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CONTENTS

2018, vol. 96, no. 4

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CONTENTS

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HISTORY OF MEDICINE AND MILITARY HEALTH CARE

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2018, tom 96, nr 4

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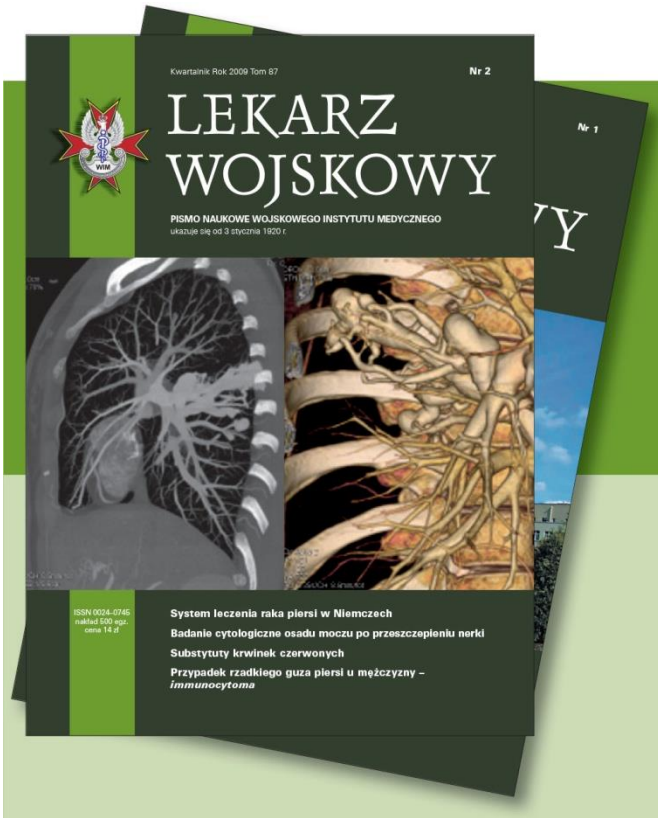

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SPIS TREŚCI

HISTORIA MEDYCYNY I WOJSKOWEJ SŁUŻY ZDROWIA

Cushing's Disease: Adrenal recovery evaluation following successful surgical treatment

Choroba Cushinga: ocena powrotu funkcji kory nadnerczy po skutecznym leczeniu operacyjnym

Marta Izabela Mazur,[1] Grzegorz Zieliński,[2] Katarzyna Szamotulska,[3] Aleksandra Stasiewicz,[1] Marcin Ozdarski,[1] Przemysław Witek[1]

[1] Department of Gastroenterology, Endocrinology and Internal Diseases, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine, Warsaw, Poland; head: Assoc. Prof. Przemysław Witek MD
[2] Department of Neurosurgery, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine in Warsaw; head: Assoc. Prof. Andrzej Koziarski MD
[3] Department of Epidemiology and Biostatistics, Institute of Mother and Child, head: Katarzyna Szamotulska, Professor at the Institute of Mother and Child

Abstract. Cushing's disease (CD) is a state of hypercortisolemia caused by the overproduction of adrenocorticotropic hormone. The treatment of choice is transsphenoidal surgery performed by an experienced neurosurgeon. Successful surgical treatment is often linked with adrenal insufficiency, the follow-up and treatment of which is of the utmost importance during postsurgical care. The aim of the study was to investigate the duration of adrenal recovery in CD after successful surgery. The study involved 23 patients after successful surgery performed due to CD, performed at the Neurosurgery Department of the Military Institute of Medicine. Adrenal recovery at 3, 6, 12 and 18 months was achieved in 4 (17.4%), 4 (17.4%), 5 (21.7%) and 7 (30.4%) patients, respectively. By 18 months after successful neurosurgery treatment of CD, full recovery of adrenal functions can be expected in almost 90% of cases. The appointment pattern presented here enables early identification of patients with adrenal recovery and leads to optimization of a substitution treatment with hydrocortisone.
Key words: adrenal recovery, cortisol, Cushing's disease, secondary adrenal insufficiency, transsphenoidal surgery

Streszczenie. Choroba Cushinga (CD) jest stanem hiperkortyzolemii wynikającym z nadprodukcji hormonu kortykotropowego. Leczeniem z wyboru jest przezklinowa resekcja gruczolaka przysadki wykonana przez doświadczonego neurochirurga. Skuteczne leczenie operacyjne wiąże się z wystąpieniem niedoczynności kory nadnerczy. Jej optymalne monitorowanie oraz leczenie są kluczowymi elementami opieki pooperacyjnej. Celem badania była ocena czasu trwania niedoczynności kory nadnerczy po skutecznej przezklinowej resekcji gruczolaka przysadki. Metody. Do badania włączono 23 pacjentów po skutecznym leczeniu operacyjnym z powodu CD przeprowadzonym w Klinice Neurochirurgii WIM. Wyniki. Powrót funkcji osi przysadkowo-nadnerczowej po 3, 6, 12 i 18 miesiącach wykazano odpowiednio u 4 (17,4%), 4 (17,4%), 5 (21,7%) i 7 pacjentów (30,4%). Wnioski. Po 1,5 roku od skutecznego leczenia neurochirurgicznego z powodu CD można spodziewać się powrotu funkcji osi przysadkowo-nadnerczowej u niemal 90% pacjentów. Zaproponowany schemat wizyt umożliwia wczesną identyfikację pacjentów z normalizacją funkcji kory nadnerczy, a w konsekwencji optymalizację substytucyjnych dawek hydrokortyzonu.
Słowa kluczowe: wtórna niedoczynność kory nadnerczy, kortyzol, choroba Cushinga, przezklinowa resekcja gruczolaka przysadki, powrót funkcji kory nadnerczy

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Corresponding author
Marta Izabela Mazur MD
Department of Gastroenterology, Endocrinology and Internal Diseases, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine
128 Szaserów St., 04-141 Warsaw
telephone: +48 261 817 255
e-mail: mimazur@wim.mil.pl

Introduction

Cushing's disease (CD) is a state of hypercortisolaemia resulting from excessive production of adrenocorticotropic hormone by a pituitary adenoma. The incidence is 2-3 cases/million/year, and the prevalence is 40 cases per million people. The disease occurs significantly more often in females, and it is estimated that the incidence among women is 3-8 times higher than in men [1]. The treatment of choice in patients with CD of pituitary origin is transsphenoidal adenomectomy performed by an experienced surgeon. The guidelines for postoperative evaluation (hormonal and neuroradiological) help unify and optimise the management of this group of patients. However, the data regarding adrenal cortex recovery following successful surgical treatment of CD is insufficient.

Aim of the study

The aim of the study was to assess the duration of adrenal cortex insufficiency in patients after a successful transsphenoidal adenomectomy due to CD.

Material and Methods

The study included 23 patients after a successful transsphenoidal resection of a pituitary adenoma performed in the Department of Neurosurgery of the Military Institute of Medicine, all by the same surgeon, and all following the same surgical protocol. Patients were informed about the aims and methods employed in the study, and gave their written consent to participate in it. The study design was approved by a Bioethical Committee. The study group consisted of 21 females (91.3%) and 2 males (8.7%). The female to male ratio was 11:1. The average age was 35.2 years old (median: 29.7, range: 18.4 – 57.2).

Study protocol

The recovery of the pituitary-adrenal axis function was assessed by determination of the blood serum cortisol concentrations at 08:00, following the above pattern, i.e. in months 3, 6, 12, and 18 following the pituitary surgery (Fig. 1). Normal adrenal cortex function was found in patients with cortisol concentrations below the lower limit of normal (5 µg/dl) at any time point.

The cortisol concentrations were determined with the IMMULITE 2000 analyser using the enzymatic immunochemiluminescence method. The analytic sensitivity of the test was 0.2 µg/dl. The laboratory reference standard for morning cortisol assays was 5 – 25 µg/dl.

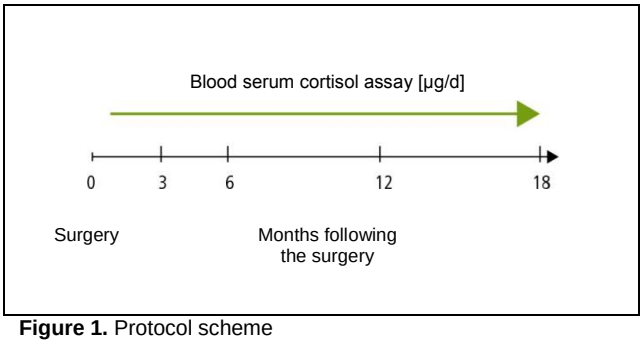

Figure 1. Protocol scheme
Rycina 1. Schemat protokołu badania

Results

Mean cortisol concentration of 3.13 ±2.5 µg/dl (median: 2.85; range: 1–9.8) after 3 months of follow-up, 4.69 ±4.49 µg/dl (median: 2.97; range: 1–14.2) after six months, 7.34 ±5.17 µg/dl (median: 6; range: 1–18.6) after 12 months, and 9.22 ±4.12 µg/dl (median: 10.2; range: 1–16.4) after 18 months. Figure 2 presents the dynamics of the mean cortisol concentrations in the blood serum.

Pituitary-adrenal function recovery at the first time point (3 months following the surgery) was observed in 4 patients (17.4%), after six months in another 4 patients (17.4%), after 12 months in another 5 patients (21.7%), and after 18 months in 7 another patients (30.4%). At months 3, 6, 12 and 18 following surgery, adrenal cortex insufficiency persisted in 19 (82.6%), 15 (65.2%), 10 (43.5%) and 3 (13%) patients, respectively. The data are presented in Figure 3.

The above results indicate that the recovery of the pituitary-adrenal axis function following successful neurosurgical treatment is initially observed in a limited number of patients. However, after 18 months the recovery of adrenal cortex function can be expected in the majority of patients (87%).

Discussion

Proper evaluation of the pituitary-adrenal axis function following successful surgical treatment is necessary for adequate patient management. Monitoring of the adrenal cortex function with appropriate hormonal and diagnostic tests during frequent follow-up visits help optimise the substitution therapy with hydrocortisone, and to individualise the duration of the treatment duration according to the needs of individual patients.

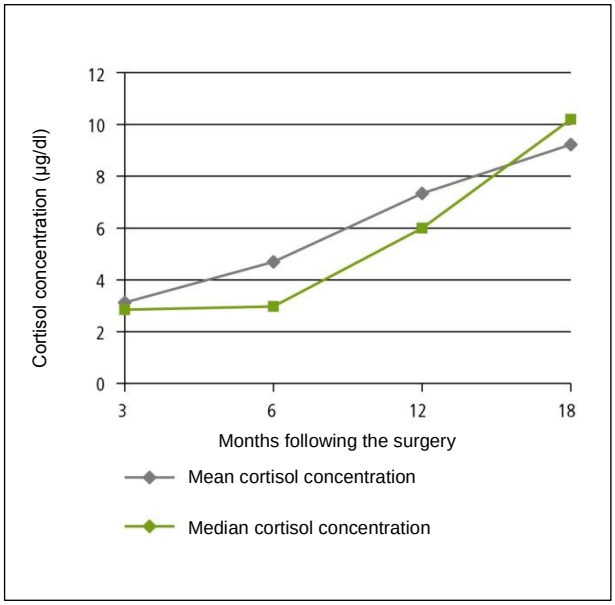

Figure 2. Change in mean serum cortisol levels after successful surgery
Rycina 2. Dynamika średniego stężenia kortyzolu po skutecznym leczeniu operacyjnym

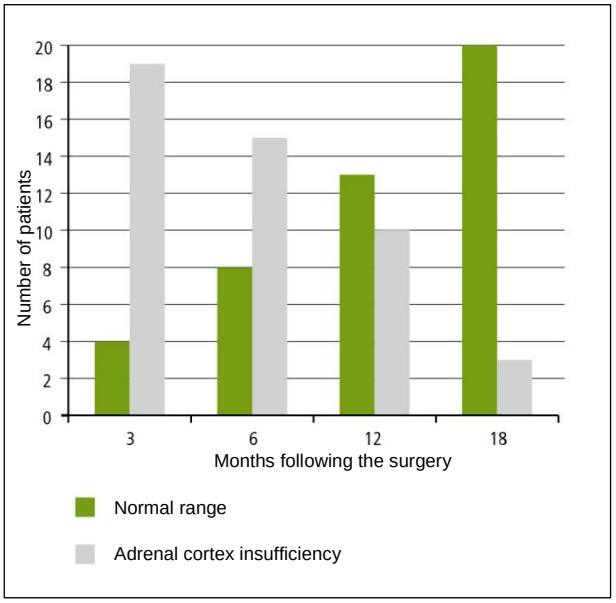

Figure 3. Adrenal recovery after successful surgery for Cushing's disease
Rycina 3. Powrót czynności osi przysadkowo-nadnerczowej po skutecznym leczeniu operacyjnym choroby Cushinga

As a consequence, the patient's quality of life improves, and potential iatrogenic effects of unnecessary substitution therapy are prevented. Successful surgical treatment in the group of patients participating in the presented study was associated with a 100% probability of adrenal insufficiency. According to Ajlan and other authors [2], impairment of the pituitary-adrenal axis is observed in 0.8–44% of patients. Such a high discrepancy between the data may be due to the fact that these studies involved patients with various types of pituitary tumour, which means they included a wider population of patients. In the study by Gomez et al. [3], involving 20 patients with Cushing's syndrome, of whom 17 had CD, all the patients required substitution therapy after the surgical treatment.

Another issue is the type of examination and diagnostic tests performed to assess adrenal recovery. According to the Endocrine Society guidelines [4] the recommended examinations include: morning serum cortisol assay and/or synthetic ACTH stimulation test or insulin tolerance test [5, 6]. According to Flitsch et al. [7] the first marker of adrenal recovery is normalisation of adrenocorticotropic hormone levels. The authors advocate that hormonal substitution therapy is indicated when cortisol concentration is <5 µg/dl, while if cortisol levels are ≥7.4 µg/dl, synthetic ACTH stimulation is recommended. When cortisol concentration increases by ≥18 µg/dl at any time point during the test, it indicates that the adrenal function is restored.

It should be emphasised that at every stage of the monitoring of the pituitary-adrenal axis function, a clinical assessment is of the greatest importance, and particular attention should be paid to the symptoms reported by the patient. The expected time of adrenal insufficiency according to Nieman et al. [4] is 6-12 months, and according to Flitsch and Ludecke [7-10] it is longer - at approximately 17 months. Based on the results of this work and observations reported in the literature, the period of increased monitoring should be extended to 18 months, to reduce the risk of unnecessary therapy with hydrocortisone. Variations in the time to adrenal recovery are also interesting. According to some German authors [7], this time depends primarily on the amount of Crooke's cells, produced as a result of the pathological, suppressive effect of hypercortisolaemia on the pituitary corticotropic cells that leads to endoplasmic hyalinisation, formation of vacuoles around the cell nucleus, and granulations in the cytoplasm. Values of >25% may be associated with a longer time to adrenal recovery.

In summing up, hypocortisolaemia indicates the surgical treatment was successful. However, there are certain discrepancies regarding the duration of this condition and the monitoring methods.

Conclusions

At 18 months after successful neurosurgerical treatment for CD, full recovery of the adrenal function may be achieved in almost 90% of cases.

The suggested frequency of follow-up visits enables the early identification of patients whose adrenal cortex function has normalised, and to optimise the duration and dosing of the substitution therapy with hydrocortisone.

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Heavy user patient phenomenon in outpatient medical care

Fenomen pacjenta typu heavy user w ambulatoryjnej opiece medycznej

Tomasz Ameljańczyk[1,2]

[1] Department of Medical Radiology, Military Institute of Medicine in Warsaw; head: Artur Maliborski MD, PhD
[2] Lux Med. Sp. z o.o. in Warsaw, Medical Director: Krzysztof Kurek MD, PhD

Abstract. *Heavy users* are defined as patients who use medical resources to the greatest extent in a healthcare system. It is estimated that they constitute one to ten percent or more of the healthcare beneficiary population. Estimating the number of this type of patient and identifying the most frequent services they consume is crucial for optimal planning and delivery of medical services, including minimizing their ineffective use.
Key words: heavy user patient, anti-heavy user patient, outpatient medical care

Streszczenie. Mianem *heavy users* określa się pacjentów, którzy w systemie opieki zdrowotnej w największym stopniu korzystają z zasobów medycznych. Przyjmuje się, że stanowią oni od około jednego do kilkunastu procent populacji beneficjentów opieki zdrowotnej. Oszacowanie liczby tego typu pacjentów oraz identyfikacja najczęstszych konsumowanych przez nich usług ma kluczowe znaczenie dla optymalnego planowania i dostarczania usług medycznych, w tym minimalizacji ich nieefektywnego wykorzystania.
Słowa kluczowe: pacjent *heavy user*, pacjent anty-*heavy user*, ambulatoryjna opieka medyczna

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Corresponding author
Aleksander Tomasz Ameljańczyk
Department of Medical Radiology, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine
128 Szaserów St., 04-141 Warsaw
telephone: +48 261 816 258
e-mail: tameljanczyk@wim.mil.pl

Introduction

The problem of increased demand for medical services has been evolving for many years, posing a challenge for healthcare systems (HS). This is primarily due to population ageing, the occurrence of new medical technologies, increased health awareness in patients, and extended average life expectancy. On the other hand, due to the limited financial, personal and organisational resources, it is impossible to match the increased demand with an adequate supply of medical services. Therefore, special attention is paid to the optimal use of the available resources, i.e. to proper planning, based on the mapping of health needs, the provision of relevant medical services and minimising of their ineffective use. The increased demand and growing costs of medical services, combined with insufficient funding of healthcare systems, have forced the decision makers and the people directly involved in the healthcare system to examine the population of patients who take a disproportionately large advantage of the available medical resources. The subject literature offers a number of terms used to describe this group of patients: heavy users (HU), frequent users, high-resource users, super-users, frequent presenters, repeat patients, frequent attenders, high utilizers, hyperusers, revolving door patients and high users. Considering the origin of the problem, the term 'high-cost frequent (health system) users' would be appropriate, as it reflects the difficulties the healthcare systems are facing ("high cost" does not refer only to the financial aspect). The analysis of previous scientific reports indicates that heavy users form a heterogeneous group of patients, demonstrating a large number of chronic diseases, mental disorders, psychosocial problems and high mortality rates, although these observations apply mostly to the HU patients of Emergency Departments (EDs) [1-4]. Two mechanisms

are distinguished in the way HU patients use medical services: frequent use and misuse, associated with the justified or unjustified (from a medical point of view) frequent use of medical services.

Heavy users are the source of two issues:

- proper allocation of medical resources in the healthcare system, i.e. planning the availability of medical services relevant for the group of patients with higher health needs (frequent use) [5], known as the problem of providing relevant medical services,
- optimisation of the use of HS resources by patients who abuse them (the problem of medical service misuse) [6-7]. The following subclasses of HU patients can be distinguished:

Heavy users **type N** (*normal*) – in these patients the demand for HS resources is raised due to a serious disease (usually only temporarily). After some time, the use of HS resources by these patients decreases to the level observed before the disease, or it remains elevated if they become chronically ill patients. Due to similar patterns of behaviour, this group of patients can be temporarily perceived as heavy users.

Heavy users **type H** (*hypochondriac*) – in these patients no medically justified need for such a frequent use of healthcare system resources is found. They are predominantly patients with psychosocial problems [8], often with concurrent chronic diseases. In this group the increased use of healthcare system resources is typically temporary. If the heavy use of healthcare system resources is permanent, the behavioural pattern in these patients resembles that of chronically ill individuals.

Based on the observation of the way out-patients use medical services, another class of patients was determined: anti-heavy users, i.e. patients who did not use any healthcare resources for a long time, for at least a year (individuals who avoid contact with healthcare institutions). This group should be the target of prophylactic programmes.

The scope of the heavy user phenomenon has not been established. International publications in which the heavy user phenomenon was studied in Emergency Departments (ED) [9-11] indicate that this population may comprise 0.2-11% of the patients using ED services, generating 1.9-32% of all visits. In out-patient healthcare it is estimated that 10% of the patients most frequently visiting general practitioners account for 30-50% of all visits, and approximately 40% of them become HU patients in the following year [12, 13]. However, these are merely estimates, and no specific data are available regarding the scope of HU phenomenon or all the services provided within the primary and specialist out-patient healthcare.

Aim of the study

The aim of the study was to develop and characterise HU patients based on analysing the use of medical services by patients with access to out-patient healthcare (primary and specialist healthcare) in the medical subscription services model ("prepaid medical care plan").

Material and Methods

The study population involved 678,178 clients of the company offering subscription services in 2013 (beginning of the study) to 813,432 patients in 2015 (the end of the analysis). The study included subjects regardless of their age, mostly employees (the prepaid medical care plan was provided by employers) and their family members. The analysis included only patients who had a subscription for the entire year of 2013.

Research model

The subscription medical services (prepaid medical care plan) market in Poland completes the national health insurance system. This complementary system covers only part of the population, usually employees (and, optionally, their family members) in companies that decide to participate in an additional services programme for employees. In out-patient care, both models - prepaid medical care plans and national health insurance system - are based on similar principles. The prepaid medical care plan provides unlimited access to a predefined set of healthcare services in return for a subscription fee, similarly to the national health insurance system, where the health insurance contributions also ensure unlimited access to a predefined set of medical services.

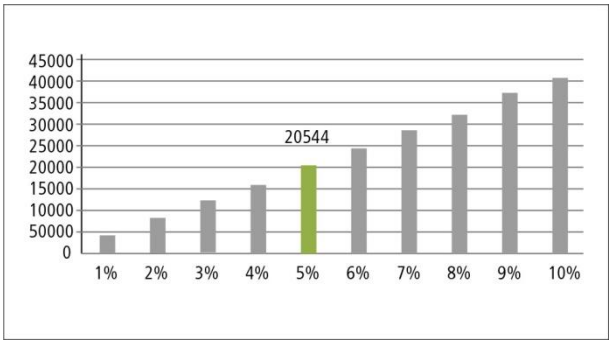

Figure 1. Size of HU patient population in 2013 according to the HU patient definition
Rycina 1. Liczebność populacji pacjentów HU w 2013 roku w zależności od przyjętej definicji pacjenta

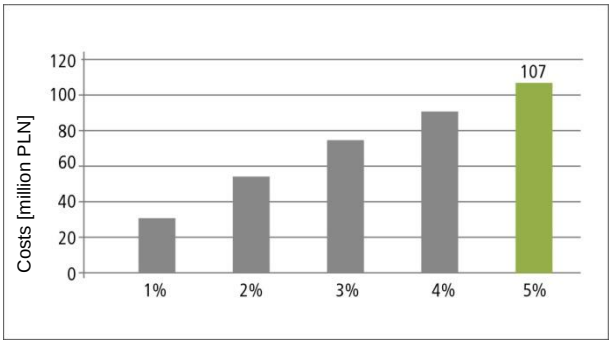

Figure 3. Annual cost of health services generated by HU patients according to the HU patient definition (M PLN)
Rycina 3. Roczny koszt świadczeń zdrowotnych generowany przez pacjentów HU w zależności od przyjętej definicji pacjenta HU (mln PLN)

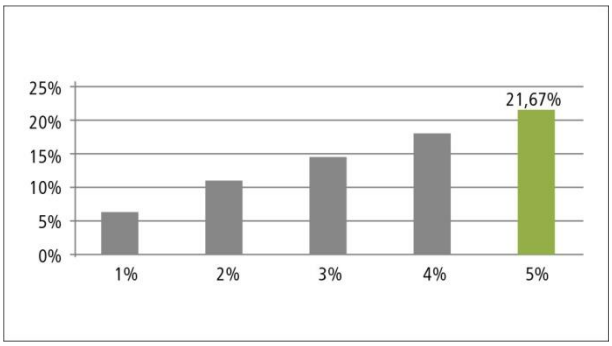

Figure 2. Consumption of system resources by HU patients
Rycina 2. Konsumpcja zasobów systemowych w zależności od przyjętej definicji pacjenta HU

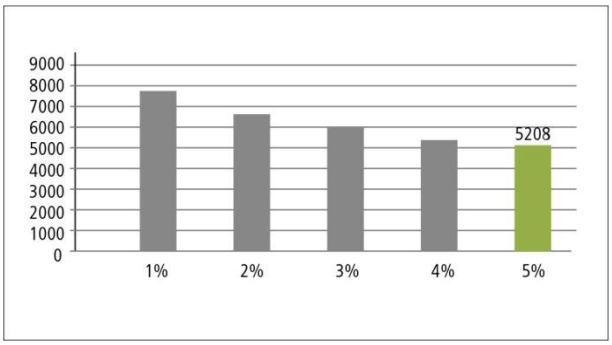

Figure 4. Average annual medical cost per HU patient according to the patient HU definition (PLN)
Rycina 4. Średnioroczny koszt medyczny na pacjenta HU w zależności od przyjętej definicji pacjenta HU (PLN)

Research method

An observational, retrospective study (without intervention), followed by a cohort observational study and a statistical analysis of the data regarding the completed medical services. The patients included in the study were treated in many out-patient clinics in Poland. The services were implemented in all the medical offices of the Lux Med group in Poland (without any limitations). The patient identification number was used to identify the services provided to individual patients (anonymised data). The HU patients were compared with the non-HU patients (population of all Lux Med patients) using descriptive statistics (data for the year 2013).

Statistical analysis

This was based on the medical events recorded in the Lux Med database, and conducted with the use of the Excel program and R Statistical Package, version 3.2.1.

Results

The first step in defining a HU patient in the out-patient healthcare framework in the prepaid healthcare plan model involved the analysis of the distribution of the number of patients that met an adopted definition of a HU patient based on specific cut-off points, i.e. the percentage of the highest cost-incurring patients. For instance, with a cut-off point of 5%, the number of HU patients was 20,544 (Fig. 1).

Next, the rates of healthcare system resources consumed according to the adopted definitions of a HU patient were analysed (Fig. 2).

As presented in the diagram above, 5% of patients generating the highest medical costs consume 21.67% of all the system resources.

In the next step, the total annual costs generated by HU patients were analysed, according to the adopted definition.

In the studied population, 5% of patients generate PLN 107 million in medical costs per year (Fig. 3).

Next the mean annual cost generated per HU patient was determined, according to the adopted definition (Fig. 4).

The collected data indicate that if the definition of a HU patient is extended from the top 1% to the top 5% of patients, the mean annual medical cost is reduced from PLN 7,721 to PLN 5,208. While developing the definition of a HU patient in out-patient healthcare, the principal goal was to find a definition that would enable finding effective organisational solutions to improve care over the group of patients most frequently using the healthcare system resources. Those solutions proven to be ineffective based on the analysis of previous scientific reports were avoided. Therefore, the popular definition of a HU patient, based exclusively on the frequency of medical consultations, was rejected, as no universally effective solutions to improve healthcare in this group of patients have been found. Instead, the cost-based definition was used. It is not contradictory to the definition based on the frequency of medical consultations, but rather extends it to include all other medical services a patient receives as part of out-patient healthcare. The cost-based definition of a HU patient is largely consistent with that based on the frequency of medical consultations, as they generate the highest expenses in out-patient care. Moreover, cost synthetically includes all the medical services a patient received, and enables a direct comparison between the varied manners of using the healthcare system resources by individual patients. A commonly used mechanism of introducing cut-off points for the definition of HU patients was applied. The cut-off values for the adopted definitions, ranging from a few to several per cent, were analysed. A specific cut-off value was selected considering the ability to introduce an effective model of healthcare for out-patients, offering a compromise between needs and feasible organisational solutions.

Eventually, the following definition of HU out-patients was adopted: a patient who actively uses the out-patient resources of the healthcare system, and is in the top 5% of the people generating the highest total annual healthcare expenses. Depending on the duration as a heavy user, we can distinguish short-term HU patients (up to 1 year), temporary HU patients (alternate periods of meeting the criteria for a HU patient for 1 year and periods when the patient does not meet the definition), and long-term HU patients (those who meet the definition of a HU patient for at least 3 years).

The basic characteristics of HU patients in 3 consecutive years were examined, starting with the year 2013. A cost-based definition of a HU patient was adopted (5% of the patients generating the highest medical costs in a given year). The total costs incurred by HU patients were analysed and compared with those generated by non-HU patients (people who used medical services in a given year, but do not meet the definition of a HU patient). The next step consisted in calculating the percentage of medical costs consumed by the above group of patients. The mean annual medical cost of a patient was calculated for the above groups, and divided into the cost of medical consultations and other (remaining) medical services (Tab. 1). The other columns present the following data regarding HU patients and non-HU patients: mean number of consultations per year, mean number of services per year, mean number of ICD-10 diagnoses, mean cost of a service, and mean costs for patients, divided into consultations and other services. The gender structure of the HU and non-HU patient groups is also presented. In addition, the average age of the patients and the mean number of diagnoses per consultation were analysed. Analogous data were demonstrated for the following 2 years (2014 and 2015).

HU patients (according to the cost-based definition: the top 5% of patients generating the highest medical costs) in 2013 were responsible for approximately 21.6% of all medical costs, although they constituted merely 5% of the treated population. The mean annual per-patient cost of services provided to this group of patients was PLN 5218, compared to the mean annual cost of PLN 994 for the services received by non-HU patients. When we compare the components of this cost, i.e. the mean annual cost of consultations and services (other), it appears that the annual cost of consultations in the HU population is 4.35 times higher than in the non-HU population (cost of services is 7.21 times higher). The HU patients had 22.3 consultations on average (4.13 times more than the non-HU patients). The mean number of ICD-10 diagnoses in HU patients was 11, compared to 3.3 in non-HU patients. The HU patients were willing to cover the higher costs of medical services (services requiring an additional fee), i.e. PLN 193.4 on average, compared to PLN 22.9 of additional costs covered by non-HU patients. Tables 2 and 3 present analogous comparisons of the basic characteristics of the HU population in the following years.

Table 1. Basic characteristics of HU patients in 2013
Tabela 1. Podstawowe charakterystyki pacjentów typu HU w 2013 r.

2013		Number of patients	Total costs (PLN)	% of total costs	Mean costs/patient/year	Mean costs of consultations/patient/year	Mean costs of services/patient/year	Mean number of consultations/patient/year
Heavy users	5%	20,477	106,842,756	21.6%	5218	2968	2,250	22.3
Non-heavy users	95%	388,845	386,879,262	78.4%	995	683	312	5.4
Total	100%	409,322	493,722,018	100%	1,206	797	409	6.2

		Mean number of services/patient/year	Mean number of ICD-10 diagnoses/patient/year	Mean cost of a service	Mean amount paid by the patient for services/year	Mean amount paid by the patient for consultations/year	Rate of females	Mean age of a patient	Mean number of diagnoses per consultation
Heavy users	5%	45.8	11.0	55.8	193.45	25.40	75.6%	39.60	0.50
Non-heavy users	95%	7.2	3.3	40.1	22.90	4.70	52.9%	35.30	0.60
Total	100%	9.1	3.7	44.8	31.35	5.70	53.7%	35.50	0.59

Table 2. Basic characteristics of HU patients in 2014
Tabela 2. Podstawowe charakterystyki pacjentów typu HU w 2014 r.

2014		Number of patients	Total costs (PLN)	% of total costs	Mean costs/patient/year	Mean costs of consultations/patient/year	Mean costs of services/patient/year	Mean number of consultations/patient/year
Heavy users	5%	22,232	118,558,876	21%	5333	2991	2342	21.9
Non-heavy users	95%	422,415	434,624,934	79%	1029	692	337	5.3
Total	100%	444,647	553,183,810	100%	1244	807	437	6.1

		Mean number of services/patient/year	Mean number of ICD-10 diagnoses/patient/year	Mean cost of a service	Mean amount paid by the patient for services/year	Mean amount paid by the patient for consultations/year	Rate of females	Mean age of a patient	Mean number of diagnoses per consultation
Heavy users	5%	47.5	10.9	49.3	183.99	23.03	75.1%	39.64	0.50
Non-heavy users	95%	7.6	3.2	44.4	22.95	4.11	53.0%	35.32	0.61
Total	100%	9.6	3.6	45.6	31.00	5.05	54.1%	35.54	0.59

Table 3. Basic characteristics of HU patients in 2015
Tabela 3. Podstawowe charakterystyki pacjentów typu HU w 2015 r.

2015		Number of patients	Total costs (PLN)	% of total costs	Mean costs/patient/year	Mean costs of consultations/patient/year	Mean amount paid by the patient for consultations/year	Mean costs of services/patient/year	Mean number of consultations/patient/year
Heavy users	5%	25,095	133,732,235	21%	5329.04	3022.95		2306.09	21.4
Non-heavy users	95%	476,801	492,900,338	79%	1033.77	697.01		336.75	5.1
Total	100%	501,896	626,632,573	100%	1248.53	813.31		435.22	5.9

		Mean number of services/patient/year	Mean number of ICD-10 diagnoses/patient/year	Mean cost of a service	Mean amount paid by the patient for services/year	Mean amount paid by the patient for consultations/year	Rate of females	Mean age of a patient	Mean number of diagnoses per consultation
Heavy users	5%	46.6	10.9	49.5	190.44	22.84	75.1%	39.48	0.51
Non-heavy users	95%	7.4	3.3	45.5	24.11	4.08	53.0%	35.59	0.63
Total	100%	9.4	3.6	46.5	32.43	5.02	54.1%	35.78	0.61

Conclusions

Following the analysis of the ways in which patients use medical services, a definition of a HU out-patient was developed, based on the costs of medical generated in a 12 month period. Moreover, the HU patients were divided into subclasses, according to the time of heavy use of medical services: short-term (meeting the criteria of a HU patient for 1 year), temporary and long-term HU patients (those who meet the criteria for at least 3 consecutive years). The most characteristic features of HU patients were determined (statistically and clinically significant), including the number of consultations, number of other medical services received, number and type of diagnoses, willingness to cover additional healthcare costs, mean annual cost of medical care, age and gender of the HU patients.

Study limitations

The presented research model has certain limitations, including the differences between the analysed population of clients of the company offering subscription services and the general population (overrepresentation of working people, living in the city and of lower mean age). Also provision of medical services differs from the model offered by public healthcare (variations regarding obligatory referral for specialist consultations in public healthcare). The study used primarily the cost of a medical service; therefore, the results of analyses, at least theoretically, are sensitive to changes in the prices of medical services. The results of the study cannot be simply and automatically applied to the entire patient population in Poland. Considering that the presented model of provision of medical services applies to a few million people in Poland (it is implemented also by other companies offering subscriptions for medical services), the conclusions derived from this analysis could be useful for other medical enterprises.

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Characteristics of postoperative pain and measurement of its intensity in patients of general surgery and oncology wards

Charakterystyka bólu pooperacyjnego i pomiar jego natężenia u chorych na oddziale chirurgii ogólnej i onkologicznej

Anna Jankowska,[1] Magdalena Milan,[1] Jan Juzwiszyn,[1] Magdalena Matuszewska,[1,2] Agnieszka Maj,[1] Mariusz Chabowski,[1,2] Dariusz Janczak[1,2]

[1] Division of Surgical Procedures, Department of Clinical Nursing, Faculty of Health Science, Medical University, Wroclaw, Poland; head: Prof. Dariusz Janczak MD, PhD
[2] Department of Surgery, 4th Military Clinical Hospital; head: Prof. Dariusz Janczak MD, PhD

Abstract. Management of post-operative pain is a difficult task requiring a multidisciplinary approach. The aim of the current study was to evaluate the characteristics and efficacy of treatment of post-operative pain, and to assess the impact of selected factors on perceived pain by patients. The study was conducted in January and February 2014 on 100 patients subjected to different modes and extents of surgery. The data analysed included about the patient, the pharmacotherapy and its efficacy, and the impact of psychophysical factors on the patient's status. The VAS scale for pain was used. The remaining parameters were assessed based on questionnaires created by the authors. The study showed that the level of pain decreased systematically after the operation. The mean levels of pain on days 0, 1, 2, 3 and 4 post-surgery were 8.3 ±3.5, 7.4 ±2.9, 5.5 ±4.1 and 4.4 ±4.1, respectively. Lower levels of pain were reported by patients with better emotional status, white-collar workers, patients with planned and with smaller extent of surgery, slightly obese patients and those operated under spinal anaesthesia. An increased level of pain was associated with increased arterial blood pressure, breath rate and pulse rate.
Key words: pain management, post-operative pain, post-operative treatment, VAS scale

Streszczenie. Leczenie bólu pooperacyjnego jest trudnym wyzwaniem, wymagającym interdyscyplinarnego podejścia. Celem badania była ocena charakterystyki oraz efektywności leczenia bólu pooperacyjnego, a także wpływu wybranych czynników na odczuwanie bólu przez chorych poddanych operacji. Badanie przeprowadzono od stycznia do lutego 2014 r. w grupie 100 chorych operowanych w różnym trybie i o różnej rozległości operacji. Zebrano i przeanalizowano dane operowanych, a także zastosowane farmakologiczne leczenie bólu z uwzględnieniem jego efektów oraz wpływ czynników psychofizycznych na stan chorego. Do oceny bólu wykorzystano skalę VAS. Pozostałe parametry oceniono na podstawie kwestionariuszy autorskich. Wykazano, że ból systematycznie zmniejszał się po zabiegu operacyjnym. Średni poziom bólu w 0., I, II, III i IV dobie po zabiegu wyniósł odpowiednio 8,3 ±3,5, 7,4 ±2,9, 5,5 ±4,1 i 4,4 ±4,1. Mniejsze dolegliwości bólowe odczuwali operowani w lepszym stanie emocjonalnym, pracownicy umysłowi, operowani w trybie planowym, pacjenci poddawani lżejszym zabiegom, pacjenci z niewielką nadwagą i operowani w znieczuleniu rdzeniowym. Większe nasilenie bólu związane było z wyższym ciśnieniem tętniczym, większą częstotliwością oddechów i przyspieszonym tętnem.
Słowa kluczowe: ból pooperacyjny, opieka pooperacyjna, leczenie bólu, skala VAS

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Corresponding author
Mariusz Chabowski MD, PhD
Department of Surgery, 4th Military Research Hospital
5 Weigla St., 50-981 Wrocław
telephone: + 48 261 660 247, fax + 48 261 660 245
e‑mail: mariusz.chabowski@gmail.com

Introduction

Modern medicine has two priorities as goals: the diagnosis, prevention and treatment of diseases, and the alleviating of the patient's pain and suffering [1, 2]. Medical personnel play a key role in pain management, as they identify those patients experiencing pain, regularly assess its intensity using scoring systems, take action to relieve it, document the treatment process and monitor any adverse events [3]. The International Association for the Study of Pain (IASP) has defined pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" [4]. Pain is a multidimensional phenomenon, and as such it should be managed by multidisciplinary teams. Effective pain management should be based on understanding all its psycho-physical components [5-7].

Proper assessment of pain intensity is one of the most important skills of the therapeutic team. It requires systematic knowledge, careful, detailed observation and listening to the patient, as well as constant re-testing and verification of the information regarding the pain [8]. In 1995, the American Pain Society considered pain to be the fifth vital parameter, emphasising the need to measure its intensity and other concurrent symptoms, as well as to document properly the clinical information in order to ensure patient safety and objectively determine the effects of pain management [9]. Regardless of the fact that numerous scores evaluating the intensity of post-operative pain are available, the symptoms are not monitored regularly [10]. Pain is subjective, so the best method of measuring it is self-assessment. In 1986, the World Health Organisation introduced a treatment scheme according to a three-step analgesic ladder which has become a world-wide standard in pain management [11]. Proper assessment of post-operative pain intensity is crucial in choosing optimal analgesic treatment. NRS or VAS scores are the most popular ones in clinical practice [12].

