 2001. The staff of those teams was already trained at the centre in Puławy between 23 and 27 April. Biological Identification Teams were planned as basic components capable of fast and preliminary identification of biological threats. The tasks of the teams in field conditions include: sampling and securing material suspected to be contaminated, securing contaminated areas, preliminary identification of the pathogen and transportation of appropriately secured samples to the MIHE Biological Threats Identification and Countermeasure Centre in Puławy or another accredited lab. MIHE as a scientific institute recommended the teams to implement modern methods of detecting and identifying biological agents under field conditions, including the mentioned luminometry, fast immunochromatographic tests or real time PCR, which at the time was becoming a technology not only available in laboratories but also in field conditions. Initially, the teams were not adequately supplied due to financial problems. The situation changed dramatically in autumn 2001 when, due to events in the USA (letters containing anthrax), the superiors became aware of the dangers of



**Figure 6.** MIHE officers of the mobile laboratory team during the Iraqi Freedom Operation mission (Iraq, 2003)

**Rycina 6.** Załoga laboratorium mobilnego złożona z oficerów WIHiE w czasie misji Iraqi Freedom (Irak, 2003 r.)

bioterrorism. The budget of the Ministry of National Defence included funds for fully equipping the teams who, at the turn of 2001 and 2002 obtained: specially adapted vehicles, power generators, tents, disinfection cabins, gas-proof protective suits, equipment for sampling, reagents and disinfectants.

A team prepared for operations abroad was formed from two teams in MIHE in the spring of 2002. The team was additionally equipped with an off-road vehicle and field diagnostics equipment (including field RAPID PCR set) used in 2003 in Iraq as a part of operation Iraqi Freedom, and fulfilled its mission (with a staff rotating every 6 months) until the end of the operation in 2008 (fig. 6).

In the period of accession to NATO and the following years, the Polish Armed Forces carried out a multidirectional restructuring which also included the Military Sanitary Inspection. In 1999, Military Sanitary and Epidemiological Stations were formed from the prior five District Sanitary and Epidemiological Stations, assigned with appropriate territorial jurisdictions; whereas on 1 March 2003, after a merger with the Military Veterinary Inspection, a new structure in the Polish Military was formed on the basis of reorganisation of the MSEP - Military Centres of Preventive Medicine (MCPM), which also included Military Pharmaceutical Inspection in 2007. Biological Identification Teams were included in the MCPM. The merger of two inspections (sanitary and veterinary) increased the capacity for the identification and counteraction of biological actions. Those measures were accompanied with equipping the laboratories with a modern apparatus enabling fast and precise microbiological diagnostics. Gradually all microbiological laboratories in MCPM were modernized to meet the criteria of BSL-2 (currently Containment

Level 2). Thanks to the merger of inspections, different specialists were given opportunity of close cooperation, which also allowed the provision of appropriate staff for the BIT teams (doctors, vets, and microbiologists). As a result of later reorganisation measures, teams like Biological Identification Sections became parts of Epidemiological Response Teams of MCPM along with Medical Evacuation Section and Deactivation and Decontamination Section. Currently BITs are present in the Military Centres of Preventive Medicine (Modlin, Bydgoszcz, Gdynia, Wrocław and Kraków), at the Epidemiological Response Centre of the Polish Armed Forces in Warsaw and a corresponding team in the Central Institute of Contamination Analysis (the unit forms part of the chemical forces).

The Veterinary Research Centre of the Military Institute of Hygiene and Epidemiology in Puławy became a laboratory facility for the diagnostics of militarily significant biological pathogens thanks to the trained specialists and collaboration with American centres (since 2002 the Biological Threats Identification and Countermeasure Centre - BTICC), which performs the role of referential laboratory for biological agents of weapons of mass destruction, specified in a regulation of the Ministry of National Defence [6]. As mentioned above, since 2000 the centre is the sole institute in Poland to participate in the annual international SIBRCA laboratory tests organised by NATO, showing proficiency in the detection and identification of biological weaponry agents.

The formation of a microbiological laboratory with an increased security level (e.g. BSL-3 according to WHO) as an important element of the biological system was an important event (fig. 5). An intradepartmental group of experts assumed that a natural place to establish such a laboratory for the needs of the Armed Forces was BTICC MIHE in Puławy. The investment required significant financial expenditure on both overhauling part of a building of the centre as well as outfitting it with appropriate equipment and apparatus. The project gained the support of the executives of the Ministry of National Defence, the Office of National Security and the Office of Defence Cooperation of the US Embassy. Thanks to a significant support from the Office of National Security, it was possible to acquire an investment grant for building a laboratory from the Committee of Scientific Research. Thanks to the aid and direct involvement of the US Embassy in Warsaw, it was possible to acquire the above-mentioned funds from American FMS fund for equipping the laboratory with modern apparatus (e.g. class II and III chambers for safe microbiological work, PCR sets, readers and scrubbers for ELISA, HEPA filtration system, equipment of sterilization room). The personal interest of Ambassador

Christopher R. Hill and great involvement of the head of the Office of Defence Cooperation of the Embassy, Col. Peter J. Podbielski and his deputy, Ms Betty Dent, in the implementation of the project should be emphasized. Specialists from the Centre of Applied Microbiology Research (CAMR) in Porton Down (UK) participated along with their American colleagues in consultations concerning technical issues. A group of five American experts arrived before the opening of the laboratory in order to perform a validity assessment in terms of biological security compliant with American standards. The outcome of the audit was positive. The opening ceremony of the laboratory took place on 25 April 2002. [7] In 2013, thanks to subsidies from MNiSW and American funds, a second Level 3 laboratory was commissioned, which specialised in viral diagnostics. Currently the centre in Puławy has Level 3 biological security bacteriological and viral laboratories and staff with highest qualifications and state-of-the-art diagnostic apparatus. The centre is connected to a network of laboratories which monitor the epidemiological situation in the world and newly appearing dangerous biological agents, including the NATO microbiological laboratories of the military Global Emerging Infections Surveillance and Response System), European Bio-Defence Laboratory Network (EBLN-EDA) and European Emerging Viral Diseases-Expert Laboratory Network (EVD-Labnet).

A unique and important event which confirmed close scientific cooperation between the Military Institute of Hygiene and Epidemiology and scientific institutes of the US Armed Forces was the defence of the doctoral dissertation of Peter J. Stopa, a scientific employee of the US Army ECDC titled "The application of flow cytometry for the detection and identification of microbiological agents" before the Scientific Council of the Military Institute of Hygiene and Epidemiology on 28 December 1999 (dissertation supervisor: Col. Prof. Michał Bartoszcze, reviewers: Prof. Vito del Vecchio, Prof. Jerzy Mierzejewski and Prof. Józef Knap). It was the first such event in the history of research collaboration between military scientific institutes of Poland and the USA. There was great interest in the submission, and high ranked representatives the Ministry of National Defence and the US Embassy in Warsaw participated in the ceremony (fig. 4).

Another important event for the biological defence system was the formation of the Epidemiological Response Centre of the Armed Forces of Poland (ERC AFP). The unit was created on the basis of the 74th anti-epidemic battalion, previously existing in MIHE, expected to be mobilized in case of "W". This was the result of several years of activities aiming at creating a fully professional unit with modern equipment, high

mobility, able to counteract biological threats, both in the times of war and peace. The role of the first and long-serving commandant of ERC ARP, Col. Artur Zdrojewski, PhD, should be emphasized. The colonel's involvement and experience acquired from MIHE as a commander of BIT and the 74th antiepidemic battalion contributed to the fact that the unit reached high standards very quickly. The formation of ERC AFP was connected with the dissolution of the Biological Identification Teams in MIHE and increasing the scientific activity of the institute. However, the knowledge and skills acquired by the staff of MIHE in the field of environmental diagnostics resulted in their involvement in the training process of the staff of ERC AFP, BIT WOMP, COAS and units of the Ministry of Internal Affairs: BOR, PSP, ABW. Furthermore MIHE was involved in the accreditation process of the biological component of the Multinational Weapons of Mass Destruction Defence Battalion of the 12th set of SO NATO in the field of the ability of sampling and detection of biological agents. Acquisition of the mentioned skills by the teams is key to successful response to incidents which involve particularly dangerous bacteria, viruses and toxins.

ERC ARP also organizes training, exercises and conferences, and participates in domestic and international exercises concerning mass events, especially those involving biological weapons, participates in the activity of 3 NATO teams (Medint, JHAFG, MMSOP). For many years it has cooperated closely with the National Guard of Illinois, which resulted in joint exercises in Poland and USA. It has also cooperated with the medical services of Slovakia and Hungary. The staff of the centre has participated in foreign missions in Iraq, Chad, Afghanistan and Kosovo, working in mobile microbiological laboratories [8]. The unit is well equipped with modern equipment and apparatus. These include a set for the mass decontamination of people, including the injured, a field hospital with 40 beds, adapted for the hospitalization of people infected with especially dangerous infectious diseases, and mobile laboratories, including a microbiological laboratory in a container, equipped with modern diagnostic apparatus (RAPID sets, PCR sets, spectrophotometer).

Despite the demonstrated capabilities, the biological defence system of the Armed Forces requires constant improvement in the field of equipment and organisation, as well as adjustment to increasing allied requirements. Aside from excellent prototypes of LIDAR devices for early detection of airborne biological attack, tested in various field conditions and developed at the Optoelectronic Institute of the Military Institute of Technology, we still do not possess such devices in Poland. A system of quick real time epidemiological

supervision has not been introduced so far and a full system of medical investigation has not been developed. The current system of reporting infectious diseases and suspected cases is slow and not very effective. The stationary military hospitals lack infectious disease wards adapted for hospitalization of patients suffering from especially dangerous infectious diseases. The only four small high-degree isolation wards in Poland were created as a part of the civilian health care system, at the infectious diseases clinics in Warsaw, Gdańsk, Chorzów and Wrocław. In a time of need such units can be organised thanks to mobile isolation units, which can be installed in closed rooms, meeting high requirements of biological safety and staff protection.

It is important that Poland, in contrast to its neighbours (Germany, Belarus, Czech Republic, Russia and Belarus), still has no laboratory with the highest level of safety (BSL4 according to WHO or Containment Level 4 according to the nomenclature of the EU), which would allow to fully diagnose the most dangerous pathogens, such as smallpox, Ebola fever, Marburg disease or Crimean Congo haemorrhagic fever. Unfortunately, in spite of several positive declarations issued by the decision makers, and developed construction design concepts in Puławy or Warsaw, we still have no funds and the decision on building such infrastructure is taking ever more time [9]. Even the Parliamentary Health Commission discussed the issue; however, in spite of the opinions of many experts (including Prof. M. Bartoszcze and Prof. J. Knapa who were invited to the session), they did not express an understanding or support for the project.

In conclusion, it should be emphasized that activities undertaken to develop a modern biological defence system compliant with NATO standards began 25 years ago, 5 years before Poland's accession to the organisation. They began with developing and tightening scientific cooperation, mainly between the MIHE and scientific institutes of the American military, especially with U.S. Army ECBC in Edgewood. The result was mutual scientific research, training of the staff at the best American centres and the great assistance of our American allies in constructing and equipping the BSL-3 laboratory in Biological Threats Identification and MIHE Countermeasure Centre in Puławy. The beautiful motto of the U.S. Army ECBC *Cum scientia defendimus* was thus implemented. After the accession of Poland to NATO, organisational activities were undertaken on that basis, which led to the formation of well-equipped and trained units, able to act in various conditions, also abroad, which are important elements of the biological defence system. However, there are still parts of the system which require urgent measures to meet all NATO requirements. We hope that the planned and continued

undertakings concerning the Armed Forces will facilitate improvement of other elements of an efficient biological defence system.

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# Retinopathy caused by chloroquine or hydroxychloroquine

## Retinopatia wywołana chlorochiną lub hydroksychlorochiną

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**Abstract.** Antimalarial drugs (chloroquine and hydroxychloroquine), used for extensive periods to prevent malaria, are also useful in the treatment of systemic lupus erythematosus, rheumatoid arthritis and other autoimmune disorders. Recent studies have shown that these drugs have anticancer, antidiabetic and antiretroviral effects. They have relatively few adverse events, most of which are mild and reversible. The most serious treatment complication is irreversible, bilateral bull's-eye retinopathy, which becomes symptomatic only at the advanced stage and leads to permanent loss of vision. The growing number of patients who use chloroquine and its derivative in long-term therapy makes it necessary to educate both patients and physicians (ophthalmologists, rheumatologists, dermatologists, diabetologists, and oncologists) on the need to screen for retinopathy from the start of taking these drugs. The aim of this review is to present the characteristic symptoms of ocular toxicity, risk factors and current recommendations for monitoring patients who use antimalarial drugs.

**Key words:** antimalarial drugs, bull's eye retinopathy, chloroquine, hydroxychloroquine

**Streszczenie.** Leki przeciwmalaryczne (chlorochina i hydroksychlorochina) od dawna stosowane w profilaktyce malarii, są również użyteczne w leczeniu chorób autoimmunologicznych, m.in. toczenia rumieniowatego układowego i reumatoidalnego zapalenia stawów. Ostatnie badania wykazały, że leki te wykazują działanie przeciwnowotworowe, przeciwcukrzycowe i przeciwretrowirusowe. Mają stosunkowo niewiele działań niepożądanych; większość z nich jest łagodna i odwracalna. Najpoważniejszym powikłaniem leczenia jest nieodwracalna obustronna retinopatia typu bawolego oka, która staje się objawowa dopiero w zaawansowanym stadium, prowadząc do ciężkiego uszkodzenia widzenia. Rosnąca liczba pacjentów stosujących chlorochinę i jej pochodną w leczeniu długoterminowym sprawia, że konieczne jest zwiększenie świadomości pacjentów oraz lekarzy różnych specjalności (okulistów, reumatologów, dermatologów, diabetologów, onkologów) na temat konieczności przeprowadzania badań przesiewowych w kierunku retinopatii od początku przyjmowania leków. Celem opracowania jest przedstawienie charakterystycznych objawów okulistycznych toksyczności, czynników ryzyka oraz aktualnych zaleceń dotyczących monitorowania pacjentów, którzy stosują leki przeciwmalaryczne.