Psychological support and preparation of the patient for the surgical procedure significantly affect post-operative pain [13]. Effective reduction of somatic symptoms, rest, sleep, the positive approach of the people around, the sense of safety and the awareness that if pain occurs measures will be taken to alleviate it, increase the pain threshold [5].

In the post-operative pain management the nurse plays a very important role [14-16]. In taking care of a patient likely to experience pain symptoms, the nurse should be able to recognise and interpret the verbal and non-verbal signs of pain quickly and accurately, as well as to react and minimise them immediately [17]. She should also monitor and register pain intensity, level of sedation, arterial blood pressure, pulse, respiratory rate, saturation, diuresis and intestinal peristalsis in order to early recognise and prevent dangerous complications. While monitoring a post-operative patient, the nurse should consider the specificity of the surgical procedure and the type of anaesthesia used. Observation and management of the epidural catheter site, as well as covering the site with a sterile dressing to prevent infection, and accidental displacement or unintentional pulling out, are also very important [18].

As modern medicine makes increasingly radical procedures possible, care over the post-surgical patients requires more detailed monitoring of their post-operative status and pain symptoms. The aim of this study is to analyse the characteristics and effectiveness of post-operative pain management. The effect of selected demographic, social and psychophysical factors on the pain experienced by patients after surgical procedures at the general and oncological surgery departments was also assessed.

Material and methods

The study was based on the observation and qualitative evaluation of the relevant type of information. It involved 100 patients following surgical procedures of different types and scopes, performed in January and February 2014 at the Department of General and Oncological Surgery, University Teaching Hospital in Wroclaw.

The analgesic method used in the study subjects are the standard techniques used in the operating room. Direct analgesia is typically used in general surgery. The drugs administered during the procedure in the induction phase are usually phentanyl and metamizole. During the procedure, subsequent doses of phentanyl are added, typically 0.1 mg every 30 minutes, and ketoprofen, if ordered by the physician. After the patient is moved to the recovery room, the first-line treatment is paracetamol and, if it is ineffective, tramadol is administered. Morphine in fractional doses is used as a last resort, until the pain symptoms subside. Then the patient is transferred to the general surgery unit.

The study provided information regarding the analysed group, such as gender, age, height and body weight, which allowed the calculation of BMI index, type of work performed, diagnosis, prognosis, type of procedure and anaesthesia used, nature of procedure (emergency or elective), time, and type and method of operation.

The nature, location and factors associated with pain, its intensity before and after the analgesic treatment, time of reaction to the analgesic agent, and patient's emotional status were carefully observed over the first four days following the surgery.

Patients participating in the study were informed about the method of collecting information about post-operative pain based on VAS. Other parameters were assessed on the basis of questionnaires developed by study authors.

The study was approved by a Bioethical Committee. All the subjects received information about study procedures, and provided their written consent.

Results

The subjects most frequently reported nagging pain (67%) and persistent pain (23%). In both men and women the pain usually occurred when coughing or lying down, and it was reported by 19% and 20% of women, and by 20% and 12% of men, respectively. The lowest number of patients complained about pain associated with walking or applied pressure. A regular reduction of pain symptoms following the surgical procedure was demonstrated. Mean degrees of pain in days 0, 1, 2 and 3 following the surgery were: 8.3 ±3.5, 7.4 ±2.9, and 5.5 ±4.1, respectively. Pain symptoms on the day of the procedure were determined by the type of surgery: the strongest pain was experienced by patients undergoing laparotomy, laparoscopy or hernia repair (Tab. 1). The longer the procedure, the greater degree of pain patients experienced.

To analyse the relationships between the emotional status of patients and the level pain, the VAS pain scores were divided into three groups, where mild pain was represented by the scores 0, 1, 2 and 3, moderate pain by the scores 4, 5 and 6, and severe pain by the scores 7, 8, 9 and 10. Next, the emotional status of patients on days 1, 2, 3 and 4 following the surgery was determined. Evaluation of the emotional status on day 0 was unjustified, as surgical patients at that time are usually drowsy. In the first day following the surgery patients described their emotional status as apathetic (60% of subjects), and 21% of patients demonstrated nervousness. On day 2 the majority of patients were still apathetic, but 28% of subjects described their mood as positive. On days 3 and 4 the patients were predominantly in a positive mood (day 3 - 52%, day 4 - 63%). Patients who described their status as apathetic experienced the highest level of pain (Tab. 2).

Pain was evaluated before and after the pharmacological treatment, on every day following the surgery. On day 0 of the procedure, the level of pain experienced by the majority of patients before the pharmacological treatment was 8 in women, and 10 in men. The mean degree of pain on day 0 was 8.3 ±3.5. On day 1, the most frequently reported levels of pain in women were 7 and 8, whereas men most often assessed their pain as 7 and 10. The mean degree of pain before drug administration on day 2 was 7.4 ±2.9.

Table 1. Level of pain on day 0 after operation in relation to type of surgery
Tabela 1. Ból w 0. dobie po operacji ze względu na rodzaj operacji

Type of surgery	Pain intensity following drug administration										
	0	1	2	3	4	5	6	7	8	9	10
Laparoscopy	–	–	–	–	–	–	4	–	12	3	2
Quadrantectomy	–	–	–	–	1	–	1	–	4	–	–
Laparotomy	–	–	–	–	–	1	1	1	6	2	11
Striping	–	–	–	–	–	–	1	1	2	–	3
Hartmann	–	–	1	–	–	–	–	–	–	–	1
Bypass anastomosis	–	–	–	–	–	–	–	–	3	1	3
Appendectomy	–	–	–	–	–	–	–	–	3	2	2
Lower limb amputation	–	–	–	–	–	–	–	–	1	–	2
Hernia repair	–	–	–	–	–	–	2	–	6	1	6
Fistula removal	–	–	–	–	1	–	–	1	–	–	1
Strumectomy	–	–	–	–	–	–	1	–	1	1	1
Lipoma removal	–	–	–	–	–	–	–	–	2	–	–
Endometriosis	–	–	–	–	–	–	–	–	1	–	–

Table 2. Level of pain on day 1 after operation in relation to emotional status
Tabela 2. Ból w 1. dobie ze względu na stan emocjonalny

Emotional status	Pain score on day 1										
	Mild pain				Moderate pain			Severe pain			
	0	1	2	3	4	5	6	7	8	9	10
Apathy	–	–	–	3	3	4	7	14	12	10	7
Low mood	–	–	–	–	–	1	–	–	1	–	–
Nervousness	–	–	–	–	–	–	3	6	6	2	5
Depression	–	–	–	–	–	–	–	–	–	–	1
Positive	–	–	–	–	1	2	–	2	1	–	–
Tearful	–	–	–	–	–	–	–	–	–	1	1
Blackout	–	–	–	–	1	–	–	3	2	1	–

On days 1 and 2 after the surgery, the patients usually assessed their pain before the pharmacological treatment as 6. However, the mean level of pain on day 3 was 5.5 ±4.1, whereas on day 4 the mean was 4.4 ±4.1.

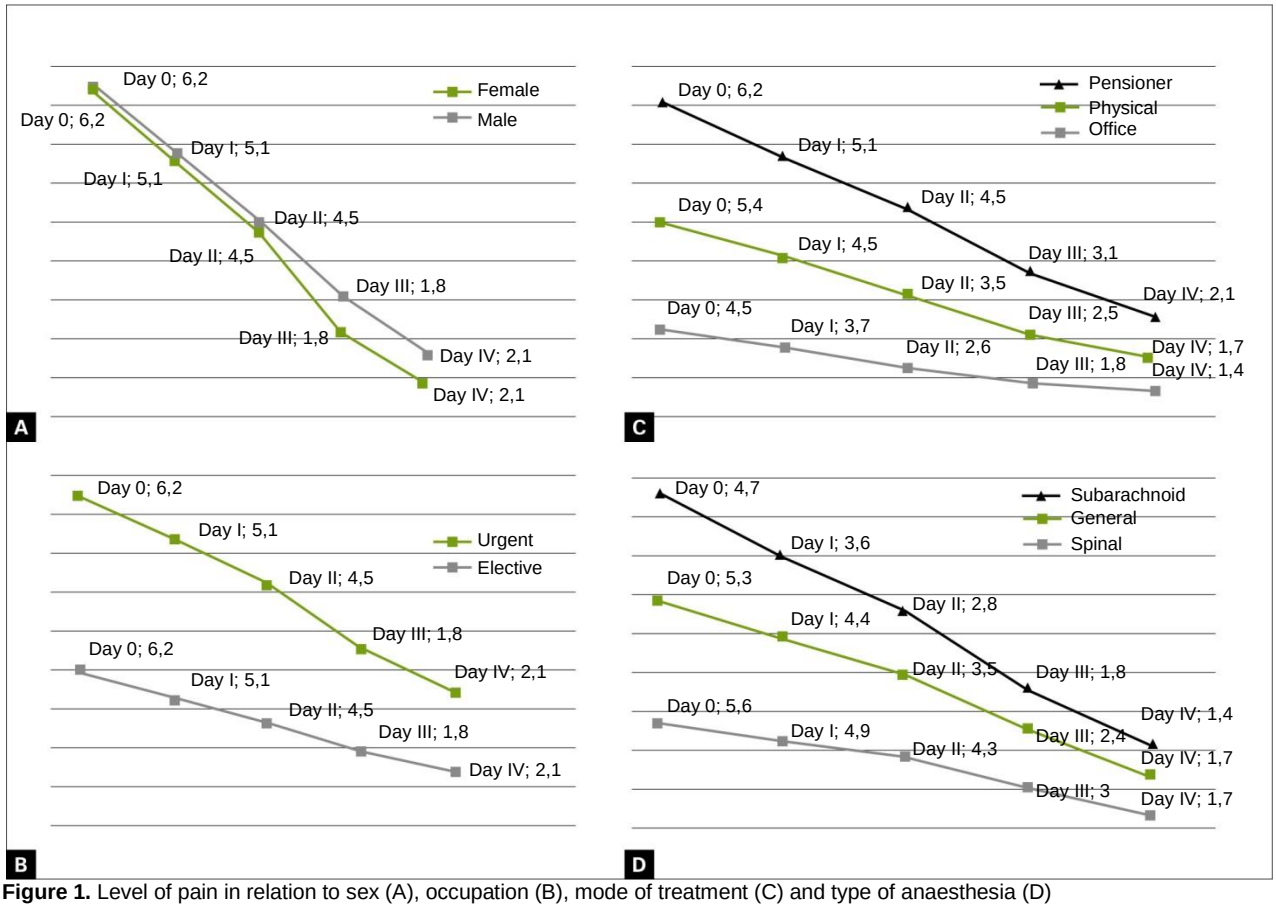

Figure 1. Level of pain in relation to sex (A), occupation (B), mode of treatment (C) and type of anaesthesia (D)
Rycina 1. Poziom dolegliwości bólowych w zależności od płci (A), wykonywanej pracy (B), trybu zabiegu (C) i rodzaju znieczulenia (D)

According to the study analysis, office workers experience the lowest level of pain. On every day following the surgery, before the pharmacological treatment, the mean level of pain in the group of pensioners was higher than in the other two groups. The patients undergoing elective surgeries experienced lower pain before the administration of analgesics on every day following the procedure than the subjects after emergency surgeries. In the patients after elective procedures the mean pain score on every day following the surgery was approximately 1 degree lower than in the patients undergoing emergency surgeries.

Analysis of the level of pain experienced by the subjects according to their BMI index revealed that patients who were overweight or obese experienced lower levels of pain than those with normal body weight or malnourished. The mean level of pain in patients with normal body weight was 8.78 ±1.23 in women and 8.85 ±1.52 in men. To compare, the mean level of pain in patients with 1st degree obesity was 7.63 ±1.52 in women and 8.33 ±1.44 in men. The analysis revealed that higher BMI index was correlated with a lower degree of experienced pain.

Depending on the type of analgesia used during the procedure, the mean level of pain experienced before the pharmacological treatment in patients on days 0, 1 and 2 following the surgery was highest in those who had received spinal anaesthesia, whereas on days 3 and 4 after the surgery in those who had received general anaesthesia. The relationships between pain symptoms and gender, type of work performed, nature of procedure and type of anaesthesia are presented in Figure 1.

The most frequently administered analgesics in pharmacological therapy on every day following the surgery were ketoprofen, metamizole and tramadol. On day 4 following the surgery over 16% of subjects did not require pharmacological treatment. The mean post-operative pain score on day 4 following surgery (1.66) compared to day 0 (5.23) was reduced by 68%. The dominant post-operative pain score in women was 6 and 4 on day 0, and 5 on days 1 and 2 following the surgery, and 0 on days 3 and 4 following the surgery.

Table 3. Systolic blood pressure by pain type
Tabela 3. Ciśnienie skurczowe z podziałem na rodzaj bólu

Pain	Systolic blood pressure				Diastolic blood pressure			
Mild	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
n	39	48	66	82	39	48	66	82
Min.	80	90	95	95	40	40	60	60
Max.	180	170	178	170	100	100	100	95
Mean	129.9	131.9	132.2	128.4	71.8	71.4	76.6	75.6
Deviation	22.7	19.5	18.5	16.9	12.0	11.3	8.1	6.7
Mean	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
n	38	38	28	13	38	38	28	13
Min	92	94	100	100	40	60	60	60
Max	180	180	160	174	100	100	82	80
Mean	133.6	135.6	128.7	130.0	74.0	76.1	72.8	76.0
Deviation	24.8	22.2	16.5	17.3	13.3	9.1	7.1	6.2
Severe	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
n	23	14	6	5	23	14	6	5
Min.	80	85	84	85	40	50	50	60
Max.	200	200	170	180	100	100	100	80
Mean	137.0	136.2	139.7	137.0	70.9	72.9	72.3	70.0
Deviation	30.5	28.0	37.4	41.8	17.6	11.4	17.2	10.0

The mean pain score in women on day 0 was 5.25, and decreased gradually, reaching 1.82 on day 4 following the surgery. In men, the mean post-operative pain score on day 1 was 5.21, and also demonstrated a decreasing trend, reaching 1.44 on day 4 following the surgery.

In the surgical patients who perform office jobs the most frequently reported pain level on day 0 was 6, whereas on the other days, the dominant level of pain was as follows: 5 and 1 on day 1, 8 and 6 on day 2, 0 and 2 on day 3, and 0 on day 4. In patients who were physical workers the dominant level of pain was 6 on day 0, 6 and 1 on day 1, 4 and 5 on day 2, 0 and 4 on day 3, and 0 on day 4. In pensioners the most frequently reported levels of pain were as follows: 6 on day 1, 5 and 7 on day 2, 2 on day 3, and 1 on day 4.

In patients after an elective surgery, the most frequently reported pain levels were 6 on day 0, 1 on day 1, and 0 on the other days following the surgery. Regarding emergency procedures, the dominant levels of pain reported by patients were 9 on day 0, 5 on day 2, 4 on day 3, and 0 on day 4. On day 1 following the emergency procedure, the distribution of the reported pain levels was the same for the scores 3, 8 and 9.

In 98 out of 100 studied patients, the applied analgesic therapy did not cause any complications, whereas in the remaining 2 subjects numbness of legs or pulling out of the catheter were observed.

The mean time of reaction to analgesics was 44 minutes. In over half of the subjects (54%) the pharmacological treatment started working after 30 minutes. The analgesic effect after 15 minutes was noticed by 6% of patients, and 12% reported noticing the effect after 90 minutes.

The systolic and diastolic blood pressure values recorded on days 1-4 following the surgery are presented in Table 3. The highest systolic blood pressure values (200 mm Hg) were observed on days 1 and 2 following the surgery, whereas the lowest value (80 mm Hg) was found on day 1 following surgery. The highest diastolic blood pressure values (100 mm Hg) were observed on days 1, 2 and 3 following surgery, whereas the lowest value (72 mm Hg) was found on day 1. The highest mean diastolic blood pressure on day 2 was observed in patients who experienced mild pain, whereas on other days in subjects who reported moderate pain scores. The mean systolic blood pressure was the highest in patients with severe pain.

The pulse was recorded on all four days following the surgery. Its values are presented in Table 4. The highest pulse (120 beats/minute) was recorded on days 1, 2 and 4 following the surgery, whereas the lowest (40 beats/minute) was found on day 1 following the surgery. The lowest mean pulse value on day 4 was observed in patients who classified their pain as moderate, and on other days the lowest pulse was found in patients reporting mild pain scores. The highest pulse (120 beats/minute) was recorded on day 1 (mild and moderate pain) and day 2 (mild pain).

Table 4. Pulse and breaths by type of pain
Tabela 4. Puls i oddechy z podziałem na rodzaj bólu

Pain	Pulse				Breaths			
Mild	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
n	39	48	66	82	39	48	66	82
Min	45	45	55	60	10	10	10	8
Max	120	120	110	120	28	24	18	22
Mean	72.4	73.0	72.4	71.3	14.7	13.6	14.0	14.3
Deviation	13.5	11.9	11.2	10.2	4.2	2.9	2.0	2.0
Mean	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
n	38	38	28	13	38	38	28	13
Min	40	60	60	60	10	10	10	10
Max	120	100	93	82	20	19	21	22
Mean	77.6	74.6	73.6	71.0	13.9	13.9	14.6	14.7
Deviation	15.3	10.0	8.5	6.7	3.0	2.4	2.9	3.2
Severe	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
n	23	14	6	5	23	14	6	5
Min	60	62	60	60	10	12	10	12
Max	100	110	111	110	22	23	23	25
Mean	76.0	77.2	78.2	76.4	13.9	15.2	14.7	16.2
Deviation	13.4	11.9	17.5	20.1	3.4	3.5	4.5	5.1

Bradypnoe (8 breaths) was found in one woman on day 4, and tachypnoe (28 breaths) was observed in one man on day 1. In patients with mild, moderate and severe pain, the minimum number of breaths was 10, and the highest number was observed in mild pain on day 1. The effect of pain intensity on the respiratory rate is presented in Table 4.

Discussion

In the present study the level of pain in patients following surgical procedures was high, especially on day 1 after surgery, when it reached VAS scores of 7-8. The pain symptoms gradually subsided with time. The high level of pain immediately after the procedure may result from many factors. The study revealed differences in the perception of pain depending on the patient's characteristics. A higher level of pain was reported by patients who had received emergency surgeries, had subarachnoid anaesthesia or were advanced in age.

Patients consider pain as one of the most unpleasant and cumbersome effects of a surgical procedure. Due to the constant development of knowledge regarding the treatment process, patients expect fast and effective elimination of the pain associated with medical procedures. A study conducted by Jałowiecki et al. [15] revealed that nearly 75% of patients undergoing surgeries were satisfied with the visit of an anaesthesiologist after the surgery. One of the reasons was the fact that the anaesthesiologist prescribed additional analgesics. Therefore, patients seem to suffer in silence, both for psychological and physical reasons. Unfortunately, elimination of post-operative pain is still insufficient, as confirmed by the present study. Surgical patients do not have the sense of complete safety. In the studies mentioned above, over 40% of patients complained about pain at the surgical site immediately after waking up from anaesthesia. A study by Ziser and Murray demonstrated that 58% of patients at the surgery department suffered from severe pain [16].

Many authors emphasise the need to use various scores to assess post-operative pain [18-20]. In Polish studies, the most popular scoring method is the ten-point VAS scale, as used by the authors of this study. However, for the personnel taking care of patients in the first days following surgery, the objective assessment of pain poses the greatest challenge. Regular monitoring by medical staff members and frequent measurement of pain intensity may be useful, as it can help patients accept the pain and strive to reduce its intensity. In a study by Melzack et al. [21] the intensity of pain on days 1 to 4 was 2.5, very similar to the results of the present study. It is worth remembering that Melzack's study was conducted in 1987.

However, patients still believe that post-operative pain is inevitable. Therefore, the degree of satisfaction with the treatment appears to depend on the level of pain experienced by the surgical patient. A similarly high degree of satisfaction, despite the significant shortcomings of the system of post-operative pain management, was presented by Symonowicz [22].

The problem of post-operative pain treatment is still present, and it has not been addressed entirely. It was demonstrated that effective pain management is beneficial not only for the patient, but also for the institution providing the treatment. The advantages for the patient include the restored homeostasis of individual systems and organs, whereas the benefits for the hospital comprise reduced costs of therapy and shorter time of hospitalisation. Such management also reduces the number of complications, resulting in lower mortality rates associated with surgical procedures. Ineffective management of acute pain has consequences not only for individual patients, but also in the socio-economic dimension, as the resulting increased number of post-operative complications significantly extends the hospitalisation period. A person experiencing severe pain after surgery has respiratory problems, does not expectorate from the airways, and is forced to limit their range of movement in the first days following the procedure, which increases the adverse symptoms. Successful pain management necessarily requires the assessment of pain intensity. Effective therapy of post-operative pain should be used to promote hospitals that treat patients without exposing them to unnecessary unpleasant sensations. Pain management should not be considered a luxury service. Patients should demand that their symptoms be treated seriously. Every patient has the right to be pain-free, so whenever possible they should choose a hospital where they will not suffer during the post-operative period. Unfortunately, patients still tend to complain about pain only when it is unbearable, which seems to stem from the false conviction that suffering is inevitably associated with every serious disease.

In Poland there are hospitals where information about pain is recorded in the patient's medical history. The hospital where the present study was conducted is one of them. For the recording purposes, proper standards of pain management were developed. As Professor Jan Dobrogowski stated, those hospitals where post-operative pain management is commonly used could receive certificates of the Polish Association for the Study of Pain [23]. Therefore, those hospitals that introduce the most recent standards of post-operative pain treatment could be certified. This increases the chances that the problem of pain experienced by patients undergoing surgical procedures will be further analysed, which may result in an increased effectiveness of the therapies.

Improvement of the quality of post-operative care in respect to pain management depends on numerous factors. The present study emphasises the importance of socio-demographic factors and the clinical characteristics as predictors of the experienced pain symptoms. It is worth emphasising that patients undergoing emergency surgeries should receive more information about the disease and possible methods of pain management, as they may be prepared less well for the procedure information-wise than patients having elective surgical procedures. It is possible that emergency situations trigger an emotional component that affects the intensity of experienced pain. Another aspect is the above mentioned belief in the inevitability of pain, widespread among surgical patients. The task of medical personnel is to educate patients about the possibility of analgesic therapy, so that they know that pain can be eliminated, and that they are entitled to it. The standards of analgesic treatment also play a significant role. Pain assessment initiated by the medical staff is very important, so that the patient receives proper treatment at the right time, before the pain reaches a very high level [24].

This study offers only a short introduction to a deep analysis of the subject. A multidisciplinary approach to pain treatment includes all the members of the therapeutic team that ensures continuous care over the patients following surgical procedures (from the period immediately after the surgery to hospitalisation at the surgery department), as well as effective pain reduction, patient satisfaction and the desirable effects of treatment.

Conclusions

As objective assessment of pain following surgical procedures is difficult, socio-demographic factors and clinical characteristics of the patient may help to monitor the intensity of post-operative pain. A multidisciplinary approach to the monitoring and management of pain ensures the optimal pain treatment.

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Evaluating the factors that affect the eye in patients with permanent facial nerve palsy

Ocena czynników wpływających na stan narządu wzroku u pacjentów z utrwalonym porażeniem nerwu twarzowego

Izabela Nowak‑Gospodarowicz, Radosław Różycki, Marek Rękas

Department of Ophthalmology, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine in Warsaw; head: Col. Prof. Marek Rękas MD, PhD

Abstract. Permanent facial nerve palsy causing lagophthalmos leads to serious ocular complications. The aim of the study was to evaluate the factors affecting the eye condition in patients with this disease. The study group included 59 middle-aged people aged 55.5 ±17.4 years: 40 females (67.8%) and 19 males (32.2%) with unilateral permanent paralysis of the facial nerve. The evaluated factors were: patient's age, aetiology and duration of facial nerve palsy, size of the lagophthalmos, Bell's phenomenon, corneal sensation, Schirmer's test for BCVA and cornea damage level. The Kruskal-Wallis equality of populations rank test showed a significant influence of age and Bell's phenomenon on BCVA, and of Bell's phenomenon and corneal sensation on the severity of exposure keratopathy ($p < 0.05$). The aetiology and duration of facial nerve palsy, size of the lagophthalmos and Schirmer's test were not statistically significant for BCVA and cornea damage level in the study group. Bell's phenomenon and corneal sensation proved to be the most important prognostic factors affecting the condition of the eye in the examined group of patients.
Key words: exposure keratopathy, facial nerve palsy, lagophthalmos, risk factors

Streszczenie. Trwałe porażenie nerwu twarzowego powodujące niedomykalność szpary powiekowej prowadzi do poważnych powikłań okulistycznych. Celem pracy była ocena czynników mających wpływ na pogorszenie stanu narządu wzroku u pacjentów dotkniętych tą chorobą. Grupa badana obejmowała 59 osób w średnim wieku 55,5 ±17,4 roku: 40 kobiet (67,8%) i 19 mężczyzn (32,2%), z jednostronnym trwałym porażeniem nerwu VII. Badano wpływ: wieku pacjenta, etiologii i czasu trwania porażenia nerwu twarzowego, wielkości niedomykalności szpary powiekowej, objawu Bella, czucia rogówkowego i testu Schirmera na BCVA (*best corrected visual acuity*) oraz stopień uszkodzenia rogówki. Analiza jednoczynnikowa wariancji dla rang Kruskala-Wallisa wykazała istotny wpływ wieku i objawu Bella na BCVA oraz objawu Bella i czucia rogówkowego na ciężkość keratopatii ekspozycyjnej ($p < 0,05$). Etiologia i czas trwania porażenia nerwu twarzowego, wielkość niedomykalności szpary powiekowej i wynik testu Schirmera nie wpływały istotnie statystycznie ani na BCVA, ani na stopień uszkodzenia rogówki w badanej grupie. Objaw Bella i zachowane czucie rogówkowe okazały się najważniejszymi czynnikami rokowniczymi wpływającymi na stan narządu wzroku w badanej grupie pacjentów.
Słowa kluczowe: porażenie nerwu twarzowego, niedomykalność powiek, keratopatia ekspozycyjna, czynniki ryzyka

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Corresponding author
Izabela Nowak‑Gospodarowicz MD
Department of Ophthalmology, Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine in Warsaw
128 Szaserów St., 04-141 Warsaw
telephone: +48 261 816 575, fax +48 22 515 05 08
e-mail: istabel@wp.pl, inowak‑gospodarowicz@wim.mil.pl

Introduction

Facial nerve palsy affects people across the world, regardless of gender or race [1]. The impaired function of the facial nerve that provides movement of the muscle responsible for closing the eyelid over time results in reduced visual acuity [2, 3]. It is a consequence of damage to the cornea which, without the protection of eyelids that do not close properly, is constantly exposed to drying and the effects of external factors [4-6]. Initially the lesions include deficits in the corneal epithelium, and then infection, deep ulcerations and corneal perforation may occur, resulting in the loss of the eye [3-5].

Table 1. Relationship between Bell's phenomenon and BVCA
Tabela 1. Związek BCVA z objawem Bella

Bell's phenomenon	Number of observations	Mean BCVA	Standard deviation	χ2	P
Very good	23	0.45	0.34	8.879	0.011
Absent	11	0.16	0.19		
Present, but incomplete	25	0.48	0.35		
Total	59				

In some patients visual problems and advanced pathological lesions of the cornea are observed very early, within a few days from the onset of the disease, despite the application of local therapy with lubricant eye drops and obturation of the eye on the affected side [3]. Other patients, even after a few years following the onset of the disease, may have good visual acuity, and corneal lesions are found an ophthalmological examination only with the use of special methods involving staining of the eye surface. There are no standards in place for the treatment of lagophthalmos due to facial palsy [7]. From a clinical point of view, identification of the risk factors associated with impaired visual acuity is important, as it could offer future guidelines for diagnostic and therapeutic management in this group of patients.

Aim of the study

The aim of the study was to evaluate the factors affecting the eye in patients with permanent facial nerve palsy.

Study material and methods

The study was a prospective case series. It was conducted in the Department of Ophthalmology, Military Institute of Medicine, in the years 2009-2014, following the principles of Good Clinical Practice and the Declaration of Helsinki. It was approved by the Bioethical Committee of the Military Institute of Medicine.

The study was financed by a grant for young scientists, as part of the statutory activity of the Military Institute of Medicine.

The study involved 59 patients: 40 females (67.8%) and 19 males (32.2%) with the mean age of 55.5 ±17.4 years, with documented unilateral facial nerve palsy persisting for at least 3 months, and not improving despite intensive rehabilitation. A total of 37 patients (62.7%) had a permanent left facial nerve palsy, and 22 patients (37.2%) had a right facial nerve palsy. The majority of subjects (46 people, 78%) were patient with tumours located in the area of the cerebellopontine angle, or with primary tumours removed neurosurgically. The study also included 5 patients (8.5%) following removal of the accessory parotid gland cancer, 4 patients (6.8%) following trauma, 2 patients (3.4%) with congenital palsy and 2 patients (3.4%) with idiopathic palsy, whose prognosis regarding restoration of the facial nerve function was poor.

The data regarding aetiology and duration of palsy, as well as previous treatment, were obtained from the medical history. Best Corrected Visual Acuity (BCVA) and level of corneal damage (keratinopathy) were assessed, and measurements of the eye protective apparatus were conducted for clinical evaluation.

Visual acuity was tested at 5 m, using Snellen charts.

Corneal sensation was tested bilaterally, using a cotton bud. No reaction to the touch was interpreted as the absence of corneal sensation; stimulation felt by the patient, but without an expressed defence reaction, was classified as a reduced sensation; a well-expressed defence reaction to touch was interpreted as a lack of impairment of the corneal nerves. Corneal damage based on a slit lamp image and an assessment following the fluorescein staining test was classified from the mildest to the most severe, where: 1 – a lack of damage (Fig. 1A), 2 – epitheliopathy, first-degree damage manifested by deficits of the corneal epithelium (Fig. 1B), 3 – damage to the deeper corneal layers – parenchyma (Fig. 1C), and 4 – ulceration associated with the risk of eye perforation, perforation or corneal leukoma (Fig. 1D) [8].

Examination of the protective apparatus of the eye involved the following tests: measurement of lagophthalmos in millimetres, assessment of Bell's phenomenon (a reflexive upward movement of the eye while closing the eyes), assessment of the function of levator palpebrae superioris, expressed in millimetres, with the use of a ruler, evaluation of the position of the eyelids and lacrimal puncti, as well as the height and asymmetry of the palpebral fissures.

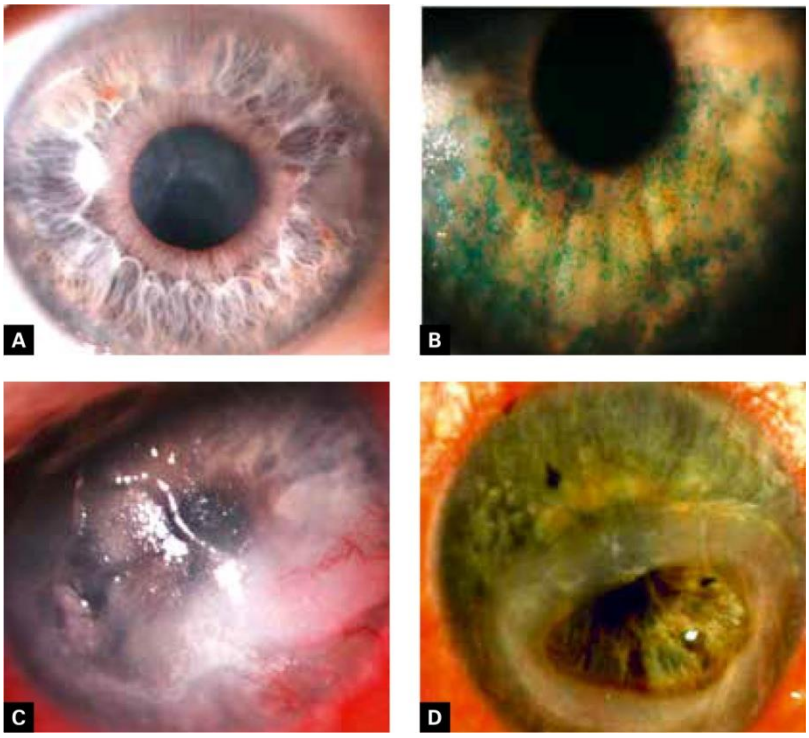

Figure 1. Classification of the keratopathy grade using biomicroscope imagery. **A.** No corneal pathological changes. **B.** Corneal epithelial defects stained with lysamine green. **C.** Corneal stromal changes. **D.** Corneal perforation at the ulcer site.

Rycina 1. Klasyfikacja uszkodzenia powierzchni gałki ocznej na podstawie obrazu w biomikroskopie.
A. Brak zmian patologicznych rogówki. **B.** Ubytki nabłonka rogówki wybarwione zielenią lizaminy.
C. Uszkodzenie istoty właściwej rogówki. **D.** Perforacja rogówki w miejscu owrzodzenia.

Bell's phenomenon was evaluated during the attempt to close the eyes, and was classified as:

- very good – if no corneal exposure was observed after the upward rotation of the eyes,
- incomplete – if it did not provide sufficient protection of the cornea,
- absent – if no upward movement of the eye was observed.

Schirmer's test was conducted following administration of an anaesthetic to the conjunctival sac, and was classified as abnormal if the results on the test strip placed in the conjunctival sac was < 10 mm after 5 minutes.

The patients enrolled in the study are still under the supervision of the Ophthalmological Clinic of the Military Institute of Medicine.

The study results were analysed statistically using the SPSS software.

The values of the analysed measurable parameters were presented as mean, median and standard deviation. For the measurable characteristics, the normality of distribution of the analysed parameters was examined using the Shapiro-Wilk test. To analyse the relationships between the studied characteristics, the $\chi 2$ independence test was used.

The goal of the analysis was to identify parameters affecting best corrected visual acuity (ACVA) and degree of keratopathy. Kruskal-Wallis univariate variance analysis by ranks was used to examine the relationships between BCVA and baseline keratopahy and the following characteristics: patient's age, aetiology and duration of facial nerve palsy, size of lagophthalmos, Bell's phenomenon, corneal sensation and Schirmer's test.

The adopted level of significance indicating the presence of statistically significant differences or correlations was $p < 0.05$.

Results

In the study group the mean size of lagophthalmos was 7.1 ±2.8 mm, and the mean duration of facial nerve palsy was 115.9 ±201.7 months.

Bell's phenomenon was very good in 23 patients (39%), incomplete in 25 (42.4%), and absent in 11 (18.6%).

The mean best corrected visual acuity (BCVA) on the Snellen chart was 0.4 ±0.3. In 3 patients (5%) lens opacity was found.

Exposure corneal damage was observed in all patients. Epithelial deficits (epitheliopathy) was found in 31 patients (52.5%). Pathology in deeper corneal layers, i.e. Parenchymal lesions, were observed in 14 patients (23.7%). Also 14 patients (23.7%) demonstrated deep corneal ulceration, associated with the risk of perforation.

Table 2. Relation between selected variables and initial BCVA
Tabela 2. Związek wybranych cech z wyjściową BCVA

Studied variable	Test p value
Age	0.029*
Aetiology of the facial nerve palsy	0.759
Duration of palsy	0.604
Size of lagophthalmos	0.592
Bell's phenomenon	0.012*
Schirmer's test	0.505
Corneal sensation	0.072

*Values with statistical significance of <0.05

Table 3. Relation between selected variables and initial keratopathy
Tabela 3. Związek wybranych cech z wyjściową keratopatią

Studied variable	Test p value
Age	0.776
Aetiology of the facial nerve palsy	0.924
Duration of palsy	0.750
Size of lagophthalmos	0.267
Bell's phenomenon	0.032*
Schirmer's test	0.465
Corneal sensation	0.002*

*Values with statistical significance of <0.05

Corneal sensation was normal in only 22 patients (37.3%), reduced in 23 (39%), and absent in 14 (23.7%). On average, patients used 9.2 ±5.5 lubricant eye drops per day. Schirmer's test results were abnormal in 12 cases (20.3%).

The Kruskal-Wallis univariate variance analysis by ranks was used to examine the relationships between baseline BCVA and the following characteristics: patient's age, aetiology and duration of the facial nerve palsy, size of lagophthalmos, Bell's phenomenon, corneal sensation and Schirmer's test to reveal any significant role of Bell's phenomenon ($p = 0.01$). In patients who lacked Bell's phenomenon the BCVA was statistically lower than those who demonstrated at least the presence of Bell's phenomenon (Tab. 1). However, no statistically significant difference in visual acuity was demonstrated between patients with very good Bell's phenomenon and incomplete Bell's phenomenon ($p = 0.67$).

Apart from Bell's phenomenon and age, all other analysed parameters appeared to be insignificant (Tab. 2).

The Kruskall-Wallis univariate variance analysis by ranks, conducted to determine the effect of the above characteristics on the degree of keratopathy before treatment, revealed a statistically significant result ($p < 0.05$) only for Bell's phenomenon and corneal sensation (Tab. 3).

Discussion

Visual acuity is the basic parameter used in ophthalmic examination to quickly assess the condition of the eye. Normal acuity, measured using normalised charts, indicates integrity of the structures of the anterior and posterior eye, the visual pathway and visual cortex [2]. Human cornea, physiologically transparent and avascular, not only ensures continuity of the eye wall, but also enables penetration of visual stimuli into the eye and focusing them on the retina, which is necessary for normal vision. During sleep the eyelids protect the eye surface against drying, and then during the day through the blinking reflex they clean the eye and protect it from foreign bodies. By distributing the tear film on the eye surface, and supporting the flow of tears to the lacrimal puncti, they ensure optimal hydration of the eye.

Corneal damage is the main factor adversely affecting visual acuity in patients with facial nerve palsy and lagophthalmos [3, 6, 7]. In the analysed group corneal damage was identified in all the patients qualified for surgical treatment for correction of lagophthalmos. The aetiology of the facial nerve palsy did not affect significantly the severity of corneal lesions (Tab. 2 – 3). However, it should be emphasised that they were more advanced in patients who had large tumours removed from the area of the cerebellopontine angle. This is probably due to the fact that in these cases there is damage not only to the facial nerve but also the ophthalmic branch of the trigeminal nerve, whose function determines normal corneal sensation [2, 10-12]. This observation can be confirmed by a low p value, indicating a strong relationship between the severity of keratopathy and the preserved corneal sensation (Tab. 3). Unexpectedly, neither the duration of the nerve palsy, nor the size of lagophthalmos had any significant effect on worsening of the corneal condition and deterioration of visual acuity (Tab. 2 – 3). Severe ulceration was observed in the analysed group even in patients who had nerve palsy for less than 3 months, and whose lagophthalmos was minor - approximately 3 mm. On the other hand, surprisingly harmless, mild epithelial deficits were observed in patients with long-term damage to the facial nerve, and in patients with significant lagophthalmos (>10 mm). However, it should be emphasised that in these cases Bell's phenomenon, which was demonstrated to affect in a statistically significant manner the condition of cornea and BCVA ($p < 0.05$), was preserved [Tab. 1 – 3]).

No significant relationship between the amount of tears secreted and the degree of corneal damage or BCVA was demonstrated (Tab. 2 – 3), probably due to the fact that all the patients in the analysed group used commonly available lubricant eye drops for local use.