**Słowa kluczowe:** retinopatia typu bawole oko, leki przeciwmalaryczne (LPM), chlorochina (CQ), hydroksychlorochina (HCQ)

Delivered: 22/08/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 65-70

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## Introduction

Antimalarial drugs (AD) such as chloroquine (CQ) and hydroxychloroquine (HCQ), apart from their primary indications such as the prophylaxis and treatment of malaria, are widely used for numerous other therapeutic indications: in rheumatic diseases (systemic lupus erythematosus, rheumatoid arthritis), infectious diseases (HIV, Q fever), neurological conditions

(neurosarcoidosis), and other immune diseases. Their anti-inflammatory, anticoagulatory and anti-diabetic effects, beneficial effect on the metabolism of lipids, maintenance of remission in rheumatic diseases, and even reduction of death risk are all emphasised [1, 2]. The use of AD in neoplastic diseases is under study [3]. CQ and HCQ are medications with high safety profile, and can be used by pregnant and breastfeeding women [1, 2]. They have relatively few adverse effects, most of

which are mild and reversible. The most severe adverse effect is toxic bull's-eye retinopathy, as no means of treatment are available and, until severe damage is observed, the disease may remain undetected for many years. CQ is more toxic than HCQ, due to the presence of the hydroxyl group in the latter, which reduces the possible penetration of the molecule through the blood-retinal barrier. Until recently, CQ was mostly used in Poland, as HCQ was available only through the direct import of drugs [4].

The introduction of advanced methods in diagnostics of the retina contributed to early detection of toxic damage, already at the subclinical stage, and the incidence of this condition is now higher than previously believed. It is estimated that a detectable hydroxychloroquine-induced retinopathy may be a problem in approximately 7.5% of patients using the drug for 5 years, and it may affect 20-50% of patients after 20 years of therapy. Chloroquine retinopathy begins earlier, and the risk of its occurrence is 10 to 26.6% [5, 6]. The toxicity of antimalarials increases proportionately to the dose and duration of therapy, with simultaneous use of tamoxifen and concurrent renal dysfunction. Therefore, performing screening tests for toxic retinopathy in all patients using quinolone products is of the utmost importance. Presented below are the latest recommendations regarding screening for cQ- or HCQ-induced retinopathy, the signs of drug toxicity, and the identified risk factors. The primary goal is to reduce the risk of vision loss due to undiagnosed CQ/HCQ-induced retinopathy by detection of early, subclinical signs of toxicity with the use of consistent, presently recommended screening tests in all the patients using antimalarial drugs in long-term treatment.

## Discussion

Chloroquine retinopathy was described in the medical literature as early as in the 1960s [7]. Although its clinical picture and symptoms are well-established, the mechanism of CQ and HCQ toxicity has not been fully understood. It is believed that the drugs demonstrate melanotropic activity, i.e. they accumulate in the melanin-rich retinal pigment epithelium (RPE) and in the choroid, which may contribute to their prolonged toxic effects. The degenerative process initially affects the cells in the external retinal layers, then the photoreceptor layer and RPE, without lesions in the internal retinal layers [8].

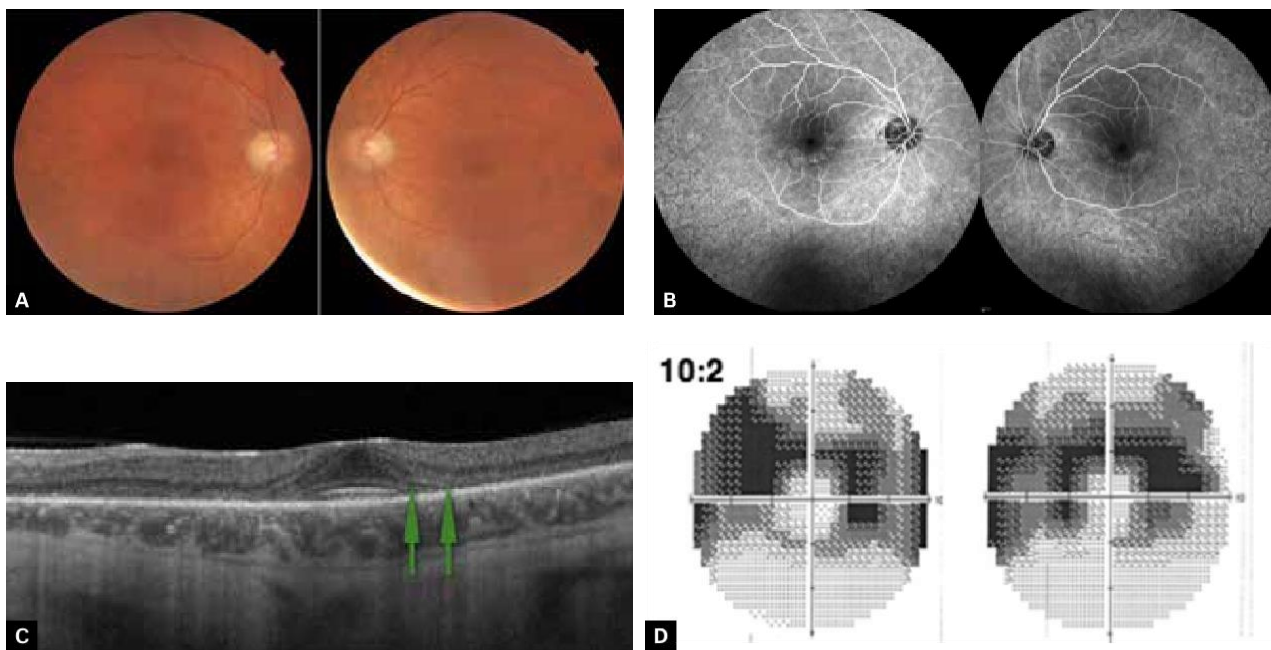
The characteristic feature of CQ and HCQ toxicity is bilateral bull's-eye retinopathy, which can be divided into three stages. In the initial (subclinical) stage anomalies are visible only in complementary studies, and visual acuity is typically normal, or subtle paracentral scotoma

may occur. In the later (clinical) stage, patients may develop the typical picture of bull's eye retinopathy, in which the specific feature is bilateral atrophy of RPE in the parafoveal area, with preservation of the structures in the macular centre, which may be accompanied by a paracentral scotoma, while visual acuity may be normal or reduced (Fig. 1). In the advanced, final stage, extended atrophy of RPE is observed, resulting in the loss of the central field of vision, loss of the peripheral field of vision, and impaired mesopic vision. Recent studies demonstrated that in patients of Asian origin the initial damage develops in a more peripheral area of the retina [7]. Other symptoms of toxicity, usually occurring at the beginning of treatment, include cornea verticillata (subsiding during or after therapy), cystoid macular oedema, transient accommodation disorders, and the accelerated development of cataract [5, 8, 9].

Differential diagnosis of bull's-eye maculopathy should include: retinopathy induced by chloroquines, clofazimine, Stargardt disease and fundus flavimaculatus, atrophic AMD, macular dystrophies (cone-rod dystrophy or cone dystrophy), and central areolar choroidal dystrophy [5]. Chloroquine retinopathy may develop even after the drug is discontinued, but disease progression and the risk of visual acuity impairment are highest during therapy [10]. Therefore, systematic screening tests are recommended in patients using CQ and HCQ, to detect ocular lesions in the pre-clinical stage, and prevent their progression to irreversible symptomatic damage of the retina.

The latest recommendations regarding screening for retinopathy due to prolonged use of antimalarials were updated, as new data regarding drug toxicity and risk factors became available, and the effectiveness of screening tools increased [5, 11]. After a careful review of the available literature, this study presents the most significant information regarding prophylaxis of ocular complications induced by CQ and HCQ, based on the American Academy of Ophthalmology (AAO) recommendations from 2016, and the recommendations published by the Royal College of Ophthalmologists in 2018 (RCOphth).

The above documents maintain that the risk of toxic retinal damage induced by antimalarial drugs increases proportionately to the dose and duration of treatment. Important changes include abandonment of dose calculation based on the ideal, fat-free body mass, and using the patient's actual weight instead, contrary to the previous AAO guidelines from 2011 [10]. It is assumed that the course of chloroquine retinopathy resembles hydroxychloroquine retinopathy, so the above recommendations apply to both therapies.



**Figure 1.** Advanced chloroquine retinopathy of a 30-year-old female who had taken chloroquine at the dose of 8.2 mg/kg per day for systemic lupus erythematosus for 5 years. Vou = 20/20. The fundus photo (A) shows a mild, paracentral RPE depigmentation area around the fovea, and streaky peripheral depigmentation. The retinal vessels are narrow. Retinal changes may be difficult to see for an inexperienced physician, but are easy to notice in the fluorescein angiography (B) as a ring of parafoveal hyperfluorescence, the most marked below the macula. The SD-OCT (C) shows generalized thinning of the outer retinal segments and retinal pigment epithelium (RPE) damage in the extrafoveal area (arrows). Epiretinal membrane formation is noted. The picture of toxic CQ and HCQ damage in the OCT is described as like a “flying saucer” [13]. The 10:2 grey scale visual field of both eyes shows (D) an annular scotoma with saving central and inferior quadrant vision. From materials of the Ophthalmology Department of the Military Institute of Medicine.

**Rycina 1.** Zaawansowana retinopatia chlorochinowa u 30-letniej pacjentki przyjmującej z powodu toczenia rumieniowatego układowego chlorochinę w dawce 8,2 mg/kg mc./d przez 5 lat. Vou=20/20. Zdjęcie dna oka (A) przedstawia łagodny, paracentralny obszar depigmentacji RPE wokół dołeczka oraz pasmowate przegrupowania barwnika na obwodzie. Naczynia są zwężone. Zmiany na dnie oka mogą być trudno dostrzegalne dla niewprawionego lekarza, lecz łatwo zauważalne w badaniu angiografii fluoresceinowej (B) jako obszar okołodołkowej hiperfluorescencji, najbardziej zaznaczonej od dołu plamki. Badanie SD-OCT (C) przedstawia znaczną utratę w zewnętrznej warstwie jądrazastej oraz uszkodzenie nabłonka barwnikowego siatkówki (RPE) w obszarze pozadołczkowym (strzałki). Błona nasiatkówkowa. Obraz uszkodzenia toksycznego CQ i HCQ w badaniu OCT opisywany jest jako obraz latającego kosmicznego spodka (*flying saucer*) [13]. Pole widzenia statyczne 10:2 obu oczu w skali szarości (D) przedstawia mroczek okrężny z zachowaniem widzenia centralnego i w kwadrantach dolnych. Materiał Kliniki Okulistyki CSK MON.

A daily dose of HCQ with a relatively low risk of toxicity is  $\leq 5.0$  mg/kg actual body weight. No current data are available on CQ, but according to the literature reports, 5 mg/kg of HCQ corresponds to 2.3 mg/kg of CQ. Based on the above, the recommended daily CQ dose has been established at  $\leq 2.3$  mg/kg of actual body weight [5]. No minimal dose that would be absolutely safe and would not require patient monitoring for retinopathy has been established.

As HCQ is available in 200 mg tablets, and CQ in 250 mg tablets, prescribing doses perfectly adjusted to patient's body weight may seem challenging. However, the concentration of these medicines in blood stabilises over a period of a few weeks, so variable dosing will average out over time, and intermediate doses can be

achieved by splitting tablets, or eliminating a tablet on certain days of the week. If the recommended doses are used, the risk of toxicity during the HCQ therapy lasting < 5 years is < 1%, for < 10 years the risk is < 2%, whereas later on the risk of maculopathy increases significantly, to > 20% after 20 years [5].

The main risk factors for retinopathy include:

- Daily dose: HCQ >5.0 mg/kg bw, daily dose: CQ >2.3 mg/kg bw,
- Duration of therapy > 5 years, in absence of other risk factors,
- Renal diseases involving reduced GFR (glomerular filtration rate) - the drug is eliminated through the kidneys,
- Using tamoxifen (risk increases by a factor of 5),

- Previous retinal or macular diseases that impair interpretation of tests [5, 10, 11].

In addition, it should be noted that toxicity of CQ has been significantly less studied, as the drug is less frequently used (5% of patients receiving antimalarial treatment); it is suspected that CQ toxicity is higher due to the absence of the hydroxyl group that reduces the penetration through the blood-retinal barrier [12]. The higher risk of toxicity to the retina in patients receiving CQ suggests that the fact should be considered a significant risk factor, qualifying patients for annual screening from the beginning of the planned long-term therapy with CQ, or, if possible, switching to HCQ therapy [11].

The 2018 RCOphth guidelines suggest that doctors prescribing the treatment should inform every patient starting long-term therapy with CQ/HCQ about potential adverse effects, including the toxic effect of HCQ/CQ on the ocular retina, and that regular ophthalmological screening tests should be performed for the rarely detected symptoms of toxicity. An initial ophthalmological examination should be conducted in the first year of treatment (preferably within the first 6 months). The baseline test should include assessment of the risk factors, examination of the eye fundus, colour fundus photography, and spectral domain optical coherence tomography (SD OCT). If any abnormalities have been found in the eye fundus (macular lesions, glaucoma etc.) that could affect the interpretation of the screening test results, additional automated computed 10-2 visual field (VF) testing should be performed, using the SITA strategy. Annual screening should be conducted after 5 years following the start of HCQ therapy in patients without significant risk factors, or abnormalities in the initial examination. If serious risk factors are present (renal insufficiency with GFR <60 ml/min/1.73 m<sup>2</sup>, use of tamoxifen, high doses of HCQ >5.0 mg/kg bw, or use of CQ for over 12 months), screening should be performed on an annual basis from the start of the therapy. However, early ophthalmological supervision (every 12-18 months within the first 5 years) appears to be justified, as diseases of the connective tissue frequently have ocular manifestations, previously unnoticed risk factors for retinopathy may occur, the patients' awareness should be raised, while patients and clinicians should ensure regular screening tests for retinopathy.

The basic screening test recommended by AAO is the Humphrey visual field test (using a white stimulus), 10-2, using SITA (dedicated for detection of macular

injury), followed by pupil dilation and macular imaging with SD OCT. The combined tests offer satisfactory sensitivity and specificity in detection of retinopathy. RCOphth also recommends, as a basic test, wide-angle fundus autofluorescence (FAF), as it can be performed on the same device as macular SD OCT, and helps to identify initial, also extra-macular, toxic retinal damage.

Typical changes in the field of vision consistent with parafoveal damage present as areas of reduced central retinal sensitivity within 2-6°; in advanced cases the lesion presents as a complete or incomplete classic annular scotoma, with preserved central vision. Studies demonstrated that the initial subtle and non-specific damage is usually located in the superior nasal quadrants of the field of vision (corresponding to the damage in the inferior temporal part of the macula). In Asians and people with extramacular structural lesions, 30-2 VF testing is recommended to visualise more peripheral retinal injuries [7].

Toxic lesions detected by SD OCT are situated in the parafoveal area, initially in the inferior and inferior temporal quadrants. The morphological lesions detectable with SD OCT include: thinning/damage of the outer nuclear layer and the ellipsoid zone (EZ), loss of the interdigitation zone (the photoreceptor outer segment layer), damage to the RPE and accumulation of drusen, as well as increased choroidal reflex due to loss of RPE.