Statistically significantly worse BCVA was observed in elderly patients ($p < 0.05$ [Tab. 2]); however, age did not affect the condition of cornea in the analysed group ($p > 0.05$ [Tab. 3]). This can be explained by age-related development of other eye diseases that impair visual acuity, e.g. cataracts, AMD or glaucoma.

No studies regarding the defence mechanisms responsible for corneal protection in patients with permanent facial nerve palsy were found in the PubMed database. A retrospective analysis by Joseph et al. [13] demonstrated that visual acuity deteriorated only in 13.5% of 96 patients with facial nerve palsy. It should be emphasised that, contrary to the subjects with treatment-resistant corneal lesions, in the majority of patients (82%) studied by Joseph et al. only superficial lesions of the corneal epithelium were found, and the mean size of lagophthalmos was small: 3.5 ±3.1 mm. Sohrab et al. [14] point to the difficulties with corneal lesion healing in patients with reduced corneal sensation. The results of the presented studies confirm the need for identification of the factors contributing to impaired visual acuity in patients with facial nerve palsy. Among the factor analysed in the studied group the clinically and statistically significant ones included preserved corneal sensation and good Bell's phenomenon.

Conclusions

Bell's phenomenon appeared to be the most important parameter affecting visual acuity in the analysed patients. The degree of corneal damage was determined by the presence of Bell's phenomenon and corneal sensation. The results of this study indicate that Bell's phenomenon and corneal sensation should be the basic parameters evaluated in every patient with facial nerve palsy in clinical practice.

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The effect of FemtoLASIK surgery on tear film parameters and ocular surface condition in patients with myopia

Wpływ zabiegu FemtoLASIK na parametry filmu łzowego i stan powierzchni oka u pacjentów z krótkowzrocznością

Marcin Smorawski,[1,2] Janusz Sierdziński,[3] Joanna Wierzbowska[2,4]

[1] Doctoral Programme, Military Institute of Medicine in Warsaw; head: Prof. Dariusz Jurkiewicz MD, PhD
[2] Optegra Ophthalmology Hospital in Warsaw; head: J. Oficjalska MD, PhD
[3] Department of Medical Informatics and Telemedicine, Medical University of Warsaw; head: Andrzej Cacko MD, PhD
[4] Department of Ophthalmology, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine in Warsaw; head: Prof. Marek Rękas MD, PhD

Abstract. FemtoLASIK is currently the world's most common laser surgery technique used to correct sight defects. The purpose is to evaluate the influence of corneal flap thickness, as an effect of FemtoLASIK surgery on tear film parameters and ocular surface condition in patients with myopia. The prospective, interventive and open study involved 143 patients (143 eyes, 80 females, mean age 27.6 ±5.9 yrs) with myopia (-0.75 to −7.75 diopters), mean SE of 4.76 ±1.63 D. The patients underwent FemtoLASIK surgery with a 110 or 140 micron flap. Schirmer I and II, TBUT and fluorescein eye stain tests were conducted before the surgery and on week 1 and months 1, 2, 4 and 6 after the surgery. All the evaluated tear film parameters altered after the surgery and remained lower throughout the whole 6-month follow-up period. Tear film alterations and dry eye syndrome were more frequent after thicker corneal flap creation and in females.
Key words: dry eye syndrome, femtosecond laser, laser in situ Keratomileusis, myopia, refractive surgical procedures, tear film

Streszczenie. Wprowadzenie. Zabieg FemtoLASIK jest obecnie najczęściej na świecie wykonywaną procedurą laserowej korekcji wad wzroku. Cel. Ocena wpływu grubości wytworzonego w czasie zabiegu FemtoLASIK płatka rogówki na parametry filmu łzowego oraz stan powierzchni oka u pacjentów z krótkowzrocznością. Materiał i metody. Badanie prospektywne, interwencyjne, otwarte. Do badania włączono 143 pacjentów (143 oczy, 80 kobiet, śr. wiek 27,6 ±5,9 roku) z krótkowzrocznością od -0,75 do -7,75 dioptrii (D) (średni ekwiwalent sferyczny, śr. ES 4,76 ±1,63 D), u których przeprowadzono zabieg FemtoLASIK z płatkiem o grubości 110 oraz 140 µ. Badania filmu łzowego (test Schirmera I, II, czas przerwania filmu łzowego [TBUT]) oraz ocena barwienia rogówki za pomocą fluoresceiny były przeprowadzane przed zabiegiem, następnie po 1 tygodniu oraz 1, 2, 4 i 6 miesiącach po zabiegu. Wyniki. Wszystkie badane parametry filmu łzowego uległy zmianie po zabiegu FemtoLASIK i pozostały zmniejszone w 6-miesięcznym okresie obserwacji.
Wnioski. Zmiany parametrów filmu łzowego i występowanie zespołu suchego oka są bardziej nasilone w oczach, w których wykonano grubszy płatek rogówki, oraz u kobiet.
Słowa kluczowe: krótkowzroczność, chirurgiczne procedury refrakcyjne, laser *in situ keratomileusis*, laser femtosekundowy, zespół suchego oka, film łzowy

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Corresponding author
Marcin Smorawski MD
Optegra Ophthalmology Hospital
18 Bitwy Warszawskiej 1920 r. St., 02-366 Warsaw
e-mail: marcin.smorawski@interia.pl

Introduction

Uncorrected refractive disorders are among the main causes of impaired vision and blindness across the world. Population studies indicate that myopia affects 10–18% of the world's population, while hyperopia and presbyopia affect 35–55% of the population [1, 2]. For the past 30 years, laser surgery of the cornea has been available as an alternative to classical methods of sight defect correction, such as corrective glasses and contact lenses. This technique uses excimer and/or femtosecond lasers to correct the refraction error, by reshaping the anterior corneal surface.

The laser eyesight correction methods comprise superficial and deep procedures. The superficial procedures consist in removal of the corneal epithelium and laser ablation of the exposed Bowman's layer and the underlying stroma. The deep procedures consist in preparation of a 110–160 μm thick corneal flap in the corneal stroma, using a microkeratome (in the LASIK method [*laser in situ Keratomileusis*]) or a femtosecond laser (in the FemtoLASIK method [*femtosecond laser in situ Keratomileusis*]), followed by excimer laser ablation of the exposed corneal stroma. One of the most common complications of refractive laser procedures is dry eye syndrome (DES).

DES is a multifactorial disease of the ocular surface and the tear film, manifested by varying degrees of discomfort, foreign body sensation and photophobia that may result in temporary or permanent damage to the eye surface. This is associated with the increased osmolarity of the tear film [3].

The damage to the afferent nerve fibres of the cornea resulting from keratorefractive procedures causes deregulation of the communication between the ocular surface and the lacrimal gland, reduces reflective lacrimation, impairs the defence reactions of the cornea, and slows down the repair processes of the corneal surface [4]. Other factors contributing to the development of DES following refractive procedures include: damage to the conjunctival goblet cells by the suction ring (LASIK and FemtoLASIK methods), less frequent blinking, modified distribution of the tear film due to reshaping of the cornea, and induction of subclinical inflammation (increased concentration of cytokines) [5].

The incidence of DES symptoms following laser corrective procedures is 10–40%. In some patients the symptoms are transient and subside within a few weeks, whereas in others they may persist for as long as a few years after the procedure. Clinical observations indicate that disorders of the tear film and the ocular surface disappear sooner after superficial procedures compared to the deep procedures, such as LASIK and FemtoLASIK. During the latter the nerve endings in the area of laser ablation and flap cut are damaged. Another factor potentially contributing to a higher incidence of post-operative DES following the LASIK and FemtoLASIK procedures is the size of the intervention area: the flap diameter is 8.5–9.5 mm, significantly larger than the typical ablation area of approximately 6.5 mm [6].

There is no clear evidence confirming a relationship between the intraoperative aspects of the LASIK and FemtoLASIK procedures, such as flap thickness or flap hinge width, and the incidence of post-operative DES. According to some authors, using a thinner corneal flap and a wider flap hinge may reduce the risk of disorders of the tear film and the ocular surface after these procedures [7].

The aim of the study was to determine and compare the incidence of quantitative and qualitative disorders of the tear film and of the corneal surface in patients with myopia undergoing a FemtoLASIK procedure with the use of a corneal flap of a lower (110 μm) and higher (140 μm) thickness during a 6-month follow-up.

Material and methods

The study was approved by the Bioethical Committee of the Military Institute of Medicine in Warsaw (resolution no. 48/WIM/2015 of 16/09/2015). All participants provided an informed consent to a laser procedure to correct the sight defect, and to the use of the obtained results for scientific purposes. The laser procedures for sight defects were performed at the Optegra Ophthalmological Hospital in Warsaw.

The study involved adult patients, both male and female, with myopia, who attended the Optegra Ophthalmological Hospital for laser correction of a sight defect, and were qualified for a FemtoLASIK procedure. Exclusion criteria included: current or previous DES, active ocular disease, previous laser and surgical procedures of the eyes, eye injury, keratoepitheliopathy, corneal neovascularisation, keratoconus or other corneal dystrophies, history of recurrent corneal erosion, local or general use of drugs that may contribute to DES (beta-blockers, antidepressants, hormonal replacement therapy, isotretinoin derivatives, antihistamines, diuretics), general diseases (Sjögren's syndrome, diabetes, rheumatoid arthritis, connective tissue disorders, thyroid disorders), cataract, pregnancy or breastfeeding. Patients were not considered in the final analysis if they did not follow the recommended treatment, or did not attend the follow-up visits.

The prospective, open study involved 143 patients (143 eyes, 80 females, mean age 27.6 ±5.9 years) with myopia of -0.75 to -7.75 dioptres (D) (mean spherical equivalent ES -4.76 ±1.63 D), qualified for FemtoLASIK surgery. The patients were divided into two groups,

according to the thickness of the corneal flap created during the surgery: group 110 and group 140, in which the flap thickness was 110 and 140 microns (μ), respectively. Group 110 comprised 73 patients (73 eyes, 43 females, mean age 27.2 ±5.1 years, mean ES -4.93 ±1.11 D), and group 140 comprised 70 patients (70 eyes, 37 females, mean age 28.0 ±6.1 years, mean ES 4.67 ±1.43 D).

Pre-operative examination

In all the subjects medical history was collected, and the following studies were conducted: autofractometry and non-contact tonometry (Nidek Tonoref II), corneal endothelial test (NIDEK CEM 530), uncorrected distance visual acuity (UDVA), and best corrected distance visual acuity (BCDVA). Next, the condition of the ocular surface was assessed using the following tests: tear breakup time (TBUT), Schirmer's test I and Schirmer's test II (following administration of a drop of Alcaine solution [TearFlo, Ophthalmic People]). Further, corneal imaging tests using a Scheimpflug camera (Pentacam, Zeiss), corneal topography (Ztlas, Zeiss) and aberrometry (Wasca CRS, Zeiss) were performed. Subsequently, following three administrations of 15 solution of tropicamide solution into the conjunctival sac, autorefraction and BCVA after cycloplegia were measured, the anterior and posterior eye was examined with the use of biomicroscope, Volk lens and Goldmann three-mirror lens. Prior to the qualification tests, patients were required to stop using soft contact lenses for two weeks. All the diagnostic tests were performed by one doctor.

Assessment of corneal staining

The corneal staining was assessed using a biomicroscope, with 10 x magnification, and a cobalt filter, 2 minutes after the administration of 3 μl of fluorescein sodium solution into the conjunctival sac. The corneal surface was assessed in 5 zones (the central zone and four peripheral zones: nasal, inferior, temporal and superior) with the use of a round measure placed on the eyepiece of the biomicroscope, whose edge corresponded to the border of the corneal limbus.

The intensity of corneal staining was graded in each zone according to the five-point Baylor scale (8, 9), with no staining = grade 0, 1 to 5 spots = grade 1, 6 to 15 spots = grade 2, 16 to 30 spots = grade 3, > 30 spots = grade 4. The scores for each of the 5 zones were summed, and one additional point was added if there was confluent staining in one area, or two points if the confluent staining occurred in at least two areas of the cornea. A total score of at least 3 was used a criterion of the dry eye syndrome, following de Paiva [10].

Tear film breakup time

A fluorescein strip (BioGlo, Ophthalmic People) moistened with a drop of 0.9% NaCl solution was used in the test. The moistened fluorescein strip was applied to the inferior tarsal conjunctiva of the patient. The patient was asked to blink a few times to distribute the dye evenly in the conjunctival sac. Next, 30 seconds after the application of fluorescein, the time between the last blink and the first breakup of the tear film was measured. The test was repeated three times, and the mean from three measurements was used for analysis. The result was considered normal if the time to breakup of the tear film was at least 10 seconds.

Schirmer's tests I and II

A paper strip (Tear- Flo, Ophthalmic People) was placed for 5 minutes in the inferior fornix of the conjunctiva, at 1/3 of the distance from the lateral angle of the eye. First, Schirmer's test I was conducted to test the reflex production of the tear film. Fifteen minutes after a single administration of analgesic drops with 0.5% proxymetacaine hydrochloride (Alcaine 0%), Schirmer's test II was performed to test basic tear production using a paper strip (TearFlo, Ophthalmic People). Moistening of the diagnostic strip was measured in millimetres (mm) from the edge of the lower eyelid. The normal results for the tests were at least 10 m of moisture in the case of Schirmer's test I, and 5 mm for Schirmer's test II. All the tests were performed by the same person, in the same conditions regarding air temperature and humidity. Patients were sitting during the test; prior to the application of a diagnostic strip, the conjunctival sac was dried using a cotton bud.

Surgical technique

All procedures were performed by the same surgeon (MS). Following the administration of anaesthetic drops with 0.5% proxymetacaine hydrochloride (Alcaine 0%), and application of an eyelid dilator, a suction ring of the femtosecond laser (Ziemer Femto LDV4, Ziemer) was placed on the eye, and a corneal flap of a set thickness was created: 110 μ in the 110 group or 140 μ in the 140 group.

Table 1. Characteristics of study groups
Tabela 1. Charakterystyka badanych grup

	Group 110	Group 140	P
Eyes (n, right eye, left eye)	73, (40, 33)	70, (35, 35)	0.673
Sex (F/M)	43/30	37/33	0.057
Age (mean ±SD)	27.19 ± 5.70	28.03 ± 6.12	0.412
ES (D) (mean ±SD)	4.93 ± 1.11	4.67 ± 1.43	0.112
CCT (μ) (mean ±SD)	542.15 ± 26.93	567.22 ± 25.053	0.0474
Ablation depth (μ) (mean ±SD)	77.3 ± 19.8	70.9 ± 17.4	0.0712
Flap thickness + ablation depth (μ) (mean ±SD)	197.3 ± 19.8	210.9 ± 17.4	0.0712

After lifting the flap, ablation of the revealed corneal stroma was performed with an MEL 80 excimer laser (Zeiss), following the SCA Tissue Save program. The laser ablation zone was 6.5 mm in each eye. After setting the corneal flap back into place, a contact lens was placed on the eye, and antibiotic drops (levofloxacin, Oftaquix®, Santen) and artificial tears were administered. In the post-operative treatment, the following pharmacological therapy was recommended for each patient: loteprednol etabonate 0.5% (Lotemax, Baush & Lomb) three times a day for the first day, then twice a day for 6 days, levofloxacin (Oftaquix, Santen) every 2 hours for the first day, followed by 4 times a day for a week, Systane Ultra every 2 hours for the first day, followed by 6 times a day for 2 weeks, and 4 times a day for two months.

Follow-up visits were conducted after one week, and after 1, 2, 4 and 6 months following the procedure. Autorefractometry, non-contact tonometry, UDVA and BCDVA assessment, tear film examination (Schirmer's tests I and II, TBUT) and fluorescein corneal staining assessment were performed. In addition, 6 months after the procedure, a corneal imaging test was conducted, using a Scheimpflug camera (Pentacam, Zeiss).

T-Student's test was used in the comparative analysis of the two study groups (groups 110 and 140). The results of the study were compared and analysed using the Anova variance analysis and Bonferroni test.

Results

The analysis included 73 patients from the 110 group (73 eyes, 43 females, mean age 27.2 ±5.7 years) and in 70 patients from the 140 group (70 eyes, 37 females, mean age 28.3 ±6.1 years). The characteristics of both patient groups were similar. The study group did not differ statistically in size, sex, age, ES or depth of ablation. No differences were found between the groups in the pre-operative examination regarding the values of quantitative and qualitative parameters describing the tear film and fluorescein corneal staining. None of the patients in the 110 or 140 groups demonstrated signs of DES according to the de Paiva criteria used in the study [10]. The group characteristics are presented in Table 1.

The analysis of the parameters describing condition of the ocular surface demonstrated their reduction after the FemtoLASIK procedure during the follow-up in both study groups. The majority of the parameters of the tear film changed significantly already after a week following the surgery. In the 110 group, TBUT was reduced significantly from 10.9 ±2.0 seconds before the procedure to 7.1 ±1.3 seconds after a week, and 7.4 ±2.2 seconds after 6 months following the surgery ($p = 0.042$). The same parameter in the 140 group decreased significantly from 10.4 ±1.7 seconds before the procedure to 6.1 ±1.6 seconds after a week, and 6.4 ±1.6 seconds after 6 months following the surgery ($p = 0.034$) (Tab. 2). The comparative analysis of groups 110 and 140 revealed a statistically greater reduction of TBUT in the 140 group ($p < 0.001$). Changes in TBUT during the 6-month follow-up are presented in Figure 1.

Schirmer's test I and Schirmer's test II in the 110 group reduced in a statistically significant manner from 22.3 ±4.2 mm and 18.1 ±4.8 mm to 19.4 ±3.4 and 16.6 ±3.1 mm after 6 months following the surgery ($p = 0.0019$ and $p = 0.00001$). Similarly, in the 140 group the Schirmer's test values were statistically significantly reduced from the baseline 21.9 ±3.2 mm and 17.3 ±3.0 mm to 16.9 ±3.8 and 14.5 ±3.1 mm after 6 months following the surgery ($p = 0.0014$ and $p = 0.000001$) (Tab. 2).

The greatest reduction in tear production measured with Schirmer's test II was observed a week after the procedure in the 110 group (13.3 ±1.45 mm), and a month after the procedure in the 140 group (11.9 ±1.2 mm). The comparative analysis of the 110 and 140 groups demonstrated a statistically greater reduction in the parameters measured by Schirmer's tests I and II in the 140 group, compared to the 110 group (respectively: $p < 0.0001$ and $p < 0.0001$) (Tab. 2). Changes in the parameters measured in Schirmer's tests I and II during the 6-month follow-up in both study groups are presented in Figures 2 and 3.

Table 2. Characteristics of ocular surface parameters before and 6 months after FemtoLASIK in both study groups
Tabela 2. Charakterystyka parametrów powierzchni przed zabiegiem i 6 miesięcy po zabiegu FemtoLASIK w obu badanych grupach

	BUT (sec.)	Schirmer I (mm)	Schirmer II (mm)	Mean fluorescein staining score	Cases of dry eye n (%)
110 group Before the procedure	10.9	22.3	18.1	0.42	0 (0%)
6 months after FL	7.7	19.4	16.6	0.91	4 (5.4%)
p	0.042	0.0019	0.00001	0.0004	0.0000
140 group Before the procedure	10.4	21.9	17.3	0.39	0 (0%)
6 months after FL	6.4	16.9	14.5	2.12	15 (21.4%)
p	0.034	0.0014	0.000001	0.00023	0.0000

Table 3. Characteristics of dry-eye-syndrome group (DES) and no dry-eye-syndrome group (nDES)
Tabela 3. Charakterystyka grup pacjentów z ZSO i bez ZSO

	Flap thickness 110 µ n (%)	Flap thickness 140 µ n (%)	Female n (%)	Age (years) Mean ±SD	Ablation depth (µ) Mean ±SD
DES n = 19 (13.2%)	4 (21.0%)	15 (78.9%)	14 (73.6%)	37.9 ± 7.83	74.3 ± 19.9
No DES (nDES) n = 124 (86.8%)	69 (55.6%)	55 (44.3%)	66 (53.2%)	28.15 ± 6.78	75.9 ± 21.2
p	0.0000	0.0000	0.0001	0.0012	0.2

Six months after the refractive surgery, the corneal fluorescein staining was more pronounced in the eyes with a flap thickness of 140 µ (140 group) than in the eyes with a flap thickness of 110 µ (110 group) (2.1 *vs* 0.9, $p < 0.0001$) (Tab. 2, Fig. 4). The mean corneal fluorescein staining score in the group of eyes with a thicker flap was highest a month following the surgery (3.44 points), and decreased to 2.12 points at the 6-month follow-up. In the group of eyes with a thinner flap, the mean fluorescein staining score was highest a week after the procedure (2.67 points), and decreased to 0.91 at the end of the follow-up period.

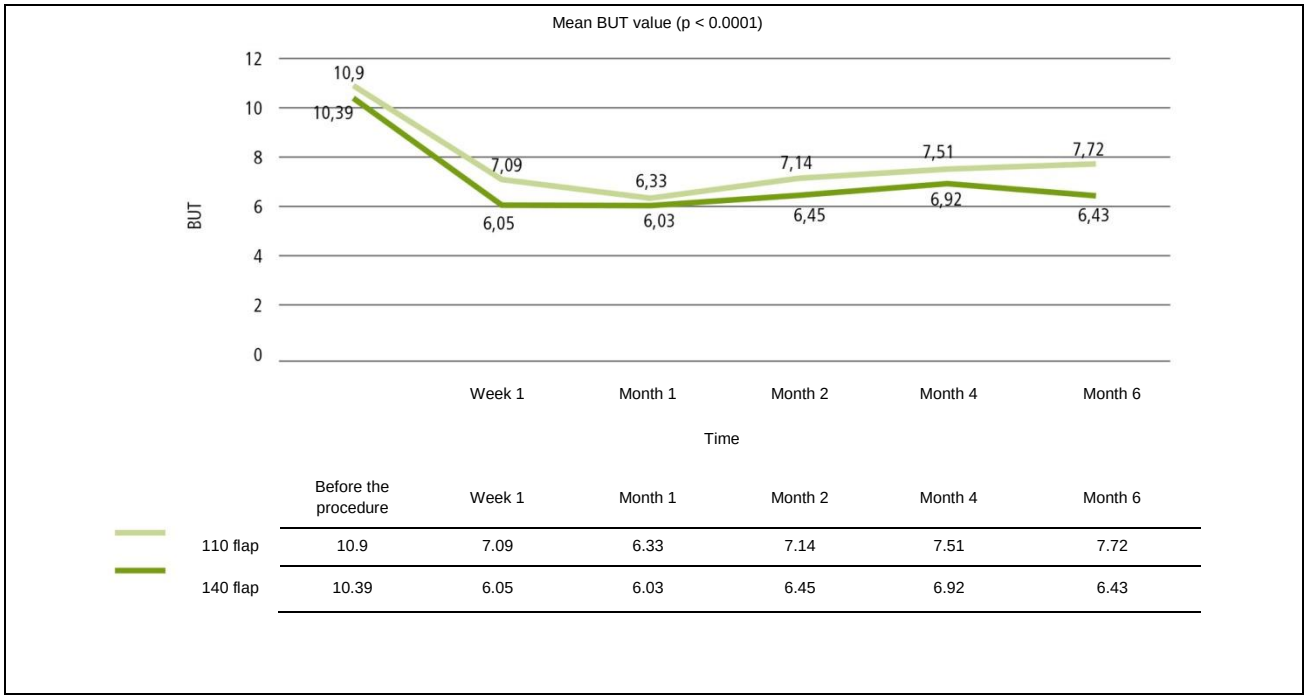
The features of DES, according to the criteria used in the study, were found significantly more often in the eyes with a thicker flap than in those with a thinner flap, and a week after the surgery they were observed in 48% of eyes in the 140 group, and in 15.0% of eyes in the 110 group. During the follow-up period the number of eyes with DES began decreasing gradually in both groups, and after 6 months was 21.4 and 5.4%, respectively ($p < 0.001$) (Tab. 2, Fig. 5).

The analysis revealed a statistical relationship between the incidence of post-operative DES and female sex (RR 1.38) and a flap thickness of 140 µ (RR 1.78). The cumulative risk for both features was 2.45 (Bayes estimator risk ratio). No relationship was found between the occurrence of post-operative DES and age or depth of laser ablation (Tab. 3).

Discussion

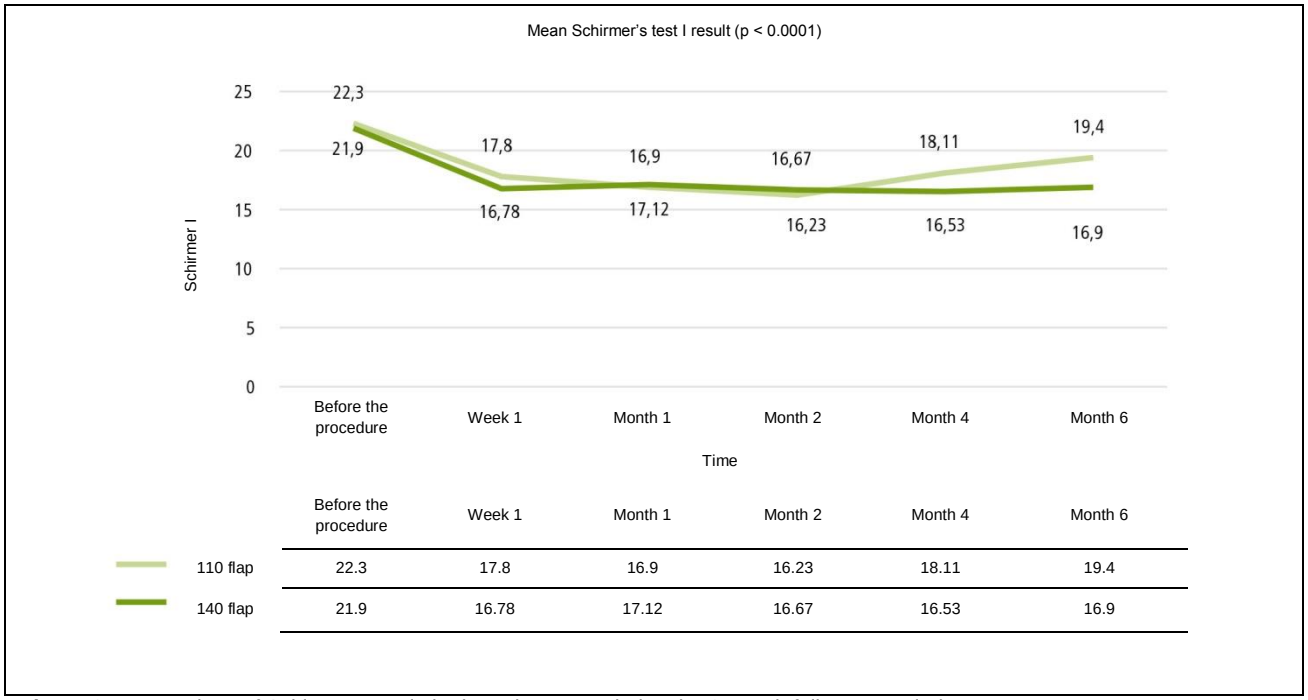
The cornea is highly innervated by the ophthalmic branch of the trigeminal nerve. The nerve endings, originating primarily from the long ciliary nerves, pass from the limbus to the transparent cornea for 2/3 of its anterior part, where they run in parallel, and then intertwine. After passing through the Bowman's layer, they create the corneal epithelial sub-basal plexus. The most superficial afferent nerve fibres end between the cells of the corneal epithelium.

DES is the most common complication of refractive surgery, especially in deep procedures such as LASIK and FemtoLASIK. An increased predilection for this complication following deep surgeries results from significant damage to the afferent nerves of the cornea, and compressive damage of the Meibomian glands. DES following deep procedures is usually mild and transient, but in rare cases, especially when it affects the central cornea, it may lead to refraction disorders, secondary aberrations of the optic system, and even to reduced corneal transparency.



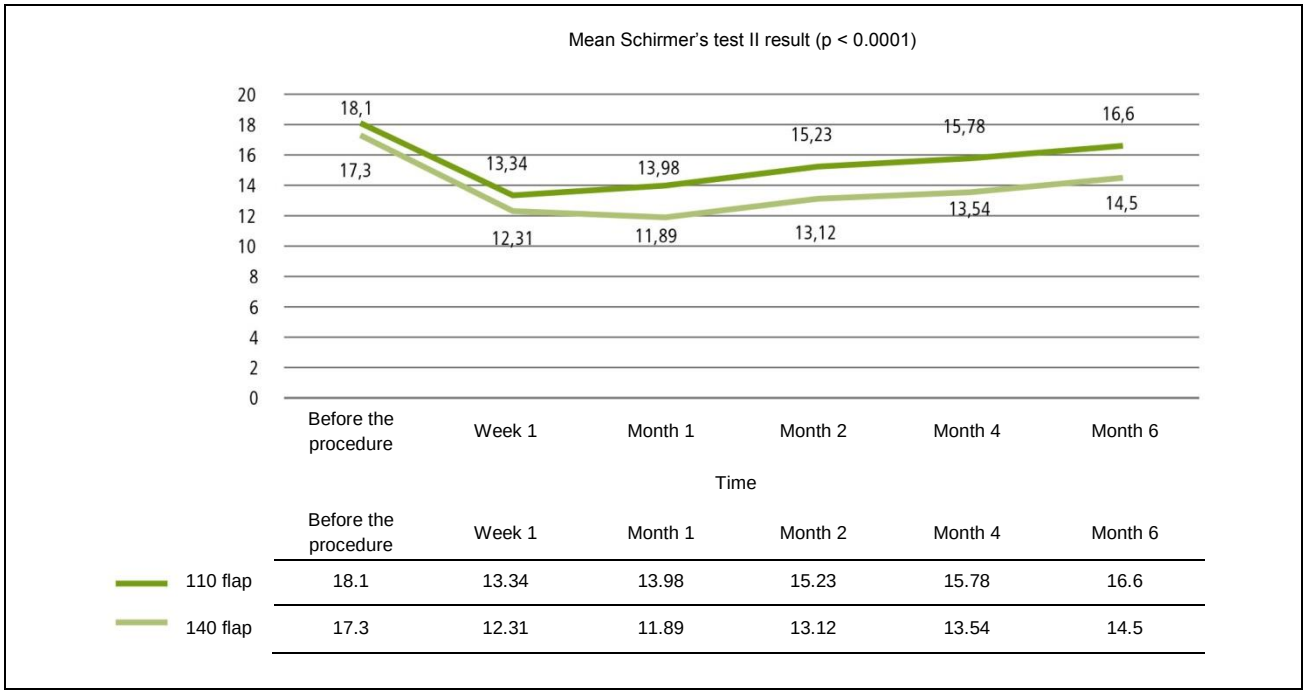
	Before the procedure	Week 1	Month 1	Month 2	Month 4	Month 6
110 flap	10.9	7.09	6.33	7.14	7.51	7.72
140 flap	10.39	6.05	6.03	6.45	6.92	6.43

Figure 1. Mean TBUT in both study groups during 6-month follow-up period
Rycina 1. Średni czas przerwania filmu łzowego (TBUT) w obu badanych grupach w czasie 6‑miesięcznej obserwacji



	Before the procedure	Week 1	Month 1	Month 2	Month 4	Month 6
110 flap	22.3	17.8	16.9	16.23	18.11	19.4
140 flap	21.9	16.78	17.12	16.67	16.53	16.9

Figure 2. Mean values of Schirmer I test in both study groups during the 6-month follow-up period
Rycina 2. Średnie wartości testu Schirmera I w obu badanych grupach w czasie 6-miesięcznej obserwacji



	Before the procedure	Week 1	Month 1	Month 2	Month 4	Month 6
110 flap	18.1	13.34	13.98	15.23	15.78	16.6
140 flap	17.3	12.31	11.89	13.12	13.54	14.5

Figure 3. Mean values of Schirmer II test in both study groups during 6-month follow-up period
Rycina 3. Średnie wartości testu Schirmera II w obu badanych grupach w czasie 6‑miesięcznej obserwacji

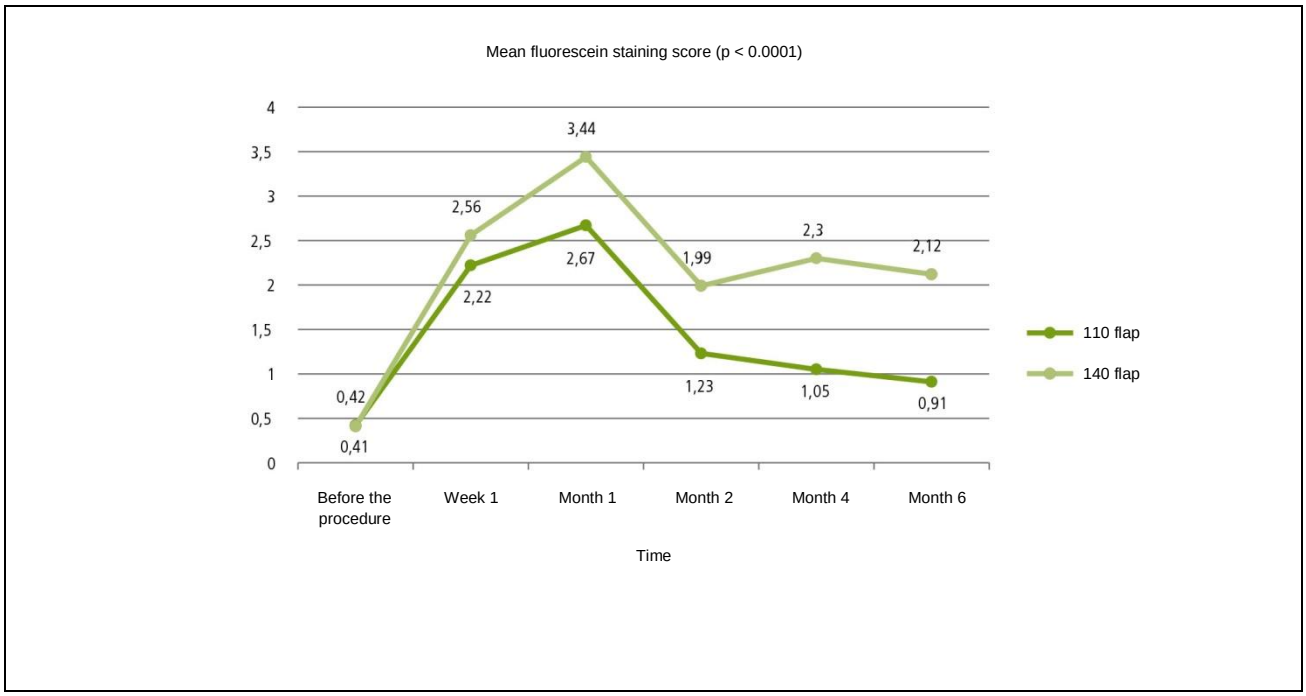
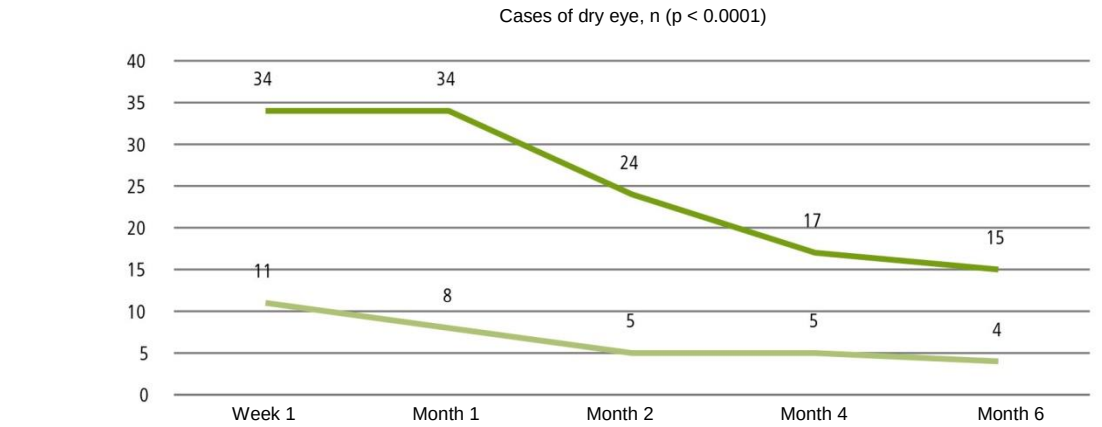


Figure 4. Mean fluorescein staining scores in both study groups during 6-month follow-up period
Rycina 4. Średnie wartości barwienia fluoresceiną w obu badanych grupach w czasie 6‑miesięcznej obserwacji



	Week 1	Month 1	Month 2	Month 4	Month 6
110 flap	11	8	5	5	4
140 flap	34	34	24	17	15

Figure 5. Number of dry-eye-syndrome eyes in both study groups during 6-month follow-up period
Rycina 5. Liczba oczu demonstrujących zespół suchego oka w obu badanych grupach w czasie 6-miesięcznej obserwacji

The main cause of secondary DES is disturbed reflex production of tears by the lacrimal gland due to cutting through most of the afferent nerve endings of the ophthalmic branch of the trigeminal nerve during production of the corneal flap. Additional causes of this complication include post-operative inflammatory reactions, toxic effects of drugs used after the procedure, or increased evaporation of the tear film.

Previous studies demonstrated that during the first 13 hours after the FemtoLASIK surgery, corneal nerves are significantly degenerated due to cutting of the flap. In the healing process, the nerve endings innervating the corneal flap from the stroma regenerate first, and those near the edge of the flap regenerate later. Within the first 6 to 12 months following the surgery, nerve ending occurs in the basal epithelium of the central cornea [11]; however, a structure of the sub-basal plexus and nerve density comparable to that from before the surgery is restored a year or two after the procedure [12]. In superficial procedures, the corneal sensation and results of Schirmer's tests are restored after only 3 to 4 months following the procedure [13], and TBUT, according to some authors, does not change significantly.

In the presented study, DES was observed in 13.2% of patients after a FemtoLASIK surgery during a 6-month follow-up period. The study results are similar to those demonstrated by other authors who found DES in 10-18% of Caucasian patients following LASIK [14, 15]. In the analysed material, all the measured parameters of tear film changed after the FemtoLASIK surgery, and remained reduced during the entire 6-month follow-up period. TBUT was decreased by 30% on average in both study groups, although the reduction was significantly greater in the group with the thicker flap (39% *vs* 29%). Reflex and basic production of the tear film was more reduced in eyes with a thicker (140 µ) corneal flap than in those with a thinner (110 µ) flap; also the corneal staining scores in the eyes with a thicker flap were higher.

Studies by other authors revealed that after deep procedures, the production of tears measured by Schirmer's tests I and II is reduced, but the condition is much less pronounced that the reduction of TBUT [16]. It is believed that deep procedures lead to a decreased stability of the tear film due to qualitative changes caused by impaired secretion of mucin from conjunctival goblet glands damaged by the vacuum and suction ring of the microkeratome or femtosecond laser [17]. According to some authors, the qualitative parameters of the tear film are affected more after LASIK procedures with the use of microkeratome, as the associated compression of the tissues of the ocular surface and the applied vacuum are higher than in FemtoLASIK surgeries [17].