In CQ/HCQ-induced retinopathy FAF may help to detect parafoveal hyperfluorescence (indicating early damage to the photoreceptors), and hypofluorescence (evidence of late damage to RPE).

Patients with abnormal FAF results, but without abnormalities in the 10-2 field of vision test should receive extended diagnostics on a different day, including 30-2 field of vision test. Persistent changes in the field of vision, characteristic for HCQ/CQ-induced retinopathy, in the absence of structural damage in SD-OCT or FAF examination, should be verified with multifocal electroretinography (mfERG).

The guidelines do not recommend using the following in screening tests: biomicroscopy alone, photographic documentation of the eye fundus, time domain OCT, fluorescein angiography, full-field ERG, Amsler grid, colour vision test or electrooculography [5]. It is believed that these tests are not sufficiently sensitive to detect the toxicity of antimalarial drugs at the subclinical stage. However, they may be used to confirm the diagnosis.

**Table 1. Summary of recommendations on screening for CQ/HCQ retinopathy**  
**Tabela 1. Podsumowanie wytycznych dotyczących badań przesiewowych w kierunku retinopatii CQ/HCQ**

<b>Recommended dosing</b>	
HCQ ≤ 5.0 mg/kg bw CQ ≤ 2.3 mg/kg bw	
<b>Dose averaging over time:</b> splitting tablets, elimination of a tablet on certain days of the week	
<b>Primary risk factors</b>	<b>Early symptoms</b>
Daily dose: HCQ > 5.0 mg/kg bw, CQ > 2.3 mg/kg bw, Duration of therapy: > 5 years (HCQ) >1 year (CQ) Renal diseases: ↓ GFR Retinal and macular disorders Using tamoxifen	SD – OCT parafoveal thinning of the outer retinal layers, followed by damage to RPE VFT 10-2 paracentral deficits ↑ or ↓ of the autofluorescence signal
<b>Initial ophthalmological test in the first year of therapy</b>	<b>Late symptoms</b>
Assessment of risk factors, patient education Examination of the eye fundus, colour eye fundus photography, SD-OCT If abnormalities are found in the macula - additionally VFT 10-2	↓ visual acuity, annular scotoma Bull's-eye maculopathy
<b>Follow-up tests every 12 months</b>	<b>Recommended screening tests</b>
Necessary > 5 year of HCQ therapy and >1 year of CQ therapy; more often if significant risk factors are present	Basic tests: VFT 10-2 SD – OCT FAF Additional tests: mfERG VFT 30-2
CQ/HCQ – chloroquine/hydroxychloroquine, GFR – glomerular filtration rate, SD-OCT – spectral domain optical coherence tomography, RPE – retinal pigment epithelium, VFT – visual field test with the use of white stimulus, using SITA strategy, FAF – fundus autofluorescence, mfERG – multifocal electroretinography	

Further patient management is determined by the results of the recommended screening tests [11]. The absence of the toxic effects of CQ and HCQ on the ocular tissue is found when no abnormalities have been found in the screening tests (VFT 10-2, SD-OCT, FAF), and the therapy may be continued, with the recommendation of an annual ophthalmological screening test. Possible toxicity is found if one screening test result is abnormal. Then, FVT 10-2 should be repeated (if it revealed any abnormalities), and the diagnostics should include FVT 30-2, and mfERG. CQ/HCQ treatment should be continued until retinopathy is finally confirmed/excluded. Abnormal results of two screening tests (one subjective, and one objective) provide evidence of definite CQ/HCQ toxicity, and form the basis for diagnosing retinopathy. CQ/HCQ therapy should be discontinued by the doctor treating the primary disease.

The goal of screening for retinopathy is not to stop the use of valuable drugs after any borderline abnormality has been detected, but to recognise definitive signs of toxicity by using sensitive diagnostic tools at an early enough stage (before the loss of RPE) to prevent a loss of visual acuity. Apart from performing regular control tests, ophthalmologists should inform the patient and physicians specialising in other fields about adverse effects, safe dosing, and adequate monitoring of therapy with CQ/HCQ.

The aim of this article was to update the guidelines regarding monitoring of treatment with CQ/HCQ, as

these recommendations, based on certain studies, are still relatively unknown in clinical practice. Shulman et al. demonstrated that in 128 physicians (60 rheumatologists and 68 ophthalmologists) only 5% and 15%, respectively, are aware of the recommended ophthalmological tests for initial and follow-up assessments. Moreover, 96% of the doctors participating in the study did not know the risk factors for retinopathy that should be considered while supervising the treatment [13].

## Conclusion

HCQ and CQ are basic medications used in treatment of systemic lupus erythematosus. Their safety profile is favourable, but they may lead to a severe complication: bull's eye retinopathy. The updated AAO and RCOphth guidelines are often relatively unknown to ophthalmologists and rheumatologists, but emphasise the significance of adjusting the dose to patient's actual body weight and dose verification, as well as the need of annual ophthalmological monitoring with the use of appropriate tools. Bull's-eye retinopathy is irreversible, and untreatable. Its early detection (before damage to RPE) is essential for the prevention of central vision impairment or loss. The 5 × 5 rule summarises the guidelines for therapy with HCQ: the dose of < 5 mg/kg bw/daily should be maintained, and annual screening tests should start 5 years after the beginning of the therapy.

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# Split thickness skin grafts and adjunctive therapies as surgical treatment methods for chronic wounds in patients with vascular diseases

Przeszczepy skóry pośredniej grubości oraz techniki wspomagające jako metody leczenia chirurgicznego ran przewlekłych u pacjentów z chorobami naczyniowymi

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**Abstract.** Wound healing is a multistage and dynamic process of tissue repair that includes three phases: inflammation, proliferation and remodelling of scar tissue. There are many factors, both systemic and local, preventing normal wound healing, resulting in chronic wounds. In clinical practice, there are increasing numbers of vascular disease patients with chronic wounds. In these patients, we can use a wide therapeutic spectrum, both conservative and surgical. According to current research, continuous development is being made in treatments for chronic wounds. This article describes split thickness skin grafting methods and treatment support techniques.

**Key words:** chronic wound, split thickness skin graft, surgical treatment, wound healing, vascular diseases

**Streszczenie.** Gojenie ran jest wieloetapowym i dynamicznym procesem naprawczym tkanek obejmującym trzy fazy: zapalną, wytwórczą i dojrzwania blizny. Istnieje wiele czynników – zarówno ogólnoustrojowych, jak i miejscowych – uniemożliwiających prawidłowy proces gojenia, dając przewlekły charakter rany. W praktyce klinicznej można zaobserwować zwiększającą się liczbę pacjentów z chorobami naczyń, u których występują rany przewlekłe. U tych chorych można zastosować szerokie spektrum terapeutyczne – zarówno metody zachowawcze, jak i chirurgiczne. W świetle aktualnych badań dostrzegalny jest ciągły rozwój sposobów leczenia ran przewlekłych. W artykule zostały opisane metody wykonywania przeszczepów skóry pośredniej grubości oraz techniki wspomagające leczenie.

**Słowa kluczowe:** rana przewlekła, przeszczep skóry pośredniej grubości, leczenie chirurgiczne, gojenie rany, choroby naczyniowe

Delivered: 09/06/2018

Accepted for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 71-75

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## Wound healing process

Wound healing is a multi-step repair process that involves immediate inflammatory reactions, regeneration and remodelling of the tissue exposed to injury [1, 2]. It

comprises complex chemical and physical phenomena involving biologically active factors, resulting in scar tissue formation. The wound healing process consists of three consecutive, partially overlapping stages [3, 4]. The

inflammatory phase starts immediately after the injury, due to interrupted continuity of blood vessels and blood extravasation [5]. During the initial stage, blood platelets play an important role, as they produce growth factors. This phase is also associated with the migration of neutrophils and macrophages. The next stage is the proliferative phase, which involves the synthesis of collagen fibres, strengthening and neovascularisation of the scar tissue [6]. This is when re-epithelialisation begins, and occurs in a “leap-frog” fashion, every 12-18 hours, and results, with normal healing, in the formation of new epidermis at a rate of approximately 2 mm of tissue daily. The final stage involves remodelling of the collagen fibres. Type III collagen fibres are transformed into type I collagen, until the balance characteristic for healthy skin is restored. Then, the wound is remodelled, by formation of collagen cross bonds. The excess collagen undergoes degradation, the density of capillaries decreases, and the quantity of glycosaminoglycans reduces. This phase determines the final appearance of the scar, whose form and function can be assessed not sooner than after 6-12 months. The main goals of wound management include:

- haemostasis,
- restoration of tissue continuity,
- creating favourable conditions for healing,
- obtaining good function, without scar contractures,
- obtaining optimal aesthetic effect [7, 8].

### Characteristics of chronic wounds

Multiple theories attempt to explain the mechanism of disturbed wound healing on a molecular level. One of them mentions the lack or abnormal form of fibronectin in the wound matrix. The prolonged presence of the factor that caused the chronic wound significantly delays, and sometimes even prevents its final healing. Therefore, the wound becomes chronic, and various stages of the physiological healing process coexist with the chronic pathological factor. The incidence rate for chronic wounds is constantly increasing, along with ageing of society, and the increased frequency of concurrent vascular diseases. The genetic factor also significantly affects the frequency of chronic angiogenic ulcerations (mainly of the lower leg).

Due to a simultaneous presence of multiple local and general systemic factors that impair the normal wound healing process, the problem gains importance. The general systemic factors adversely affecting wound healing include:

- nutritional status (blood concentration of albumins),
- deficiency of iron, vitamins A, C, E and folic acid,
- deficiency of microelements,
- obesity,

- chronic infections,
- diabetes mellitus,
- neoplastic and autoimmune diseases,
- long-term pharmacotherapy (steroids, cytostatics, immunosuppression),
- nicotine addiction,
- status post irradiation [10].

Local factors include:

- wound site,
- blood supply to the wound area,
- presence of necrotic or devitalised tissues, or foreign bodies in the wound,
- presence of haematoma in the wound,
- infection,
- intratissue oedema.

Such external factors as temperature and ambient humidity are also important. It has been established that the intensity of regenerative processes decreases significantly with time [11].

### Aetiology and characteristics of chronic wounds in patients with vascular diseases

An increasing number of patients with vascular diseases and chronic wounds can be observed in clinical practice. Due to the simultaneous presence of multiple local and general systemic factors preventing the normal wound healing process, the problem gains importance.

The most common causes of angiogenic chronic wounds include venous ulcerations and ischaemic wounds of the lower leg, diabetic foot syndrome, and wounds with mixed aetiology (venous-ischaemic).

Venous ulcerations of the lower leg are the most frequently occurring wounds that are difficult to heal [12]. They are believed to comprise up to 90% of all shin ulcers [13]. Venous ulcers are usually located at the distal end of the lower limb, above the medial ankle.

Ulcers that are difficult to heal may tend to spread, extending to the entire circumference of the leg. Moreover, other concurrent symptoms specific for chronic venous disorder are found on the lower limb: telangiectasia, varicose veins, oedemas, discolorations, indurations and trophic lesions [14, 15].

Another cause of chronic wounds in patients with vascular diseases is ischaemia of the lower leg. Ulcerations of ischaemic aetiology are typically situated distally of the leg over bone elements (medial heel border, foot border, dorsal surfaces of toes). The picture of a chronically ischaemic limb is specific: muscular atrophy, atrophy of skin appendages, skin dryness, pallor and cooling.

Vascular lesions in the course of diabetes mellitus are the next causes of chronic wounds. The locations of ulcers in diabetes is similar to that of chronic wounds with

an ischaemic aetiology. In addition, the skin lesions develop where pressure is exerted on the foot, and in the spaces between the toes [16].

In patients with vascular diseases a wide spectrum of therapeutic options can be applied, including conservative and surgical methods. In the light of the present studies, a constant development in chronic wound management is observed. Accurate determination of the wound aetiology is fundamental for further treatment. Medical history, detailed clinical examination, measurement of the ankle/arm index and additional tests, such as duplex-Doppler ultrasound or computed tomography play an important role in the diagnostic and therapeutic process [17].

Lower leg ulcers can be single or multiple, and may demonstrate varying levels of clinical advancement, from superficial to lesions that cover the entire circumference of the lower leg.

The wound usually progresses inside, without penetrating the fascia. It may exude serous or purulent content.

In patients suffering from vascular diseases who develop chronic wounds treatment of the underlying cause is important [17]. Compression therapy, both active and passive, is an effective method of treatment in patients with ulcers formed in the course of venous insufficiency. It consists in applying pressure of varying duration and strength, adjusted to the functional phases of the veno-muscular pump of the lower leg. The form of compression is selected on an individual basis, which significantly improves the flow in the venous circulation, providing proper haemodynamic parameters for wound healing [18]. If indications for compression therapy are present, it should be applied also after the wound healing, as secondary prophylaxis [19, 20]. Various forms of physical therapy are also used in the treatment, including manual, pneumatic and biomechanical massage. Patients should be made aware that lifestyle changes are necessary, such as increased physical activity, obtaining proper body weight, quitting smoking, and assuming resting positions that facilitate the outflow of the venous blood from the lower limbs [17]. Pharmacotherapy includes phlebotropic, analgesic and anti-inflammatory drugs, as well as blood rheology-improving agents and anticoagulants, as indicated [21-25]. Ulcer treatment should be supported by targeted antibiotic therapy, based on the culture results. In some patients additional medical nutrition may be necessary. Superficial venous insufficiency with concurrent chronic deep vein insufficiency is responsible for venous ulcers of the lower leg. Therefore, surgical treatment of venous ulcers should involve closure of the failing perforators, and removal of the inefficient superficial veins.

### Surgical treatment of ulcers of the lower limb: wound preparation and split-thickness skin grafts

A patient with a non-healing venous ulcer should be treated by a multi-disciplinary team. Apart from the surgical treatment of the underlying diseases, performed by a vascular surgeon, surgical management of the superficial layers of the wound is important [26, 27]. The European and Polish Wound Management Association guidelines on healing of the venous ulcer recommend using the TIME strategy: T – tissue debridement, I – infection and inflammation control, M – moisture balance, E – epidermisation stimulation, edges [28]. The most effective method of wound cleaning is autolytic debridement using moist dressings, and biological debridement with the use of *Lucilia sericata* larvae. In the case of non-healing ulcers persisting for many years, in over 50% covered with necrotic tissue or fibrin, the wound needs to be cleaned surgically.

Ultrasound or hydrosurgical cleaning (Versa-Jet) can be applied to debride the tissue. In local management it is important to remove dry fibrin from the wound edge every time. Re-epithelialisation usually starts at the edges, and proliferating keranocytes move towards the centre of the wound. In some chronic wounds the epidermis may migrate from a single skin island, or, if the healing is intensive, from multiple islands of fully functional epidermis forming across the entire wound surface. The skin around the ulcer should be treated with special care. A wound demonstrating granulation and proper epidermisation should be covered with a dressing in the form of hydrocolloid, polyurethane membranes of hydrogel, or complex dressings for flat wounds [29, 30].