In our study DES was most pronounced during the first and second follow-up visit, i.e. a week and a month after

the refractive surgery. A week after the procedure in the group of patients with 140 µ flaps almost half of the subjects (48.5%) met the criteria of DES. At the same time, in the group of patients with 110 µ flaps, only 15.0% of patients experienced this complication. During the follow-up period, the rate of patients with DES gradually decreased, and at the end of the observation period it was 21.4% in group 140, and 5.4% in group 110. A relationship between the flap thickness and the mean corneal fluorescein staining score was also found. In the eyes with thicker flaps a longer and more pronounced disorder of the corneal surface was observed, as well as a slower regeneration than in the group of eyes with thinner flaps. Mean corneal staining score in group 140 was 23% higher than in the 110 group; in both groups the most intense staining of the corneal surface was found after a month. At the end of the follow-up period, the mean corneal staining score was significantly lower in the eyes with a thinner flap (by 65.1%) than in those with a thicker flap (by 39%), compared to the values obtained a week after the procedure.

The results of the basic tear production examined with Schirmer's tests I and II demonstrated significant differences between the two groups of patients. Interpretation of the Schirmer's test I, measuring the level of moisture on a strip of paper due to reflex production of tears, should be careful, and the limited diagnostic value of this test should be taken into consideration, as other authors demonstrated it is associated with a high rate of false-positive results [18, 19].

The effect of a greater flap thickness on a significantly higher incidence of DES was observed also by other authors. Battat et al. [20] observed a mean reduction in the Schirmer's test I values from 24 mm before the procedure to 18 mm after the FemtoLASIK surgery. A considerable reduction in BUT values, persisting for up to 9 months after the FemtoLASIK procedure, were reported by Benitez‑del‑Castillo et al. [15]. Yu et al. demonstrated a decrease in the Schirmer's test results from 13.2 mm to 11.2 mm after a week, and 10.8 mm after a month following the refractive procedure [21]. In the presented study, the TBUT value was reduced from 5.3 to 4.1, and 4.5 after one day and one week following the procedure, respectively. Until now, few studies have examined the relationship between the thickness of the corneal flap and intensity of DES symptoms, demonstrating the effect of a thicker flap on the increased incidence of this complication. However, other authors did not find any relationship between the studied parameters [22-24]. Researchers often confirm a higher incidence of ocular surface disorders in patients undergoing a LASIK procedure, compared to those who had FemtoLASIK surgery. This may be associated with a deeper cut into the cornea, and the direct effect of microkeratome on the conjunctival surface [25]. The results of previous studies regarding the risk of DES after refractive procedures are reflected in the guidelines of various societies of refractive surgeons that recommend using thin layer cuts in deep refractive procedures on the cornea [26-28].

The study also revealed that DES following FemtoLASIK was more frequent in females, and their age was a risk factor for DES. The cumulative risk for female patients and a 140 µ corneal flap was 2.45, which means that in women undergoing a FemtoLASIK procedure with a flap thickness of 140µ DES was observed 2.45 times more frequently. The role of sex hormones in the pathogenesis of DES has often been analysed. A higher incidence of dry eye syndrome in women receiving hormone replacement therapy was demonstrated [29]. It is also suggested that androgen and oestrogen deficiency may contribute to insufficiency of meibomian glands, and to instability of tear film in post-menopausal women [30].

The presented study has certain limitations. Firstly, the flap diameter in the eyes with thicker flaps was slightly larger (9.5 mm) than in those with a thin flap (9.0 mm), which could be one of the causes of increased incidence of DES in the former group of eyes. Secondly, corneal sensitivity was not examined with the use of a contact corneal aesthesiometer, although the test would enable an analysis of the correlations between the studied parameters and the level of regeneration of nerve endings.

In summing up, the study demonstrated that a FemtoLASIK procedure in myopic eyes changes the tear film parameters and corneal fluorescein staining effects during a 6-month follow-up. The changes are most pronounced in the first month following the procedure, and are more frequently found in the eyes with a thicker flap and in female patients.

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Is this really the transplant renaissance in the CML acceleration phase?

Czy to naprawdę renesans transplantacji w fazie akceleracji przewlekłej białaczki szpikowej?

Tomasz Chojnacki, Piotr Rzepecki
Department of Internal Diseases and Hematology, Military Medical Institute, Warsaw, Poland; head: Professor Piotr Rzepecki, MD, PhD

Abstract. In the WHO 2016 guidelines regarding the diagnosis and treatment of chronic myeloid, the leukaemia criteria of acceleration phase identification were revised. Despite these changes, the guidelines are still not standardized and differ significantly from the guidelines of most important European and world scientific societies. These changes resulted, however, in the necessity to diagnose the acceleration phase much more frequently than previously, according to WHO. It is particularly significant for patients already treated with first line tyrosine-kinase inhibitors, as it increases the percentage of patients with indications for allogenic hematopoietic stem cell transplantation. The case of a patient with a decision concerning second line treatment made before 2016 shows that in the tyrosine-kinase inhibitor era the changes in WHO guidelines contrasted with everyday practice and the tendency to marginalize the role of transplanting hematopoietic cells in this disease classification unit. It seems necessary to conduct a discussion, and perhaps to plan and perform an appropriate clinical trial, to provide more data and to optimize the treatment in such controversial cases.
Key words: acceleration phase, chronic myeloid leukaemia, indications for allogenic hematopoietic stem cell transplantation

Streszczenie. W wytycznych WHO 2016 dotyczących rozpoznawania i leczenia przewlekłej białaczki szpikowej zrewidowane zostały przede wszystkim kryteria rozpoznawania fazy akceleracji. Pomimo tych zmian kryteria te nadal nie są ujednolicone i różnią się znacząco w porównaniu z innymi wytycznymi europejskich i światowych towarzystw naukowych. Zmiany spowodowały jednak, że fazę akceleracji według WHO należy rozpoznawać znacznie częściej niż dotychczas. Ma to szczególne znaczenie dla pacjentów już leczonych w pierwszej linii inhibitorami kinaz tyrozynowych, gdyż zwiększa odsetek chorych ze wskazaniami do allogenicznej transplantacji komórek krwiotwórczych. Opis przypadku pacjenta, u którego decyzje terapeutyczne dotyczące wyboru sposobu leczenia drugiej linii podejmowane były jeszcze przed 2016 r., pokazuje, że zmiany w wytycznych WHO stoją w sprzeczności z codzienną praktyką i tendencją do marginalizacji roli przeszczepienia komórek krwiotwórczych w tej jednostce chorobowej w erze inhibitorów kinaz tyrozynowych. Wydaje się, że niezbędna jest dyskusja, a być może również zaplanowanie i przeprowadzenie odpowiedniego badania klinicznego, które dostarczyłyby większej ilości danych i pozwoliłyby zoptymalizować postępowanie w takich kontrowersyjnych przypadkach.
Słowa kluczowe: przewlekła białaczka szpikowa, faza akceleracji, wskazania do alogenicznej transplantacji komórek krwiotwórczych

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Corresponding author
Aleksander Tomasz Chojnacki
Department of Internal Diseases and Haematology, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine
128 Szaserów St., 04-141 Warsaw
telephone: +48 261 816 167
e-mail: tchojnacki@wim.mil.pl

Introduction

The WHO 2016 [1] guidelines regarding chronic myeloid leukaemia (CML) do not contain ground-breaking changes. The main revisions concerned the criteria for acceleration phase (AP) identification. Despite these changes, the guidelines are still not standardized and differ significantly from the guidelines of European LeukemiaNet (ELN) [2], International Bone Marrow Transplant Registry (IBMTR) and M.D. Anderson Cancer Center, for example (Tab. 1). Compared to previous editions of the WHO classification, new parameters have appeared, the presence of which requires identification of the acceleration phase. In this case, one should list chronic leukocytosis (>10 × 10^9 /L) non-responsive to treatment, chronic splenomegaly non-responsive to treatment, and additional clonal chromosomal aberrations (the “major route”) in Ph^+ cells on diagnosis.

Table 1. Criteria of acceleration phase in chronic myeloid leukaemia
Tabela 1. Kryteria rozpoznania fazy akceleracji w przewlekłej białaczce szpikowej

Criterion	MDACC	IBMRT	ELN	WHO 2008	WHO 2016
blasts	PB or BM 10–29%	PB or BM ≥10%	PB or BM 15–29%	PB or BM 10-19%	PB or BM 10-19%
blasts and promyelocytes	>30%	PB or BM ≥20%	≥30% with blasts <30%	NA	NA
basophils	PB or BM ≥20%	PB ≥20%	PB ≥20%	PB ≥20%	PB ≥20%
platelets	>1000 × 10^9 /L or <100×10^9 /L, not responding to treatment	persistent thrombocytosis	persistent thrombocytopenia (<100 × 10^9 /L) independent of treatment	persistent thrombocytosis (>1000 × 10^9 /L) not responding to treatment persistent thrombocytopenia (<100 × 10^9 /L) independent of treatment	persistent thrombocytosis (>1000 × 10^9 /L) not responding to treatment persistent thrombocytopenia (<100 × 10^9 /L) independent of treatment
leukocytes	>10 × 10^9 /L	difficult management	NA	increasing WBC count not responding to treatment	persistent or increasing WBC count (>10 × 10^9 /L) not responding to treatment
anaemia	NA	anaemia not responding to treatment	NA	NA	NA
splenomegaly	persistent splenomegaly, not responding to treatment	increasing spleen size	NA	increasing spleen size	persistent or increasing splenomegaly, not responding to treatment
cytogenetic disorders	NA	clonal evolution	“major route” type clonal chromosomal aberrations in Ph^+ cells during treatment	clonal evolution absent at the time of diagnosis	additional “major route” type cytogenetic disorders in Ph^+ cells during diagnosis. Each new clonal cytogenetic disorder in Ph+ cells occurring during therapy
other	NA	bone marrow fibrosis chloroma	NA	large foci or clusters of blasts in marrow biopsy	NA
provisional	NA	NA	NA	NA	haematological resistance to first TKI (or lack of CHR during first-line treatment) any haematological, cytogenetic or molecular resistance to treatment with second TKI occurrence of 2 or more mutations in BCR-ABL1 during TKI therapy

MDACC – M. D. Anderson Cancer Center, IBMRT – International Blood and Marrow Transplant Registry, WHO – World Health Organization, ELN – European LeukemiaNet, NA – not applicable, WBC – white blood cells, PB – peripheral blood, BM – bone marrow

New **provisional** criteria also appeared, related to the response to therapy using tyrosine kinase inhibitors (TKI). Among the latter, the following were distinguished: haematological TKI resistance when used as a first-line treatment, or when there is a lack of complete haematological response (CHR) during first-line treatment when using TKI; haematological, cytogenetic or molecular resistance during treatment with a subsequent second TKI; or the presence of two or more mutations within BCR/ABL during TKI therapy. These changes resulted in the necessity to diagnose the acceleration phase much more frequently, compared to the ELN criteria, for example. This is important, particularly for patients already treated with TKI, as it increases the percentage of patients with indications for allogenic hematopoietic stem cell transplantation (allo-HSCT). It contrasts with everyday practice and the tendency to marginalize the role of transplanting hematopoietic cells in the case of this disease

classification unit, in the TKI era. This thesis as such is best illustrated with an example.

Table 2. Indications for HSCT in chronic myeloid leukaemia – stand of experts at Hammersmith Hospital
Tabela 2. Wskazania do alotransplantacji komórek krwiotwórczych w przewlekłej białaczce szpikowej – stanowisko ekspertów z Hammersmith Hospital

First chronic phase	Acceleration phase		Blast crisis phase
failure of therapy using available TKI (search for donor should be started after first-line therapy failure)	less advanced acceleration phase at the time of diagnosis – treatment as in the case of first chronic phase	cases at the borderline of diagnosing blast phase, and patients with symptoms of transformation to the acceleration phase during TKI treatment – treatment as in case of blast phase	HSCT immediately after reaching chronic phase using TKI or polychemotherapy (one should consider subsequent treatment with second-generation TKI after transplantation)

Case report

Our patient was female, and 68 years old at the time of the diagnosis. Leukocytosis of 22 × 10^9 /L and thrombocytosis of 1252 × 10^9 /L, found accidentally during routine screening tests, which formed the indication to extend diagnostics. Over the course of further diagnostics significantly hypercellular bone marrow with a "left shift" in the granulopoiesis system were found. CML was diagnosed on 4 December 2015, based on Philadelphia chromosome (Ph) presence in the cytogenetic test, the presence of t(9;22)(q34;q11.2) translocation in a test using the FISH technique, and the presence of BCR/ABL p210 transcript in a test using the RT-PCR method. The disease was in a chronic phase (CP). Blasts constituted 4.3% of bone marrow nucleated cells, and basophils 4% of nucleated cells in the peripheral blood. The risk according to the EUTOS scale was estimated as low. From 7 January 2016 imatinib was used at a dose of 400 mg/day. After the first month of treatment, leukocytosis of 30.05 × 10^9 /L was found, as well as thrombocytosis of 1052 × 10^9 /L. After 3 months of treatment, the absence of complete haematological remission (CHR) was found. As a reminder, CHR condition is characterized by: white blood cell (WBC) count <10 × 10^9 /L, platelet (PLT) count <450 × 10^9 /L, absence of young granulocyte line cells in a peripheral blood smear, lack of splenomegaly on palpation and basophil percentage in the peripheral blood <5%. In our patient, the WBC count was 56.71 × 10^9 /L, and the PLT count was 989 × 10^9 /L. The Ph chromosome was present in the karyotype test in all analysed metaphases. Treatment failure was stated based on these results. Analysis using a sequencing method did not show mutations within the BCR/ABL coding domain. The patient was qualified for the second-line treatment with dasatinib (100 mg/day). CHR was achieved after 3 months of treatment. In the karyotype test, Ph+ cells constituted 82% of all the analysed metaphases (14/17), which allowed the determination of the minimal cytogenetic response (minCyR) and constituted a *warning* criterion according to ELN 2013. Higher molecular response (MMoIR) was also not achieved, the amount of BCR/ABL transcript was 29.5% according to the international scale (IS). After 6 months of treatment, the response was already optimal. CHR was maintained, complete cytogenetic response (CCyR) was achieved, as well as higher molecular response (BCR/ABL percentage of 0.006%, according to IS).

Discussion

As we can see, the patient achieved an optimal response to treatment with the second generation TKI over a relatively short time, and the response magnitude systematically increased. According to previous clinical practice at our facility, a shift to second-generation TKI and the use of response criteria with regard to second-line treatment according to the ELN guidelines is the optimal procedure. Here, then, is the appropriate time to pose the question: what effect on the patient's future would the use of the new WHO criteria regarding diagnosis of acceleration phase and diagnosing with AP achieve? AP diagnosis is related to quite a radical change in the strategy of the proceedings. According to ELN 2013, this strategy differs from newly diagnosed patients, and patients previously treated with TKI. In the case of patients previously treated with TKI, progression to AP or BP is related to changing TKI for one that was not used prior to progression to AP/BP (ponatinib – only in case of T315I mutation being present). Allo-HSCT in this patient group, according to ELN 2013, is recommended FOR ALL PATIENTS, preferably after reaching the chronic phase. Polychemotherapy might be necessary in order to prepare a patient for transplantation.

EBMT guidelines [3] recommend HSCT in the following cases.

- in patients with suboptimal response or failure of first-line therapy treatment in the case of:
  - EBMT risk score of 0–1 (recommended to include second-generation TKI and perform transplantation after obtaining an optimal response),
  - EBMT risk score of 0–4 in the case of losing response to imatinib (haematological or cytogenetic one),
- in patients with no haematological response to second-generation TKI, regardless of EBMT risk score (and in this case those patients may benefit from treatment with third-generation TKI, taking note of mutations within BCR/ABL coding domain and applied prior to HSCT,
- in patients with imatinibem therapy failure who are known to have mutations within BCR/ABL, resistant to second-generation TKI; and their EBMT risk score is 0–4,
- in patients with AP or BP after earlier preparation using TKI or TKI in combination with polychemotherapy. Transplantation should be performed possibly quickly after reaching the second chronic phase, yet in this case reaching profound cytogenetic or molecular response is not required.

It is also worth mentioning the stand of experts at the London Hammersmith Hospital of 2013 [4] which presented a similar and slightly more intuitive approach to the subject of qualifying patients for HSCT after first-line therapy failure (Tab. 2).

According to the above analysis, it is clear that following the most important guidelines (ELN, EBMT, NCCN) in the case of our patient one should strive to perform HSCT. Such proceedings were not considered, because at the time when the decision was made with regard to second-line treatment (April 2016), the number of data elements in favour of diagnosing AP was lower than the number of those excluding diagnosis of the advanced disease phase. In our opinion, the WHO guidelines of 2016 changed that situation. It seems necessary to conduct a discussion, and perhaps to plan and perform an appropriate clinical trial to provide more data and allow to optimize the proceedings in such controversial cases.

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Pyramidal cataract surgery. A case report

Zaćma piramidowa – leczenie chirurgiczne. Opis przypadku

Mateusz Tłustochowicz, Karolina Krix-Jachym
Department of Ophthalmology, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine in Warsaw; head: Prof. Marek Rękas MD, PhD

Streszczenie. Wstęp. Zaćma biegunowa przednia jest zaćmą wrodzoną, która występuje często obustronnie i obejmuje przedni biegun soczewki. Metody. Przeprowadzono operację fakoemulsyfikacji zaćmy piramidowej ze wszczepieniem sztucznej soczewki zwijalnej tylnokomorowej. Cel pracy. Przedstawienie przypadku rzadko występującej zaćmy wrodzonej. Wyniki. Poprawa ostrości wzroku ograniczona niedowidzeniem oka z zaćmą wrodzoną. Wnioski. Usunięcie zaćmy wrodzonej u osoby dorosłej może mieć ograniczony wpływ na poprawę widzenia w oku niedowidzącym.
Słowa kluczowe: zaćma piramidowa, fakoemulsyfikacja

Abstract. A pyramidal anterior cataract is a congenital cataract, often bilateral, and effects the anterior segment of the lens. Pyramidal cataract phacoemulsification with implantation of rollable intraocular lens was conducted.
It presents a rare case of congenital cataract. Vision acuity improvement limited, with impaired eyesight due to congenital cataracts. Congenital cataract removal in an adult may not improve visual acuity in an eye with impaired eyesight.
Key words: phacoemulsification, pyramidal cataract

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Corresponding author
Mateusz Tłustochowicz MD
Department of Ophthalmology, Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine in Warsaw
128 Szaserów St., 04-141 Warsaw
telephone: +48 261 816 565
e-mail: mateusz.tlustochowicz@gmail.com

Introduction

Anterior lens opacities are found in up to 14% of paediatric patients with cataracts [1]. They are developmental disorders that occur from mesodermal tissue that is trapped in the lens capsule during embryological development [2]. They are usually stationary in size, but may progress and require surgery [3].

The polar type of anterior lens opacity is a congenital condition, often bilateral, that affects the anterior lens pole. It is usually inherited dominantly [4]. Anterior polar lens opacity is sometimes associated with microphthalmia, persistent pupillary membrane, aniridia, Peters anomaly and anterior lenticonus. A unilateral congenital cataract is rarely found, and its development is not affected by family predisposition or systemic diseases.

A pyramidal cataract may be considered a form of anterior lens cataract. It affects the anterior lens capsule and the adherent lens matter [5]. In this form of cataract, the opacity extends to the anterior chamber, its base is usually 2.0 - 2.5 mm in diameter, and the apex has a characteristic conical shape. A pyramidal cataract may be unilateral or bilateral, symmetrical or asymmetrical [5], and it represents 3-4% of congenital cataracts [6]. It is frequently associated with various corneal opacities. Typically, one or more disc-shaped opacities are found under the pyramidal cataract, in the anterior lens cortex [7]. The opacities consist of hyperplastic lens epithelium, surrounded by a collagenous matrix [5]. The surrounding cortical opacification may impair vision; therefore many patients require surgery. If a congenital cataract is not detected and surgically removed before the age of 16 weeks, the patient's eyesight is often impaired. The prevalence of impaired vision in patients with a

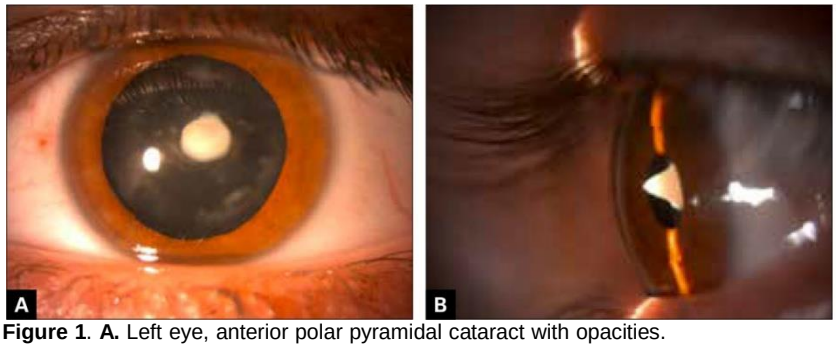

Figure 1. **A.** Left eye, anterior polar pyramidal cataract with opacities. **B.** Slit lamp collateral view.
Rycina 1. **A.** Oko lewe, zaćma piramidowa biegunowa przednia z towarzyszącymi zmętnieniami kory soczewki. **B.** Obraz w oświetleniu bocznym w lampie szczelinowej.

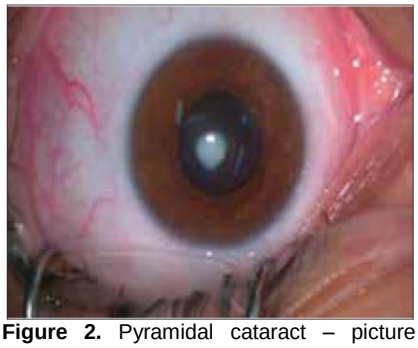

Figure 2. Pyramidal cataract – picture taken with a surgical room microscope before cataract removal
Rycina 2. Zaćma piramidowa – zdjęcie wykonane w mikroskopie chirurgicznym przed operacją fakoemulsyfikacji

pyramidal cataract is higher than in the general population, and it is most commonly caused by anisometropia. Some of the patients also develop strabismus [1]. The risk of impaired vision in patients with a pyramidal cataract is estimated at >90% [3].

Case report

A 32-year-old patient arrived with impaired vision in the left eye and convergent strabismus in the same eye. Visual acuity in the affected eye was reduced since childhood. At the time of examination the patient's acuity was finger counting at 0.5 m, without improvement regardless of the correction used. Visual acuity in the right eye was 1.0 sc. A biomicroscopic examination revealed a pyramidal cataract in the left eye, in the form of a cone with a single disc-shaped opacity extending below, into the anterior lens cortex (Fig. 1). No signs of inflammation were found in the anterior chamber, opacities in the cornea, or other abnormalities of the eye or general systemic abnormalities. A Doppler ultrasound examination revealed a normal image of the posterior section of the eye.

Due to the low visual acuity and dense anterior polar cataract (pyramidal) the patient was qualified for phacoemulsification (Fig. 2). The patient was informed about the uncertain prognosis regarding improvement of vision following the surgery, due to the high probability of permanently impaired vision in an eye resistant to treatment.

Apart from standard tests conducted as part of the qualification for the procedure, the patient had an OCT Visante test to assess the relationships between the main anatomical structures in the anterior section of the eye, and a Pentacam test that uses a Scheimpflug view to present images of the structures from the anterior corneal surface to the posterior lens capsule (Figs. 3-4). Intraocular lens implant power was measured using the immersion technique, as the IOL Master could not provide reliable parameters of the ocular length.

Typical cataract surgery was performed under local anaesthesia (Fig. 5). The surgical technique involved opening a 2.2 mm peripheral incision in the cornea, insertion of trypan blue into the anterior chamber to stain the lens capsule, and capsulorhexis. Any dye excess was removed through irrigation of the anterior chamber, and the procedure was continued in a routine manner. After administration of a viscoelastic agent, the following steps were performed: anterior capsulorhexis, hydrodissection and hydrodelineation, phacoemulsification of the lens nucleus, aspiration of the cortical matter, polishing of the lens capsule and implanting of an intraocular implant whose power was determined specifically for the patient.

Capsulorhexis was a particularly important part of the procedure (Fig. 6). The lens capsule is a flexible basement membrane composed of type IV collagen, and produced by the lens epithelial cells. The capsule is approximately 11–15 μm thick in the anterior pole, 13.5–16 μm thick at the anterior midperiphery, 7 μm thick at the equator, and a mean thickness at the posterior pole of 3.5 μm [8]. Due to its transparency and the fact that its refractive index is almost equal to that of the lens material, the capsule is difficult to visualise. To visualise the edge of capsulorhexis while opening the capsule, the red fundus reflex produced by coaxial light of the microscope, reflected by the posterior pole of the eye is typically used. When the light is not reflected back, e.g. due to a dense cataract, strong colour of the fundus, or both, differentiation between the anterior capsule and the underlying lens tissue is often very difficult, or impossible.

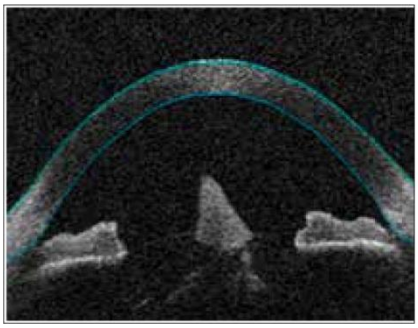

Figure 3. Pyramidal cataract – OCT Visante view
Rycina 3. Zaćma piramidowa – obraz w badaniu OCT Visante

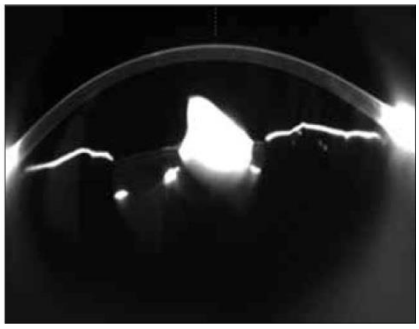

Figure 4. Pyramidal cataract – Pentacam examination (Scheimpflug view)
Rycina 4. Zaćma piramidowa – obraz w badaniu pentacam (obraz Scheimpfluga)

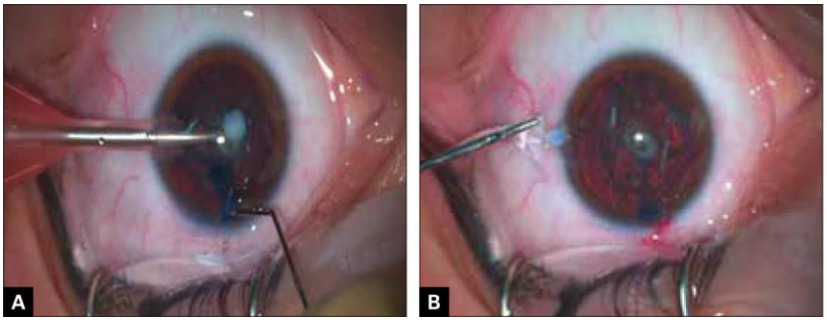

Figure 5. Cataract phacoemulsification
Rycina 5. Fakoemulsyfikacja zaćmy

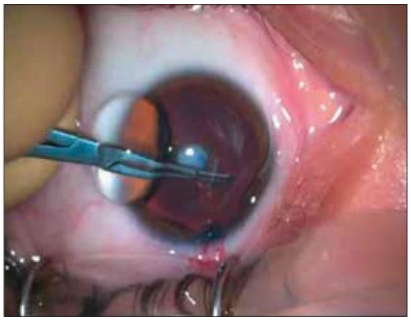

Figure 6. Anterior capsulorhexis with trypan blue staining
Rycina 6. Wykonywanie przedniej kapsuloreksji po wybarwieniu torebki soczewki za pomocą błękitu trypanu

Identification of a deficit in the anterior capsule while opening the lens capsule is an important stage of the surgical procedure. During phacoemulsification, a continuous curvilinear capsulorhexis is performed, as the round opening of the capsule is the most resistant to surgical manipulation within the lens capsule during removal of the lens matter. Inaccurate visualisation of the anterior lens capsule during the capsulorhexis may be associated with a risk of a tear extending to the equator, or beyond the equator, and resulting complications.

In the presented case of a cataract, the risk of capsular tearing during the capsulorhexis seemed to be increased due to the lens matter bulging in the centre, and causing greater capsule tension in this area, as well as a possible collagen defect.

In similar conditions a deficit in the anterior lens capsule, or even spontaneous rupture of the anterior capsule, have been reported [9]. In a few cases of anterior lenticonus a spontaneous rupture of the anterior lens capsule was also described [10, 11]. Similarly to a pyramidal cataract, anterior lenticonus is a condition characterised by a conical bulging of the axial part of the anterior lens capsule and the anterior cortex, which usually remains transparent. There have been reports of increased hyalinisation in pyramidal cataracts compared to anterior lenticonus with a concurrent cataract. However, the difficulties during capsulorhexis may be encountered in both conditions.

Spontaneous separation of a part of a congenital pyramidal cataract, and its displacement to the anterior chamber have also been reported [12, 13]. Shah et al. described a deficit in the anterior lens capsule in a pyramidal cataract. In this case, the lens tissue separated spontaneously, and moved towards the anterior chamber, where it formed a foreign body, resulting in corneal oedema [9].

Figure 7. Biomicroscope view of anterior segment of eyeball after surgery
Rycina 7. Obraz przedniego odcinka gałki ocznej w biomikroskopie po operacji zaćmy

In the presented case no spontaneous separation of the pyramidal part of the cataract was observed. However, during the procedure the pyramidal part of the cataract separated relatively easily from the rest of the lens.
The phacoemulsification procedure in the presented patient was uncomplicated. The post-operative visual acuity was 0.05 sc. The examination of the anterior eye and eye fundus after the cataract surgery did not reveal any abnormalities (Fig. 7).

Discussion

Only some cases of anterior lens opacity require surgical treatment, but in a certain group of patients, especially those with pyramidal cataract, the condition may progress to the stage that qualifies for surgery [1]. Potential future separation of the conical lens tissue and its displacement into the anterior chamber is another - next to low visual acuity - indication for a surgical intervention in patients with a pyramidal cataract, as it may prevent the loss of endothelial cells and possible development of corneal oedema. During the phacoemulsification procedure, staining with trypan blue is recommended, as it helps to visualise the lens capsule, whose continuity can be interrupted due to the bulging of the lens matter into the anterior chamber.

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Concept and conclusions concerning medical support for the Territorial Defence Forces

Koncepcja i wnioski dotyczące zabezpieczenia medycznego Wojsk Obrony Terytorialnej

Marek Skalski,[1] Adam Wegner,[1] Marian Dójczyński,[1] Mirosław Soszyński[2]
1 Department for the Organisation of the Military Health System and Public Health of the Military Institute of Medicine in Warsaw; head: Reserve Lt. Col. Marek Skalski MD, PhD
2 Unit of Organisation and Mobilisation, Military Institute of Medicine in Warsaw; head: reserve Col. Tomasz Miezancew MA

Abstract. In response to the challenges faced by national security for the Republic of Poland (RP), the Territorial Defence Forces (TDF) were established as an additional form of the Polish Armed Forces. The scope of the TDF activities is specific, which results in the use of separate medical support procedures. While analysing the objectives and tasks set for the TDF in various states of state security, the authors propose organizational solutions concerning medical support for these activities.
Key words: medical support, Territorial Defence Forces (TDF)

Streszczenie. Odpowiadając na wyzwania w zakresie bezpieczeństwa narodowego Rzeczpospolitej Polskiej (RP), powołano Wojska Obrony Terytorialnej (WOT), jako kolejny rodzaj Sił Zbrojnych RP (SZ RP). Zakres działań WOT jest specyficzny, co wymusza zastosowanie odrębnych procedur zabezpieczenia medycznego. Analizując cele i zadania stawiane WOT w różnych stanach bezpieczeństwa państwa, Autorzy proponują rozwiązania organizacyjne dotyczące zabezpieczenia medycznego tych działań.
Słowa kluczowe: Wojska Obrony Terytorialnej (WOT), zabezpieczenie medyczne

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Corresponding author
Reserve Lt. Col. Marek Skalski MD, PhD
Department for the Organisation of the Military Health System and Public Health, Military Institute of Medicine
al. 1-Maja 90, 90-973 Łódź 39, PO box 14
telephone: +48 42,750 42 75
e-mail: oozw@wim.mil.pl

Background

Current and future geographical and political conditions have placed the Republic of Poland in the front zone of NATO and the European Union. A potential future armed conflict may be hybrid in nature, which poses new challenges for the Armed Forces of the Republic of Poland (AF RP) The National Security Strategy of the Republic of Poland takes into account these facts and predicts the engagement of the entirety of the state forces in its defence [1, 2]. In the case of a security threat or war, the military and non-military components of the state will be used. Numerous activities on the line of contact between the above-mentioned systems can be entrusted to the Territorial Defence Forces (TDF).

By the Act of 16 November 2016 amending the act on the universal duty to defend the Republic of Poland and certain other acts [3], the TDF was established, which along with the Land Forces, the Air Forces, the Navy and the Special Forces, form a fifth type of force in the Armed Forces of the Republic of Poland.

The structural organisation of the TDF is associated with the administrative division of the country, as follows:

- TDF command nationwide,
- TDF brigades in provinces,
- light infantry battalions and companies in counties.

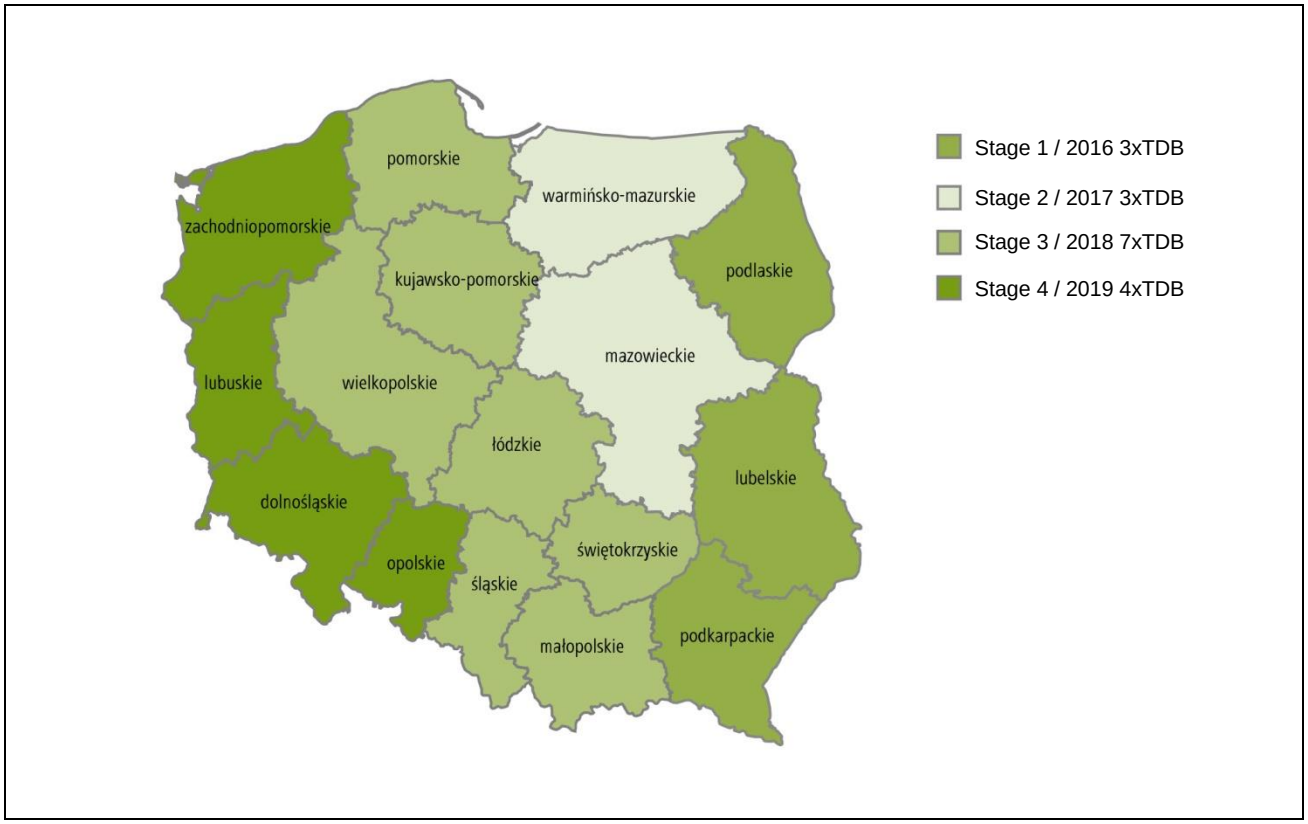

Figure 1. TDF formation schedule (based on www.mon-gov.pl/obrona-terytorialna)
Rycina 1. Harmonogram formowania WOT (na podstawie: www.mon-gov.pl/obrona-terytorialna)

Tasks, organisation and activities of TDF

The basic unit conducting operations is a light infantry company, which is ultimately intended to be located in each county [4].

The process of forming the particular components of the TDF potential has been distributed over time, which is illustrated in Figure 1.

The purpose of creating the TDF is to obtain a new cadre and operating capabilities in the following fields:

- support of operational forces,
- conducting counter-subversive and counter-terrorist operations,
- conducting anti-crisis operations,
- conducting anti-disinformation operations,
- conducting operations in cyberspace,
- conducting intelligence and reconnaissance operations,
- conducting patriotic and educational activities [5].

The designated purposes give rise to tasks that TDF units and sub-units are to perform in particular defence readiness states of the State.

- In the state of constant defence readiness of the State:

– maintaining combat readiness for defence of the territory of Poland,
– supporting local communities and elements of the non-military subsystem in the realisation of tasks related to crisis management (response), i.e. achievement of readiness and participation in immediate and general response to emergency situations of a non-military nature in order to prevent or counteract them, to minimise and remove their effects, as well as to restore the state prior to their occurrence,
– performing tasks related to planning, organisation, mobilisation and training, including training of its own sub-units,
– conducting activities related to military social communication for the purpose of shaping patriotic and civic values and attitudes.

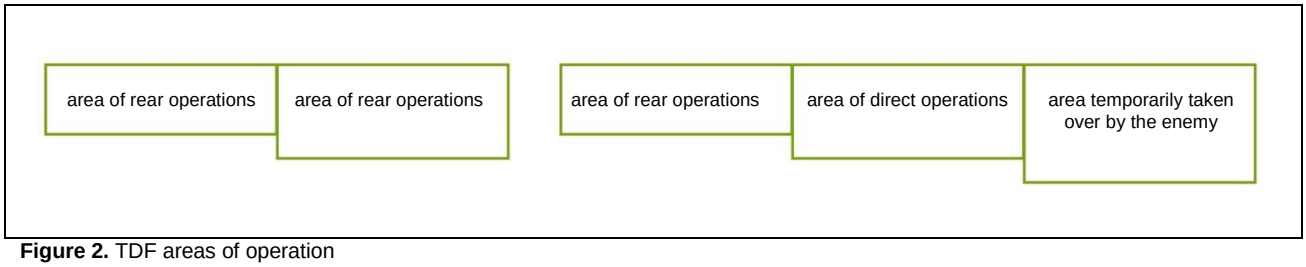

Figure 2. TDF areas of operation
Rycina 2. Obszary działania WOT

- In the state of defence readiness of the state in the time of crisis:
  – preparing Permanent Responsibility Areas (PRA) for defence and achievement of readiness to take actions in accordance with the purpose,
  – supporting elements of the non-military subsystem within the scope of reinforcement of protection and defence of the state border, critical infrastructure and facilities of particular significance for the security and defence system of the State and the local communities,
  – developing a wartime command system for TDF,
  – conducting reconnaissance activities and demonstrative and deterrent operations at the PRA,
  – supporting the process of mobilisation and operational deployment of the forces, as well as undertakings within the scope of operational camouflage and engineering development of the area,
  – supporting forces detached to prepare and support the arrival of operational and allied (coalition) augmentation forces to the PRA.
- In the state of defence readiness of the state in the time of war:
  – conducting activities at the tactical level in cooperation with the other types of the Armed Forces and the elements of the non-military subsystem,
  – providing general protection and defence for the PRA, including support for the elements of the non-military subsystem in the protection of state property, public utility facilities and cultural goods from plunder and destruction,
  – providing support for joining combat by the allied (coalition) forces,
  – providing support for functioning and restoration of the structures of government and self-government administration and public security in the liberated areas,
  – supporting undertakings related to operational camouflage and engineering development of the area [6].