The aim of complex surgical treatment, apart from the change in haemodynamics of the venous system of the lower limbs, and removal of the dead tissue, including the excision of the granulation tissue to the fascia level, is to transplant a graft on the deficit caused by the ulcer. It has been demonstrated that split-thickness skin grafting shortens the therapy, and reduces the frequency of recurrent ulcers. Free split-thickness skin graft comprises the epidermis and subepidermal layer of the dermis, of 0.25 mm to 0.46 mm thick [31]. Usually split-thickness grafts are used, collected from a donor site using electric dermatome. The anteromedial or lateral part of the thigh typically serves as the donor site. A mesh with paraffin, chlorhexidine and gauze is applied on the donor site. In numerous cases, due to the extensive wound area, the collected skin must be cut in a mesh dermatome, typically in a 1:1.5 or 1:3 ratio. The obtained graft is then sutured onto the cleared acceptor site. A mesh with

povidone-iodine is applied, followed by a dressing. If the ulcer is penetrating, it is important to leave enough periosteum to provide favourable conditions for graft survival. The graft heals in three stages: the imbibition phase - the graft is nourished through osmosis for 24-48 hours, followed by the inosculation phase - when vascular buds in the recipient bed anastomose with the vessels in the graft, and the revascularisation phase - in which the graft is properly vascularised in the 7-10 days after the procedure. In the days following the surgery, the quantity of exudate from the wound is assessed, without removal of the dressing. Wound infection control is also very important. The dressing is removed from the graft on day 5 after the surgery. It is not the end of treatment, and further graft management and lubrication of the skin around the donor site are important. The dressing from the donor site is removed after 10 days, with the instruction to lubricate the scar. The rules of dressing changing must be preserved, and careful management of the donor and recipient sites is necessary. It is equally important for graft healing as the proper grafting technique. Patient education also plays a significant role. The patient should be informed about the bed regime, i.e. elevation of the stabilised limb on the first days following the surgery, and using anticoagulation prophylaxis. It is believed that low-molecular-weight heparin considerably increases the effectiveness of graft healing [32].

Using negative pressure therapy also has beneficial effect on healing of skin grafts [33, 34]. The mechanism of negative pressure therapy consists in providing oxygen to tissues, increasing the cellular division effect on angiogenesis and local stimulation of growth factors.

Hyperbaric oxygen therapy (HBOT) also supports skin graft healing [35]. Using high concentrations of oxygen reduces inflammation in the wound, demonstrates analgesic and antibacterial effects, and promotes angiogenesis. Hyperbaric oxygen stimulates production of collagen, elastin and extracellular matrix by fibroblasts.

In chronic wounds, in order to prepare the recipient bed for the skin graft, platelet-rich plasma (PRP) may be used locally [36]. This therapy is used especially in patients with wounds resistant to compression therapy and negative pressure. Platelet-rich plasma is a concentrate of blood platelets received in the process of centrifugation of patient's own blood [37]. The beneficial effect on wound healing is due to growth factors released by thrombocytes: PDGF isomers ( $\alpha\alpha$ ,  $\beta\beta$ ,  $\alpha\beta$ ), TGF- $\beta$ 1, TGF- $\beta$ 2, VEGF and proteins responsible for cellular adhesion: fibrin, fibronectin and vitronectin [38, 39].

## Conclusion

In chronic wounds aggressive treatment is necessary to ensure fast healing. There is evidence to support the superiority of primary skin grafting over classic conservative treatment [40]. Management of chronic venous ulcers should follow the TIME and WBP strategy, considering surgical preparation of tissue, wound infection control and inflammatory process, maintaining optimal wound moisture, and stimulation of epidermisation. The choice of the treatment method needs to follow careful diagnostics, and a multi-disciplinary team requires a wide range of therapeutic options (from conservative methods to surgical treatment), and supporting techniques. Split-thickness grafts ensure considerably faster healing of ulceration compared to the natural epithelialisation that starts at the wound edges [13].

It has been demonstrated that split-thickness skin grafting after surgical preparation shortens the therapy and reduces the frequency of recurrent chronic ulcers [41]. It has been demonstrated that preparation of the recipient bed prior to the transplantation with hyperbaric oxygen therapy, negative pressure dressings, compression therapy, heparin sulphates and PRP therapy has a positive effect on the graft survival [42]. The therapy should result in a fast epithelialisation to avoid infection, and provide patients with the optimal quality of life. Treatment should be conducted by a multi-disciplinary team of physicians, nurses and rehabilitation specialists, who also provide patient education [43, 44].

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# Principles of travel medicine

## Podstawy medycyny podróży

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**Abstract.** All over the world, including in Poland, there has been rapid growth in the number of international trips, most of them related to tourism. The article discusses the basic principles of travel medicine – a new interdisciplinary speciality bringing together and making use of the majority of medical disciplines in terms of epidemiology, clinical picture, diagnostics, treatment and prevention of health conditions related to travelling and staying in areas characterized by adverse climatic conditions or those lacking sanitation. As the number of travellers to tropical and subtropical countries continues to grow, there are thousands of patients visiting their health-care providers for a pre-travel consultation on how to prepare for international travel and how to behave in unfamiliar environmental conditions. Therefore, medical practitioners, and especially primary health care providers, are faced with the challenge of how to provide their patients with accurate information enabling them to travel safely to and stay in the most distant destinations.

**Key words:** health hazards, health prevention, travel medicine

**Streszczenie.** Na całym świecie, również w Polsce, obserwuje się dynamiczny wzrost liczby podróży międzynarodowych, w większości w celach turystycznych. W pracy przedstawiono podstawowe zagadnienia dotyczące medycyny podróży, nowej specjalności o charakterze interdyscyplinarnym, skupiającej większość specjalizacji medycznych w zakresie epidemiologii, obrazu klinicznego, diagnostyki, leczenia i zapobiegania problemom zdrowotnym związanym z podróżowaniem oraz przebywaniem w miejscach uciążliwych klimatycznie i sanitarnie. W związku z coraz większą liczbą podróżujących do krajów tropikalnych i subtropikalnych, do gabinetów lekarskich zgłaszają się tysiące osób po poradę dotyczącą prawidłowego przygotowania się przed podróżą oraz właściwego zachowania podczas pobytu w obcych warunkach środowiskowych. W związku z tym zwłaszcza lekarze podstawowej opieki zdrowotnej stają przed wyzwaniem przekazania swoim pacjentom odpowiedniej wiedzy, pozwalającej na bezpieczne podróżowanie oraz pobyt w odległych destynacjach.

**Słowa kluczowe:** medycyna podróży, zagrożenia zdrowotne, profilaktyka zdrowotna

Delivered: 10/12/2018

Accepted for print: 04/01/2019

No conflicts of interest were declared.

Mil. Phys., 2019; 97(1): 76-81

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## Introduction

In the early 1990s, due to the dynamic development of international travel and tourist traffic across the world, a new field of medical specialisation developed: “travel medicine”. In 1994, in the first issue of the new “Journal of Travel Medicine” magazine, Robert Steffen and Herbert DuPont included an editorial entitled “Travel medicine: what’s that?” [1], in which they discussed the interdisciplinary specialisation, gathering numerous medical fields to address the epidemiology, prevention and treatment of diseases acquired while travelling (Fig. 1).

Currently, travel medicine could be defined as an interdisciplinary branch of medicine that requires

understanding of the health problems associated with travelling by land, air or water, of the current epidemiological data related to the presence of the risk factors for infectious and non-infectious diseases, and current guidelines and regulations regarding prophylactic measures in different countries and parts of the world. The following medical disciplines are brought together under travel medicine for the epidemiology, clinical picture, diagnostics, treatment and prevention of health problems associated with travelling and staying in places where the climatic and sanitary conditions are challenging: tropical medicine, infectious and parasitic diseases, microbiology and parasitology, general

medicine, paediatrics, geriatric medicine, gynaecology, dermatology and venereology.

Across the world a rapid increase can be observed in the number of international journeys, primarily for tourist purposes. According to the World Tourism Organisation, the number of international trips was over 1.323 billion in 2017, and continues to grow [2]. Therefore, physicians of various medical specialities, especially general practitioners, need to equip their patients with sufficient knowledge to ensure a safe journey and stay in distant destinations. The key element is consultation before the departure, by visiting medical offices for advice on how to prepare for the journey, and how to behave while staying in a foreign environment. This usually includes information about the obligatory and recommended preventive vaccinations and antimalarial chemoprophylaxis, avoidance of risk factors during the trip, and taking a first-aid kit for personal use. Doctors also provide advice for a growing number of patients at increased risk of health problems occurring during the trip.

This group includes infants and young children, the elderly, pregnant women, people with a compromised immune system or mental disorders/diseases, as well as people who practice extreme sports (diving, high-altitude climbing). The College of Family Physicians of Canada developed an algorithm to assess the risk and health status of travellers [3], which clearly states that if doctors do not feel competent to suggest appropriate preventive measures for travellers, they should recommend medical centres that offer such interdisciplinary travel medicine advice.

### Medical advice

Advice on preventive measures to be taken while travelling should be acquired from physicians, and not from Internet forums. A doctor's office should have information about their health status (presence of inhalation or food allergies, including medications, contact allergies, chronic diseases, chronic use of medications, being a carrier of infectious viruses [HIV, HBV, HCV], compromised immunity, pregnancy, the basic and complementary preventive vaccinations and re-vaccinations received), as well as about the planned journey: travel plan (country, region of the world, climate zone), duration, dates of departure and return, type of accommodation (hotel, camping), type of activities planned (relaxing on the beach, diving, high-altitude climbing, or caving). All the information related to the journey and patient's health status may be important, and help the physician in selecting the right preventive measures. The doctor, on the other hand, should have

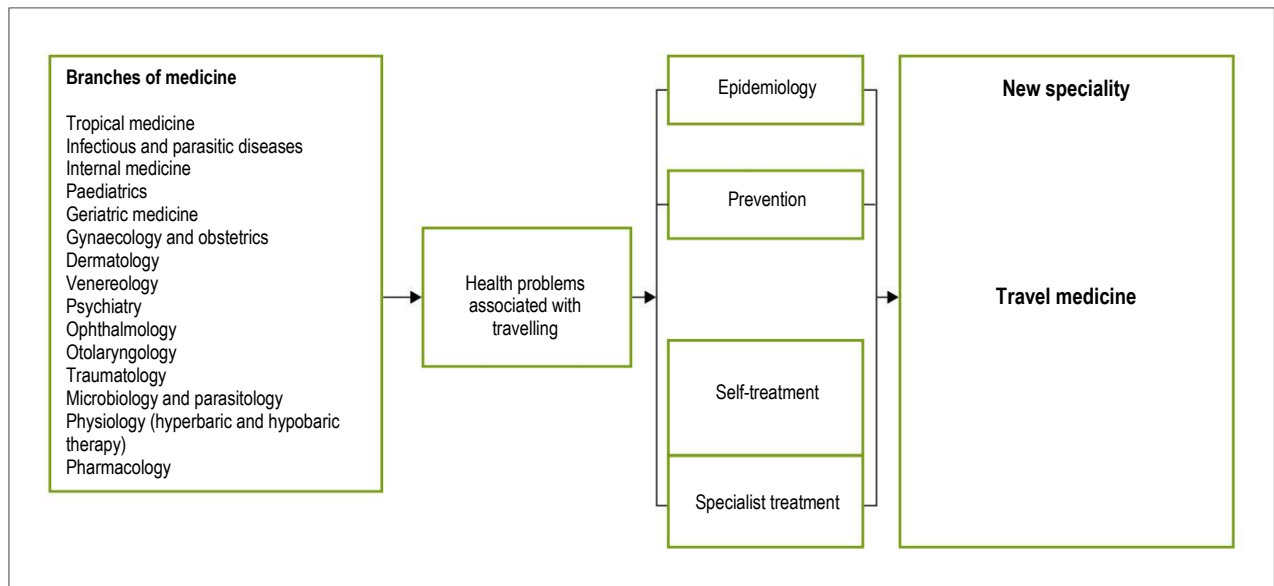
sufficient understanding of the epidemiological situation in different parts of the world (occurrence of endemic diseases), as well as the WHO and CDC guidelines and regulations regarding health prophylaxis [4-7].

### Preventive vaccinations

Preventive vaccinations should be given 4-6 weeks before the planned journey, so that all the required doses are administered in time, and the desired protective effect is obtained. Travellers who have received basic vaccinations against certain infectious diseases in the past should be re-vaccinated at a suitable moment before the departure. Yellow fever vaccination is obligatory for people travelling to the regions of Africa and South America, where the disease is endemic, whereas vaccination against meningococcal infections is obligatory for travellers going to Saudi Arabia to visit Mecca, for example. Depending on the epidemic or endemic occurrence of certain communicable diseases at the planned destinations, travellers should receive vaccinations against typhoid fever, tetanus, diphtheria, polyomyelitis, cholera, type A and B hepatitis, rabies, and Japanese encephalitis [4, 8].

### Antimalarial chemoprophylaxis

Following the WHO and CDC guidelines in the areas endemic for malaria, travellers should use one of the medications listed below (taken with meals at fixed hours): atovaquon + proguanil (1 tablet 250 mg/100 mg qd, starting 1-2 days before the departure, during the stay, and 7 days after return; it has the fewest adverse effects among antimalarial drugs, although the high price is a disadvantage); doxycycline (1 tablet or capsule 100 mg qd, 1-2 days before the departure, during the stay and for 28 days after return; its drawbacks include numerous adverse effects with prolonged use: nausea, vomiting, oral candidosis, vaginal candidosis, hypersensitivity to sunlight, photodermatoses), mefloquine (1 tablet 250 mg once a week, 1-2 weeks before the journey, during the stay, and for 4 weeks after return; due to adverse effects including neuropsychiatric disorders, the medication is contraindicated in certain professional groups, e.g. in flight personnel), chloroquine (2 tablets/500 mg once a week, 1-2 weeks before the trip, during the trip and for 4 weeks after return; due to increasing resistance of Plasmodia to the drug, it is effective only in certain world regions, e.g. Central America, North Africa and parts of Middle East, which significantly limits its use) [1, 9, 10].



**Figure 1.** Travel medicine – interdisciplinary specialization. Source: Steffen R, DuPont HL. Travel medicine: what's that? J Travel Med, 1994; 1 (1): 1–3 [1]

**Rycina 1.** Medycyna podróży – specjalizacja interdyscyplinarna. Źródło: Steffen R, DuPont HL. Travel medicine: what's that? J Travel Med, 1994; 1 (1): 1–3 [1]

### Other prophylactic measures

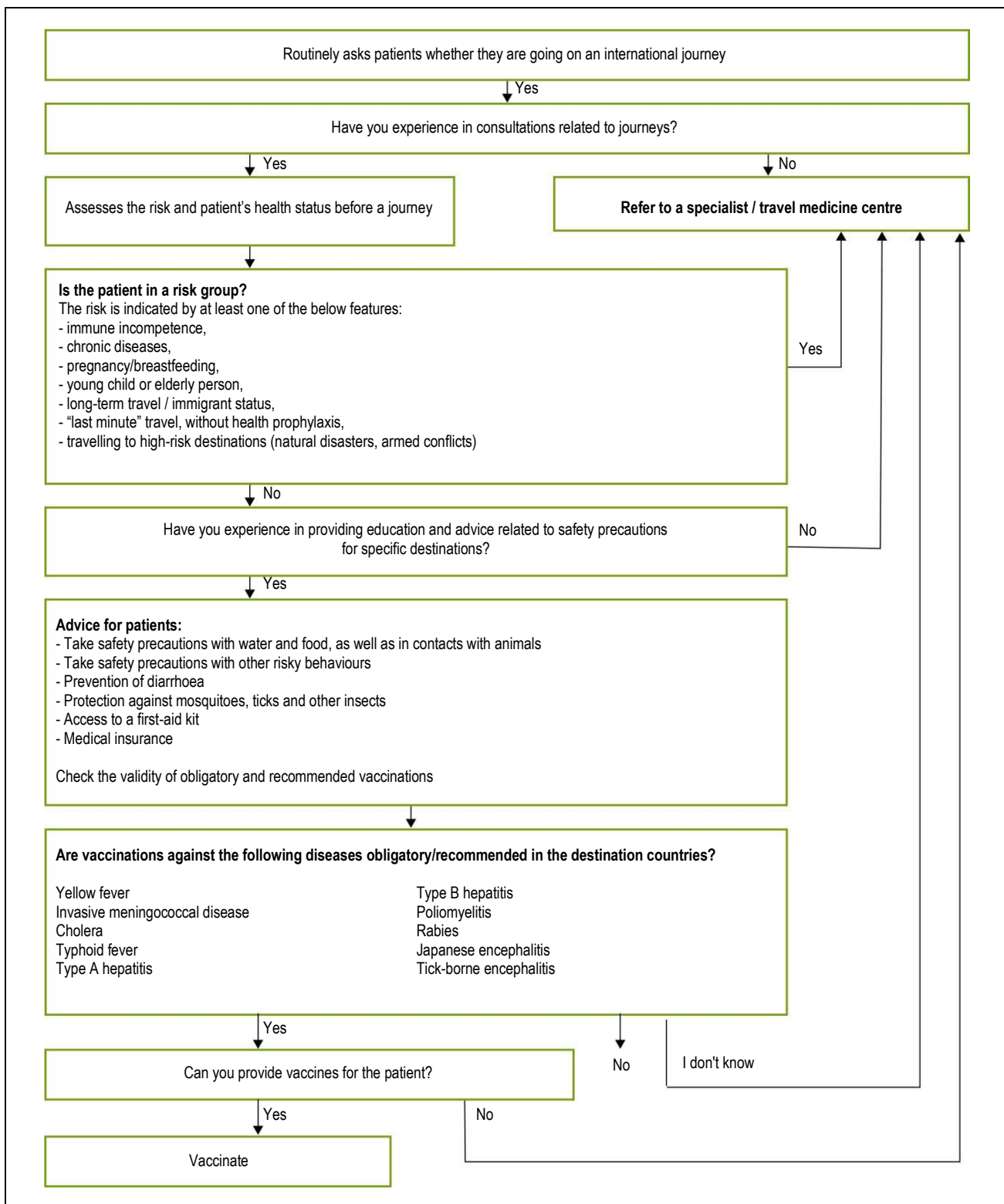
When visiting regions characterised by difficult climatic conditions and low standards of hygiene, basic principles of prevention should be followed, considering the acclimatisation process (adjustment of the organism to a new environment), personal and food hygiene. In tropical and subtropical conditions, where infectious and parasitic diseases are endemic, travellers should apply the following preventive measures [4-6].

### Protection against insect bites

- Using insect repellents - they should contain 30–50% DEET (N,N-diethyl-*meta*-toluamide) or 20% icaridin
- Wearing proper clothing (long trousers and long-sleeved shirts)
- Avoiding open spaces from dusk to dawn (the highest activity of insects), especially near water reservoirs
- Using mosquito nets in rooms, over the bed, windows and ventilation grids

### Precautions before and after animal bites

- Avoiding contact with local animals, both domesticated (dogs, cats) and wild (foxes): do not touch or feed animals!
- If bitten or scratched by an animal, the injured person should immediately wash the wound with water and soap, and seek medical assistance (post-exposure rabies vaccination)



**Figure 2.** Travel medicine – algorithm of risk and patient's health status assessment. Source: Aw B. et al. Travel medicine. What's involved? When to refer? Can. Fam. Physician 2014; 60 (12): 1091-1103 [3]

**Rycina 2.** Medycyna podróży – algorytm oceny ryzyka i stanu zdrowia pacjenta. Źródło: Aw B. et al. Travel medicine. What's involved? When to refer? Can. Fam. Physician 2014; 60 (12): 1091-1103 [3]

**Food hygiene**

- Washing hands with water and soap (if water and soap are not available, disinfectant gel or wipes should be used)
- Drinking only bottled or boiled water
- Avoiding drinks with ice or of unknown origin
- Avoiding food from street sellers
- Avoiding unpasteurised milk products

**Protection against the consequences of traffic accidents**

- Avoiding alcohol if driving a vehicle is planned
- Fastening seatbelts
- Using car seats for children
- Using a helmet when riding a bicycle/motorcycle
- Avoiding overcrowded buses or minibuses
- Avoiding driving after dark

**Other precautions**

- Prevention of altitude sickness in high mountains (acclimatisation) and excessive sun exposure (sunblock)
- Avoiding having tattoos, piercing or injections done with non-sterile needles (risk of HIV, HBV, HCV infection)
- Using condoms for occasional sexual encounters (sexually transmitted diseases)
- Avoiding walking barefoot in places where local animals might defecate (parasitic diseases, e.g. cutaneous larva migrans)
- Careful hygiene of the feet, armpits and groin to prevent epidermal irritation (fungal infections)
- Careful oral hygiene (brushing teeth at least three times a day, using bottled or boiled water)

**Travel first-aid kit**

Before the planned journey the first-aid kit should be equipped with the necessary prophylactic and therapeutic products to ensure basic safety, and documents such as vaccination card or insurance policy (medical cost insurance, transportation and repatriation cost insurance, emergency services cost insurance, accident insurance). The first-aid kit should contain a reserve of medications used regularly for chronic diseases, contraceptives for the entire length of stay, antimalarial medication, insect repellent, anti-diarrhoea medication, analgesic, antipyretic medication, antibiotic, skin disinfectant, eye drops and ear drops, dressings, spare corrective glasses or contact lenses (for travellers with vision defects), sunglasses and sunblock. The contents of the first-aid kit should be individually adjusted to the needs of the traveller, the length of the planned

trip, and health risks occurring at the destination country. Before taking any medications it is necessary to learn about the contraindications for its use or interactions with other currently used medications, as described in the patient's leaflet. Writing down the international names of drugs that the patient is taking can prove useful, in case the first-aid kit is lost, or the medications are used and their counterparts need to be purchased [4, 11, 12].

**After return**

Many doctors who offer advice related to travel medicine tend to forget that the real challenge and basis for this new medical branch is not only suggesting the appropriate prophylactic measures before the journey, but adequate supervision of the diagnostic and therapeutic process in patients who suffer from health problems after they return. It is estimated that 15-70% of tourists from well-developed countries who visit regions with different climatic and hygienic conditions develop health issues directly associated with the trip. The majority of travellers complain about mild diseases, and only 1-5% seek assistance in healthcare institutions. Most health problems are noticed during the trip, although in some diseases the incubation period extends to weeks, months, or even years. Therefore, it is important to inform the doctor about journey to environmentally different areas, where infection could have occurred, and potential importation of pathogens causing chronic diarrhoea, fever of unknown origin, treatment-resistant skin lesions or respiratory infections.

The physician collecting medical history from a patient who returned from a journey with symptoms of a disease should pay attention to the following:

- preventive vaccinations received before the journey,
- using antimalarial chemoprophylaxis before, during and after the journey,
- use of insect repellents and mosquito nets during the stay abroad,
- occurrence of diseases and associated medication before and during the travel,
- travel itinerary, visited countries and regions,
- length of stay,
- accommodation standard, staying in crowded areas,
- practising extreme sports during the travel (diving, high-altitude climbing, bungee jumping, rafting, caving),
- consumption of food from the local market (raw meat, seafood, unpasteurised milk products),
- insect bites (mosquitoes, flies, ticks) or bites of other representatives of local fauna,
- sexual encounters with local people or other travellers,

- surgical procedures, blood transfusion, injections, tattooing, piercing.

In patients who have returned from tropical and subtropical countries and present with non-specific symptoms with dominant febrile states, multiple light microscopy blood tests should be performed for malaria (thin smear, thick drop; a single test does not exclude infection. As none of the pharmaceuticals used in antimalarial chemotherapy is 100% effective, the tests should also be conducted when symptoms occur in patients using antimalarial medications), as well as complete blood count with smear, AST, ALT, urinalysis, thoracic X-ray examination, light microscopy stool testing for the presence of intestinal parasites, tests for specific diseases (e.g. HIV infection). Blood, urine and stool culturing should also be considered.

Laboratory tests after return from travel should be performed primarily in patients who have developed pathological symptoms. It is also worth remembering that many infections in travellers are asymptomatic. Therefore, the diagnostic process should include long-term travellers who experienced difficult climatic conditions and low hygiene standards, and those who show a propensity for risky behaviour (unprotected sexual encounters, consumption of food of unknown origin, and limited use of personal protection measures) [4].

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# Brig. Gen. Mieczysław Kowalski, MD (1894–1986) – his life and achievements

Gen. bryg. dr med. Mieczysław Kowalski (1894–1986) – życie i dokonania

## Stanisław Ilnicki

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**Abstract.** Mieczysław Kowalski, MD (1894–1986), a participant of the Polish-Ukrainian war of 1918–1919, the Polish-Soviet war of 1920, and the September Campaign of 1939 and the 1945 Lusatia Operation during the Second World War; decorated with the Cross of Valor (1919) and the War Order of Virtuti Militari – V Class (1939). During the German occupation Kowalski worked as a physician in the Warsaw Ghetto (1941–1943). He was imprisoned by the Gestapo as a hostage in the Pawiak prison (1942). Having escaped from the Warsaw Ghetto (1943), Kowalski went into hiding. During his military service (1918–1939 and 1945–1963) he went through all phases of a military physician's career – from the position of a doctor's assistant in an armoured train up to the Chief of the Medical Services of the Polish Armed Forces (1958–1963). Kowalski was one of the most distinguished organizers and chiefs of the medical service in the Armed Forces of Poland. He was a co-founder of the Military Academy of Medicine in Łódź, the Military Institute of Hygiene and Epidemiology in Warsaw, the blood service and the blood donors movement, as well as the psychological and psychiatric service in the armed forces. Kowalski was an active member of the Polish Red Cross organization from 1927. He was also a translator of books on military medicine and ethnology from Russian, German and French. He also wrote his memoirs "My Commanders, 1918–1963".

**Key words:** Military Academy of Medicine in Łódź, Polish Armed Forces –medical service, Warsaw Ghetto –physicians

**Streszczenie.** Mieczysław Kowalski (1894–1986), uczestnik wojny polsko-ukraińskiej 1918–1919, polsko-bolszewickiej 1920 r. oraz kampanii wrześniowej 1939 r. i operacji łużyckiej 1945 r. w czasie II wojny światowej; odznaczony Krzyżem Walecznych (1919) i Orderem Virtuti Militari V klasy (1939). Podczas okupacji niemieckiej lekarz w getcie warszawskim (1941–1943). Więziony przez Gestapo jako zakładnik na Pawiaku (1942). Po ucieczce z getta (1943) ukrywał się. W okresie służby wojskowej (1918–1939 i 1945–1963) przeszedł wszystkie etapy kariery lekarza wojskowego – od podlekarza pociągu pancernego do szefa służby zdrowia Wojska Polskiego (1957–1963). Jeden z najwybitniejszych organizatorów i szefów służby zdrowia w Wojsku Polskim. Współorganizator Wojskowej Akademii Medycznej w Łodzi, Wojskowego Instytutu Higieny i Epidemiologii w Warszawie, służby krwi i ruchu honorowego krwiodawstwa oraz służby psychologiczno-psychiatrycznej w wojsku. Aktywny działacz PCK od 1927 r. tłumacz z języka rosyjskiego, niemieckiego i francuskiego książek z zakresu historii medycyny wojskowej oraz etologii. Autor wspomnień „Moi dowódcy, 1918–1963”.

**Słowa kluczowe:** Wojsko Polskie – służba zdrowia, getto warszawskie – lekarze, Wojskowa Akademia Medyczna w Łodzi

Delivered: 11/10/2018

Approved for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97 (1): 82-88

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## Introduction

The 100th anniversary of Polish independence, the formation of the Polish Armed Forces and the military medical service justifies the remembrance of the figure of Brig. Gen. Mieczysław Kowalski MD, PhD, an active participant of those historical events. The particular

justification for the remembrance was the 60th anniversary of the establishment of the Military Medical Academy in Łódź celebrated this year, which Kowalski co-established and deemed as a crowning achievement of his service in the Armed Forces of Poland.



**Figure 1.** Brig. Gen. Mieczysław Kowalski MD, PhD – Chief of the Medical Service of the Armed Forces of Poland, 1957–1963

**Rycina 1.** Gen. bryg. Mieczysław Kowalski – szef Służby Zdrowia Wojska Polskiego, 1957–1963

Mieczysław Kowalski was born in 1894 in Częstochowa, in an assimilated Jewish family, as the third of the four children of Stanisław Kon, a lithographer, and his wife Bronisława nee Bolkowska. Since in the source documents originating before 1945 which are quoted in the article, Kowalski is present under his family name Kon, it is necessary to explain that he adopted the surname Kowalski while in hiding from the Gestapo after his escape from the Warsaw ghetto in February 1943. He officially confirmed the change of surname after the war [1-3].