Table 1. Expected medical casualties of Territorial Defence Forces (TDF) battalion in the area of direct actions
Tabela 1. Przewidywane straty sanitarne batalionu WOT w strefie działań bezpośrednich

battle casualties TBC ratio – 24.6%			
irrecoverable losses		**medical losses**	
KIA	CMIA	WIA	BS
32	15	107	31
		non-battle losses	
		Ill subjects	**non-battle injured**
		12	1
total sanitary losses		151	

TBC – total battle casualties for a battalion 24.6%, for a Brigade 8.3%, KIA – killed, CMIA – missing, WIA – wounded in combat, BS – battlefield stress

The needs and opportunities of medical support for the TDF

An analysis of the tasks and expected actions of TDF in the mentioned states of defence readiness of the State and the potential occurrence of human losses in them necessitates finding organisational solutions enabling appropriate medical support. Medical losses, which will occur in the state of constant defence readiness of the State and the defence readiness of the State in the time of a crisis, will include non-battle losses, illnesses and wounds outside of combat. It can be assumed with high probability that the percentage ratios for these losses will be slightly lower or comparable to the losses of operational forces, i.e. 1.35% for illnesses and 0.05% for personnel wounded outside the battlefield [7]. Taking into account the probable number of people engaged at a single time in an action of the TDF forces (light infantry company) and their dispersal, it can be assumed with high probability that the medical losses occurring in this period can be supported by the system of Polish Emergency Medical Services and the public healthcare system.

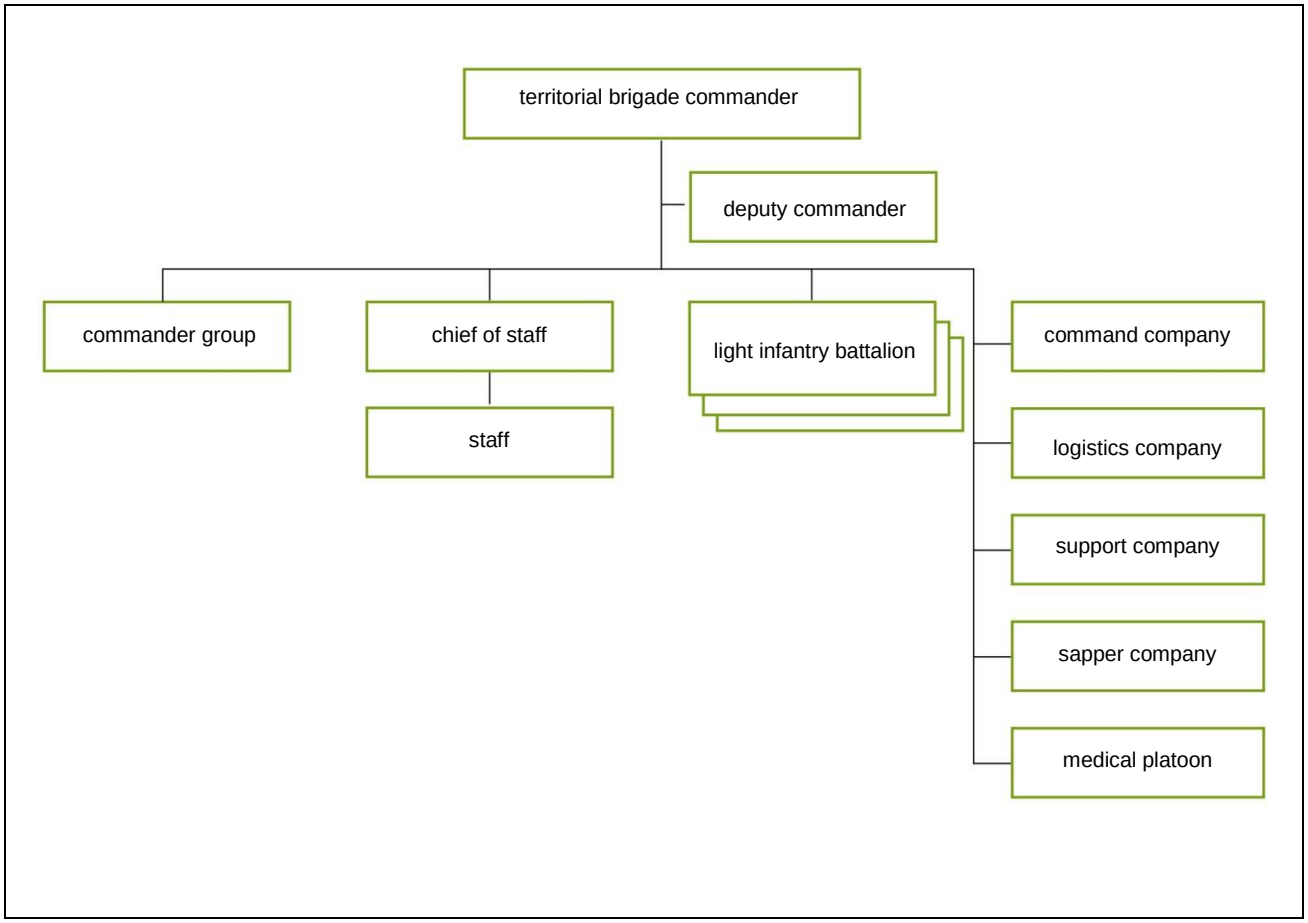

Figure 3. Organizational structure of a Territorial Defence Brigade
Rycina 3. Struktura organizacyjna brygady zmechanizowanej

In the state of defence readiness of the State during a time of war, the TDF can operate in the rear and direct area of operations, as well as in the areas temporarily taken over by the enemy, as illustrated in Figure 2. Operations in each of these areas will result in medical losses, where the level, structure and occurrence dynamics will depend, among other things, on the following factors:

- size of the forces used and their placement in their tactical grouping,
- time of the actions,
- type of operational scenario,
- type of weapons used.

It can be assumed that in the case of using a TD battalion (approx. 750 people) the predicted structure and percentage ratio of 24-hour medical losses in the area of direct operations will be at a level similar to operational forces (Tab. 1).

In total, the predicted 24-hour medical losses of a TD battalion will amount to approximately 151 wounded and ill soldiers. The forecasts should take into account the degree of engagement of the TDF forces at particular stages of the combat operations and the percentage distribution of the size of the predicted losses depending on the placement in the tactical grouping:

- 40% – in assault echelon elements,
- 30% – in reserve,
- 20% – in units located at the rear of the TD grouping,
- 10% – in the screening belt [8].

Due to the fact that records in the doctrinal documents do not predict such a form of TD battalion use, losses occurring at such a scale are unlikely, or rather impossible.

Analysing the correlations presented above, we need to consider answers to these two questions.

- Should medical structures be created for the TDF, which will support the predicted medical losses?
- Should the medical support system for combat operations be reorganised in order to ensure full medical support for medical losses of the TDF by means of the health services of cooperating operational forces?

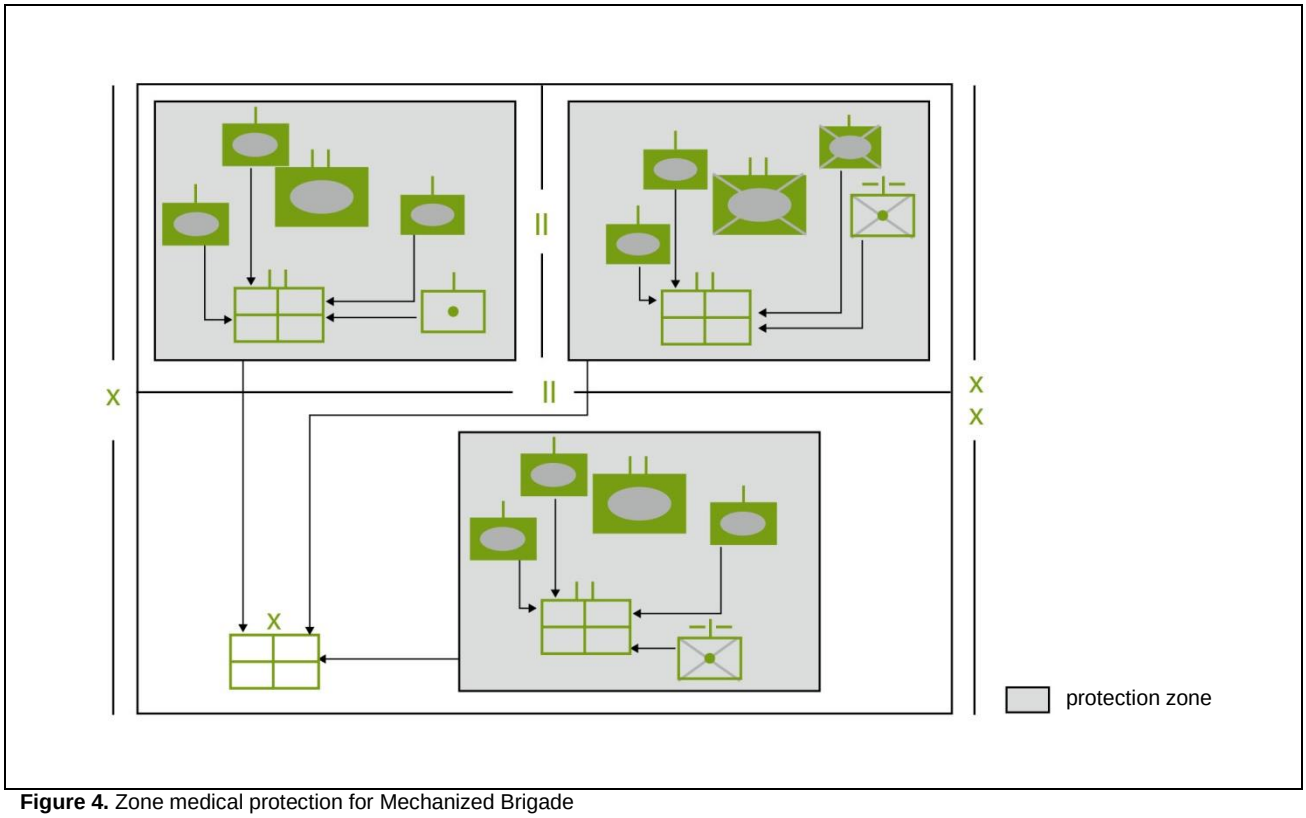

Figure 4. Zone medical protection for Mechanized Brigade
Rycina 4. Strefowe zabezpieczenie medyczne Brygady Zmechanizowanej

The current structures at the level of a TD brigade (TDB) in a logistics company assume the development of a medical platoon (Fig. 3) [6], staffed with three physicians, three paramedics, five medical evacuation teams and a psychological support group. A total of 90 positions are foreseen for paramedics in a TD battalion and 450 in a TDB.

A review of the presented organisational structure and analysis of combat operations of a TDB indicate that a medical platoon will not be able to support the occurring medical losses, especially if the brigade sub-units are dispersed in the field.

The question that arises is whether a medical platoon should only be used to support the staff of the TDB?

In a similar way, the operations of TDB sub-units, both in the rear area of operations, as well as in the area temporarily taken over by the enemy, are not conducive to the use of the medical platoon at the level of medical evacuation. At the same time, the engagement of several TDB sub-units will lead to the occurrence of major medical losses, for which it will be necessary to organise a separate level of medical aid.

In the case of the occurrence of medical losses in the course of operations in an area temporarily taken over by the enemy, having such a medical sub-unit becomes groundless. The wounded and the sick will have to be aided by a paramedic, whereas medical assistance will be received by the injured after a manoeuvre penetrating the enemy positions in the areas occupied by own forces or assistance will be provided by the local medical personnel at the medical facilities in the area occupied by the enemy.

In the Armed Forces of the Republic of Poland medical battlefield support is provided based on the system of stage treatment, with evacuation according to the indications. This system assumes development in the tactical grouping of forces at particular medical support levels, which allow medical assistance to be provided to the injured at the appropriate time in an increasingly extensive scope, in combination with medical evacuation. Until 2006–2007 at the tactical level medical sub-units and units constituted an integral part of general military units and sub-units, which they supported in battle operations. As a result of the changes concerning public healthcare and the professionalization of the AF, the military health service was isolated from the general military structures and grouped with the newly created Medical Support Groups (MSG). It is assumed that at the

time of battle operations the medical elements of the MSG will be assigned to particular units and subunits in order to support them in medical terms [9‑11].

We should consider the need to introduce "zone support" for battle operations, the essence of which would be to take over responsibility for the treatment and medical evacuation of the wounded and the sick from all the units located in the zone (including the TDF sub-units) by the brigade-level health service. An example of a tactical situation is illustrated in Figure 4.

The military health service, depending on the predicted intensity of operations and the size of the forecast medical losses, should receive reinforcements from a superior level. In the situation of zone medical support, the sub-units and groups of TDF soldiers use their own medical forces to provide first medical aid, to organise self-aid and places for the wounded, as well as carrying and evacuation of the wounded and the sick from the battlefield. Medical evacuation to developed stages of medical operational forces should, to the extent possible, be conducted by the TDF's own and ad hoc transport. Further treatment and evacuation would be included in the competences of the medical commander of the medical support zone of the brigade. These soldiers, once treated, should complement the personal strength of the operational forces.

Conclusions

- The nature of the tasks performed by the TDF will cause dispersion of sub-units and groups of soldiers in the area.
- The dispersion of the TDF forces will impede the systemic organisation of medical support for the activities of the organic TDF health service.
- The basic task for the health service of the TDF will be to provide initial medical aid and medical evacuation for the wounded and the sick.
- The primary medical force will be the paramedics in the TDB sub-units, directing and coordinating the provision of medical assistance.
- Intensive sanitary training for the personal strength of the TDB is necessary in order to achieve the desired skills related to mutual aid and self-aid.
- A relatively numerous group of paramedics and their appropriate assignments guarantee proper pre-medical-assistance support.
- There is no substantiated justification for the development of medical sub-units and units in the structures of the TDB.
- In a situation where the TDB remains in the area of direct actions, medical support should be organised on the basis of the medical support system for the operational forces.
- It is purposeful to coordinate the procedures of medical support of the TDF within the framework of zone support for a brigade of the Armed Forces of the Republic of Poland.
- Calling medical personnel to the service in the TDF structures will intensify the disproportions between the capabilities and needs related to the scope of providing medical assistance to the civilian population, it will negatively affect the morale of the civilian population and the soldiers, and will impede the already complicated situation of complementation of medical reserves by operational forces.

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Neuropsychological consequences of mild traumatic brain injury and post-traumatic stress disorder connected with hostilities – a research review

Neuropsychologiczne następstwa łagodnego urazowego uszkodzenia mózgu oraz zespołu stresu pourazowego w wyniku działań wojennych – przegląd badań

Sylwia Szymańska,[1] Mirosław Dziuk,[2] Radosław Tworus,[3] Anna Jastrzębska[4]
[1] Department of Psychiatry, Regional Hospital in Łomża; head: Irena Dworakowska MD
[2] Department of Nuclear Medicine, Ministry of National Defence, Military Institute of Medicine in Warsaw; head: Assoc. Prof. Mirosław Dziuk MD, PhD
[3] Department of Psychiatry, Combat Stress and Psychotraumatology, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine in Warsaw; head: Radosław Tworus MD, PhD
[4] SURGE Psychology Office in Warsaw; head: Anna Jastrzębska MA

Abstract. Traumatic Brain Injuries were one of the most common traumas observed in soldiers during the wars in Iraq and Afghanistan. Mild Traumatic Brain Injuries are considered to comprise up to 77% of all diagnosed traumatic brain injuries, while 42% of veterans show symptoms of mild brain injuries and posttraumatic stress disorder. The article provides a research review of an impact of mild traumatic brain injuries on the neuropsychological functioning of veterans of the wars in Iraq and Afghanistan. The authors give a wide discussion of co-occurrence and relations between PTSD and traumatic brain injury. In this regard, the article presents interesting results of a clinical trials, which are considered to be helpful in the diagnosis of PTSD coexisting with mild traumatic brain injury. The above mentioned medical conditions are also described in the context of neuroimaging studies. The authors also describe current possibilities of cognitive rehabilitation in the treatment of brain injuries observed in veterans of contemporary warfare.
Key words: mild traumatic brain injury, posttraumatic stress disorder, neuropsychology

Streszczenie. Urazowe uszkodzenie mózgu to jedno z najbardziej powszechnych obrażeń, do których dochodzi u żołnierzy podczas wojny w Iraku i Afganistanie. Łagodne urazowe uszkodzenia mózgu stanowią nawet 77% wszystkich przypadków urazowych uszkodzeń mózgu. 42% weteranów wojennych ma objawy łagodnych urazów mózgu, a także zespołu stresu pourazowego. W artykule przedstawiono przegląd badań dotyczących wpływu łagodnych urazowych uszkodzeń mózgu na neuropsychologiczne funkcjonowanie weteranów wojny w Iraku i Afganistanie. W tekście szeroko omówiono współwystępowanie zespołu stresu pourazowego i urazowych uszkodzeń mózgu oraz zależność między nimi. Autorzy artykułu dokonują przeglądu ciekawych klinicznie badań, pomocnych w ustaleniu rozpoznania zespołu stresu pourazowego współwystępującego z łagodnym urazowym uszkodzeniem mózgu. Analizowane choroby omawiane są również w aspekcie badań neuroobrazowych. W końcowej części artykułu opisywane są obecne możliwości rehabilitacji poznawczej urazów mózgu w grupie weteranów współczesnych wojen.
Słowa kluczowe: łagodne urazowe uszkodzenia mózgu, zespół stresu pourazowego, neuropsychologia

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Corresponding author:
Sylwia Szymańska MSc
Department of Psychiatry, Regional Hospital in Łomża
11 Piłsudskiego St., 18-400 Łomża
telephone: +48 695 208 441
e-mail: kontakt@sylwiaszymanska.pl

Introduction

The nature of the military conflicts in Iraq and Afghanistan increased the risk of physical and mental injuries in the soldiers and civilians stationed in these areas. The following factors contribute to the increase in the incidence of traumatic brain injuries (TBI) and other stress-associated problems, such as post-traumatic stress disorder (PTSD): repeated deployment in high combat exposure conditions, high exposure to explosions, and higher survival rates due to the better equipment of soldiers.

Blast-traumatic brain injury (bTBI) is among the most common injuries suffered during the war in Iraq and Afghanistan. In the years 2000 - 2011, 233,425 cases of TBI were diagnosed in the American Army, of which 178,961 (77%) were classified as mild traumatic brain injuries (mTBI) by the Defence and Veterans Brain Injury (DVBIC), an organisation that studies combat brain injuries in the American Army. In the last decade, mTBI most frequently developed as a result of explosions involving IED (improvised explosive devices), often used against the coalition forces. IED were accounted for approximately 75% of all combat injuries suffered by American Army soldiers. Nearly 50% of them were head traumas that led to mTBI, and bTBI resulting from the direct effect of a direct or reflected blast wave. The incidence of mTBI in the injured soldiers was 19.5%. Events resulting in mTBI also often contributed to the development of PTSD [1, 2]. Symptoms of the latter were observed in an acute form in 40% of American Army soldiers following an event that initially triggered symptoms typical for mTBI or bTBI. In 42% of veterans, mTBI and PTSD symptoms were concurrent.

Aim of the article

The authors of this article present a review of studies exploring the effect of mTBI on the neuropsychological performance of veterans of the wars in Iraq and Afghanistan. The review is limited to mTBI as the most frequently observed type of TBI observed among modern military conflicts. The authors present broadly the relationship between mTBI and PTSD in the area of neuropsychological performance, as well as in neuroimaging examinations. Further, the authors present a review of studies regarding options for cognitive rehabilitation of mild traumatic brain injuries suffered as a result of military operations.

Material and method

The review included studies from the years 2000-2015 regarding the neuropsychological consequences of mTBI in the cognitive and executive functioning of veterans of the American Army.

The TBI definition provided by DVBIC was developed in 2006 by a team of experts specialising in combat field medicine. It drew from the definitions used by the Mild Traumatic Brain Injury Committee of the American Congress of Rehabilitative Medicine (MTBIC‑ACRM), American Psychiatric Association (APA) and World Health Organization (WHO). According to this definition, "mild traumatic brain injury (mTBI) in military operational settings is defined as an injury to the brain resulting from an external force and/or acceleration/deceleration mechanism from an event such as a blast, motor vehicle accident or other direct impact, which caused an alteration in mental status and onset of symptoms such as: headache, nausea, vomiting, dizziness/balance problems, fatigue, insomnia/sleep disturbances, drowsiness in the daytime, sensitivity to light and/or noise, blurred vision, difficulty remembering, and/or difficulty concentrating." This definition endorses the biomechanical forces affecting the brain as the cause of alternation of consciousness (AOC) in various forms, such as loss of consciousness (LOC), post-traumatic amnesia (PTA), retrograde amnesia, and different forms of being dazed or confused following a traumatic event. The fact that the typical and complete loss of consciousness in the course of a traumatic event is not a prerequisite for the diagnosis of mTBI is an important operational aspect of this definition. Moreover, the experts developing it included exposure to explosion alone (blast traumatic brain injury - bTBI) as a potential brain injury mechanism. According to the MTBIC-ACRM definition, the constellation of symptoms of mild TBI is referred to as minor head injury, post-concussive syndrome, traumatic head syndrome, traumatic cephalgia and post-brain injury syndrome [3]. Moreover, following this definition, the presence of only one of the symptoms listed below is sufficient for a diagnosis of mild TBI: any period of loss of consciousness, any loss of memory concerning events immediately before or after the accident, any alteration in mental state at the time of the accident, e.g. feeling dazed, disoriented, or confused, and focal neurological deficits that may or may not be transient. In addition, if the injury is to be classified as mild, the following criteria must be met: loss of consciousness not exceeding 30 minutes, an initial Glasgow Coma Scale (GCS) of 13–15, and post-traumatic amnesia (PTA) not greater than 24 hours.

Acute mTBI symptoms, i.e. symptoms that persist for up to 3 months following the brain injury, are associated

with cognitive functions: operational memory disorders, executive functions, speed of learning and processing information. They may be significant enough to disturb everyday functioning. In a few weeks to a few months after the injury, the cognitive performance improves considerably. It is estimated that 10-44% of patients with mTBI may still show symptoms of neurocognitive disorders 3 months after the trauma [4]. Only a small rate of patients (1-5%) do not recover fully within the 12 month period following the injury. Mild traumatic brain injury symptoms that persist for more than 3 months are referred to in the literature as post-concussive syndrome (PCS). It was considered in the ICD-10 classification [5] as post-concussional syndrome, and in the American Classification of Mental Disorders, DSM V [6], as major or mild neurocognitive disorder due to traumatic brain injury.

The cognitive domains most frequently impaired in mild traumatic brain injuries are complex attention, including alertness, sustained attention, selective attention and divided attention, executive functions and memory. Patients who declare complete recovery may still experience mild cognitive dysfunctions, especially in situations involving physical or mental stress. These residual cognitive deficits are reflected in the ability to process information, both regarding the speed of processing, and the amount of information that can be processed simultaneously. The number of neurological and somatic factors may contribute to impaired mental functioning in patients with a history of mTBI, but in the context of this condition the psychological factors are believed to play the dominant role in long-term functioning after the trauma.

Prevalence of mTBI and its concurrence with PTSD

Hoge et al. [1] conducted a survey among 2525 soldiers of the America Army within 3 to 4 months of their return from deployment in Iraq. mTBI was found in 15.2% of the subjects. 4.9% of them had lost consciousness due to head trauma, and 10.3% reported a reduced level of mental functioning as a result of a head injury. In this study, the PTSD rates were higher in the soldiers who reported a loss of consciousness (43.9%), and the PTSD ratio in the group of veterans with lowered mental functioning was 27.3%. In the veterans who experienced brain injury, but not due to head trauma, the PTSD ratio was 16.2%, whereas in those who were not injured it was 9.1%. This study clearly indicates that the concurrence of brain injuries and PTSD may be more frequent than we realise, despite the loss of consciousness or a limited consciousness in the course of mTBI.

In his study Schneiderman [7] used questionnaires sent to 7259 veterans who had returned from Iraq and/or Afghanistan to estimate the prevalence of mTBI, symptoms indicating a post-concussive syndrome, and PTSD symptoms. Out of 2235 respondents, 11% confirmed the occurrence of criteria specific for mTBI. A total of 35% of veterans diagnosed with mTBI also met the criteria for the post-concussive syndrome, demonstrating at least three symptoms of the syndrome. In this study, mTBI was also a strong predictor of PTSD. mTBI and PTSD are often concurrent in veterans of the wars in Iraq and Afghanistan, which may lead to long-term problematic symptoms in this population. Lew et al. [8] estimated the prevalence of PTSD, chronic pain and persistent post-concussive symptoms in veterans hospitalised in the Veteran Health Centre in USA. In a group of 340 veterans examined 22 months after their return from a military mission, 81.5% reported chronic pain, and 68.2% revealed they had persistent symptoms of post-concussive syndrome. The persistent symptoms of this condition were defined in the study as a history of the event resulting in mTBI and at least three post-concussive symptoms. A total of 48.9% of veterans were diagnosed with concurrent PTSD and persistent post-concussive symptoms, whereas in 42.1% of respondents the symptoms of PTSD, post-concussive disorder and chronic pain were observed. The study results, shedding light on the widespread concurrence of PTSD and mTBI, are of particular importance for the healthcare system, offering polytrauma therapy and treatment for veterans.

The researchers exploring the concurrence of mild traumatic brain injury and PTSD found that soldiers with PTSD had more often experienced intense combat actions, and were exposed to blast injuries [1].

Repeated, intense combat experiences together with TBI may result in future PTSD, regardless of the memory of a traumatic event.

PTSD due to mTBI

Can PTSD be a result of an event that led to brain injury, even if we lose the memory of the traumatic event? The potential development of PTSD due to an event that resulted in mTBI is controversial, especially considering loss of consciousness and/or post-traumatic amnesia in mTBI. Criterion B for PTSD according to ICD-10 [5] and DSM V [6] requires persistent remembering or re-living of the stressor by the person diagnosed with the disorder, which may be impossible or difficult in the case of post-traumatic amnesia. The researchers offer several mechanisms that could explain the occurrence of PTSD as a result of a stressor causing mTBI. Firstly, the memory of the traumatic event may not be limited to the event itself, but also comprise the distress and fear associated with the events leading to the trauma, or occurring immediately after regaining consciousness. Secondly, the researchers mention unconscious emotional memory being observed in PTSD.

Bryant [9] came to interesting conclusions in his study. He analysed patients with persistent symptoms of mTBI. They could not remember the traumatic event, but experienced strong fear and physiological reactions to the statements made by the investigators that reminded them of the traumatic event. The authors explain this by the presence of unconscious memory in PTSD, or reconstruction of the memory of the traumatic event based on gradual remembering. The authors invoke Brewin's dual representation theory [10] and its system of situationally accessible memory (SAM). SAM can trigger intrusions and flashbacks, and it contains a script of the perceptive processes regarding the traumatic event. These traumatic memories lack any verbal code, and cannot be invoked intentionally. They are evoked by situational cues that are beyond the individual's control, and are responsible for sudden, uncontrolled flashbacks in patients diagnosed with PTSD.

According to the third explanation of the presence of PTSD after an event resulting in mTBI, post-traumatic amnesia in mTBI may be only partial [9]. Therefore, various signals, signs or images of the traumatic event may offer the patient a certain degree of reconstruction of the memory of the event, especially when other people who were present at the site provide information or details that the soldier cannot recall on his/her own. Finally, the neurobiological changes resulting from mTBI may impair the brain function, which increases the probability of PTSD occurrence.

The study by Creamer et al. [11] provides evidence for the concurrence of PTSD and TBI, regardless of the scope of memory of the traumatic event. The authors examined 307 patients for PTSD after mTBI. The results demonstrated that one year after mTBI PTSD developed in 9% of the subjects who could remember the event in detail, in 14% of subjects who remembered the event only partially, and in 7% of subjects who could not recall the event, Glaesser [12] discovered in his study that in 26.7% of survivors with TBI involving a loss of consciousness shorter than 1 hour, PTSD developed within 5 years following the trauma. This is significantly more than the 3.2% of patients who developed PTSD as a result of an injury involving a loss of consciousness lasting at least 12 hours. The results of these two studies suggest that although loss of the memory of the traumatic event may not affect the future PTSD, extensive loss of consciousness may limit the development of PTSD.

Neuropsychological consequences of mTBI

Dickman [4] conducted a review of the literature regarding cognitive damage resulting from mTBI. Strong evidence for neurocognitive regression was found in survivors of serious TBIs. The evidence of a relationship between the injury and its neuropsychological consequences in individuals who experienced a moderate TBI was considered limited, but suggestive of a possible reaction. Regarding mTBI, the authors did not find sufficient evidence for persistent neurocognitive deficits. Frencham et al. [13] conducted a study to assess neurocognitive performance in individuals with a history of mTBI in the acute phase, i.e. up to 3 months following the event resulting in mTBI, and in subjects who experienced mTBI more than 3 months earlier. The study results were compared with a control group, i.e. individuals without a history of mTBI. The results were statistically significant with respect to processing speed, operational memory, attention and executive functions. They indicated a clearly impaired performance of subjects with mTBI regarding these cognitive functions compared to the control group. The cognitive problems in the acute phase, compared to the subacute phase of mTBI, decreased towards zero, together with the time from the injury. Conversely, a few studies analysed by Bernsteins [14] suggest a small, but significant size effect of attention deficits, especially regarding divided and sustained attention, as well as processing speed in the subacute phase, i.e. over 3 months after recovery from mTBI. The author suggests that mTBI may cause rare and subtle long-term cognitive deficits. Cognitive deficits following mTBI visibly improve with time, whereas symptoms of post-concussive syndrome may be lasting. Studies frequently describe symptoms of

post-concussive syndrome reported by veterans with a history of mTBI, suggesting a persistent impairment of mental performance.

PTSD plays a significant role in the reported symptoms of PCS in veterans of the wars in Iraq and Afghanistan. Hoge et al. [2] found subjects with a history of mTBI involving loss of consciousness who reported significantly more physical symptoms 3 to 4 months after their return from the mission than soldiers with injuries other than TBI. Having taken into account PTSD and depression, the complaints about physical symptoms did not differ between the groups (except for headaches), which suggests that the psychological factors were initially considered physical complaints. Individuals with PTSD have similar post-concussive syndrome symptoms to those reported by people with a history of mTBI. Moreover, it appears that individuals with PTSD demonstrate similar symptoms of impaired cognitive performance to people with a history of mTBI alone. Deficits in attention and memory were observed, as well as executive function deficits due to PTSD, especially in the area of operational memory and reaction control [15]. Vasterling et al. [16] presented an interesting study to estimate the neuropsychological variables, based on the contingent leaving for Iraq. In this study 654 veterans were examined immediately before their deployment, and assessed again after they returned from the mission. The control group in the study comprised 307 soldiers who had never been deployed in military operations. They were tested for the same parameters of cognitive performance as the study group. Each group was assessed again: the veterans who returned from the war were examined 16.9 months after the first evaluation, approximately 73 days after their return from the military operation, and soldiers who were not deployed were tested 8.3 months after the first evaluation. There were no differences between the groups regarding age, race, marital status, years of education and years of military service. The results indicate that soldiers sent to Iraq demonstrated a considerably lower performance in neuropsychological tests measuring attention span, memory and reaction time in simple tasks. In soldiers who had not been deployed to Iraq, the cognitive tests results did not worsen. Adjustment for mTBI and PTSD did not affect the significance of differences in the test results in the group of veterans. The authors of the study conclude that the experience of military deployment may be associated with impaired neuropsychological functioning.

mTBI in neuroimaging tests

The symptoms associated with mTBI suggest disturbed functioning of the frontal and temporal parts of the brain - areas that are most susceptible to TBI. Conventional imaging studies, such as CT or MRI, do not reveal neuronal abnormalities in patients with mTBI. It is impossible to document precisely, even using advanced imaging techniques, the scope of the microscopic injuries due to diffuse axonal injury (DAI) that underlies the mechanisms of traumatic brain injury. The damage in closed injuries never have clear-cut limits, and the size of clinically significant post-TBI damage is a few microns [3].

In a few studies diffusion tensor imaging (DTI) was used to observe neuronal sequelae of mild blast-induced traumatic brain injury. McDonald et al. [17] assessed 64 soldiers with mild bTBI, and 21 soldiers who witnessed the explosion, but did not suffer from a blast-related brain injury. All study subjects had been evacuated due to orthopaedic injury, and received the DTI approximately 2 weeks after the explosion. The test revealed abnormalities in the group of veterans with bTBI in the white matter area, where axonal injuries were found. Changes in the right orbital frontal white matter were considered sensitive areas, due to exposure to the explosion. The study was continued, with the same group of soldiers, 6-12 months later, and it revealed persistent abnormalities on the group level. Diffused lesions, consistent with evolution of the injury, were observed. In a study on chronic mild traumatic brain injury, conducted on average 2 years after the exposure to the blast, no differences were found in neuronal integrity in veterans with mild and moderate bTBI, and in veterans who had not been exposed to explosion, and did not have TBI [17]. Davenport et al. [18] did not find evidence for disturbed neuronal integrity in veterans in the period of 2-5 years following the explosion, using a standard ROI (region of interest) approach. However, soldiers with bTBI had a significantly higher number of voxels with a limited integrity of white matter than those who had not experienced the explosion. The differences are associated with subtle diffused neuronal damage.

Simmons and Matthews [19] in one of their studies used positron emission tomography (PET) to examine 12 veterans of the war in Iraq with mTBI and symptoms of post-concussive syndrome. In the study group 10 veterans were also diagnosed with PTSD according to the American Classification of Mental Disorders DSM IV criteria. Their test results were compared to the results of 12 volunteers without cognitive disorders. In the veterans with symptoms of post-concussive syndrome, reduced metabolism of glucose in the cerebellum, part of the brain stem, and in the mid-temporal lobe was observed. The study outcomes suggest that the impaired metabolism in these areas may indicate post-concussive syndrome in the veterans of the wars in Iraq and Afghanistan who experienced mTBI. Peskind et al. [20]

conducted a study involving veterans with mTBI, using a PET scan and neuropsychological examination. In the veterans with a history of mTBI, a subtle reduction in verbal fluency, cognitive processing speed, attention and operational memory were found, as well as a reduced concentration of glucose in the cerebellum, partially in the brain stem pons, and in the mid-temporal lobe. The previously mentioned Levin et al. [21] studied veterans of the wars in Iraq and Afghanistan using the DTI test, and neuropsychological tests of verbal memory. The study group comprised veterans with TBI, and the control group consisted of veterans without a history of TBI. It was demonstrated that veterans with a history of TBI had weaker verbal memory, and that the deficits were not associated with the degree of PTSD. Interestingly, the DTI test revealed that the general number of words remembered by the veterans in the psychological examination positively correlated with water diffusion in the white matter.

Rehabilitation of cognitive disorders in mTBI

Standard clinical management in the rehabilitation of cognitive functions in mTBI concentrates on "prevention through education". This approach is intended to make the veteran aware of the nature and specificity of the injury, and its consequences for mental functioning. It also focuses on specialised treatment, to reduce symptoms such as headache, mood disorders and sleeping disorders, as they adversely affect neurocognitive performance. The Brain Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine (ACRM, BI-ISIG) defines cognitive rehabilitation as comprehensive, multidimensional, complementary, interdisciplinary rehabilitation interventions aimed at restoring, reorganizing, or compensating for impaired function through new cognitive patterns [15]. Guidelines based on the evidence from cognitive rehabilitation in mTBI recommend attention and memory training. The importance of metacognitive strategies in the training is emphasised, as they increase the awareness of the difficulties encountered, and help to develop continuous monitoring of the problems experienced, as well as the ability to self-regulate cognitive dysfunctions. It is a necessary condition for using the newly-acquired compensatory strategies for cognitive dysfunctions while performing tasks in the real world [15].

The programmes for rehabilitation of cognitive and executive functions concentrate on training specific strategies that help to set and achieve the aims of cognitive rehabilitation, as well as to identify and stop distractions that prevent patients from reaching the goal. It is believed that once the new strategies for improvement of executive and cognitive functions have been internalised and used in real-life situations, their implementation in daily practice will become easier for the veteran. As a result, they will be used more frequently, and will become integrated into the patient's everyday life.

Huckans [22] conducted a study involving a group of veterans from Iraq and Afghanistan who demonstrated mild cognitive impairments. The study offered a group programme lasting 6-8 weeks. It consisted in training various compensatory cognitive strategies, including organisational skills, setting goals, and problem-solving strategies. Weekly therapy sessions comprised educational presentations, discussions and exercises, followed by assignments to be performed at home. During the sessions, the subjects reported their implementation of compensatory cognitive strategies in their everyday life.

The researchers specialising in the cognitive rehabilitation of traumatic brain injuries emphasise the importance of the standardisation and development of tools for differential diagnosis of mTBI and PTSD, the need for individual treatment plans, adjusted to the needs of a given patient, the necessity of co-operation within an interdisciplinary team for the diagnosis and treatment of cognitive deficits in mTBI, and combining therapy with holistic programmes for cognitive rehabilitation. In addition, they stress the significance of telerehabilitation in that it enables the treatment of veterans in small clinical centres where the therapeutic base for neurocognitive rehabilitation is limited. Identification of the predictors of cognitive success in this type of cognitive therapy is being researched increasingly often. There is also interest in the use of biomarkers in the diagnosis of cognitive deficits in mTBI [15].

Discussion about neuropsychological sequelae of mTBI and the clinical implications of mTBI diagnosis

With regard to the neuropsychological consequences of mTBI, the researchers report the occurrence of cognitive deficits as a result of moderate and serious TBI, clearly visible in problems related to attention, concentration, memory, language, spatial orientation and executive functions. However, both the type and degree of cognitive impairment resulting from mTBI is unclear. The presented review of studies on neuropsychological dysfunctions in the population of veterans with mild traumatic brain injuries and concurrent brain injury and PTSD demonstrates different outcomes, but in most of the studies veterans with a history of mTBI and PTSD achieve worse results than those diagnosed either with mTBI or with PTSD. Many veterans with a history of mTBI experience significant cognitive deficits in attention, learning, memory, processing speed and/or emotional and behavioural symptoms, such as irritability and sleep disorders. These difficulties are typical in the first 72 hours after the injury, and even up to 3 months following the trauma. In most cases they subside spontaneously. A possible explanation for the temporary cognitive deficit can be offered by pathobiology of mTBI, i.e. diffused axonal injury (DAI) as the main cause of TBI. In mild traumatic brain injuries DAI frequently affects cells which are dysfunctional only temporarily, due to the effect of biomechanical forces that lead to stretching, twisting and shrinking of axons. At that time neurons do not die, but partially lose functionality, and restore it after some time. It is believed that after that time, individual in each case, cognitive functions also normalise. However, a few studies suggest the small, but significant effect size of attention deficits, especially regarding divided and sustained attention, and processing speed [14]. The author suggests that mTBI may cause rare and subtle long-term cognitive deficits.

Despite many extensive studies documenting the relationships between mTBI and PTSD, as well as neuropsychological weakening of these disorders, presently no neuropsycholgical profile is available for each of the conditions separately, or in concurrence, to help in diagnosis. It also seems that the formal neuropsychological tests, especially the small group of tests adapted for use in Poland, may be insufficient for detection of subtle neurocognitive changes that can lead to a subjective distress in a veteran. Moreover, it is difficult to conduct a proper study regarding cognitive deficits resulting from mTBI, as most veterans are examined a few months after the injury, or even a few years after their return from war. In “Afgan”, a research project implemented at the Military Institute of Medicine, Department of Combat Stress and Psychotraumatology, the mean time from the injury resulting in mTBI to examination of the neuropsychological consequences of the injury was 54 months (4.5 years). The time to rehabilitation of cognitive functions in veterans with a history of mTBI was similar. Researchers often pose the question: how many veterans of contemporary wars will continue the treatment of cognitive symptoms resulting from mTBI in the months post-injury? Does educating veterans a few months, or even years after the injury, have any effect? The situation with diagnosis of mTBI is similar. The assessment of symptoms resulting from mTBI is conducted months or years after the blast exposure, and it is based on retrospective self-reporting by the soldier, which is frequently distorted and biased. It is a great challenge for a diagnostician to determine if the symptoms and difficulties with cognitive performance are associated with mTBI alone, or with PTSD that can develop as a result of brain injury, or maybe with both disorders, which is also frequent with soldiers. Traumatic events associated with military deployment and a combat setting, as well as their symptoms, such as being dazed or forgetting the event, may be consequences of both: mTBI and acute reaction to stress. The diagnostic criteria for mTBI and PTSD overlap, but the time to recovery differs significantly. As mentioned before, most mTBI symptoms subside within weeks, up to 3 months following the event resulting in brain injury, whereas PTSD symptoms and associated neuropsychological deficits may intensify with time and persist for many years after the trauma event. Often it is difficult to assess mTBI symptoms objectively when veterans are evaluated months or even years after they have completed military service, especially when they could have been exposed to multiple blasts or TBI injuries during their deployment abroad. Identification of PTSD-specific symptoms, such as arousal and avoidance (according to ICD-10) [5], may be helpful in differential diagnosis, as they are not typical in civilians with mTBI.

Considering the challenges associated with diagnosing mTBI/PTSD, some researchers in this field postulate concentrating on symptoms and functional problems, rather than on symptom aetiology. This approach seems reasonable in the context of mild cognitive deficits, as there is no evidence supporting the effectiveness of other treatment strategies. To understand the impaired neuropsychological performance of veterans with a history of mTBI one should consider their motivation for tests. Veterans may be poorly motivated to perform tasks in neuropsychological diagnosis properly, and may exaggerate their problems with cognitive performance. Most veterans assessed for neuropsychological consequences of mTBI remain in active service, and

may try to prove they have suffered damage to their health in order to receive financial gratification. Damage to health is determined following the procedures of Military Medical Committees, which may be a cause for soldiers to exaggerate any cognitive problems. However, lower results in neuropsychological tests are not always caused by intentional aggravation of symptoms, and there may be many other reasons.

Treatment of cognitive deficits in patients with mTBI/PTSD is associated with numerous challenges, such as heterogeneity of the cognitive problems, variety of PTSD symptoms, or the presence of other concurrent disorders. Coping with the symptoms and therapeutic compliance are important, both for the veterans with mild traumatic brain injuries and PTSD, and for their doctors, clinical psychologists or neuropsychologists. Treatment of cognitive deficits related to TBI may be disturbed by PTSD symptoms, such as avoidance and emotional arousal. On the other hand, coping with PTSD symptoms depends on adequate cognitive resources, which may be reduced in mTBI. Clinical experience dictates that effective psychotherapy of PTSD due to war trauma requires good intellectual performance, and cognitive skills in at least the normal range. One of the main problems in planning the treatment of mTBI and concurrent PTSD is to determine the optimal timing of the cognitive rehabilitation, depending on the therapy of mental health problems. On the other hand, early treatment of cognitive dysfunctions is supported by the fact that residual cognitive deficiencies following mTBI can be reduced in the course of PTSD management, e.g. as a result of general cognitive-behavioural therapy. Limited studies in this area suggest that the treatment of acute stress-induced symptoms following psychological trauma can be effective in mTBI patients [15]. On the other hand, therapeutic interventions for PTSD may result in problems with impulse control and emotional deregulation, thus reducing the veteran's ability to participate in neurocognitive therapy. Clinicians also face another challenge regarding integration of various approaches to the treatment of mTBI and concurrent PTSD. Rehabilitation programmes are developed for a group setting, whereas the psychotherapy of war trauma often has to be individual. The use of pharmacological agents in the therapy of mTBI, PTSD and concurrent mTBI and PTSD is another important issue. Presently, there is no evidence to support pharmacological intervention in the group of patients with concurrent mTBI and PTSD. Pharmacological treatment and cognitive therapy are recommended and applied in PTSD alone, whereas certain drugs used in PTSD may exacerbate cognitive symptoms (such as attention and memory disorders, slowed cognitive performance) resulting from TBI.

Conclusions

- A detailed neuropsychological evaluation of mTBI includes an assessment of the functions that are particularly susceptible to disorders due to mTBI, namely attention, memory and executive functions.
- Neuropsychological diagnosis should be adjusted to the recovery stage of the patients, and consider the evolving nature of TBI; therefore, conducting a series of cognitive tests at various time intervals is recommended.
- Cognitive deficits due to mTBI improve visibly within 3 months of the event resulting in injury, whereas post-concussive syndrome symptoms may continue and account for a high level of veteran's mental discomfort.
- A significant rate of concurrence of mTBI and post-traumatic stress disorder has been observed. The ability to determine accurate clinical diagnosis and to apply further therapy considering both disorders should be of particular importance for the healthcare system responsible for polytrauma therapy and treatment for veterans
- New methods of functional imaging seem promising with respect to the detection of microscopic abnormalities in mild traumatic brain injury. They allow to determine the borders of the areas controlling various cognitive functions, and thus extend our understanding of damage in brain injuries.
- Standard clinical management in rehabilitation of cognitive functions in mild traumatic brain injuries concentrates on prevention through education, and on the use of metacognitive strategies to improve self-regulation of the cognitive symptoms.

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Practical guidance on nutrition in respiratory diseases. Part I. Malnutrition

Praktyczne wskazówki dotyczące odżywiania w chorobach układu oddechowego. Część I. Niedożywienie

Małgorzata Hadzik-Błaszczyk, Tadeusz M. Zielonka
Chair and Department of Family Medicine, Warsaw Medical University; head: Prof. Katarzyna Życińska MD, PhD

Abstract. The task of physicians is to take a holistic view of patients, considering not only the main diseases but also the risk factors worsening their prognosis. Respiratory diseases are among the most important diseases in clinical practice. In the course of chronic obstructive pulmonary disease, lung cancer and respiratory tract infections, undernutrition is often observed. This can be the result of disease itself but is also a risk factor in disease development. Malnutrition is frequently observed in the course of chronic respiratory diseases. Physicians should regularly assess the nutritional status in these cases using appropriate medical history and anthropometrical measurements. Diagnosed underweight or cachexia require implementation of adequate nutrition taking into account the specificity of respiratory diseases. If nutritional problems are not identified and appropriate treatment is not prescribed it will be difficult to expect good remote results in the treatment of chronic respiratory system diseases.
Key words: cystic fibrosis, diagnostics, dietary supplements, lung cancer, malnutrition, nutritional therapy, obstructive pulmonary diseases, tuberculosis

Streszczenie. Zadaniem lekarzy jest holistyczne spojrzenie na chorych z uwzględnieniem nie tylko podstawowych chorób, ale także czynników ryzyka pogarszających ich rokowanie. Choroby układu oddechowego należą do najważniejszych chorób w praktyce klinicznej. W przebiegu chorób obturacyjnych oskrzeli, nowotworów czy infekcji dróg oddechowych często obserwuje się zaburzenia odżywienia. Mogą one być skutkiem tych chorób lub czynnikiem sprzyjającym ich rozwojowi. Niedożywienie często stwierdza się w przebiegu przewlekłych chorób płuc. Lekarze powinni regularnie oceniać stan odżywienia tych pacjentów, wykorzystując odpowiedni wywiad i pomiary antropometryczne. Rozpoznanie niedożywienia lub wyniszczenia wymaga wdrożenia odpowiedniego żywienia, uwzględniającego specyfikę chorób układu oddechowego. Nie identyfikując problemów żywieniowych i nie podejmując niezbędnych działań w tym zakresie, trudno oczekiwać dobrych efektów odległych w leczeniu przewlekłych chorób płuc.
Słowa kluczowe: choroby obturacyjne płuc, rak płuca, gruźlica, mukowiscydoza, niedożywienie, diagnostyka, leczenie żywieniowe, suplementy diety

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Corresponding author
Assoc. Prof. Tadeusz M. Zielonka
Chair and Department of Family Medicine
Medical University of Warsaw
19 Stępińska St., flat 25, 00-739 Warsaw
telephone: +48 22 31 86 325
e-mail: tadeusz.zielonka@wum.edu.pl

Introduction

Holistic approaches to patients are gaining in popularity. The nutritional status of the patient plays an important role in clinical assessment, and intervention may be required in cases of undernutrition and obesity. Certain diseases contribute in particular to nutritional disorders. Cachexia is associated with acute inflammatory processes in critically ill patients, as well as with chronic diseases such as cancer, congestive heart failure, chronic obstructive pulmonary disease, cystic fibrosis, and tuberculosis of HIV infections [1]. The specificity of comorbidities must be considered when planning the therapy of nutritional disorders.

From the epidemiological point of view, chronic respiratory diseases constitute an important group of diseases. They are a frequent cause of visits to the

general practitioner, whose task is not only to diagnose and treat the diseases, but also to identify risk factors for early death (e.g. nutritional disorders or nicotine addiction), and to take proper actions to reduce their effects.

Lung diseases leading to undernutrition

Lung cancer is currently the most important malignant neoplasm, and is responsible for 30% of all deaths due to oncological diseases [2]. In Poland, over 20 thousand new cases of lung cancer are found annually [3]. Palliative treatment, applied in the majority of patients, does not stop the progression of a disease that leads to cachexia. Over half of cancer patients suffer from cachexia, including anorexia, progressive reduction of fat tissue, and muscle wasting [4]. This results not only in a considerable deterioration in the quality of life, but also reduces the response to chemotherapy and shortens survival [5]. Cachexia is caused by a disturbed energy and protein balance, i.e. the expenditure is greater than the retrieval. Oncologists conduct causative treatment, but their actions do not always address concurrent problems, such as loss of appetite and increasing wasting of the organism. The lack of a comprehensive approach by specialists results from the procedure financing system which, contrary to the guidelines and social expectations, does not include a holistic approach to complex health problems. Cachexia in patients with hyperplasia often poses a challenge for the general practitioner of hospice doctors.

Obstructive diseases of the lungs are among the most pressing health problems of the modern world. Over 300 million people suffer from asthma, and approximately 50 million are diagnosed with COPD [6, 7]. It is estimated that over 2 million patients in Poland have COPD (11% of the adult population) [8]. Most of them are not diagnosed, and do not receive treatment. This leads to progressive deterioration of the pulmonary function, and general systemic changes. Nutritional disorders are among the most common extrapulmonary symptoms of COPD [9], and are found in 10 to 15% of patients with the mild form of the disease, and in 50% of patients in advanced stages [10]. Muscle wasting is observed in 15-40% of COPD patients. This rate increases with progression of the disease [11]. It determines mortality in the course of COPD, regardless of reduced pulmonary ventilation [12].

In this group of patients, nutritional disorders depend of the phenotype. Most patients suffer from undernutrition (pink puffers), but some develop overweight (blue bloaters). Patients with emphysema in COPD (pink puffers) usually have reduced body mass index (BMI), and fat-free mass (FFM) index, due to muscle wasting [9]. This is associated with impaired protein metabolism, resulting from an imbalance between synthesis and disintegration of skeletal muscle proteins [13]. Energy imbalance, caused by increased work of the respiratory muscles, is also an important factor. Reduced appetite, decreased general physical fitness, depression and increased dyspnoea while eating, as a result of the diaphragm's limited mobility when the stomach is filled with food content, contribute to undernutrition of COPD patients [14]. Undernutrition is much less frequent in patients with asthma. However, it can be diagnosed in patients with a long, uncontrolled disease involving bronchial remodelling and emphysema. This phenotype resembles COPD more than classic asthma. Undernutrition may also occur in asthma-COPD overlap syndrome, characterised by a higher rate of comorbidities [15].

Chronic infections, persisting for weeks or months, involve increased catabolism, resulting in undernutrition or cachexia. Tuberculosis (TB) is a typical chronic infection. In populations vaccinated with BCG it is rarely acute. Often it is diagnosed after many months, whereas its treatment takes at least 6 months, and in infections with multidrug-resistant bacilli even a few years. The incidence of tuberculosis in Poland is constantly decreasing; however, over 6 thousand new cases are diagnosed every year [16]. It is increasingly often found among the homeless, the unemployed and the elderly [17]. Poverty and undernutrition are important factors for the development of tuberculosis [18]. During anti-TB treatments, the characteristic symptoms include significantly reduced appetite and nausea, which affect the food intake and increase undernutrition. Cachexia increases the risk of death and treatment failure in patients with tuberculosis [19]. In the course of gastrointestinal tuberculosis, nowadays very uncommon, cachexia is often caused by impaired absorption of nutrients. Eradication of tuberculosis in cattle and elimination of non-pasteurised milk resulted in a significant reduction in the incidence of gastrointestinal TB; however, new cases still occur, and many of them are diagnosed only after post-mortem examination [20]. Undernutrition is both a factor contributing to the development of TB and a consequence of the disease. Due to the elimination of tuberculosis clinics, these patients visit a general practitioner, who needs to pay attention to nutritional disorders.

Cachexia is an important symptom of cystic fibrosis, the most common genetic disease in Caucasians. The pathomechanism of the disease involves exocrine pancreatic insufficiency. In this group of patients, despite good appetite, physical development is poor, and stunting and low body weight are observed due to impaired fat absorption and steatorrhea [21]. Retention of thick mucus in the bronchial tree is a serious problem,

as it contributes to chronic infections that exacerbate undernutrition. Early detection of nutritional disorders in children with cystic fibrosis, followed by proper nutrition, is of key importance for their prognosis [22]. A holistic approach to patients with cystic fibrosis is very important.

Methods for diagnosing undernutrition

Several definitions of undernutrition are available. According to the European Society for Clinical Nutrition and Metabolism, it is a condition resulting from the insufficient intake or absorption of nutrients, resulting in changes to the body composition, including reduced free fat mass and cellular mass, leading to impairment of physical and mental activity, and adversely affecting the results of treatment of the underlying disease [23]. According to the International Classification of Diseases and Health Problems, undernutrition and other food-related deficits are diseases with alphanumerical codes (E40-E46 - malnutrition, and E50-E64 - other nutritional deficiencies). Therefore, they require diagnostic evaluation, a diagnosis, and application of a suitable treatment.

In order to diagnose undernutrition and determine its stage, the nutritional history should be collected, and anthropometric measurements should be used during the physical examination. In collecting the history, it is necessary to determine what factors contributed to the changes in nutrition, such as appetite disorders, quantity and quality of meals, and the presence of adverse gastrointestinal symptoms or other symptoms that could be caused by malnutrition [24]. Reduced food intake may result from difficulties with preparing meals by patients with significant exercise-induced dyspnoea who live alone, and from early feelings of fullness due to eating too large servings, or eating too quickly, especially as a result of the caregiver's impatience. Missing teeth, ill-fitting dentures, impaired mastication and swallowing, as well as inadequate consistency of meals are other factors that can contribute to the progression of nutritional disorders. Other causes include disturbed digestion and absorption in heart failure or chronic diarrhoea.

The basic anatomic parameters indicating the nutritional status may be measured in any doctor's office.

- **Measurement of body weight** – a simple method that requires only physician scales. The measurement must be made during every visit by the patient. Unintentional body weight loss of >5% within 3 months, or >10% within 6 months justifies the diagnosis of undernutrition, and requires nutritional therapy [23-25].
- **Body mass index** (BMI) is a ratio of body mass in kilograms to the square of the body height in metres [body weight (kg)]/[height (m)]^2. According to the guidelines of the World Health Organisation, BMI <18.5 defines undernutrition, and extended classification distinguished first degree of undernutrition (underweight) with BMI = 17–18.49, second degree undernutrition (moderate thinness) with BMI = 16.0–16.99, and third degree of undernutrition (severe thinness) with BMI <16 [26].
- **Measurement of mid-arm circumference (MAC) or mid-arm muscle circumference (MAMC)** with a measuring tape is a parameter used to assess the condition of all tissues: bones, muscles, fat tissue and extracellular fluid. The results should be compared with normal values (28.5 cm for women, 29.3 cm for men). It is a very simple method to assess the risk of undernutrition, and it allows the assessment of the results of ongoing nutritional therapies, especially when a patient cannot be weighed during house visits or in the case of bed-ridden patients [23-25].

Practical guidelines for treatment of undernutrition in pulmonary diseases

The first step in nutritional intervention should consist in calculating the daily energy requirement, adjusting the energy input to the degree of undernutrition and the advancement of respiratory distress. Mean daily energy requirement is estimated at 25–35 kcal/kg bw for men, and 20–30 kcal/kg bw for women [27]. At the beginning of nutritional therapy, it is better to use a lower energy input, to avoid metabolic disorders due to an increased requirement for oxygen and higher production of CO_2. Another element of proper nutrition is the distribution of calories between meals. Considering the specificity of lung diseases, such as impaired function of the muscles, including the diaphragm, it is best to have several (5-6) small meals rich in calories. The last meal should be planned for 2-3 hours before the night rest [25, 27].

Carbohydrates should cover 55-60% of the daily energy requirement [25]. The diet should be based on complex carbohydrates - they are slowly absorbed and have a low glycaemic index. This allows the reduction in postprandial hyperglycaemia that increases CO_2 production, harmful in patients with respiratory insufficiency. Extensive thermal processing is to be avoided, as it affects adversely the glycaemic index of meals. Simple sugar intake should also be significantly reduced. Cereal products, wholegrain or wholemeal bread, pasta and groats should be the source of carbohydrates. Large quantities of fresh vegetables should be included in the diet. Gas-forming foods that

cause rising of the dome of the diaphragm, increasing abdominal discomfort after a meal, should be avoided.

The diet recommended in undernourished patients with lung diseases should contain more fats than that of healthy or obese people, providing up to 45% of the total daily energy in fats [28]. Due to the increased content of fats, they should be carefully selected. Firstly, monounsaturated fats, present in olive oil and canola oil, should be used. Only these products can be used both cold and in thermal processing. Another group of recommended fats are multiunsaturated fatty acids, present mostly in sea fish, but also in sunflower oil, corn oil, flax oil and soybean oil. In patients with respiratory failure the fat intake should be preferred to compensate for increased energy requirements, as lesser amounts of CO_2 are produced in the associated metabolic processes [29].

Proteins are important tissue building material, and are necessary for the proper functioning of the immune system, enzymes, wound healing etc. In the course of chronic respiratory diseases both degradation of proteins and their supply are reduced. Daily protein requirement in cachexic patients is 1.0-1.5 g/kg bw [25]. The amount of protein in the diet should always be adjusted to the current renal status. Protein should be derived from products containing the necessary amino acids, e.g. chicken eggs, poultry, beef, fish and dairy products. Optimally, animal and plant protein, including soy products, cereal products and nuts, should be used in equal parts [30].

In preparing a comprehensive diet plan, one should remember to supplement the electrolytes, especially if drugs affecting their composition are used by the patients. Monitoring the concentrations of sodium, potassium, magnesium and calcium is necessary, followed by supplementation of potential deficits, by including in the diet products rich in these elements and by using pharmacological preparations [31]. The patient's menu should also contain products rich in fibre, necessary for preservation of normal gastrointestinal bacterial flora, and ensuring regular stool production [32]. Equally important is monitoring of the amount of consumed fluids, preferably still or weakly mineralised water or tea, providing antioxidants [33, 34].

Nutritional products useful in respiratory diseases

Sometimes nutritional therapy has to be intensified by introducing oral nutritional supplements [35]. This is a group of factory made nutrition formulae for oral use according to the recommendations and supervision of a physician. These products are distributed in pharmacies, and their characteristics are given in the product information on the containers, including main ingredients, indications, instructions for use and dosage. In Poland the following companies offer nutritional products (in alphabetical order): Braun, Fresenius Kabi, Nestle and Nutricia. Due to the varied indications, these diets are classified as standard and specialist, and used in selected groups of patients. Based on the composition, the formulas are classified as nutritionally complete and diet fortifiers. Complete formulas can be normocaloric (1 ml contains 1 kcal), hypercaloric (1 ml contains 1.3, 1.5 or 2.4 kcal) and hypocaloric (1 ml contains 0.39 kcal). Depending on the condition of the gastrointestinal tract, a low-residue diet or high-fibre diet can be used. In the treatment of undernutrition in the course of respiratory diseases, high-protein and high-energy diets are frequently used. They include Nutricomp Drink Plus, Fresubin Energy Drink, Fresubin Protein Energy Drink, Supportan Drink, Nutridrink Compact Protein, Resource 2.0, Resource 2.0 + Fibre, Resource Protein, Nutridrink, Nutridrink Yoghurt Style, Nutridrink Multi Fibre and Nutridrink Protein.

The recommendations regarding the use of oral nutritional supplements should emphasise that they need to be consumed slowly, frequently and in small quantities.

Fortifiers are used as an additional source of energy or protein in patients with special needs. The diet for patients with lung diseases who require additional sources of energy and reduced CO_2 production should include a fortifier containing a mixture of plant oils rich in multiunsaturated fatty acids (e.g. Calogen). 30 ml consumed 3 times a day provides 405 kcal, which offers good supplementation of the diet in patients with restricted fluid consumption. If additional quantities of protein are required, a fortifier in the form of protein-rich powder is recommended, e.g. Resource Instant Protein (Nestle) or Protifar (Nutricia). They are used as an ingredient in normal dishes and drinks. 2–3 spoonfuls (10–15 g of powder) of Resource Instant Protein should be added to 150 ml of liquid or 150 g of a dish (1 spoonful holds approximately 5 g of the product). Before using in hot drinks, the powder should be dissolved in a small quantity of cold liquid. One measure of Protifar contains 2.2 g of protein, and the product can be used both with and without thermal processing. In patients with disturbed swallowing and at risk of choking while consuming liquid foods, Nutilis Clear (Nutricia) thickener is recommended. In order to thicken 200 ml of liquid or a mixed food, 1-3 measures of the product should be used.

Conclusion

Despite the availability of simple tools for identification of nutritional disorders, the problem is underestimated in

out-patient healthcare, and many patients end up in hospitals with serious nutritional disorders. It is necessary to introduce easily available methods for the diagnosis of nutritional disorders into primary healthcare practice, and to apply treatment adapted to the patient's needs.

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Practical guidance on nutrition in respiratory diseases. Part II. Obesity

Praktyczne wskazówki dotyczące odżywiania w chorobach układu oddechowego. Część II. Otyłość

Tadeusz M. Zielonka, Małgorzata Hadzik-Błaszczyk

Chair and Department of Family Medicine, Warsaw Medical University; head: Prof. Katarzyna Życińska MD, PhD

Abstract. The task of physicians is to provide comprehensive care of their patients. It is necessary not only to treat chronic diseases, but also to reduce the load caused by coexisting risk factors in the development of additional diseases and premature death. Nutritional disorders are one of these. Malnutrition is dominant in chronic respiratory diseases, although in certain cases obesity is also observed. This applies especially to patients with obstructive sleep apnoea syndrome (OSAS). Some phenotypes of COPD (blue bloaters) are also characterized by obesity. A relationship was also found between obesity and asthma in children, particularly strong in boys. Therefore, for patients with chronic respiratory diseases it is necessary to assess their nutrition status. At the same time obese people should consider the needs for OSAS diagnostics. The diagnosis of obesity involves simple measurements such as BMI and waist or neck circumference, which should be routinely performed in each patient. The diagnosis of overweight or obesity imposes an obligation to undertake a holistic treatment process based on diet, change of abnormal eating habits, regular physical activity, psychological support, and in particularly severe cases, pharmacotherapy and bariatric surgery.
Key words: bariatric treatment, diagnostics, obesity, obstructive pulmonary disease, obstructive sleep apnoea syndrome, treatment of obesity

Streszczenie. Zadaniem lekarzy jest kompleksowa opieka nad chorymi – nie tylko leczenie chorób przewlekłych, lecz również zmniejszanie obciążenia spowodowanego czynnikami ryzyka rozwoju kolejnych chorób i przedwczesnego zgonu. Jednym z nich są zaburzenia odżywiania. W przewlekłych chorobach układu oddechowego przeważa niedożywienie, ale w niektórych przypadkach stwierdzić można współistniejącą otyłość. Dotyczy to zwłaszcza chorych na obturacyjny bezdech podczas snu (OBPS). Niektóre fenotypy POChP (*blue bloaters*) charakteryzują się otyłością. Stwierdzono również związek pomiędzy otyłością a astmą u dzieci, silny zwłaszcza u chłopców. U chorych na przewlekłe choroby układu oddechowego konieczna jest zatem ocena stanu odżywienia. U osób otyłych należy rozważyć potrzebę diagnostyki w kierunku OBPS. W diagnostyce otyłości pomocne są proste pomiary, takie jak wskaźnik masy ciała, jak również obwód talii i szyi, które powinny być rutynowo wykonywane u wszystkich chorych. Rozpoznanie nadwagi lub otyłości jest wskazaniem do kompleksowego leczenia opartego na diecie, zmianie nieprawidłowych nawyków żywieniowych, systematycznej aktywności fizycznej, wsparciu psychologicznym, a w szczególnie ciężkich przypadkach farmakoterapii i chirurgii bariatrycznej.
Słowa kluczowe: obturacyjny bezdech podczas snu, choroby obturacyjne płuc, otyłość, diagnostyka, leczenie otyłości, zabiegi bariatryczne

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Corresponding author
Assoc. Prof. Tadeusz M. Zielonka
Chair and Department of Family Medicine
Medical University of Warsaw
19 Stępińska St., flat 25, 00-739 Warsaw
telephone: +48 22 31 86 325
e-mail: tadeusz.zielonka@wum.edu.pl

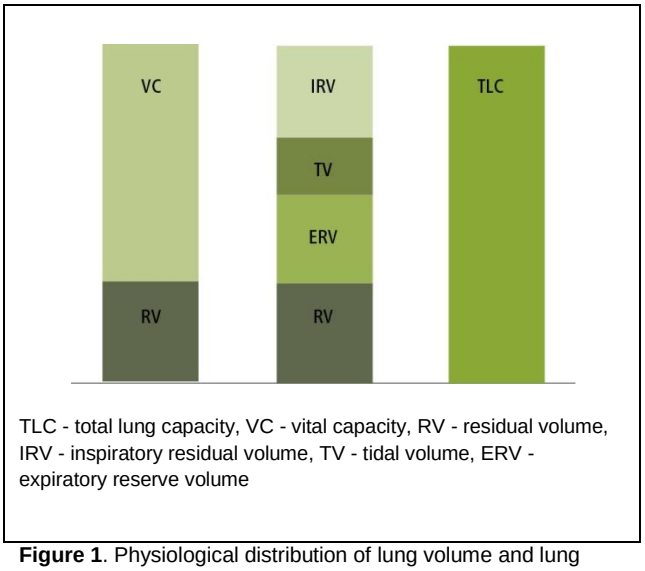
Introduction

Physicians need to apply a holistic approach to their patients, and provide comprehensive solutions for their health problems. They should pay attention not only to the treatment of chronic diseases, but also to vaccinations, the elimination of habits or addictions harmful for the patients, and to modify the patients' lifestyle. The creation of pro-health behaviours has become an important element of modern medicine. They are particularly important in patients diagnosed with chronic diseases that may result in the failure of vital organs. Obesity and overweight are among the factors that have the greatest impact on health. According to WHO, overweight is observed in over 1.5 billion people across the world, and obesity in 0.5 billion people [1]. In Poland, 65% of middle-aged people are overweight, while 30% of women and 20% of men are obese [2]. The primary cause of this epidemic in obesity in developed countries is the excessive supply of food relative to the energy requirements. This is the result of consuming large quantities of food, coupled with limited physical activity. It is a vicious circle: obesity reduces physical exercise, which in turn leads to exacerbation of the condition. Many chronic diseases of the lungs, heart and joints also limit physical activity, which contributes to the development of obesity. Therefore, early diagnosis of overweight or obesity, and prompt action preventing their harmful consequences, is of utmost importance.

The relationships between obesity and cardiovascular diseases, metabolic disorders and joint conditions are well-known. However, less attention is paid to the effect of obesity on respiratory diseases. This is particularly important in patients with obstructive sleep apnoea (OSA) [3] and in children with asthma [4]. Advanced COPD is often associated with undernutrition, or even with cachexia [5], but some patients demonstrate the phenotype associated with obesity [6].

Effect of obesity on respiration

Obesity has a significant effect on the pulmonary function. Obese patients usually have higher respiratory rates and smaller vital capacity [7]. Reduced pulmonary volume is also observed in these patients, especially expiratory reserve volume (ERV). This, in turn, reduces the expiratory flow due to early closing of the airway during regular exhalation, which produces positive end-respiratory pressure, especially when lying down [8]. It increases the respiratory effort by increasing the threshold load on the respiratory muscles, which causes dyspnoea.



TLC - total lung capacity, VC - vital capacity, RV - residual volume, IRV - inspiratory residual volume, TV - tidal volume, ERV - expiratory reserve volume

Figure 1. Physiological distribution of lung volume and lung capacities
Rycina 1. Fizjologiczny podział objętości i pojemności płuc

These patients may suffer from mild hypoxemia due to a disturbed ventilation to perfusion ratio at the base of the lungs, where minor atelectatic lesions can be observed [7]. These abnormalities are reversible and subside after the body mass index (BMI) has normalised [9]. However, more important than BMI is the distribution of fat tissue in the upper or lower part of the body. The combination of respiratory disorders, excessive production of CO_2 and reduced ventilatory drive predisposes obese patients to obesity hyperventilation syndrome [10].

Bronchial obstruction in obstructive respiratory diseases results in impaired lung emptying during exhalation, which leads to excessive lung aeration and increased residual volume. Preservation of these effects leads to emphysema. Increased RV results in reduced vital capacity (VC), which limits exercise capacity (Fig. 1). To compensate for these losses, the organism increases total lung capacity (TLC), mostly by lowering the dome of the diaphragm [11]. This helps to preserve the RV/TLC ratio as long as the compensatory mechanisms are functioning. In obese patients, due to anatomic reasons, the compensatory mechanisms are reduced, and as a result, dyspnoea develops earlier than in slim patients.

Lung diseases concurrent with obesity

Respiratory disorders during sleep pose an underestimated problem. The first American studies suggested that they could be found in 4% of adult males and 2% of females [12]. Further reports indicated that the condition is observed in up to 14% of the adult population [13]. Studies conducted in Poland demonstrated that OSA affects 7.5% of the adult population [14]. Large neck circumference, due to fat tissue accumulating in this area, contributes to pressure on the throat, reduced pharyngeal lumen, and sleep apnoea. Intensity of these symptoms correlates with the degree of obesity [15]. Metabolic disorders are so typical in OSA that according to some specialists the condition should be included as an element of metabolic syndrome [16]. The correlation with sleep respiratory disturbances is particularly pronounced in patients whose serum concentrations of leptin, insulin, IL-6 and TNF α are elevated [16]. The concurrent presence of OSA and insulin resistance and type 2 diabetes has been demonstrated [16]. Reduction of obesity decreases apnoea during sleep, and reduces treatment-resistant arterial hypertension, frequently observed in these conditions, as well as improves the metabolic status [17]. Obesity causes hypoventilation with subsequent hypercapnia and hypoxemia [10]. Percutaneous arterial blood oxygen saturation does not always allow the identification of the problem, as in some patients hypercapnia dominates. Therefore, arterial gasometry has to be performed, which is not easily accessible. Percutaneous capnography is helpful, as it offers a non-invasive method of measuring the saturation of capillary blood with CO_2.

Although in patients with COPD undernutrition is typically observed, some of them are overweight, or even obese. This applies to patients suffering from chronic bronchitis ("blue bloaters") [6]. In these cases respiratory failure develops faster than in patients with COPD, who have difficulties catching their breath ("pink puffers"). This prevents the reduction in obesity, as hypoxemia becomes a limiting factor for physical exercise. These patients require constant oxygen therapy, which may be difficult in obese patients with hypoventilation, due to their susceptibility to hypercapnia. Obesity in patients with COPD also contributes to the development of heart failure, which further reduces physical exercise and causes oedema, resulting in additional increases in body weight. Treatment of morbidly obese patients with OSA and COPD overlap syndrome is particularly difficult [18]. In this group total respiratory failure (hypoxemic and hypercapnic) and pulmonary hypertension develop faster, and precede severe bronchial obstruction. OSA and COPD overlap syndrome is associated with BMI increases [19]. In most patients with COPD, obstructive sleep apnoea was observed even when they did not demonstrate clinical symptoms typical of OSA [19]. They require continuous positive airway pressure (CPAP) at night, and non-invasive ventilation during COPD exacerbations.

A strong relationship between obesity and bronchial asthma was found, especially in children [20]. Development of paediatric obesity-related asthma is a consequence of disturbed metabolic regulatory mechanisms [20]. In paediatric patients with asthma, BMI is associated with reduction of FEV_1/FVC, more pronounced in males than in females [22]. In obese patients with asthma treatment is less effective, which may result from the changes observed in their bacterial flora [22]. In adult patients with asthma, obesity correlates with increased leptin concentration [23]. Researchers suggest that resistance to leptin may be responsible for the correlation between obesity and associated pulmonary diseases, such as asthma and OSA [25]. Leptin also regulates the production of acute phase proteins, including α1-antitrypsin, participating in the pathogenesis of obstructive lung diseases [24].

Diagnosing obesity

Obesity is characterised by an increased amount of fat tissue. Measurement of BMI and waist circumference, or the ratio between waist circumference and hip circumference, may be used in the diagnostic process. The World Health Organisation defined the following degrees of obesity, based on BMI [1]:

- BMI 25–29.9 – overweight,
- BMI 30–34.9 – 1st degree obesity,
- BMI 35–39.9 – 2nd degree obesity,
- BMI >40 – 3rd degree obesity (morbid obesity).

Measurement of the waist circumference allows us to identify overweight patients (the range for women is 80-88 cm, for men it is 94-102 cm), and obese patients with a high risk of metabolic consequences (women >88 cm, men >102 cm) [25]. Calculating the ratio of waist circumference, measured at the level of the navel, to hip circumference, measured at the level of the trochanters (waist-hip ratio, WHR) is used for classifying of 2 types of obesity [25]:

- android (abdominal, central, apple-shaped) at WHR > 0.85 for women, WHR > 1 for men,
- gynoid (pear-shaped) at WHR < 0.85 for women, WHR <1 for men.

Due to the ten-fold higher risk of OSA in patients with obesity, the assessment of anthropometric parameters should also include measurement of neck circumference using a tape measure. Neck circumferences of greater than 42 cm in men and 37 cm in women identifies those patients at risk of OSA [26].

In obese patients, regular control of arterial pressure is indicated, with the use of a cuff adjusted to the arm circumference, wide and long enough to prevent measurement error. Laboratory tests, such as lipid profile, serum concentration of uric acid, fasting and postprandial glucose, should be performed in every patient at risk of metabolic disorders.

Identification of overweight and obese patients requires physicians to introduce treatments based on a healthy diet, changing bad eating habits, increasing physical exercise, psychological support, potential pharmacotherapy, and, in special cases, to qualify patients for bariatric surgery. Before a therapeutic plan is prepared, a detailed patient history has to be collected, including the causes of the excessive body weight. Important factors to consider include eating habits, including those resulting from a particular upbringing, being a member of specific social or cultural groups, family history, analysis of genetic factors, calculating the caloric value of the meals consumed, estimating the daily energy expenditure, and the presence of comorbidities that contribute to obesity.

Non-surgical obesity treatment in patients with respiratory diseases

Dietary recommendations should include an individually adjusted, reduced amount of calories, divided into 5-6 small, regularly consumed meals. A reduction in the currently consumed amount of calories, calculated on the basis of nutritional history, by 500-1000 kcal allows body mass to be reduced by 0.5-1 kg per week [27]. Meals should be composed following the principles of a healthy diet, but with all the limitations resulting from the respiratory disease. Daily caloric input, individually adjusted to the patient's age, sex and concurrent diseases, should not be lower than 1000 kcal for women and 1500 kcal for men [28]. A diary recording the quantity and quality of meals, reviewed by the physician during visits, can help the patient to comply with the instructions regarding the everyday diet.

Table 1. Examples of glycaemic index (GI) of selected food products
Tabela 1. Przykłady indeksu glikemicznego (IG) wybranych produktów spożywczych

Low GI	Moderate GI	High GI
Yoghurt	White bread	Cooked
Dairy products	Wheat bread	carrot
Pasta	Cooked potatoes	Chips
Leguminous vegetables	Rice	Glucose
(bean, soybean, lentils,	Corn	Dates
pea)	Millet groats	Pumpkin
Fresh carrot	Beets	Popcorn
Oat bran	Turnip	Melon
Apples		Pineapple
Cherries		

Complex carbohydrates with a low glycaemic index should be preferred for a patient's diet. According to the FAO/WHO 1998 definition, glycaemic index (GI) is the percentage of blood glucose response within two hours of consuming a serving of food containing 50 g of carbohydrates, compared to the blood glucose response after consuming 50 g of carbohydrates in the form of pure glucose or white bread [29]. The higher the glycaemic index of a product, the more it will raise blood glucose level. According to GI values, carbohydrates are classified as having low GI (<50%), moderate GI (50–74%) or high GI (>75%). It is important to avoid extensive thermal processing, as it adversely affects the glycaemic index of meals. GI values for products and foods can be found in many tables (Tab. 1).

Physical exercise is an integral element in the treatment of obese patients. It should be regular, at least 3-5 times a week, and the optimal training duration is 30-60 minutes (approximately 150 minutes per week) [30]. It should be adapted to the patient's abilities, and the stage of respiratory disease. In patients with exercise-induced respiratory failure, oxygen therapy is required. It is important to increase the duration and intensity of exercise gradually, monitoring the heart function, arterial pressure, and oxygen saturation measured with a percutaneous pulse oximeter [31]. The intensity of exercise should not result in exceeding 50-70% of the maximum pulse rate, derived from the formula: HR_{max} = 220 – age. Optimal forms of physical activity include taking a walk, Nordic walking, cycling or swimming, if not contraindicated.