In 1912 Mieczysław Kowalski graduated 8th grade Russian philological middle school for male students in Częstochowa, with a silver medal. Due to the *numerus clausus* which applied to Jews in the Russian partition, he began studies in the medical department of the Silesian Frideric Wilhelm University in Wrocław (Breslau). After the outbreak of war in 1914, having completed two years of studies, as a Russian subject and hence an enemy of Germany, he was imprisoned for 3 months in Luckau-Niederlausitz and then in Berlin. In 1915 he returned to Częstochowa and from 1916 he continued studies at the Medical Faculty of the Jagiellonian University, at that time part of the Austro-Hungarian partition [1, 3].

Between 1917 and 1918, during the fourth and fifth year of studies, “to mend the budget”, he worked as a contract second doctor in Evacuation Station No. 3 in Kraków Fortress. In March 1918, he participated in a students’ meeting at the Jagiellonian University and in a temporary student militia. On 1 November 1918, he volunteered for the first company of the Kraków Academic Battalion, a seed of the forming Polish Armed Forces. At the end of 1918, he was drafted to the staff of armoured train no. 2, “Śmiały”. In Przemyśl he graduated NCO school and as a second doctor with the rank of

corporal he served in the train until sustaining an injury in March 1919. [4]

After leaving the hospital, he was promoted to a rank of cadet and was assigned to the 3rd Regiment of the Podolian Riflemen in Radymiń. As a part of a marching battalion of the regiment he reached Lviv and was appointed a doctor of the 3rd Battalion of the 40th Regiment of Lviv Riflemen. While functioning in his position in this unit - he reminisced - he “spent the whole war and for a year and half (1919-1920) traveling vast expanses back and forth, from Lviv to Kiev and then from Dziwińsk to Warsaw and Lviv and then again to Ukraine as far as Bohu”. In 1919, he was awarded the Cross of Valour and was promoted to the rank of second lieutenant [4].

In December 1920, he was awarded a military scholarship to finish his studies. In spring 1922 he received a diploma of all-medical sciences at the University of Jan Kazimierz in Lviv. He was promoted to the rank of lieutenant and posted to the 3rd Transport Division in Grodno. After a 3-month unified course for officers of the medical corps at the School of Applied Training of Ujazdowskie Hospital, he was assigned the post of head doctor of the 86th Infantry Regiment in Wilno. After half a year, he moved along with his regiment to Mołodeczno, and then in 1932 to the 31st Regiment of Kaniowski Riflemen in Łódź (from 1938 in Sieradz) [1, 2, 4].

In this regiment - with a two-year gap between 1929 and 1931 when he was posted to the 84th Regiment of Polesie Riflemen in Pińsk and for a 4 month internship as the ward physician of the internal ward of the 4th Regional Hospital in Łódź, he served for 16 years initially as a junior doctor, and from 1929 as a senior doctor. In 1925, he was promoted to the rank of captain and in 1930 to major. In 1933, he completed a vocational course, and in 1934 a physical education course for healthcare officers [2]. Aside from performing his professional duties, starting from 1927 he was also among the executives of the Łódź Division of the Polish Red Cross, working as a doctor in the Social Polish Middle School for Male Students in Łódź and in an anti-tuberculosis clinic of the Worker’s Society of Friends of Children [3, 4]. From 1 November 1938 to 30 April 1939, he attended a course for Chief Medical Officers at the Military Academy in Warsaw. During his participation in the course, he was promoted on 21 March 1939 to lieutenant colonel (being a major at the time) and appointed Chief Medical Officer of the 10th Infantry Division (ID). In performing this function in the “Łódź” Army, he participated in the defensive war of 1939 - the battles of Warta, Łódź and Łowicz and in the retreat towards Warsaw [2, 4, 5].

In the opinions of the commanders, including Col. Walerian Czuma, Gen. Olszyn-Wilczyński, Col. Dindorf-Ankowicz, and professional superiors, such as Col. Stanisław Więckowski MD, Col. Edward Wertheima, in the annual amendments to the classification lists from 1922–1938, we can see the following psychological portrait of lieutenant/captain/major Mieczysław Kowalski MD, PhD:

“Very intelligent, sharp, brisk and logical mind. Absorbs new knowledge very easily. Adapts to new conditions quickly and well. Educated, highly cultured and experienced. Coolheaded and righteous character, cheerful. Very strong willpower. Expresses his opinions openly. Does not shirk responsibility for his deeds. Works with passion and devotion. Knows soldiers and cares about them like a father. Physically very strong, energetic and lively. High initiative. Very social and amicable. Well brought up. Possesses an excellent gift for speech and has clear opinions. A very good sense of organization and leadership traits. Experienced and excellent practitioner. Works independently, self-confident, great medical authority. Active in the circles of Military Knowledge Society. Loves his profession, very promising if his talents are used and directed to the proper path of scientific and medical work. He is also very talented in the field of administrative and medical service. Excellent as a senior doctor of a regiment and distinguished CMO of the garrison in Łódź. During a summer concentration of a division he performed the function of a medical chief for several years. He is suitable for higher positions which require independence and economic and administrative abilities. During a war he may be a good medical chief of a division or a commander of a field hospital” [2].

On 13 December 1939, during battles on the outskirts of Warsaw, Lt. Col. Mieczysław Kowalski was directed to the staff of the commander of “Warszawa” Army, Gen. Juliusz Rómmel. In the capital under siege, “cut-off” from his division, he joined the staff of Col. Marian Porwita, the commander of the defence of left-bank Warsaw (“Warsaw-West section”) [4, 5]. Many years later, Col. Porwit reminisced: “Lt. Col. Kowalski assumed the function of medical chief very early, gaining general respect for his personal courage and his subtle manner of work. The wounded found a tireless protector in him” [6].

Zdzisław Jaroszewski MD, PhD, a psychiatrist, and a commander of a medical company, a subordinate of Lt. Col. Mieczysław Kowalski, reminisced: “My direct superior, Lt. Col. Mieczysław Kowalski MD, PhD, visited the headquarters several times and was not only the commander but also the caretaker of the company. I experienced with him a moment which deeply etched in my memory. One day (25 September, so called Black

Monday) the colonel arrived at the headquarters, praised one of the platoons of the company for efficient evacuation of the wounded, and then in my presence he dictated my orders, point by point. I could see that he was somewhat changed; at the third point of the order the colonel stopped, slid down on the chair and said: “My friend, they killed my wife and child...”. A bomb had hit their apartment at 12 Czacki St. and destroyed the tenement. After a moment the colonel stood up and dictated the orders again. He accepted an amicable handshake, took a piece of bread and returned to the front line. (...) On 28 September we capitulated. I received an order to destroy all documents. Col. Kowalski MD, PhD visited the company and after a briefing in a solemn atmosphere and singing the national anthem he bade us farewell, announcing further fighting with faith in the final victory” [7].

For the displayed bravery and accomplishments as a commander of a medical battalion, the commander of Army “Warszawa”, Maj. Gen. Juliusz Rómmel, issued an order on 29 September 1939 to award *Virtuti Militari* V class War Order to Lt. Col. Mieczysław Kowalski [1, 3].

Lt. Col. Mieczysław Kowalski ended up in a POW camp after the capitulation of the capital on 1 October 1939. He resided in Błonie, Sochaczew and then in different Oflag. On 18 February 1940 he was sent back to Warsaw along with other Jewish officers. The occupier gave him a choice: further “care” by German authorities or becoming a civilian. The officers who chose the uniform were shot. Lt. Col. Kowalski chose “civilian life”. He resided in the ghetto together with his mother and sister at 57 Sienna St. [3, 8].

In order to earn money for a living he filed a request for acquiring the right to perform his profession to the occupier’s Health Chamber (*Aerztekammer*) in January 1941. The obstacle was a lack of documents, lost during the hostilities. After the confirmation of his identity on the basis of statements of 2 witnesses – doctors, he was registered on 19 February 1941 and began to work in the Health Department of the ghetto [8]. In February 1942, at the request of Prof. Ludwik Hirsfeld - the chairman of the Health Council in the ghetto, he was appointed the head of the department. Prof. Hirsfeld reminisced: “(...) I heard many good things about this colonel of the Armed Forces of Poland, a doctor, Mieczysław Kon (Kowalski) PhD, residing in the district. I invited him to my place, first in private: handsome, sharp face, tall, thin figure, the attitude of a soldier. Focused, strong facial expression. I heard that during the siege of Warsaw he acted with great bravery. He was one of the chiefs or medical inspectors and visited the most dangerous places. In the heat of combat he learned that a bomb killed his wife and daughter. He did not interrupt his work [9].

(...) Judging from Colonel Kon's attitude, it was clear that he could impose his will. And we needed someone who could give orders in the district. I remember a conversation when he was employed as a manager of the Department of Health. When asked by Milejkowski MD (head of the Department of Health of the Jewish Council) whether he would accept the position, he replied: "Yes, but only until I am drafted by the Armed Forces of Poland". I liked his answer." [9] As a manager of the Health Department, apart from administrative task, Dr Mieczysław Kowalski participated in organising hygiene activities meant to counteract the typhus epidemic [9, 10]. He helped Janusz Korczak as much as he could, supplying the orphanage with soap and drugs. He also saved him from imprisonment in Pawiak [11, 12].

On 21 July 1942, a day before the so-called Great Resettlement Action of the ghetto, during which over 250 thousand Jews were transported to a death camp in Treblinka, and approx. 6 thousand Jews were shot on the spot, Dr Kowalski was imprisoned in Pawiak as part of a group of approx. 50 hostages [4, 10, 13]. They were meant to be shot in the case of insubordination of the population towards the German decrees. After two months all the hostages were released, and the majority of them were then transported to Treblinka. Expecting the same fate, on 15 February 1943 Mieczysław Kowalski escaped from the ghetto [3]. He remained in hiding until the end of 1945 – together with his mother and sister – thanks to assistance of the wife of an officer imprisoned in an Oflag – Ms. Wierciakowa from the "Military Family Association". Initially in Zielonka near Warsaw and, after the front moved in winter 1944, in the town of Rybno near Sochaczew [3].

His relatives did not survive the war: his wife Maria and daughter Zuzanna died in September 1939 from an air bomb in Warsaw, his older brother Ludwik was murdered in Warsaw in 1943, his younger brother Antoni was murdered in a death camp of Auschwitz in 1944. Only his mother Bronisława and sister Natalia survived [3].

On 1 March 1945 Dr Mieczysław Kowalski volunteered to the Armed Forces of Poland. As a lieutenant colonel he was appointed chief medical officer of 11th ID forming in the area of Łódź. Along with the division, as a part of the Second Army of the Armed Forces of Poland, he participated in the Łużyce Operation, in the area near the front in Sommerfeld (Lubsko) [1, 4].

After the end of the war, between 2 July 1945 and 4 January 1946, he served as a deputy of the head of the First Branch of the Organisation and Mobilisation Health Care Department. On 31 December 1945 he was promoted to colonel [1]. Between 5 January and 1 March 1951 he served in the Command of Military District no. 2



**Figure 2.** On a training area, 1961  
**Rycina 2.** Na ćwiczeniach poligonowych, 1961

in Bydgoszcz. Initially as the Head of the Health Care Department, and from 1 June 1951 as the Head of the Health Care Department of the Quartermaster Corps of the district. In 1946, he was awarded Officer's Cross of the Order of Polonia Restituta [1, 4].

Despite changes in the military (politicisation, soviet commanders), the professional qualifications of Col. Mieczysław Kowalski MD, PhD were assessed similarly as before the war. It was emphasized that he was "highly respected by subordinates, who sense his great experience and high professional knowledge. He has organizational skills and the ability to lead people, commanding them properly, depending on their talents. (...) Medical service in hospitals is organised in an exemplary manner. (...) No cases of epidemics were noted during the exercise camps. During simulated and actual applied exercises he achieved good results". He was only accused of being "maybe a bit too soft in relation to the subordinates" [1].

After promotion to a chief of the Health Care Department of the Quartermaster Corps of MD no. 1 in Warsaw on 1 March 1951, critical assessments appeared in the professional opinions of Col. Kowalski: "He does not fully devote his efforts to his duty. He could make much more effort, but is sort of lazy. (...) In relation to the immediate superiors his honesty is doubtful. (...) He has weak control over the performance of the medical service apparatus in the military. Lack of proper initiative" [1]. The Chief Medical Officer of the Polish Armed Forces, Gen. Leo Samet MD, PhD defended Col. Kowalski: "He is fully dedicated to his duty and very active despite his age (58 years), without any signs of laziness. He is demanding towards his subordinates and at the same time very understanding towards younger officers who do not know their duties well, whom he teaches well and introduces to the routine of the service". On May 1953, the participation of Col. Kowalski in a war game as Chief Medical Officer of the Armed Forces was highly valued,

but on 20 August of the year he was “sidelined” to the position of head of the Military Department of the Ministry of Health and Social Welfare (MHSW) [1, 4].

In relation to the approaching date of Col. Kowalski’s retirement age (60 years) the human resources section of the ministry prepared on 30 September 1954 a staff notice suggesting a discharge from professional military service. It was argued, among other things, that “he was submissive and showed lack of firmness towards some departments which selected candidates for the professional military service, as a consequence of which the plan to draft specialised practitioners from the civil medical service to the military of 1954 was not performed, he does not have further perspectives for development in the medical service of the armed forces”. It was reminded that he served in the Polish Armed Forces under the Sanation, participated in the Polish-Soviet war in 1920, studied in Germany in 1912–1914, and took a three-week trip to France in 1934, etc. [1].

The plans were foiled by the objection of the minister, Jerzy Sztachelski, and the positive response of the minister of national defence to a request of Col. Mieczysław Kowalski for permission to stay in active military service. One of the contributing factors was perhaps the fact that he was entrusted by the administration of MND – as a part of the Military Department of MHSW – with the performance of preparatory works for the establishment of the Military Medical Academy in Łódź. In consequence, Resolution No. 417 of the Council of Minister of 7 November 1957 concerning formation of the Military Medical Academy was passed [1, 4, 14, 15].

On 18 December 1957, Col. Kowalski was appointed a chief of the Health Care Department of MND.

Col. Tadeusz Roźniatowski, PhD, one of his subordinates, reminisced: “Col. Mieczysław Kowalski, soon promoted to general (1 July 1958) (...) was already 63 at that time, but with his sharpness of mind, energy, vitality and even physical condition he surpassed some of the 40 year-olds. (...) There were no new or difficult situations for him in the medical service (or even maybe in the military). He already had already seen and experienced everything, nothing could surprise him. When he went to refer something to the chief quartermaster or the minister, he did not need any assistance in the form of reports, tables or other “cheat sheets”. He kept everything in his head, and when he was asked a question he replied immediately, without asking for a moment to think. With such a boss, we immediately felt more confident and assured, knowing that we could report to him for advice at any moment. He was always glad to assist us, and also shared many anecdotes related to his professional career, discussed



**Figure 3.** Commissioning of graduates at the Military Academy of Medicine in Łódź; being commissioned are, from the left: Jerzy Łysakowski and Roman Milkiewicz; standing is the Chancellor, Professor Marian Garlicki, January 22, 1962  
**Rycina 3.** Promocja oficerska w Wojskowej Akademii Medycznej w Łodzi, promowani m.in. od lewej: Jerzy Łysakowski i Roman Milkiewicz; stoi komendant-rector gen. bryg. Prof. Marian Garlicki, 22.01.1962 r.

an attractive film or an article in a newspaper, recommended to visit a painting exhibition... He had time for everything because he knew his profession and service thoroughly. It was pleasant to listen how he spoke during briefings, training courses or party meetings. Always factual, on the topic and in an interesting manner. His longer, official speeches and newspaper articles were prepared by himself. What is there to discuss – we were proud of a boss with whom our service was smooth and without conflicts” [16].