The effectiveness of the therapy depends on co-operation between physician and patient, based on competence, but also on the kindness and engagement of the doctor. Psychotherapy is particularly important in motivating patients who are in doubt or cannot achieve the expected body mass reduction, especially if the

patient made a dietary transgression or could not perform the recommended physical exercise.

Pharmacotherapy is also used in obesity treatments, particularly in patients with comorbidities such as diabetes, prediabetes, lipid disorders etc. In Poland orlistat is a drug approved for long-term use in obese patients. It is an inhibitor of the lipases produced by the gastrointestinal tract, and is used in combination with a low-calorie diet [32]. It impairs digestion and the absorption of fats. The recommended dose is 120 mg of the product 3 times a day, immediately before, during, or no more than 1 hour after a meal containing fat. If body mass is not reduced by 5%, the drug should not be used longer than for 12 weeks. If the desired body mass loss is obtained, the treatment may be continued for a maximum of 12 months, to maintain the outcomes. During the therapy, the amount of fats in the diet should be reduced (max. 30% of the daily energy requirement). Failure to follow this recommendation may result in adverse gastrointestinal effects, such as abdominal pain, flatulence and diarrhoea. These symptoms may discourage the patient from further therapy, and also indicate that products leading to obesity are present in the diet. Due to a potential deficiency of vitamins soluble in fats (A, D, E, and K) in patients treated with orlistat, supplementation of these elements should be considered [32].

Physicians should educate patients and draw practical conclusions that help to eliminate harmful products from the diet. When obesity is concurrent with disorders of the carbohydrate metabolism, and there are no contraindications due to respiratory issues, metformin is recommended [33]. Plants rich in fibre can also be used in obesity treatment, as due to their expansion and increasing the volume of consumed food, they provide the feeling of fullness [34].

Metabolic surgery

Conservative methods of treatment do not always ensure a satisfactory therapeutic effect; therefore, metabolic surgery is increasingly used. It is the only therapy that offers a significant and long-lasting body mass reduction. It is indicated in 3rd or 2nd degree obesity with concurrent OSA, diabetes, arterial hypertension, coronary disease or advance osteoarthritis [35].

Several types of bariatric procedures are available. They include restrictive methods – limiting the volume of meals by reducing the size of the stomach, and methods that reduce the absorption of food, or eliminate certain parts of the gastrointestinal tract from the digestive or absorptive processes [36].

Restrictive methods include:

- laparoscopic adjustable gastric banding (LAGB),
- laparoscopic sleeve gastrectomy (LSG),
- vertical banded gastroplasty (VGB).

Methods reducing absorption of consumed food:

- biliopancreatic diversion (BPD),
- biliopancreatic diversion with a duodenal switch (BPDDS).

The latter methods are rarely used, as they are associated with nutritional deficits. Combinations of both above methods are also used. They help to obtain a better body mass reduction, while lowering the risk of nutritional deficits. The most frequently recommended procedure is Roux-en-Y laparoscopic gastric diversion.

In the post-operative period, in collaboration with a nutritionist, the effect of weight reduction should be maintained, and potential nutritional deficits due to the procedure should be prevented. For the first 4-8 weeks after bariatric surgery, a liquid diet should be used, followed by pureed foods. Next, solid foods can be gradually introduced, but they need to be carefully masticated or cut up prior to eating [37]. Patients should eat 4-6 meals, at regular hours. A single serving of food depends on the period of time since the surgery. Initially, the serving is only 30 ml, and then in the following weeks the volume can be gradually increased, but to no more than 100-150 ml (½–¾ a cup). The patient after the surgery should drink approximately 1500-1900 ml of liquids per day, between meals.

The daily energy input in the first year after the procedure should be 800 kcal, and 1200-1400 in the following years. The protein input should be 60-120 g/day. To cover such high requirement, fortifiers in the form of high-protein powder, e.g. Resource Instant Protein or Protifar, can be added to the regular diet. The recommended amount of carbohydrates is approximately 100 g/day, but simple sugars should be eliminated from the diet [37]. It is important to prevent deficits of vitamins B, vitamins soluble in fats, and minerals (iron and calcium in particular). European and American guidelines recommend using calcium preparations (1200–2000 mg/day), vitamin D_3 (400–800 mg/day), iron (150–200 mg/day), folic acid (400 µg/day), vitamin B_{12} (1000 µg/day enterally or 1000 g/month intramuscularly), and multivitamin preparations at a dose of 1–2 tablets/day [38, 39].

Conclusion

Physicians should always determine the BMI of their patients and verify if obese patients do not suffer from respiratory disorders, as well as to consider effective ways of reducing their weight and improving ventilation. At every stage of the treatment compensation should be made for metabolic disorders, including normalisation of glycaemia, lipid profile and arterial pressure.

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Percutaneous endoscopic gastrostomy (PEG) placement techniques

Technika wytwarzania endoskopowej gastrostomii odżywczej (PEG)

Cezary Adamiec, Tomasz Nowak, Agnieszka Wołyńska-Szkudlarek, Mariusz Bobula, Przemysław Dyrla, Przemysław Witek

Department of Gastroenterology, Endocrinology and Internal Diseases, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine, Warsaw, Poland; head: Assoc. Prof. Przemysław Witek MD, PhD

Abstract. A patient's nutritional status is frequently a determining factor concerning both the patient's treatment in a healthcare unit setting and their long-term prognosis. A suitable nutritional therapy is as important for the patient as pharmacology or surgery. The most common indication for providing artificial nutrition is dysphagia. The gold standard for long-term enteral nutrition is the implementation of percutaneous endoscopic gastrostomy (PEG). The technical differences between various types of PEG allow a reduction in the complication risk related to making a fistula.
Key words: malnutrition, needle gastropexy, PULL type PEG, PUSH type PEG

Streszczenie. Stan odżywienia chorego jest bardzo często czynnikiem determinującym bezpośrednie postępowanie z pacjentem, jak również odległe rokowanie. Terapia żywieniowa jest tak samo ważna dla pacjenta, jak farmakoterapia czy leczenie operacyjne. Dysfagia jest najczęstszym wskazaniem do wytworzenia sztucznego dostępu do przewodu pokarmowego. Złotym standardem postępowania podczas długotrwałego odżywiania dojelitowego jest wykorzystanie przezskórnej endoskopowej gastrostomii (PEG). Odmienności techniczne różnych metod wprowadzania PEG pozwalają zmniejszyć ryzyko wystąpienia powikłań związanych z wytworzeniem przetoki.
Słowa kluczowe: niedożywienie, PEG typu PULL, PEG typu PUSH, gastropeksja igłowa

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Corresponding author
Przemysław Dyrla MD, PhD
Department of Gastroenterology, Endocrinology and Internal
Diseases, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine
128 Szaserów St., 04-141 Warsaw
telephone: +48 261 81 80 61
e-mail: tadeusz.zielonka@wum.edu.pl

Maintaining an adequate nutritional status in a patient is a key factor in increasing treatment effectiveness, including for oncological therapies. Cachexia should not be perceived as part of the disease. The data collected in the "Nutrition Day in POLAND" programme demonstrate that 30% of patients admitted to hospital report a body weight reduction within 3 months prior to hospitalisation, and 20% declared that the weight loss was greater than 5 kg. Signs of undernutrition are observed in approximately 60-70% of hospital patients, and up to 85% of patients in long-term care facilities [1]. At oncological departments, 40-80% of patients demonstrate signs of undernutrition [2].

Patients who require short-term enteral nutrition, and are likely to return to oral nutrition, are fed through a nasogastric or nasointestinal tube.

In patients with dominant dysphagia, artificial nutrition frequently has to be used for many weeks. The method of choice in the long-term nutritional therapy of patients with swallowing disorders is percutaneous endoscopic gastrostomy (PEG) [3, 4]. This technique was used for the first time in 1979 [5], and was received with enthusiasm. It was considered to be easy, safe and fast, as well as particularly useful in patients at high risk of general anaesthesia [6, 7]. The initial technical problems were gradually eliminated, and today it is one of the most frequently performed endoscopic procedures. In the USA approximately 200,000 PEG procedures are conducted annually [8].

Currently physicians can choose from a number of PEG techniques.

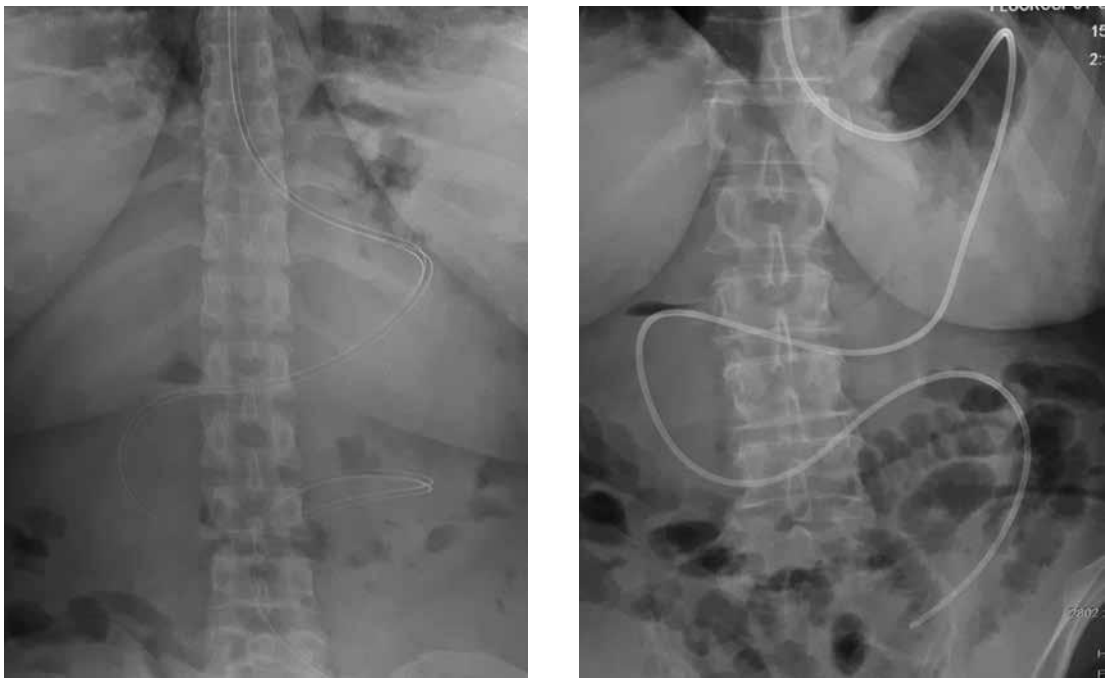

Figure 1. Naso-jejunal tubes in two cases of severe pancreatitis
Rycina 1. Sondy nosowo-jelitowe u dwóch pacjentek z ciężkim zapaleniem trzustki

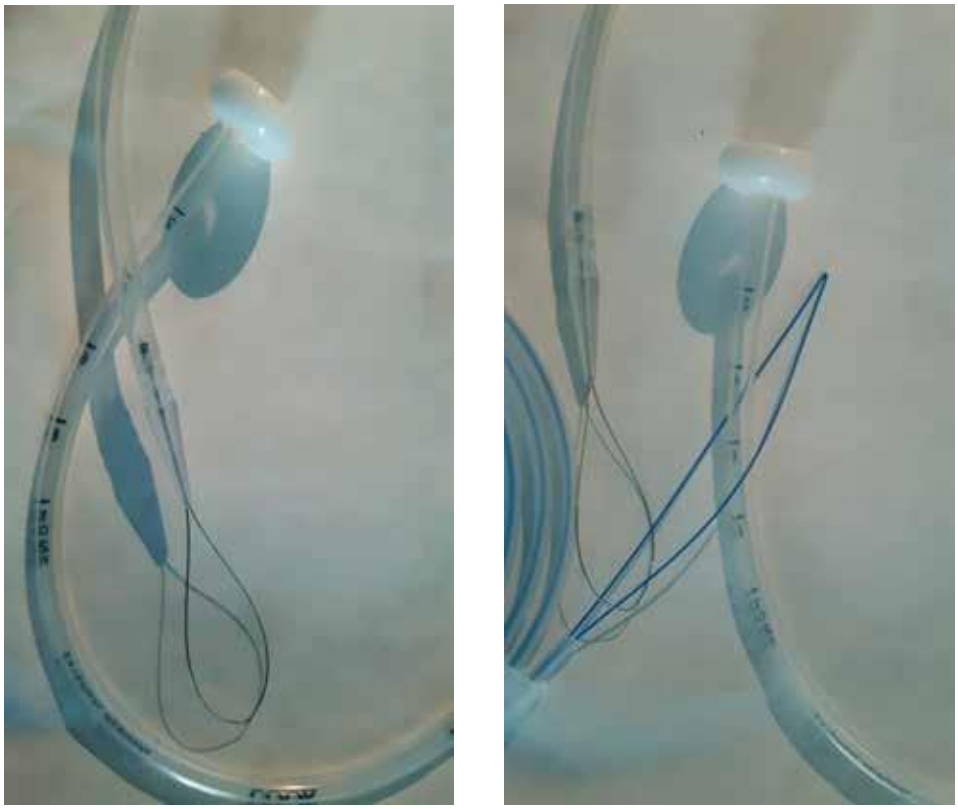

Figure 2. PULL type PEG by the COOK company. On the left – proximal and distal ends of PEG. On the right – the fastening of the PEG's loop and the leader.
Rycina 2. PEG typu PULL firmy COOK. Na lewym zdjęciu proksymalny i dystalny koniec PEG. Na prawym zdjęciu mocowanie PEG do prowadnika.

Table 1. Positive and negative aspects of different types of PEG
Tabela 1. Zalety i wady różnych typów gastrostomii endoskopowej

Gastrostomy technique	Positive aspects	Negative aspects
Ponsky-Gauderer method *(pull-string PEG technique)*	– easy – inexpensive – forces present during the introduction press the stomach to the abdominal wall	– it is necessary to introduce the endoscope to the stomach twice – PEG in contact with oral bacteria, or a potential tumour of the throat and oesophagus – oesophageal strictures can prevent passing of the internal bumper – another endoscopic procedure is required to exchange or remove the PEG
Sachs-Vine method *(push-guidewire PEG technique)*	– easy (due to serial dilators, passing it through the layers is easier than in the PULL technique) – inexpensive (slightly more expensive than PULL) – forces present during the introduction press the stomach to the abdominal wall	– it is necessary to introduce the endoscope to the stomach twice – PEG in contact with oral bacteria, or a potential tumour of the throat and oesophagus – oesophageal strictures can prevent passing of the internal bumper – another endoscopic procedure is required to exchange or remove the PEG – while removing from the stomach the guidewire may deform due to the pressure of the loop
Russell method - (introducer technique)	– single introduction of the gastroscope to the stomach – catheter is not in contact with oral bacteria, or a potential tumour of the throat and oesophagus – can be introduced even with a significant oesophageal stenosis, using a transnasal gastroscope – can be exchanged at the patient's bed, without the need for an endoscopic examination	– expensive – demanding from a technical point of view – gastric balloon may impair gastric emptying – frequent checking of the filling of the gastric balloon is required – forces present during the introduction move the stomach away from the abdominal wall
Brown-Mueller method *(introducer technique with T-fastener)*	– single introduction of the gastroscope to the stomach – catheter is not in contact with oral bacteria, or a potential tumour of the throat and oesophagus – can be introduced even with a significant oesophageal stenosis, using a transnasal gastroscope – can be exchanged at the patient's bed, without the need for an endoscopic examination	– very expensive – very demanding from a technical point of view – multiple introductions into the abdominal layers and stomach increase the risk of complications – risk of buried bumper syndrome – gastric balloon may impair gastric emptying – frequent checking of the filling of the gastric balloon is required – forces present during the introduction move the stomach against the abdominal wall

Ponsky-Gauderer method *(pull-string PEG technique)*

During gastroscopy, the feeding site is selected using diaphanoscopy (illumination with the endoscope) and the visible impression on the frontal abdominal wall when external pressure is applied. A needle is introduced into the stomach, and the PEG guidewire pushed through the lumen. Next, the guidewire is grasped with the endoscopic snare, and is withdrawn together with the endoscope. The PEG is secured to the guidewire. Then, while removing the guidewire through the skin of the abdomen, the PEG is pulled in through the mouth and oesophagus to the stomach. The method is referred to as "PULL", because it consists in pulling the PEG. It is most frequently used, and is considered to be the easiest and safest, since during the procedure the force pulling the PEG presses the gastric wall to the abdominal wall. The procedure usually requires introducing the gastroscope into the stomach twice, and passing the PEG through the mouth and oesophagus.

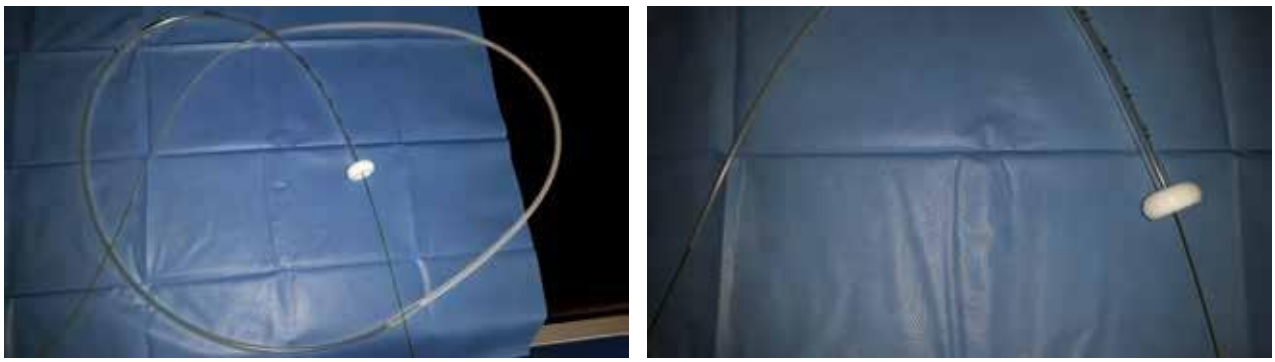

Figure 3. PUSH type PEG by COOK. On the left – whole PEG thread on the leader. On the right – internal bumper and proximal part of the PEG, similar to endoscopic dilator.
Rycina 3. PEG typu PULL firmy COOK. Na lewym zdjęciu cały PEG nanizany na prowadnik. Na prawym zdjęciu wewnętrzny krążek zabezpieczający i początkowy odcinek PEG o budowie poszerzadła endoskopowego.

Figure 4. 20 Fr diameter dilator and splitting tube
Rycina 4. Poszerzadło o średnicy 20 Fr i rozrywalna kaniula

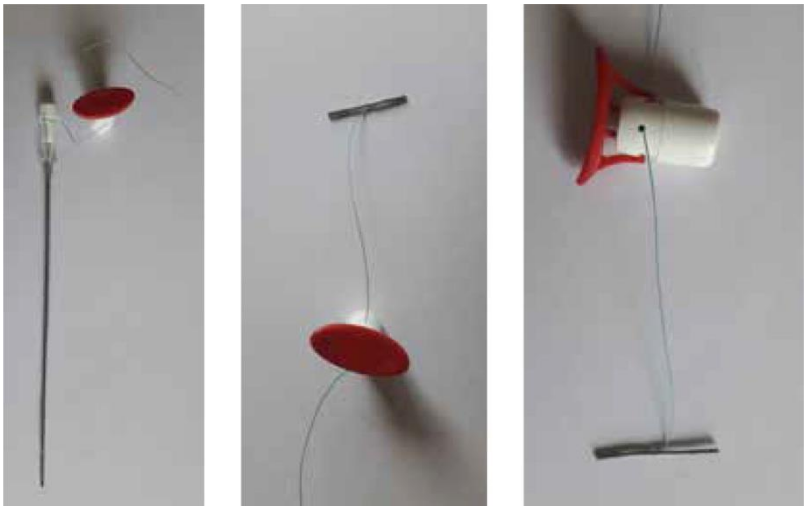

Figure 5. Gastropexy needle set
Rycina 5. Zestaw igłowy do gastropeksji

Sachs-Vine method *(push-guidewire PEG technique)*

This is a modified PULL technique. After withdrawing the guidewire from the stomach through the mouth, the wire is held tightly. The PEG tube is threaded onto the taut guidewire, and pushed through the mouth and oesophagus into the stomach. This method requires tougher materials and a PEG whose design enables pushing of the tube - similar to an endoscopic dilator. The method is referred to as “PUSH”, because it entails pushing the PEG. The procedure usually requires introducing the gastroscope into the stomach twice, and passing the PEG through the mouth and oesophagus.

Russell method - *(introducer technique)*

This method consists in introducing a needle, and then a guidewire through the abdominal layers, into the gastric lumen. A serial passage dilator is advanced over the guidewire, followed by a special peel-sheath introducer. Next, a catheter is introduced through the sheath into the stomach, with an internal retention balloon. The forces present during the procedure move the gastric wall away from the abdominal wall, increasing the risk of complications. This procedure requires a single introduction of the gastroscope into the stomach, and prevents any contact between the PEG and oral bacterial flora or a potential neoplasm of the throat or oesophagus.

Brown-Mueller method *(introducer technique with T-fastener)*

This is a modified Russell technique. The modification consists in initial fixing of the frontal gastric wall to the abdominal wall using special gastropexy needles, and introducing the PEG according to the Russell method. The gastropexy is maintained for 2-3 weeks, which is the time of maturation of the PEG fistula. Then the threads are cut. The internal elements pressing the gastric wall to the abdominal wall are spontaneously excreted with the stool. This procedure requires a single introduction of a gastroscope into the stomach, and prevents any contact between the PEG and oral bacterial flora or any potential neoplasm of the throat or oesophagus.

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Individual Medical Pouch – necessary changes and directions of development

Indywidualny Pakiet Medyczny – niezbędne zmiany i kierunki rozwoju

Grzegorz Lewandowski

Brig. Gen. Stefan Hubicki MD, Military Centre for Medical Education in Łódź; commander: Col. Zbigniew Aszkielaniec MD

Abstract. An Individual Medical Pouch (IMP) is a piece of medical equipment for soldiers of the Polish Armed Forces. The content of the package allows the provision of necessary medical assistance on the battlefield before the introduction of advanced procedures at subsequent levels of medical evacuation. However, the IMP requires a redesign of both its contents and structure. The aim of the study is to present the IMP in respect of its contents and usefulness on the contemporary battlefield.
Key words: IMP, CLS, battlefield

Streszczenie. Indywidualny Pakiet Medyczny (IPMed) stanowi wyposażenie medyczne żołnierza Sił Zbrojnych RP. Zawartość pakietu pozwala na udzielenie pomocy medycznej na polu walki w niezbędnym zakresie przed wprowadzeniem zaawansowanych procedur na kolejnych etapach ewakuacji medycznej. IPMed wymaga jednak rekonstrukcji, zarówno pod względem wyposażenia, jak i w aspekcie technicznym. Celem pracy jest przedstawienie IPMed pod względem zawartości i użyteczności na współczesnym polu walki.
Słowa kluczowe: IPMed, CLS, pole walki

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Corresponding author
Maj. Grzegorz Lewandowski MD
Military Medical Training Centre
92 6-go Sierpnia St., 91-464 Łódź
telephone: +48 608 550 577
e-mail: szpikerman@wp.pl

Introduction

An Individual Medical Pouch (IMP) contains medical equipment for every soldier. It is intended for self-aid or to provide assistance to other soldiers in the combat setting. The IMP contains an emergency tourniquet, scissors, gloves, nasopharyngeal tube, lubricant for the nasolaryngeal tube, occlusive dressing (vented) for the chest, haemostatic dressing, field dressings and compressed gauze [1]. An IMP allows urgent life-saving measures to be performed in the case of haemorrhage, thoracic injury, and airway obstruction. The role of the IMP on the battlefield is very important, as it enables prevention of death due to the most common causes: airway obstruction, pneumothorax, and massive blood loss [2, 3]. According to the available literature regarding battlefield medicine, full blood must be used to fill the vasculature. Blood transfusion in a combat setting is a serious problem that must be resolved at an early stage of medical evacuation. Infections of the upper and lower limbs, abdomen, or respiratory tract are also pressing problems. No satisfactory solution has yet been found for antibiotic prophylaxis on the battlefield to enable the prevention of sepsis. In 2018, 7 years after introduction of the IMP, the time has come to introduce changes, such as adding new elements: a syringe pre-filled with antibiotics, additional needles for intraosseous injections, a pneumothorax needle, or burn dressings. The IMP seems to insufficient to address the challenges of the modern battlefield, both in the case of haemorrhage and the prophylaxis of infections.

Figure 1. Individual Medical Pouch (IMP)
Rycina 1. Indywidualny Pakiet Medyczny (IPMed)

Similarly, from the technical point of view, the size of the IMP and its transportation are far from ideal, and require urgent modification to make the pouch effective to use. The aim of the study is to present the contents and usefulness of the IMP in the modern combat setting.

Combat Lifesaver – CLS

In 2011, American instructors conducted the first Combat Lifesaver (CLS) course in the Military Medical Training Centre in Łódź. The goal of the course was to provide instructors and lecturers with a theoretical understanding and practical skills regarding the use of the individual medical pouches by every soldier. The instructor training resulted in a CLS course for soldiers of the Polish Armed Forces. For the past 7 years, the CLS course has formed the basis for training in medical assistance on the battlefield for any soldier, from the onset of an event to the moment of evacuation, followed by medical assistance at the subsequent levels of medical evacuation. Human life-saving measures are at the heart of the Polish Armed Forces doctrine [4]. The year 2011 witnessed a breakthrough in military medical education, especially given the fact that the CLS course has met the expectations of modern military medicine, and the soldiers who complete the training demonstrate the same skills as the soldiers of other NATO armies. The importance of the acquired skills and their use in compliance with the TCCC (Tactical Combat Casualty Care) guidelines should be emphasised [5]. CLS is one of the courses conducted in the Military Medical Training Centre in Łódź. Every officer cadet of the Military University of Land Forces in Wrocław who is a student of the Military Medical Faculty at the Medical University of Łódź must take such a course. The CLS course is a part of the military medical standard of the Military Medical Training Centre in Łódź. The terrorist attacks we have been witnessing in European cities cause the same injuries as armed conflicts. Therefore, the practical skills acquired during the CLS course and the TCCC guidelines are increasingly often used by civilian healthcare services. It is a part of the typical and well-known process of implementing military experiences in civilian medicine.

Individual Medical Pouch

An Individual Medical Pouch (IMP) enables the provision of medical assistance, either as self-aid or by helping another soldier in a combat setting, as well as in urban areas following terrorist attacks due to the similarities in the injuries [6, 7]. The IMP presently used by the Polish Armed Forces includes: emergency tourniquet (for mechanical control of haemorrhages), scissors and emergency gloves, nasopharyngeal tube + lubricant (to restore airway patency), occlusive dressing (vented) for the chest (to prevent respiratory failure and pneumothorax), haemostatic dressing (for biologically-assisted control of haemorrhages), field dressing and compressed gauze (Fig. 1). Use of any of the tools and materials is determined by the type of injury and helps to prevent the trauma triad of death. The instruction for use of the IMP was approved by the Military Healthcare Inspectorate, and introduced on 17 August 2011.

Emergency tourniquet CAT or SOFTT-W

An emergency tourniquet is the basic element of the pouch, as haemorrhages directly contribute to mortality rates in a combat setting. It is self-fitted or applied with the help of another soldier to an upper or lower limb. The failure to use a tourniquet, or its incompetent application, may result in bleeding out and the death of the victim. Any soldier who is wearing an emergency tourniquet should be marked with the letter “T” on the forehead or cheek (for “tourniquet - compression bandage”). In 2012, a training standard was introduced to assess the soldiers' ability to use a tourniquet in a given time interval, and which determines the grade obtained during the exam [8].

Table 1. Training norms and blood loss prognosis at the time of stasis placement. Predicted loss of blood in litres and % in 10 seconds (description in the text)
Tabela 1. Normy szkoleniowe oraz prognoza utraty krwi w czasie zakładania stazy. Prognozowana utrata krwi w litrach i % w czasie 10 s (opis w tekście)

Myocardial function	Cardiac output	Blood loss after 60 seconds / grade C	Blood loss after 50 seconds / grade B	Blood loss after 40 seconds / grade A
70	5 l	5 l	4.16 l	3.33 l – 66.6%
100	7 l	7 l	5.83 l	4.7 l – 67%
120	8.4 l	8.4 l	6.7 l	5.33 l
140	9.8 l	9.8 l	8.16 l	6.6 l
70	5 l	Blood loss of 2.5 l after 30 seconds	Blood loss of 1.66 l after 20 seconds	Blood loss of 0.83 l – 16% after 10 seconds
100	7 l	Blood loss of 3.5 l after 30 seconds	Blood loss of 2.33 l after 20 seconds	Blood loss of 1.16 l – 16% after 10 seconds

Table 1 presents training standards and predicted blood losses during the application of a tourniquet. In the mathematical model, mean volume of blood pumped from the left ventricle to the aorta (stroke volume) is approximately 70 ml. The mean cardiac output derived from the stroke volume multiplied by the cardiac function at rest (70/minute) is 4900 ml (5 l/minute). When the cardiac muscle function is 100/minute, with the same stroke volume of 70 ml, the cardiac output increases to 7 l/minute. In the first case, when the mechanism of blood loss control is not triggered, the loss according to the mathematical model using time intervals of 60, 50 and 40 seconds (during application of a tourniquet) is 7 l, 5.83 l and 4.7 l (67% of blood lost), respectively. Installation of the tourniquet in 40 seconds, currently graded as A, is associated with the risk of losing nearly the entire circulating blood volume. According to the author, in the mathematical model it is important to note that the blood loss after 10 seconds is only 1.16 l, i.e. 16.6% of blood from the 7 l of cardiac output. This value is of great importance in the context of the information presented in Table 2.

According to the blood loss classification of the American College of Surgeons, class I corresponds to a blood loss of <15%, with a cardiac output of 7 l/minute, and a pulse rate of 100 beats/minute. Fitting of a tourniquet in 10 seconds results in a limited blood loss and meets the criteria for class I blood loss. Therefore, the training standard should be modified to offer grade A for fitting a tourniquet 10 seconds, instead of 40 seconds, which would be possible if tourniquets were used that did not affect blood rheology and did not impair limb mobility, were permanently fixed to the uniform and worn constantly in the combat setting. In the combat zone, in the armed conflict area, leaving ready-to-use tourniquets in typical places could significantly reduce mortality rates among individuals injured on the battlefield. In the suggested scenario no time would be wasted on the preparation and installation of the tourniquet, and only control of the bleeding after fixing the tourniquet would be required. However, the present field uniforms are not equipped with a system of hidden or detachable tourniquets (e.g. using Velcro). A prompt change should be made in this area.

Another solution involves including in the uniform a permanently fixed device similar to an inflatable cuff, like the ones in blood pressure monitors. Such a cuff would be activated by opening a valve, resulting in the air being sucked in from the outside. Compression of the bleeding site would be achieved even faster. This technique offers tissue compression similar to that obtained with a cuff of a blood pressure monitor.

Scissors and emergency gloves

Emergency gloves (preferably nitrile, a few pairs) should be easy to put on a sweating hand. Black or red gloves should not be used in contact with an injured person. Manufacturers offer gloves with long cuffs, to protect the user from excretions and secretions. Scissors are used to cut the victim's uniform, and their design protects the paramedic against injury. Initially, the examination of the injured person involves all parts of the body, following the examination protocol and anatomic topography. The skilful use of scissors is necessary to provide quick access to the injury site, and evaluate the scope and nature of the trauma. The post-traumatic examination ends with conclusions that determine the scope of medical assistance. Note: the IMP should contain additional pairs of gloves.

Table 2. Classification of blood loss according to the American Society of Surgeons (for males weighing 70 kg)
Tabela 2. Klasyfikacja utraty krwi według Amerykańskiego Towarzystwa Chirurgów (dotyczy mężczyzn o masie ciała 70 kg)

	Class I	Class II	Class III	Class IV
Blood loss (ml)	<750	750-1500	1500-2000	>2000
Blood loss (% blood volume)	<15	15-30	30-40	>40
Pulse rate (per minute)	<100	100-120	120-140	>140
Blood pressure	Normal or decreased	Decreased	Decreased	Decreased
Capillary refill time	Normal	Normal	Extended	Extended
Respiratory rate (per minute)	14-20	20-30	30-35	>35
Urine output (ml/h)	>30	15-30	5-15	Negligible
Conscious	Anxious	Anxious	Anxious, confused	Confused, lethargic
Fluid replacement	Crystalloids	Crystalloids	Crystalloids and blood	Crystalloids and blood

Nasopharyngeal airway tube

The nasopharyngeal airway tube is used to restore airway patency. It is made of a soft material (silicone). After removal from the packaging, it should be covered with a lubricant (gel) to facilitate its entry into and passage through the nasal cavity. It would be more practical if the tube was already lubricated. The optimal solution would involve placing the tube in a sterile package with lignocaine gel that provides both lubrication and anaesthesia. However, creating a tube that would not change its properties at low and high temperatures poses a challenge. Too high an ambient temperature, such as in a desert, results in irreversible damage to the tube. At low temperatures, the tube material can crumble. Moreover, due to low temperatures, the tube may have a traumatic effect on the nasal wall, similar to that of a sharp object.

Occlusive dressing (vented) for the chest

Occlusive dressing for penetration wounds is used to stop immediately the entry of air into the chest. It is covered with a layer of strong adhesive that prevents easy removal of the dressing. Dressings provided in the pouch include an Asherman Chest Seal – ACS (vented), designed for gunshot wounds to the chest, and featuring a typical valve for removing blood and air, or a Sam Chest Seal, designed for stab wounds resulting in tension pneumothorax. It features a special valve with a plug that enables removal of the air from the chest, while preventing the sucking of air in from the outside. These dressings are to prevent respiratory failure, as well as respiratory-cardiovascular failure. An occlusive dressing is an alternative option for a valve dressing, depending on the injury.

Haemostatic dressing

The haemostatics used in the combat setting play an important role in the process of blood clotting. They contain chitosan, a biodegradable substance found in the shells of marine crustacea. Haemostasis with chitosan consists in reactions between positively charged chitin and a negatively charged platelet (thrombocyte) surface. As a result, a haemostatically active gel dressing is formed, and later transformed to harmless glucosamine. Chitin indirectly activates blood platelets. High resistance to MRSA or VRF strains, as well as to *Acinetobacter baumannii* (the information applies to ChitoGauze dressing) is another benefit of this group of haemostatics. The mechanism of action is the same in another haemostatic product: Celox Gauze; however, this one is not absorbed by the organism. Apart from chitosan-based haemostatics, we can use products with kaolin – a silicate clay. The presently used kaolin-based haemostatics do not produce high temperatures that could have a traumatic effect resulting in protein coagulation. Kaolin activates blood clotting factors in the intrinsic coagulation pathway with the vWF factor, with high-molecular-weight kininogen, blood plasma coagulation factors VII, IX, XI and XII, which leads to fibrin formation. The described mechanism of blood clotting is supported by Combat Gauze and QuikClot ACS.

Field dressing

A sterile, vacuum-sealed OLAES field dressing is another element of the IMP. It is not only designed to stop haemorrhaging, but due to its highly absorbent gauze it may be used for additional dressing for a gunshot wound. If the IMP does not contain an OLAES field dressing, it should have an Israeli dressing which features a characteristic plastic pressure bar that allows changing of the direction of the bandage to create pressure on the wound, and stop the bleeding. Apart from the emergency tourniquet, this is a second dressing that can be used to prevent the loss of full blood. However, it should be a second choice if a tourniquet is

available, as that is the principal tool for the mechanical control of haemorrhage.

Proposed changes in the content of the IMP

Every soldier of the Polish Armed Forces and employee of the National Defence Department should be equipped with an Individual Medical Pouch, following the guidelines on the principles of material management regarding the Individual Medical Pouch (IMP) in financial departments and organisational units with this function, issued by the Chief of the Support of the Armed Forces Inspectorate on 1 July 2017. Medical services in every military unit should prepare a training programme regarding pre-medical assistance with the use of an IMP kit; in addition, the programme should cover basic life support (BLS) methods with the use of an automated external defibrillator (AED).

According to the author of this article, the IMP contents (which should be distributed on the uniform) also needs to include a pre-filled syringe with an antibiotic agent, a pneumothorax needle, and a burn dressing.

Antibiotic therapy on the battlefield

Injuries to soldiers in combat settings are susceptible to infection, i.e. a pathological process involving an inflammatory reaction to pathological or potentially pathological microorganisms. These microbes may be present in the tissues, cavities and fluids of the organism, which in normal conditions remain sterile. Therefore, life-threatening conditions associated with bacteraemia should be taken into consideration. Infections of the wounds in the lower limbs and abdomen pose a significant problem in the modern combat setting, as they may determine the success of the implemented emergency strategy. They may cause death, regardless of the correctness of the protocol in force based on the TCCC. As soldiers operate in various environmental conditions, the determinants defining the spectrum of aetiological factors in contaminated wounds will change. They include the type of wound, injury site, time interval between the injury and primary surgical treatment, climate factors, geographic zone, sanitary conditions and personal hygiene. Due to this combination of factors, it is impossible to determine a universal type of antibiotic prophylaxis for the pre-medical care of an injured soldier. Following the classification of a surgical wound, a contaminated open wound is a post-traumatic wound with an inflammatory process other than infection in the operation field, with a penetrating trauma within 4 hours of the procedure, and a chronic wound to be covered with a transplant, with a 20% risk of infection. According to this classification, a contaminated wound is a penetrating trauma wound more 4 hours of the procedure, procedures involving necrotic tissue, with signs of infection in the operating field, pre-operative gastrointestinal perforation, perforation of the biliary tract, or airways, with a 40% risk or infection [9]. If the patient injured on the battlefield is later treated by the Polish healthcare services in a hospital setting, and peri-operative antibiotic prophylaxis is used [10], the general principles of peri-operative prophylaxis do not question the validity of using antibiotics. The problematic issues include what type of antibiotic should be administered, and at what time before the surgery or other medical procedures. In most cases, the antibiotic should cover methicillin-sensitive staphylococci, in the case of urological procedures - Gram-negative bacteria, and in procedures involving opening the gastrointestinal tract, its scope of action should include Gram-negative and anaerobic bacteria. Antibiotic therapy in battlefield medicine has been carefully analysed by numerous authors. Based on combat experience, they believe that antibacterial drugs should be provided early, if possible, up to 3 hours after the injury. At levels 1 and 2 of medical evacuation, cefazolin should be administered. Aminoglycosides and fluoroquinolones are not recommended for Gram-negative bacteria, and penicillin is not recommended to prevent *Clostridium* gangrene or streptococcal infections. In extreme wounds (skin, soft tissue or bone), cefazolin should be administered, in combination with metronidazole in the wounds of the central nervous system, chest and abdomen. According to the TCCC guidelines, a conscious and aware injured person should receive oral moxifloxacin, while an unconscious one should receive intravenous ertapenem [13-16]. Nowadays we understand antibiotics better, as well as their mechanisms of action, when they can be used and at what doses, and we also understand how bacteria develop drug resistance, and can determine the types of bacteria present in a given environment (hospital, city, country). All this does not make it easy to choose the right antibiotic, but there is no doubt that under battlefield conditions antibiotic agents are absolutely necessary. There are numerous reports, from the Vietnam War to the recent Ukrainian conflict, regarding bacteria and the role of wound infections in the recovery process in soldiers. Another problem is the fact that, following the interpretation of the TCCC committee, it is legal for American soldiers to use antibiotics, whereas in the regulation of the Polish Minister of Health on medical rescue activities and health services other than medical rescue activities that can be provided by paramedics [17] antibiotics are not listed; therefore, they cannot be used by Polish paramedics during war. We should strive to introduce legislative changes regarding this issue, to achieve complete compatibility between

Polish and American paramedics. After the administration of an antibiotic, the activity/procedure should be recorded in the medical evacuation chart, and the soldier should be marked with a letter A, as in the case of a tourniquet (T).