After assuming the function of the Chief Medical Officer of the Polish Armed Forces Col./Gen. Kowalski still directed organisational works to establish the Military Medical Academy. He reminisced: “The issue of the military’s own medical academy had often been discussed by relevant authorities since the beginning of the 1950s. (...) The best solution was and still is the military’s own Medical Academy, because both the selection of candidates as well as many years of training guarantee proper level of health care officers. Furthermore, such an academy is not only a centre of education, but also a scientific centre, needed by the military healthcare to keep up with the growing demands of modern war (...) [4].

Gen. Prof. Marian Garlicki, appointed as a dean of the newly-formed Military Medical Academy, reminisced: “General Mieczysław Kowalski MD, PhD was a highly cultured officer with impeccable manners, which was not so common in the period. During my entire service in the military our mutual relations were exemplary and Gen. Kowalski was my honest advocate in many difficult service affairs” [17].



**Figure 4.** With Col. Piotr Goździk MD at the construction site of the 2nd Central Clinical Hospital of the Military Academy of Medicine in Warsaw, 1962

**Rycina 4.** Z płk. lek. Piotrem Goździkiem na budowie 2. Centralnego Szpitala Klinicznego WAM w Warszawie, 1962

In accordance to the order of the Minister of National Defence of 19 May 1958, the Military Centre of Medical Training (MCMT) was dissolved and the Military Medical Academy was formed on 1 July 1958, consisting of the following: MCMT, Central Clinical Hospital in Łódź, Central Hospital of the Ministry of National Defence in Warsaw and a centre of training for officers of the reserve in Przemyśl. On 3 October 1958, the first academic year of the academy began [4, 14]. "(...) for the significant personal contribution to the formation of the Military Medical Academy in Łódź" on 4 October 1958 Gen. Mieczysław Kowalski was awarded Commander's Cross of the Order of Polonia Restituta [1].

When summarising his life, excluding his work on formation of the Military Medical Academy, Gen. Mieczysław Kowalski recounted the following fields where he "left a certain mark" as Chief Medical Officer of the Armed Forces of Poland. These are:

- Establishment of Karol Kaczkowski Military Institute of Hygiene and Epidemiology ,
- Formation of blood and voluntary blood donation service in the Armed Forces of Poland,
- Formation of a psychological and psychiatric section in the Armed Forces of Poland,
- Construction and organisation of Central Clinical Hospital of the Military Medical Academy (Hospital at Szaserów St.) in Warsaw (opened in October 1964) [4, 18, 19].

During his retirement, he translated books on the history of military medicine, ethology and other books from Russian, German and French [20-22] He actively participated in sessions of the Historical Society of Military Medicine of the Hospital at Szaserów St. [23]. In 1978, on the 25th anniversary of the Military Medical Academy and "in recognition of his significant contribution to the development and activity of the Academy", he was awarded the Order of Gen. Prof. Bolesław Szarzecki. In 1980, on the 35th anniversary of MIHE, he was awarded the Anniversary Medal of Gen. Karol Kaczkowski. In 1984, he participated in the 20th anniversary of the Hospital at Szaserów St. [3]. In the same year, in company of his friends and former collaborators, he celebrated his 90th birthday. Toasting, he said: "The military, both in times of war and peace, creates the conditions and atmosphere which helps form bonds of friendships between soldiers. It is worth noting that the common fear of discipline, borne by candidates for military services, the relationship between a subordinate and a superior does not prevent friendships from flourishing" [3].

Disapproving of the fact that he could not continue his social works in the Polish Red Cross (which had lasted many years since 1927) after his discharge from the military, the general confessed: "If you retire after being in good health, it is the best time to use your acquired experience for social work. Those essentially insignificant shortcomings however did not change my attachment to the Polish Military, to the institution whose lights and shadows I experienced and to which I devoted larger part of my life" [4].

Gen. Mieczysław Kowalski wrote his memoirs which he called "a tale about his commanders because the commanders determine the nature of the military and are its essence. They create the disciplines in a team, but at the same time they are the "consumers" of those most essential traits of the military, reaching their goals through orders" [4].

Unfortunately, the publishing house of the Ministry of National Defence refused to publish those memoirs on various pretexts. They were published by Wydawnictwo Literackie publishing house in Kraków five years after the death of the author [5]. The reviewer of the book,

Tadeusz Brzeziński, a colonel, professor, ethicist and historian of medicine, the dean of Military Medical Academy and Medical Academy in Szczecin, former subordinate of Gen. Kowalski, wrote: "It is a marvellous tale of friendship, humanity and cooperation of people from seemingly different worlds. (...) It is an authentic story, written without political leanings, made even more precious because it is free of opportunism commonly found among writers of memoirs. (...) I always admired and respected the general like everyone who met him. Aside from the dignity and high culture he displayed he also earned respect by respecting others, but was also a demanding and strict commander" [24, 25].

Andrzej Felchner, a professor and historian of military healthcare, emphasized in his review: "Even if the story of his own life and deeds is sufficient to write several volumes of a fascinating book, the author only writes as much about himself as it is necessary to describe situations related to other people. This modesty, a very characteristic trait of the general, is remembered by everyone who knew and respected him and had the honour to serve under his command. (...) the pages of the book feature different issues of Poles, hence it is a valuable and helpful book to every reader. In an era when more and more new divisions are made, it demonstrates the bond joining people regardless of the paths that led them to the pages of the book - the bond is Poland" [26].

In the introduction to the book, Lt. Gen. Józef Kuropieska, commander and head of the Chief Staff Academy, and also historian and military writer, noted: "The general (Mieczysław Kowalski) admirably performed high and responsible functions in the reborn Polish Armed Forces. (...) Along with General Szarecki, he was our best chief medical officer. Whenever he spoke during sessions of the military council of the minister (in which I also participated), I was always encouraged by the level of those speeches, which proved his preparedness and great knowledge, the reliability of his assessment and accuracy of his predictions. His conclusions almost always (after few weeks or months) turned out to be true. To me they were original, interesting and valuable. Mieczysław Kowalski made many interesting remarks on the activity of the medical service during the war. However, he was often not understood by his direct superiors (...)" [4].

The achievements of Brig. Gen. Mieczysław Kowalski MD, PhD ensured his permanent place in the history of Polish military medicine and deserves preservation in the memory of the modern and future generations of his successors.

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# "We were taken somewhere in the forest, something like a summer resort" – a tribute to Lt. Col. Dionizy Krechowicz, PhD (1896–1940), the last commandant of the 3rd Regional Hospital in Grodno

„Przywieziono nas gdzieś do lasu, coś w rodzaju letniska” – w hołdzie ppłk. dr. Dionizemu Krechowiczowi (1896–1940), ostatniemu komendantowi 3. Szpitala Okręgowego w Grodnie

## Zbigniew Kopociński, Krzysztof Kopociński

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**Abstract** Grodno is a city which during the September Campaign of 1939 engaged in a heroic battle with the Red Army. One of the important elements of Polish resistance was the 3rd Regional Hospital in Grodno, led by Lt. Col. Dionizy Krechowicz (1896–1940), Polish military physician, officer, and last commandant of the 3rd Regional Hospital in Grodno. He was born in Zbaraż, on 8 April 1896, his parents were Piotr and Maria nee Chimuk. In the years 1914–1920, he took part in the First World War and the Polish-Soviet War. In 1925, he graduated from the Jan Kazimierz University in Lviv. In the years 1925–1931, Krechowicz served in the 5th Tatra Rifles Regiment in Przemyśl. In 1937, he became the commandant of the 3rd Regional Hospital in Grodno. During the September Campaign of the 1939 defensive war he was captured by the Red Army and imprisoned in the POW camp in Starobielsk. He was murdered by the NKVD in the spring of 1940. Lt. Col. Dionizy Krechowicz is buried at the War Cemetery in Kharkiv. In April 2010, a Polish delegation to attend a ceremony in Katyn, to pay tribute to the Polish officers killed there, including the defenders of Grodno, died in a plane crash near Smolensk. It was undoubtedly a tragic coincidence.

**Key words:** Defence of Grodno, Dionizy Krechowicz, Katyn, Starobielsk, 3rd Regional Hospital

**Streszczenie.** Grodno to miasto, które w czasie wojny obronnej we wrześniu 1939 r. stoczyło heroiczny bój z Armią Czerwoną. Jednym z ważnych elementów polskiego oporu był 3. Szpital Okręgowy w Grodnie, dowodzony przez ppłk. dr. Dionizego Krechowicza (1896–1940), polskiego lekarza wojskowego, oficera, ostatniego komendanta 3. Szpitala Okręgowego w Grodnie. Urodził się 8 kwietnia 1896 r. w Zbarażu, w rodzinie Piotra i Marii z Chimuków. W latach 1914–1920 uczestniczył w I wojnie światowej i wojnie z Rosją. Dyplom lekarza uzyskał w 1925 r. na Uniwersytecie Jana Kazimierza we Lwowie. W latach 1925–1931 służył w 5. Pułku Strzelców Podhalańskich w Przemyślu. W 1937 r. został komendantem 3. Szpitala Okręgowego w Grodnie. W czasie wojny obronnej 1939 r. dostał się do sowieckiej niewoli i przebywał w obozie w Starobielsku. Zamordowany przez NKWD wiosną 1940 r. Ppłk. dr. Dionizy Krechowicz spoczywa na Cmentarzu Wojennym w Charkowie. W kwietniu 2010 r. polska delegacja udająca się na uroczystości w Katyniu, aby oddać hołd zamordowanym tam polskim oficerom, w tym obrońcom Grodna, zginęła w katastrofie lotniczej pod Smoleńskiem. Był to niewątpliwie niezwykle tragiczny spłot wydarzeń.

**Słowa kluczowe:** Dionizy Krechowicz, Obrona Grodna, 3. Szpital Okręgowy, Starobielsk, Katyń

Delivered: 5/11/2018

Approved for print: 10/12/2018

No conflicts of interest were declared.

Mil. Phys., 2019; 97 (1): 89-96

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### Introduction

Almost 80 years have passed since the tragic September of 1939; however ramifications of the Second World War are felt to this day. In a result of invasion of Poland launched by Third Reich and USSR (with participation of Slovakia), we lost our independence. Since the first day of the conflict, through the next six years, Polish soldiers fought on all fronts in the forces of the anti-Hitlerite coalition. Unfortunately, the invasion of Russia launched by Hitler on 22 June 1941 made the Soviets join the group of countries fighting the Third Reich which was extremely unfavourable for Poland. Our "great allies", USA and the United Kingdom, ignored the loyal stance of their bravest ally from the banks of the Vistula and decided to establish good relations with Stalin at Poland's expense, secretly de facto sanctioning the invasion of Poland launched by USSR and the unlawful annexation of the Eastern Borderlands of the Second Republic of Poland. Even deprived of its sovereignty after 1945, the Polish nation would have been a different country if it still possessed within its borders the grand centres of domestic science, culture and art: Vilnius, Grodno and Lviv. Grand politics impacted cruelly on the fate of hundred thousands of Polish families, including doctors from the Eastern Borderlands of the Second Republic of Poland. If any scenario writer wrote a story about the experiences of the whole family of Col. Krechowicz, the critics would certainly treat it as too embellished and unreal, but it is not fiction – everything that happened in Kharkiv-Piatykhatky and Katyn was real.

### The beginning and development of the military and medical career

The future commandant of the 3rd Regional Hospital in Grodno was born on 8 April 1896 in the borderland town of Zbaraż, in the family of Piotr and Maria nee Chimuk. Reading the "Trilogy" by Henryk Sienkiewicz raised him in a patriotic spirit, and, in a similar way to the majority of contemporary young Poles, he dreamed about participating in the fight for independence. It was not a coincidence then that after the breakout of the First World War he volunteered to Polish Legions, on 12 September 1914. He initially received training at the Training School in Kraków, and then served as a private of in a company in Kęty and in the 1st Artillery Regiment. In January 1915, his hand got injured near Tuchów. He underwent treatment in Jarosław Hospital No. 1 in Żywiec, which perhaps had an impact on his choice of future path and taking on the burden of medical studies. In 1918, he was granted leave in order to obtain a certificate of secondary education from the middle school in Tarnów, and then, on 1 November 1918 he began

service in the reborn Armed Forces of Poland as a medical sergeant at the Modlin garrison. After a year he was promoted to medical second lieutenant and as a part of Reserve Medical Company No. 1 he was sent to Mokotów Hospital in Warsaw, and to medical studies at the University of Warsaw. Then as a captain second doctor (higher rank from 1 June 1919) he was appointed a junior doctor of the 5th Regiment of the Podhale Riflemen in Przemyśl, and sent to acquire further education. He obtained the diploma of doctor of all-medical sciences in 1925 at the Medical Faculty of the Jan Kazimierz University in Lviv, and assumed the position of battalion doctor and then the position of head regimental doctor in the 5th Regiment of the Podhale Riflemen in Lviv, where in 1930 he was promoted to the rank of major. In 1933, as one of few military doctors, he completed a 2-year course at the Military Academy, and then became a commandant of the Reserve Staff of the 1st Regional Hospital in Warsaw, a function he performed until 12 November 1935. The next stage of his professional career was the function of head of the office of the Organisational Branch of the Department of Health of the Ministry of Military Affairs.

His last great professional achievement was promotion to the rank of lieutenant colonel on 19 March 1937. His fate would be sealed on 22 November 1937, when he was appointed as commandant of the 3rd Regional Hospital in Grodno, but perhaps in this happy moment of his life he did not suspect that he would never be posted elsewhere [1-4].

### Grodno and his 3rd Regional Hospital

The military hospital in Grodno was at the time within walls of the New Castle on Zamkowa St. The historic building was created in the years 1734-1751 by order of King Augustus III. It was designed by the renowned Saxon architects: Joachim Jauch, Friedrich Pöppelman and Johann Friedrich Knobel. The beautiful horseshoe-shaped palace was built in the style of Louis V, with an exquisite hall – senatorial chamber and its own chapel. The entry gate to the yard was formed by two pillars and pilasters. The brick pillars remain to this day, on which artworks depicting sphinxes and cherubs a'la Jacques Francois Blondel were placed. In 1789, by order of King Stanisław August Poniatowski, an Italian architect, Giuseppe de Sacco, overhauled the New Castle according to his own design. Many sessions of the Sejm of the Republic were held within the senatorial chambers, including the last one, held by Tsarina Catherine II in order to pass the treaties with Russia and Prussia imposed on Poland by force, sanctioning the second partition of Poland (17 June – 24 November 1793). Within the walls of the future military clinic, the



**Figure 1.** Lt. Col. Dionizy Krechowicz, PhD (1896–1940) (courtesy of Ewa Solska)

**Rycina 1.** Ppłk. dr Dionizy Krechowicz (1896–1940) (dzięki uprzejmości Ewy Solskiej)

First Republic of Poland symbolically ended by abdication signed by King Stanisław August Poniatowski on 25 November 1795.

Over the next few decades, the building slowly fell into ruin as the result of its use as a barracks for the military. During The First World War the Germans established a military hospital with capacity of 500 beds within its walls. After Poland regained independence, the New Castle was renovated and designated as the headquarters of a military clinic [5-7].

From 1925 Grodno was the headquarters of one of ten regional military healthcare outposts existing at the time - the 3rd Regional Hospital (created as a result of the transformation of the District Hospital which existed beforehand). The following wards were established within the structure of the hospital: commandant's team, patients' wards (internal, surgery with gynaecological and maternity subwards, neuropathology ward, infectious diseases ward, dermal and genital ward, ear ward, eye ward), RTG lab, bacteriological lab, dental clinic, hospital and garrison drug store and specialised dispensaries. It



**Figure 1.** New Castle (former 3rd Regional Hospital) gateway in Grodno, 2003 (photo by Z. Kopociński)

**Rycina 2.** Brama wejściowa Zamku Nowego (dawny 3. Szpital Okręgowy) w Grodnie, 2003 (fot. Z. Kopociński)

should be noted that the 3rd Regional Hospital did not have its own psychiatric ward, so such patients were directed to the Hospital of the Fortified Territory of Vilnius. In 1931, the range of duties of regional outposts were extended to include the issues of mobilization (registry of the rank and file personnel in health care and the officers of the reserve of the Corps District, supplementing the personnel of non-registered healthcare units within the region, mobilization and demobilization of all healthcare units in the area in terms of staff and equipment, storage and maintenance of materials required for mobilization). In order to perform them, the Reserve Staff (RS) within the structures of the 3rd Regional Hospital, formed as a result of the reorganization of the 3rd Medical Battalion from Grodno. The commandant of the RS was also the deputy commandant of the hospital. It should be noted that, in contrast to the majority of district units, the Reserve Staff of Grodno was stationed in Sokółka, outside the headquarters of their parent outpost.

At the moment of assuming the position of commandant by Lt. Col. D. Krechowicz, PhD the unit had a total of 400 beds in 7 wards: internal ward, surgical ward, gynaecological-maternity ward, dermal-genital ward, neuropathology ward, laryngeal ward and ophthalmic ward. It also had a summer branch, the Seasonal Military Hospital in Druskienniki (Druskininkai), very popular among health resort visitors. It began operation in 1926 on a seasonal basis, from May to September, initially with only 40 beds but gradually increased due to the high interest among the officers and their families. During the service of Lt. Col. Dionizy Krechowicz, PhD, the branch unit in Druskienniki of the 3rd Regional Hospital reached its highest ever number of beds, at 200. It mostly hosted people suffering from



**Figure 3.** Dionizy Krechowicz with his wife Zofia, Iwonicz Zdrój, 1936 (courtesy of Ewa Solska)

**Rycina 3.** Dionizy Krechowicz z żoną Zofią, Iwonicz Zdrój, 1936 (dzięki uprzejmości Ewy Solskiej)

muscoskeletal, gynaecological and neural diseases [8-12].

### The military hospital during the defence of Grodno against the Red Army in 1939

During his two years of commanding the outpost, Krechowicz familiarized himself perfectly with all members of the staff and became fond of them. Most were professional officers, tempered in battle like their commandant, during the First World War and the war of 1920. The almost twenty-year-long period of peaceful existence ended for them on 31 August 1939, on the day of declaring general mobilization. In the early morning of the following day, German bombers launched an intensive air raid on Grodno, killing and injuring many inhabitants. It should be emphasized that everyone who needed immediate help received it quickly and efficiently,

thanks to the staff of the 3rd Regional Hospital. Lt. Col. Dionizy Krechowicz, PhD, was prepared for such an eventuality; during the morning briefing he handed sealed envelopes with mobilization call-ups to his doctors. The majority of the professional staff of the outpost went to the front, the vacancies being filled by reservists mobilized as a part of the Reserve Staff [16].

In 20–22 September 1939, Grodno, along with its military hospital, became famous for their heroic defence against overwhelming Soviet forces. The 15th Armoured Corps of the Red Army commanded by Gen. Petrov received the order to capture Grodno. The brains and organisers of the defence were Roman Sawicki, the deputy president of the city and the commandant of the local RKU, Maj. Benedykt Serafin. It should be noted that even though Grodno was a large military garrison and stationed there in the interbellum period were Corps District Command no. 3, the 3rd Regional Hospital and units of the 29th Infantry Division (76th Infantry Regiment, 8th Regiment of Grodno Riflemen, 29th Regiment of Light Artillery, 7th armoured battalion and a squadron of AA artillery), at the moment of the outbreak of the war it had no such a force. Subdivisions of the Grodno Division were moved in August 1939 in accordance with operational Plan Z to the western border, and mobilisation of surpluses which constituted the “Grodno” Operational Group were moved on 10 September to defend Lviv. Only two infantry battalions remained in the city: a marching battalion, commanded by Cpt. Piotr Korzon, and a guard battalion commanded by Maj. Benedykt Serafin, and small subdivisions from Vilnius and Lida (part of the 5th Air Regiment, 94th AA artillery battery). The medical service was well organized and its activity was coordinated by the local military hospital, which was also the main point of evacuation of the injured.

The battle for the city began on 20 September around 8.00 with an attack by Soviet tanks of the reconnaissance squadron of the 27th Armoured Brigade from the left bank of the Niemen River, via a road bridge, and then in the direction of the centre. It was stopped by the Polish defenders in a very daring manner. One of the most beautiful moments in Polish history was the moment when boy scouts stopped Soviet tanks with gasoline filled bottles and grenades. The intense fighting lasted the whole day, during which the enemy used around 70 combat vehicles and tanks. Despite the overwhelming advantage, the Red Army could not enter the city, and retreated its forces after twilight. During the night, the Polish defenders, encouraged by their successes, launched several raids on the left bank, successfully eliminating a number of Soviet outposts and even taking POWs. In the morning, around 4.00-4.30, following an artillery bombardment, another Soviet attack

was launched and repelled, and would have ended with a massacre of the enemy units if not for the arrival of support in form of the 16th Riflemen Corps and the 6th Cavalry Corps of the Red Army. Thanks to such an overwhelming advantage they managed to enter the centre of the city in the afternoon of 21 September, where fighting took place in the streets and squares. The garrison of the Old Castle and the barracks of the 81<sup>th</sup> Regiment of Grodno Riflemen resisted the longest. During the night, the Soviet command ordered its soldiers to retreat from the city and planned a general assault for the following day. In the morning, some of the defenders left the city and headed in the direction of Lithuania, while others dispersed. During the fighting on 20-22 September, the defenders managed to destroy over 10 different armoured vehicles and to kill or injure around 200 Red Army soldiers. It should be especially emphasized that the 3rd Regional Hospital gave assistance both to the injured of both sides, reflecting the most glorious traditions of Polish military healthcare.

The symbol of the defence of the city became the death of 13-year-old Tadeusz Jasiński, who was captured by the Soviets and on September 21 tied to the turret of a tank, where he was heavily injured (5 gunshot wounds). Military doctors tried to save his life without success and the description of his death is an excellent example of what the 3rd Regional Hospital meant for the defenders: "... He dies in the embrace of his mother and in a piece of free Poland, because the military hospital is still in our hands..." In the Morning of 22 September 1939, part of the staff of the hospital retreated to Lithuania where they were interned. The worse fate awaited those who stayed in Grodno. Soon after the capture of the city, the invaders shot approx. 300 defenders, including teenage boys. Some of the Polish wounded (mostly those uniformed) were taken for safety from the 3rd Regional Hospital and placed in private apartments because the locals were justifiably afraid of repressions of the invaders. At the moment of the entry of Soviets to the hospital the majority of the wounded were soldiers of the Red Army [14-16].

### Soviet captivity

After the end of hostilities, the authorities of USSR broke international conventions according to which the military takes care of POWs and the captured Polish officers were entrusted to the Soviet security services – NKVD (National Committee of Internal Affairs). Two days after the invasion of Poland, the Management of Affairs of Prisoners of War and Interned was formed within NKVD's structures, led by Major Piotr K. Soprunienko by virtue of an order of the People's Commissar of Internal Affairs of the USSR, First Rank Security Commissar Lavrentiy P.

Beria. Polish POWs, placed at the end of hostilities in September 1939 in many transit camps (the largest in Shepetivka), were moved by train to several main, fixed camps.

The commandant of Grodno's military clinic, which was a pillar of the medical security of the defence of the city, Lt. Col. Dionizy Krechowicz, PhD, was captured by Soviets in unknown circumstances. He remained in a camp in Starobilsk, a small town in Voroshilovgrad Oblast (now Luhansk Oblast). Polish POWs were placed in a complex of buildings in a former Orthodox female monastery, which was walled and consisted of two brick churches and several barracks. Initially the camp was not well guarded, the fencing was damaged, there were no guard gatehouses and the POWs could contact the civilian population. This created conditions for easy escapes, but whether such attempts were made and what was their result it is hard to say, as there are no remaining accounts. The living conditions of POWs were initially very bad. Due to the lack of a kitchen, they only received one warm meal a day. There was no laundry, so with no opportunity to change bedsheets or underwear, skin diseases and lice infestation were commonplace. They placed approx. 3800 officers in the camp, including 344 doctors, mostly officers of the reserve. Lt. Col. Krechowicz, PhD met many acquaintances from the period of his service in Grodno and other garrisons. The doctors maintained the camp dispensary, where, despite the lack of basic medical supplies, they tried to aid their sick compatriots. Around 30 inmates died in the camp, partly due to wasting and tuberculosis [17-18].

During the stay in the prison, the authorities took classic prison photographs and created personal records in which they gathered materials from many interrogations conducted by NKVD agents (the authorities of Russian Federation claim that the documents were destroyed). The chief of this murderous organization, Security Commissar of Internal Affairs of USSR Lavrentiy Beria, turned to the Political Bureau of the Central Committee of the Communist Party of the Soviet Union with a motion to shoot the POWs, because they are "hardened enemies of the Soviet authorities without hope for improvement", which was approved by a resolution of the party authorities of 5 March 1940, signed by Stalin, Voroshilov, Molotov and Mikoyan. Pursuant to the resolution, the Polish POWs from the camp in Starobilsk were gradually transported to Kharkiv and the nearby town of Derhachi in the period between April and the beginning of May 1940. Most of them were shot in the back of their heads at the Kharkiv headquarters of NKVD, some of them were transported directly from Derhachi to trenches already dug up in the forest in Piatykhatky and eliminated there. All murdered Polish officers, including Lt. Col. Dionizy Krechowicz and

many other doctors of Grodno, were secretly buried in the sixth forest-park zone in Piatykhatky (currently a district of Kharkiv) in spring 1940 [17]. The exact date is unknown.

The last commandant of the 3rd Regional Hospital in Grodno, a combatant for independence during the First World War and in the war against Russia in 1920, the defender of Grodno in September 1939, was awarded for his self-sacrificing service a Golden Cross of Merit, a medal of 10th Anniversary of Regaining Independence, the "Poland To His Defender" medal, the "For Long Service" (bronze) medal, and other distinctions.

In his private life, he had a successful marriage to Zofia Krechowicz, and the apple in the parents eye was the daughter Halina whom they tried to bring up as decent and honourable person, which certainly happened, with the proof being her attitude during the German occupation. Halina Janiczek (with her husband's surname) was a soldier of the Home Army, arrested in 1942 by the Gestapo, later to die in the Nazi German Auschwitz-Birkenau death camp, orphaning a trio of little children. The family traditions in the field of medicine are continued by her daughter, Ewa Solska, PhD, an excellent and empathetic doctor, who was the head of the Provincial Centre of Oncology in Gdańsk for many years.

On 23 June 2013 at I. Paderewski Park in Toronto, an Oak of Memory was planted to honour Lt. Col. Dionizy Krechowicz, PhD [1, 19, 20].

### Sorrowful epilogue

The geopolitical changes of 1989 allowed the acquisition from Russian authorities some of the documents concerning the atrocity in Katyn, and to commence excavation and archaeological works in the places of rest of the murdered POWs. Similar research in Piatykhatky was conducted in 1991 and 1994-1996, which allowed the documenting of the manner in which Polish officers from the camp in Starobilsk were murdered. A war cemetery was founded at the place of the massacre. The opening ceremony of the necropolis took place on 17 June 2000 in the presence of the Prime Minister of the Republic of Poland, Jerzy Buzek, and the Prime Minister of Ukraine, Viktor Yushchenko. This reminds us that the authorities of Ukraine participate in the commemoration of victims of crimes committed by Russians, but they diligently falsify knowledge about the actions of UPA and make efforts aimed at restricting the commemoration of Poles murdered as a part of genocide conducted by Ukrainian nationalists.

On 10 April 2010, the husband of the granddaughter of Dionizy Krechowicz, Leszek Solski – known activist of the Katyn Families Association, was on board of the

plane with the Polish delegation to commemoration in Katyn, where he planned to lay wreaths to commemorate his father murdered in Katyn, Cpt. Kazimierz Solski, his uncle, Maj. Adam Solski, and the grandfather of his wife, Lt. Col. Dionizy Krechowicz, PhD. He did not fulfil his intention, as he died in the plane crash close to the place of the murder of his father.

A diary of Adam Solski was found in the Katyn pits, where the entry of 9 April 1940 notes: "Five a.m. (...) We were transported somewhere to a forest, to a place resembling summer resort. A detailed inspection. They took a watch, it showed 6.30...", which is a testimony to the last moments of life of the officer and his colleagues (the fragment appeared in an excellent film directed by Andrzej Wajda, "Katyn") [17, 19, 21, 22].

The very tragic history of Dionizy Krechowicz and his family clearly shows the reality of life for common people and the dramatic consequences it carries, also from future perspective. During our hectic lives it is worth to stopping and reflecting on the fragility of human life, to always remember our own faults and those who passed away.

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