Pneumothorax needle

The use of a pneumothorax needle is indicated in the case of pneumothorax, a condition resulting in acute respiratory failure. The procedure is simple and should be performed as indicated in injured soldiers at every stage of medical assistance, including level 1. Pneumothorax decompression is conducted in the second or third intercostal space in the midclavicular line, or the fourth or fifth intercostal space in the anterior axial line.

Burn dressing

Injuries due to high temperature are not common, but their nature and complications may be associated with life-threatening conditions. Modern burn dressings maintain the required temperature for up to 24 hours, they do not dissolve, and do not impede ultrasonographic examinations. The dressing creates and maintains a moist environment in the wound, provides a barrier for external bacteria, enables gas exchange, absorbs wound effusion, alleviates pain, which offers comfort to the patient, does not stick to the wound, and as it is transparent, the healing process can be monitored without removing the dressing. Due to the presented benefits, burn dressings are necessary elements of medical equipment.

IMP - technical aspects

The analysis of issues related to IMP should also include technical aspects, such as size of pouch, distribution of its elements, and change of location from thigh to torso, which seems to be more convenient and safer. A location on the thigh significantly impairs self-aid in the supine position, limits agility and speed while running or crawling, and is problematic when soldiers need to sit next to each other in a combat vehicle or air-raid shelter. The necessity to remove the thigh pack from an injured soldier extends the time to fit the emergency tourniquet on a lower limb. Therefore, the IMP should be moved to another area (e.g. at the front, left side or right side of the torso), in compliance with the MOLLE system (Modular Lightweight Load-bearing Equipment), used in the American Armed Forces. An IMP attached to a tactical vest is simple to use, and individual elements can be easily taken out of the pouch. If the injured soldier is in supine position, lying on the right side or on the left side, reaching for the pouch is easier.

Another method of improving the technical parameters is to increase the size of the IMP, and use it on the thigh in the form of an instrument table (Fig. 2). Enlarging the pouch is necessary due to addition of a pre-filled syringe with an antibiotic, a pneumothorax needle, a burn dressing and an intraosseous needle. In tactical operations one or two soldiers (medical operator or paramedic) in every combat group or team should have an EZiO electric drive kit, and each soldier should have two needles for the drive. By default, there are three needles included in the EZiO: 1.5 cm, 2.5 cm, and 4.5 cm. The IMP variant with additional needles is designed not only for rapid reaction forces. For every soldier who has an intraosseous injection should have this fact recorded in the evacuation chart. Moreover, the injection site should be marked with the exact time and date of injection. The injured soldier should be then marked with “IO”, as with “T” for tourniquet, and “A” for antibiotic, which provides concise information in the form of: TIOA. Another suggestion is a rollable medical pouch whose elements can be packed in thermally sealed plastic packages, as in the individual first aid kits (IFAK). The difference between the IMP and IFAK consists in the ability to use only the tools and material that are required at a given moment (depending on the injury).

Figure 2. Individual Medical Pouch (IMP) – author's proposal
Rycina 2. Indywidualny Pakiet Medyczny (IPMed) – propozycja autora

Conclusion

Every soldier of the Polish Armed Forces and employee of the National Defence Department should be equipped with an IMP. Its content should be changed according to the expiration dates, and individual components must be used in time during medical training for the personnel of every military unit. The content of the IMP should be modified, i.e. a pre-filled syringe with antibiotic, pneumothorax needle, burn dressing and a 2.5 EZIO needle should be added, especially for soldiers in special forces and rapid reaction forces. The IMP should be compliant with the MOLLE system, undergo technical reorganisation, and have its location changed from the thigh to the torso (front, side), or possibly used as a tabletop mounted on the thigh.

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Medical officers and physicians of Kedyw AK (Home Army Sabotage Management) in the Warsaw Uprising

Lekarze-oficerowie i medycy Kedywu Armii Krajowej w Powstaniu Warszawskim

Maciej Kledzik,[1] Stanisław Niemczyk[2]

1 Professor emeritus of history and 19th and 20th century military history, author of 12 books, including 8 on the Warsaw Uprising
2 Head of the Department of Internal Diseases, Nephrology and Dialysis, Central Clinical Hospital of the Ministry of National Defence, Military Institute of Medicine in Warsaw

Abstract. The authors present profiles and experiences of physicians associated with the Home Army Sabotage Management during the Warsaw Uprising. The information comes from historical sources and shows the tragic and heroic fate of Warsaw, its population and physicians.
Key words: Home Army Sabotage Management, Warsaw Uprising, Sabotage Management medical doctors, Jan Zaorski School

Streszczenie. Autorzy przedstawiają sylwetki i losy lekarzy oraz medyków związanych z Kedywem AK w czasie Powstania Warszawskiego. Informacje pochodzą ze źródeł historycznych. Pokazują tragiczne heroiczne losy ludności, miasta Warszawy oraz warszawskich lekarzy.
Słowa kluczowe: Kedyw AK, Powstanie Warszawskie, lekarze i medycy Kedywu, szkoła doc. Jana Zaorskiego

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Corresponding author
Prof. Stanisław Niemczyk MD, PhD
Department of Internal Diseases, Nephrology
Dialysis, Central Clinical Hospital of the Ministry of
National Defence, Military Institute of Medicine
128 Szaserów St., 04-141 Warsaw, Poland
e-mail: sniemczyk@wim.mil.pl

Sabotage Management, abbreviated in Polish to “Kedyw”, was created by Gen. Stefan “Grot” Rowecki, commander of the Home Army by order no. 84 – “Regularisation of the active combat section” dated 22 January 1943. The regularisation concerned the reorganisation of the Union of Armed Struggle - Home Army’s Retaliation and incorporation of “Wachlarz” and the Secret Military Organisation (Polish abbreviation: TOW) in Sabotage Management. Command of Sabotage Management was taken by Col. Emil “Nil” Fieldorf.

In a single-storey house with a garden in the Pelcowizna area (right-bank Warsaw), Col. Fieldorf, in the presence of Capt. Adam “Pług” Borys, met with Capt. Cyprian Sadowski MD, the medical chief of the Wola Area of the Warsaw District of the Home Army. Earlier, Doctor Sadowski complained to his direct supervisor, Col. Henryk “Bakcyl” Lenk, the medical chief of the Warsaw District Command of the Home Army, that service in the Wola district was dull and not for him. This is what led to the meeting with Col. “Nil” Fieldorf, recorded by Doctor Sadowski in his diary.

"Do you know what duties lie ahead of you?" asked Col. “Nil”

"I don’t know yet," said Doctor Sadowski

"We need to organise the medical system, a very elastic and devoted one, arrange hospitals, establish dressing points, get physicians for the units, and organise the staff and mail. Are you aware of the task and the responsibility we will lay on you?"

"I am aware and I am fully at your disposal," Doctor Sadowski replied [1].

During that meeting Doctor Sadowski adopted the underground pseudonym of “Skiba”, from the name of a

friend, Edward Skibiński, murdered by the Germans in a concentration camp. The medical station received the cryptonym "Rola". Appointed as the deputy to Doctor "Skiba" and the chief surgeon of Sabotage Management was Czesław "Bryła" Narkowicz MD. Doctor "Skiba"'s aide was recommended by Capt. "Pług" and it was OCdt. "Zbigniew Podlewski" (Doctor Sadowski only learnt his real name, Zbigniew A. Zawadzki, some years after the war), a student of medicine at the school of Associate Professor Jan Zaorski (students without a medical diploma were medics). The Secretariat of the Medical Station was managed by Sub-Scoutmaster "Pani Stasia" ("Stasia") – Stanisława Kwaskowska. The medical training was managed by Sub-Scoutmaster Zofia Krassowska, known as "Pani Zosia" or "Zośka", a student of medicine. Most of the units of Sabotage Management were formed by scouts.

The first person recruited to work at the Medical Unit of Sabotage Management was a medic, Zbigniew Dworak, known as "Doktor Maks" or "Maks", who became a physician for the "Pegaz" company and for the "Parasol" battalion. At the "Zośka" battalion the medical station was led by a medic, Zygmunt "Brom" Kujawski. All of them had origins in the scouts and were friends from the Medical Officer Cadet School [2]. After a few months the Medical Station was joined by: a medic, Jan "Kalina" Lipieński – to the "Parasol" battalion, a medic, Tadeusz "Poraj" Biernacki – to Dispositional Unit "A", and Jan "Pobożański" Chomiczewski MD, PhD.

The organiser and head of the Warsaw's Sabotage Management, subordinate to the commander of the Home Army District Warsaw, was Capt./Maj. Jerzy Lewiński, and after he was arrested in November of 1943, Józef "Pan Andrzej" Rybicki, a teacher and invalid of 1920, advanced to the rank of a wartime second lieutenant on 1 August 1944. He commanded two dispositional units, "A" and "B", and several smaller ones, as well as the Combat Diversion Units (Polish abbreviation: ODB) from six city districts and from Warsaw County [3]. The medical station was managed by a medic, Tadeusz "Poraj" Biernacki and a medic, Włodzimierz "Wodołaz" Nakwaski. According to an account by Doctor Kujawski from 1987, "Wodołaz" suffered a nervous breakdown and was replaced by 2Lt. Jerzy "Bogdan" Kaczyński MD [4].

Sabotage Management also included physicians and medics who did not practice. The Combat Diversion Unit in Żoliborz was commanded by 2Lt. medic Stanisław Janusz "Stasinek" Sosabowski. The Women's Mine Laying Patrols, a dispositional unit of Sabotage Management of the Warsaw District, was managed by a sports physician, Zofia "Doktor" Franio ("Pani Doktor"). A few days before the outbreak of the uprising she took over command of the Women's Mine Laying Patrol at the High Sapper Command of the Warsaw District Command of the Home Army.

On the day when the death sentence was passed upon SS-Brigadeführer and General-Major of the police, Franz Kutschera, Col. "Nil" Fieldorf congratulated Doctor "Skiba" Sadowski on his promotion to major with seniority, received via radio from London, from 11 October 1939. Soon afterwards Col. "Nil" Fieldorf was replaced as commander of Sabotage Management by Lt. Col. Jan "Radosław" Mazurkiewicz.

On 1 August 1944, around noon, in the apartment of Doctor "Skiba" at 40 Krucza Street, apartment 6., a briefing was held for the team of the Medical Station of Sabotage Management. It was attended by the following: Zbigniew "Maks" Dworak, Zygmunt "Brom" Kujawski, Stanisława "Stasia" Kwaskowska, Zofia "Zośka" Krassowska, Maria "Maria" Szaadowa and aide medic, "Zbigniew Podlewski". After a lunch consisting of potato pancakes, they rode away to their waiting spots. Doctors "Skiba", "Maks" and "Zbigniew Podlewski" went to Wola, to the Karol and Maria Children's Hospital at Leszno, which was the main point of the Medical Station for the "Radosław" Group. After many years Prof. "Zbigniew Podlewski" Zawadzki remembered that on the third day of the uprising he drove off insurgents from a room with wounded Germans, who were looking for members of the SS and Gestapo: "We thought that any lynching of the wounded, regardless of their organisational and military affiliation, was not compatible with the dignity of the Polish people" [5].

On the third day of the Uprising Maj. "Skiba" visited his subordinate Wolski Hospital on Płocka Street. He was guided by Doctor Marian Piasecki, director of the hospital. Operations were conducted on the wounded, numbering approximately seventy. When they were about to sit down with Doctor Piasecki to have a meal, the Germans entered the hospital. Doctor "Skiba" managed to jump out of a window. The physicians, the personnel and the wounded were murdered. The situation was similar at the Karol and Maria Children's Hospital. This is where 2Lt. medic Stanisław J. "Stasinek" Sosabowski was led to on 4 August. By order of the commander of Sabotage Management, Lt. Col. "Radosław" Mazurkiewicz, he was sent with 2Lt. Physician "Bogdan" Kaczyński and OCdt. Stanisław "Stach" Likiernik with the task of taking over the building of the St. Sophia Hospital in Warsaw at the corner of Żelazna and Leszno Streets. While observing the facility, he was hit in the right eye by a ricochet bullet (he had already lost his left one in an accident during childhood) [6]. At the very last moment before the entry of the Germans to the Karol and Maria Hospital, he was led out from there by his wife, an orderly at Sabotage Management. She later led him through the sewers from

the Old Town to the north and then to the south Śródmieście (city centre). He was taken captive. He remained in exile in England, where after he obtained a medical diploma he worked as a physical therapist.

Once the Germans took over the Karol and Maria Hospital, the field hospital was organised at the warehouse of a captured camp in Gęsiówka, in the ghetto area, with an operating theatre where Cpt. Stanisław Gierałtowski MD operated. Due to the approach of the Germans the field hospital was evacuated to the St. John of God Hospital in the Old Town.

Major "Skiba" MD suffered pneumonia after arriving in the Old Town. On 28 August he was evacuated through the sewers to Żoliborz with a group of 70 wounded people. He described this dramatic passage in his "Diary" [7]. He was led from Żoliborz through the German positions to the Kampinos Forest, where he served as the medical chief for the Kampinos Group. After the war he was the chief physician at Ciechocinek Spa for many years. He died in 1985.

What were the fates of the other physicians and medics acting as the physicians at Sabotage Management?

Medic and 2Lt. of the medical corps, Zbigniew "Doktor Maks" Dworak ("Maks") travelled through the sewers from the Old Town to Śródmieście. He was directed by the "Parasol" battalion to Upper Czerniaków, and crossed the spans of the partly demolished Poniatowski Bridge to Saska Kępa. He obtained a medical diploma in 1945. He became a director at the Medical and Epidemiological Station in Szczecin. He died in 1963.

A medic and active medical corps service lieutenant, Zygmunt "Brom" Kujawski travelled through the sewers from the Old Town to Śródmieście, from there to Czerniaków, and then again through the sewers with the soldiers of the "Zośka" battalion to Mokotów, and on 26 September again through the sewers to south Śródmieście. He was taken prisoner and taken to the Stalag IV B Zeithain camp. After his return to Poland he obtained a medical diploma. He died in 1996.

Lieutenant Jerzy Ryszard "Bogdan" Kaczyński MD worked in the Old Town at the "Crooked Lantern" hospital. He travelled through the sewers to Śródmieście, then to the Upper Czerniaków, from there through the sewers to Mokotów, and from Mokotów through the sewers to south Śródmieście. A prisoner of the Stalag IV B Zeithain camp, he returned to Poland. He died in 2011.

The fate of a student of medicine, Tadeusz "Poraj" Biernacki, in the Dispositional Unit "A" of Sabotage Management, in the Uprising in the Protective Detachment of Col. "Monter" Antoni Chruściel, was tragic. He worked at the hospital in the underground part of PKO at Świętokrzyska Street, on the corner of Jasna Street. After the building was bombarded he remained in the ruins with 4–5 dying and 12 wounded persons. On 6 September they all died from an aerial bomb, which buried them in the ruins [8].

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Hospital No. 1 “Technika” and its head of ophthalmology during the Defence of Lviv, 1-22 November 1918

Szpital nr 1 „Technika” i jego szef okulistyki podczas Obrony Lwowa 1–22 listopada 1918 roku

Krzysztof Kopociński, Zbigniew Kopociński

Subdepartment of Ophthalmology of the 105th Borderlands Military Hospital with Outpatient Clinic: head: Krzysztof Kopociński MD, PhD

Abstract. The defence of Lviv is one of the most important events in Polish history. On 1-22 November 1918, the civilian population of the city (mostly middle school and university students) fought against the Ukrainian soldiers of Dmytro Wytowsky, who had achieved a coup d’etat. The Polish health service response was based on two main hospitals: Hospital No. 1 “Technika” and Hospital No. 2 “Dwójka”. The commandant of Hospital No. 1 was Adam Ferdynand Czyżewicz, PhD (1887–1962), and, from 11 November 1918, Lieutenant Aleksander Domaszewicz, PhD (1887–1948). Lieutenant Kazimierz Listowski (1892–1922) served as the commandant for administrative and military affairs. The head of the ophthalmology ward was Lieutenant Juliusz W.S. Drak, PhD (1888–1966), assistant at the Ophthalmological Hospital of the Lviv University, and a student of Professor Emanuel Machek. An excellent Lviv ophthalmologist, Juliusz Drak defended Lviv again in September 1939, this time against German troops. After 1945, he moved to Wroclaw. He died on 17 August 1966 and was buried in the Osobowicki Cemetery.
Key words: Adam Czyżewicz, defence of Lviv, Juliusz Drak, Military Hospital No. 1, Lviv Defenders Cemetery, Lviv University of Technology

Streszczenie. Obrona Lwowa to jeden z najważniejszych epizodów w historii Polski. W dniach 1–22 listopada 1918 r. mieszkańcy miasta (głównie gimnazjaliści i studenci) walczyli z ukraińskimi żołnierzami Dmytra Wytowskiego, który przeprowadził zamach stanu. Polska służba zdrowia działała w oparciu o dwa główne szpitale: Szpital nr 1 „Technika” i Szpital nr 2 „Dwójka”. Komendantem Szpitala nr 1 był doc. dr Adam Ferdynand Czyżewicz (1887–1962), zaś od 11 listopada 1918 r. por. dr Aleksander Domaszewicz (1887–1948). Funkcję komendanta ds. administracyjno-wojskowych piastował por. Kazimierz Listowski (1892–1922). Ordynatorem oddziału ocznego był por. dr Juliusz W.S. Drak (1888–1966), asystent Kliniki Okulistycznej Uniwersytetu Lwowskiego, wychowanek profesora Emanuela Macheka. Znakomity lwowski okulista, dr Drak, bronił Lwowa kolejny raz we wrześniu 1939 r., tym razem przed Niemcami. Po 1945 r. zamieszkał we Wrocławiu, zmarł 17 sierpnia 1966 r., został pochowany na Cmentarzu Osobowickim.
Słowa kluczowe: Obrona Lwowa, Szpital Wojskowy nr 1, Juliusz Drak, Adam Czyżewicz, Politechnika Lwowska, Cmentarz Obrońców Lwowa

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Corresponding author
Zbigniew Kopociński MD, PhD
Subdepartment of Ophthalmology
105th Borderlands Military Hospital with Outpatient Clinic
2 Domańskiego St., 68-200 Żary
telephone: +48 684 707 862
e-mail: zkopocinski@wp.pl

Hospital No. 1 “Technika” during the Defence of Lviv

On the night of 31 October to 1 November 1918, Ukrainian units under the command of Dmytr Wytowsky initiated an armed takeover of the main strategic points in Lviv: the city hall, the citadel, the Ferdinand barracks, the High Castle, the station, etc. In response to these actions on the Ukrainian side, the Supreme Command of Lviv Defence (SCLD) was formed under the command of Capt. Czesław Mączyński (1881–1935), the Medical Chief of which was Lt. Lesław Ignacy Węgrzynowski MD (1885–1956).

Figure 1. Lviv University of Technology, former Hospital No. 1 "Technika", Lviv, Sapiehy Street, 2017 (photograph by Z. Kopociński)
Rycina 1. Politechnika Lwowska, dawny Szpital nr 1 „Technika", Lwów, ul. Sapiehy. 2017 r. (fot. Z. Kopociński)

Figure 2. Lt. Col. Prof. Professor Adam Ferdynand Czyżewicz (1887–1962), first commandant and chief surgeon of Hospital No. 1 "Technika" during the Defence of Lviv in November 1918 (after Nicieja SS. Cmentarz Obrońców Lwowa. [The Lviv Defenders Cemetery] Issued by Zakład Narodowy im. Ossolińskich, Wrocław-Warsaw-Kraków 1990: p. 33.)
Rycina 2. Ppłk prof. Adam Ferdynand Czyżewicz (1887–1962), pierwszy komendant i naczelny chirurg Szpitala nr 1 „Technika", podczas Obrony Lwowa w listopadzie 1918 r. (źródło: Nicieja SS. Cmentarz Obrońców Lwowa. Wyd. Zakład Narodowy im. Ossolińskich, Wrocław–Warszawa–Kraków 1990: 33.)

The fight for their beloved city was joined by the civilians, to a large extent extremely devoted youths from schools, gymnasiums and universities (the Lviv Eaglets), which is why the armed clashes were very hard-fought and bloody, paid for by the significant number of people killed and wounded. It was not until 19 November 1918 that the representatives of the Ukrainian National Council and the Polish National Committee reached an agreement on the protection of the wounded and the fallen, according to which hospitals were excluded from direct war operations and had the right to maintain a unit of 15 soldiers, and after each clash five-man medical patrols bearing the flag of the Red Cross could safely collect the wounded and dead [1-4].

The Medical Chief of the SCLD headed two main treatment facilities: Hospital No. 1 "Technika", located in the building of Lviv Polytechnic, and Hospital No. 2, located in the buildings of the House of Invalids on Kleparivska Street. When the fighting started, Lviv Polytechnic formed a quarter of the Austrian 1st Military Reserve Hospital ("Der I. K.u.K. Reservespital") under the command of a surgeon, Col. Henryk Hilgenreiner (1870–1954).

On 2 November 1918 a unit commanded by Ludwik Wasilewski took over this outpost, which made it possible to organise a Polish military hospital there, which initially adopted the name of the "Hospital of the Polish Forces at Technika" (a white plate with amaranth letters was hung on the building of the Polytechnic), which over time became more widely known as Hospital No. 1 "Technika". It should be emphasised that this was a major success of the Polish Medical service, as this facility was well supplied and organised by the Austrian army, with a commandant who was primarily a physician and rendered valuable services to the Polish side by participating in the treatment of the wounded and the sick.

Figure 3. Col. Professor Aleksander Domaszewicz (1887–1948), from 10 November 1918 commandant of Hospital No. 1 "Technika", during the Defence of Lviv (after Wawrzkowicz E, Klink J, eds. Obrona Lwowa 1–22 listopad 1918. Organizacja listopadowej Obrony Lwowa. Ewidencja uczestników walk. Lista strat [The Lviv Defence on 1-22 November 1918. Organisation of the November Defence of Lwów. Combatant record. List of losses]. Vol. III Volumen Publishing House, Warsaw 1994: p 96.)

Rycina 3. Płk prof. Aleksander Domaszewicz (1887–1948), od 11 listopada 1918 r. komendant Szpitala nr 1 „Technika", podczas Obrony Lwowa (źródło: Wawrzkowicz E, Klink J, eds. Obrona Lwowa 1–22 listopad 1918. Organizacja listopadowej Obrony Lwowa. Ewidencja uczestników walk. Lista strat. Tom III. Oficyna Wydawnicza Volumen, Warszawa 1994: 96)

The first person appointed as the Polish commandant of the hospital was Associate Professor Adam Ferdynand Czyżewicz PhD (1887–1962), who on 10 November 1918 passed the command to Lt. Aleksander Domaszewicz (1887–1948), at the same time remaining the chief surgeon of the outpost. The function of administrative and military commandant was taken over by Medical Lt. Kazimierz Listowski (1892–1922) [1, 5, 6].

It should be emphasised that the commandants of the outpost, both by their attitude during the Defence of Lviv and by means their lifetime achievements, went down

Figure 4. Cemetery near Hospital No. 1 "Technika", Lviv, 1918 (after Nicieja SS. Cmentarz Obrońców Lwowa [The Lviv Defenders Cemetery]. Issued by Zakład Narodowy im. Ossolińskich, Wrocław–Warsaw–Krakow 1990: p. 68)

Rycina 4. Cmentarz w rejonie Szpitala nr 1 „Technika", Lwów, 1918 r. (źródło: Nicieja SS. Cmentarz Obrońców Lwowa. Wyd. Zakład Narodowy im. Ossolińskich, Wrocław–Warszawa–Kraków 1990: 68)

extremely well in Polish history. Adam F. Czyżewicz was an excellent gynaecologist, and when the fighting began in Lviv was an assistant at the Obstetrics and Gynaecology Clinic of the University of Lviv. In 1920 he was nominated professor and took over as the head of Obstetrics and Women's Diseases of the University of Warsaw. For his devoted service to his homeland he was promoted to lieutenant colonel, decorated with the Commander's Cross of the Order of Polonia Restituta, the Cross of Valour, the Lviv Defence Cross and the Decoration of Honor "Eaglets" [7, 8].

The second commandant, Aleksander Domaszewicz, was an experienced and battle-hardened military physician, who in the years 1915–1917 was the head of the field hospital of the 1st Brigade of the Polish Legions, whereas in the inter-war period he was elected to the Sejm in the 3rd and 4th term, as well as becoming president of the Non-Party Bloc for Cooperation with the Government (BBWR). After 1945, as a professor, he acted as the head of the Department of Neurosurgery at the University of Warsaw. In consideration of his devoted service he was promoted to colonel, decorated with the Virtuti Military Cross, the Officer's Cross of the Order of Polonia Restituta, the Lviv Defence Cross and the Cross of Valour and bar [9].

Military Hospital No. 1 "Technika" had the following wards: surgical, internal diseases, neurology, ophthalmology, laryngology, infectious diseases, and dental. The facility had a medical-transport column of cars and wagons, a well-supplied pharmacy and warehouses, pantry and kitchen. The main department was located in the building of the Polytechnic, it also had

Figure 5. Capt. Juliusz W.S. Drak, PhD (1888–1966), Lviv, 1912 (courtesy of Barbara Drak)
Rycina 5. Kpt. dr Juliusz W.S. Drak (1888–1966), Lwów, 1912 r. (dzięki uprzejmości Barbary Drak)

branches elsewhere: in the Piramowicz dormitory at 6 Listopada Street, in the correctional facility for women and the Russian gymnasium at on Sapieha Street. The surgical ward was headed by the chief surgeon of the hospital, Associate Professor Adam F. Czyżewicz MD, supported by Prof. Hilary Schramm (1857–1940). The laryngology ward was headed by Maj. Prof. Teofil Zalewski (1872-1953), the ophthalmology ward by Lt. Juliusz Drak MD (1888–1966), and the neurology ward by Capt. Associate Professor Jakub Rothfeld MD (1884–1971). Maj. Associate Professor Wincenty Czernecki MD (1876–1960) was the lead in the internal diseases ward, supported by Prof. Juliusz Karol Marischler (1869–1931). The stomatology patients were taken care of by Lt. Zygmunt Manovarda de Jana (1889–1938). The ranks of the medical personnel forming the team of the facility also included Tadeusz Walichiewicz (1877–1954), Andrzej Kończacki, Capt. Ludwik Csala PhD (he became famous in 1931 during the well-known trial of Rita Gorgonowa, charged with the murder of her stepdaughter, he conducted the examination of the body of Elżbieta Zarembianka, murdered in Brzuchowice near

Figure 6. Gravestone of Juliusz and Zofia Drak, Osobowicki Cemetery in Wroclaw, 2018 (photograph by Z. Kopociński)
Rycina 6. Grób Juliusza i Zofii Drak, Cmentarz Osobowicki we Wrocławiu, 2018 r. (fot. Z. Kopociński)

Lviv), Janina Morawiecka PhD and Capt. Józef Aleksiewicz PhD (1884–1957) [1, 10].

It should be emphasised that there was not even the slightest problems in staffing the hospital, although the work at the facility was not easy and was significantly risky, related both to the infectious diseases (raging typhus exanthematicus, Spanish flu, trachoma, and other epidemics) as well as being fired on by the Ukrainians, who did not respect the international conventions nor the agreements concluded with the Polish side and who numerous times attacked the facilities marked with the Red Cross sign.

The option of joining the ranks of the Polish Military Health Service resulted in dozens of young women "storming" the Polytechnic, asking the hospital's commandant to be accepted into its ranks. As recounted by Count Maurycy Mycielski, a veteran of the Defence of Lviv, who at Hospital No. 1 acted as a storekeeper for soldiers' deposits: "…The example of a handful of young people (…), which was to take the 6th district, had such a stimulating effect on the civilian population that everyone craved to serve in the military and idly remaining at home was considered shameful and dishonourable…".

The staff of the facility was also reinforced by prisoners of war (Italians, Serbs and Russians) taken over from the Austrians, who performed ancillary activities. A major problem during the Defence of Lviv were power shortages, which forced the personnel to work by the light of candles and kerosene lamps (a power-generating unit was obtained later) [6].

The ophthalmology ward of Hospital No. 1 and its head

War operations result in unavoidably numerous cases of damage to the eyes. Isolated eye injuries are definitely

not direct threats to life, but they are a potential source of permanent disability in the form of blindness. The years 1916–1917 in Lviv brought a large number of patients with eye injuries as a result of all kinds of explosions, direct firing and wounds caused by shrapnel. In over 1000 maimed patients, most of them were under age (8–18 years), which might also indicate that playing with unexploded shells or ammunition was one source of the problem.

Similar issues had to be faced by Lt. Juliusz Drak PhD, the head of the ophthalmology ward of Hospital No. 1 "Technika", for whom an additional serious problem was the then spreading trachoma epidemic, a serious infectious disease affecting the eyes. Luckily for the patients, he was a well-educated ophthalmologist, from the famous "Lviv school of ophthalmology" of Prof. Emanuel Machek (1852–1930). Certainly, the figure of this physician, who joined the team of Hospital No. 1 "Technika" without hesitation to protect Polish Lviv, is worth presenting [1, 11].

Juliusz Władysław Seweryn Drak was born on 8 August 1888 in Lviv to the family of Juliusz and Jadwiga Drak. His father was a valued official in Lviv's Treasury Chamber, therefore ensuring that the financial situation of the family was very good, and which allowed the son to be provided with a good education. Young Juliusz graduated in 1906 from the well-known Imperial-Royal 6th Gimnazjum in Lviv, and began studies at the Faculty of Medicine of the University of Lviv (at that time under the name Imperial-Royal Francis I University). He obtained the diploma of doctor of all medical sciences in 1912. His favourite field was ophthalmology, which is why he decided to develop his professional career in that direction. In the years 1914–1921 he was an assistant at the Ophthalmology Clinic in Lviv, headed by Prof. Emanuel Machek. He cooperated with Assistant Professor Wiktor Feliks Reis PhD (1875–1943), Albin Musiał PhD (1886–1959) and Janina Mikulińska PhD.

He reconciled the pursuit of ophthalmology as a specialisation and academic work with a medical practice at 17 Nabielaka Street in Lviv, which ensured him a fair existence. Taking advantage of the educational talents and experience of his masters and older colleagues, in a few years he became a good and valued ophthalmologist. It should be particularly emphasised that at that time Emanuel Machek belonged to the group of top ophthalmologists on a global scale, whose achievements with the entire team of associates placed the Ophthalmology Clinic in Lviv in 4th position in the world in 1914, according to the international Nagel's statistics, after Berlin, Amsterdam and New York (which contemporary Polish clinic could come even close to this result?). Just like every other student of Machek, Juliusz Drak did not neglect his academic work. He published several case studies, such as "Gruczolak torbielowaty rąbka spojówki" [Cystic adenoma of the limbal conjunctiva] (1925), "Rzęsa w komorze przedniej z guzem tęczówki po urazie" [An eyelash in the front chamber with an iris tumour after an injury] (1926), and "Przypadek śródbłoniaka marszczki półksiężycowatej" [A case of endothelioma in the semilunar ruga] (1927) [1, 11-18]. After the outbreak of World War I, as a part of the mass mobilisation, he was enlisted in the Imperial-Royal army as a physician of the 3rd Reserve Military Hospital ("Der III. K.u.K. Reservespital"), where he served until 12 December 1915.

When the Russians entered Lviv on 4 September 1914 this outpost was officially handed over for the needs of the Committee of the Red Cross, and the Ophthalmology Clinic organised the 5th surgical and ophthalmologic pavilion under the supervision of a gynaecologist, Rudolf Brejter PhD. The ophthalmological patients were taken care of by Juliusz Drak PhD and Albin Musiał PhD. In the course of the Defence of Lviv on 18 November 1918 the then Lt. Juliusz Drak PhD took over as head of the ophthalmology ward of Hospital No. 1 "Technika", where he performed his duties until 1 May 1919, that is until the end of the siege of Lviv by the Ukrainians. His patients included participants of the fighting in Lviv, the soldiers taking part in the relief, as well as the civilian population (regardless of their nationality – including Ruthenians). Most of them were people with all kinds of injuries caused by foreign bodies resulting from explosion or shooting: superficial and penetrating wounds of the eyelids and the walls of the eyeball, foreign bodies in the cornea and the conjuctiva, intraocular foreign bodies, different types of inflammations, including trachoma infections, etc.

After the end of the siege of Lviv, Doctor Juliusz Drak was soon assigned to the Gendarmerie Command in Lviv, and from 8 May 1919 he became a part of the team of Field Hospital No. 601. On 22 June 1919 he joined the ranks of the Regional Hospital in Lviv, where he served for the next six months. With the beginning of 1920 he took over as the physician of the reserve battalion of the 40th Children of Lviv Infantry Regiment – the unit which at that time seized Różany and Kopytyńce. At the end of March 1920 he spent several days with the reserve battalion of the 39th Lviv Rifles Infantry Regiment in Jarosław, from where he was directed to serve at the Military Hospital in Jarosław, where he remained until 27 August 1920. The commanders of both of these units rated his attitude highly in the critical days of the Polish offensive during the Battle of Warsaw. At the end of August 1920 he took up the position of physician with the 51st Borderlands Riflemen Infantry Regiment, which at that time was engaged in tough fighting in the area of Przemyślany and Świrz, as well as by the Gniła Lipa

River. He returned from the front to Lviv on 28 October 1920 to reinforce the team of the local Regional Hospital again for four months. Then he put on the yellow hatband and the colours of the 14th Jazlowiec Uhlan Regiment, taking up the position of physician in the Reserve Squadron. With a short break he served in this unit, called Lviv's charm and the favourite regiment of the Semper Fidelis city, until demobilisation on 29 February 1922. In consideration of his devoted attitude in the course of war operations he was promoted to the rank of captain with seniority from 1 June 1919 and decorated with the Lviv Defence Cross (I.2846), the Young Eagles Badge of Honour and the Badge for Being at the Front. After demobilisation he was assigned as a reserve officer to the 2nd medical battalion in Lublin and in 1937 he was transferred in the registry to the Reserve Cadre of the 6th King John III Sobieski Regional Hospital in Lviv [11, 19].

In the 20 years of the interwar period, Doctor Juliusz Drak ran a thriving ophthalmological practice at 56 Syskstuska Street (1st floor), where he worked at the following hours: 11am–1pm and 2pm–5pm. He also worked for an insurance company in the ophthalmological outpatient clinic at 2 Fredry Street.

This period of peaceful and safe existence lasted less than 20 years. This was probably one of the happiest episodes in the life of Juliusz Drak. On 27 August 1939, as a 51-year-old, he was moved to the mass mobilisation group in the face of the German threat and again mobilised to active military duty by the Reserve Cadre of the 6th Regional Hospital in Lviv. During the tragic September 1939 campaign he defended Lviv for the second time in his life, this time against the Germans. Under the Molotov–Ribbentrop Pact Lviv, which resisted the German invader, due to a hopeless tactical situation, was surrendered to the Soviets.

On 27 September 1939 Capt. Juliusz Drak PhD was released from military service, which he confirmed with a signature in his military service book. The commandant of the hospital, Lt. Col. Zygmunt Sawicki PhD (1888–1940), was arrested a month later by the NKVD and murdered. This is how the ophthalmologist from Lviv managed to avoid the arrest by the Soviet special forces and a death in Katyń, where many of his colleagues lost their lives. Together with his family he survived the difficult time of the occupation and the mass murders committed by the Ukrainian nationalists. After 1945, like a major part of the academic world of Lviv, he made his way to what were called the Recovered Territories, to Wrocław [11, 20, 21]. In this capital of Lower Silesia he was one of the many pioneers of medicine from the Borderlands, where he worked in such places as District Clinic No. 2.

In his private life he had a fulfilling marriage to Zofia Antonina Schally (1901–1967), a sister of the Chief of the Military Office of the President of the Republic of Poland, Brig. Gen. Kazimierz Piotr Schally. It is worth mentioning that a nephew of Zofia Drak, Andrzej Wiktor Schally, was also a physician and biochemist, who in 1977 received a Nobel Prize in the field of medicine for discoveries related to the hormone production by the brain's hypothalamus.

Doctor Juliusz Drak was a passionate traveller and an expert on Esperanto, which was created by another Polish ophthalmologist, Ludwik Zamenhof PhD (1859–1917). The son of Juliusz and Zofia Drak, who in accordance with family custom was also named Juliusz (1921–1978), continued the professional family tradition and worked as a physician in the capital of the Lower Silesia. The grandson of the heroic Defender of Lviv, Andrzej Drak, also followed in the footsteps of his father and grandfather; he became a great surgeon, head of the trauma surgery ward at the Marciniak Hospital in Wrocław.

The head of this great, multigenerational family of physicians, Capt. Juliusz Władysław Seweryn Drak, a great ophthalmologist from the "Lviv school of ophthalmology", a student of Prof. Emanuel Machek, head of the ophthalmology ward of Hospital No. 1 "Technika" during the Defence of Lviv, died on 17 August 1966 and was buried two days later at the Osobowice Cemetery in Wrocław, area 41, row 2, grave 455 A [11, 22].

Conclusions

Hospital No. 1 "Technika", owing to the attitude of its cadre during the Defence of Lviv, went down in the history of the Polish military health service in golden letters. As a result of the treaties of Yalta and Potsdam all the eastern borderlands including Lviv were annexed by the USRR. For almost half a century one could not even utter the name "Lwów", or honour the heroic soldiers of the Always Faithful city of the polish Republic. It is high time we restored due position in the pantheon of Polish national heroes to the defenders of Lviv, including the members of the military hospitals who risked their lives to save the residents of the city of lions. It should be strongly emphasised that the fighting cost the lives of 439 soldiers and members of the military medical service, killed outright or dying as a result of wounds, including 8 physicians. On the 100th anniversary of Poland regaining its independence, and at the same time the Defence of Lviv in November 1918, it is our duty to shed light on the obscured figure of this ophthalmologist from Lviv, who while his stature might not have been significant (167 cm), his fighting spirit and will were tremendous. When the battle for his city began,

he did not hesitate for a single moment and joined the team of the Polish military hospital, without mobilisation and legal enforcement, just out of heart's need [3, 11]. This is how the borderland youth were brought up, as in families from Lviv patriotism and service to the homeland were always predominant. He provided medical assistance to all those in need, also to the people of other nationalities, including the Ruthenians, who as the source of aggression at that time (Ukrainians). It can be stated without any doubt that Doctor Juliusz Drak should be a role model for all the contemporary military physicians, especially ophthalmologists.

The inscription on his tombstone, where he is buried with his wife, informs passers-by that they were both from Lviv and that the doctor practised ophthalmology. Unfortunately, it does not mention that an officer of the Polish Army and a two-time Defender of Lviv lies there. This example is doubtlessly an inspiration to consider the possibility of adopting appropriate legal solutions by the state (self-government) authorities, which would ensure marking all the remaining graves of the Defenders of Lviv in Poland with a Lviv Defence Cross and at the same time taking over the duty to maintain them by the Cemetery Administrations, in order to prevent liquidation of the graves of heroes in the case of the childless death of their kin.

In this way we would be able to save the graves of people of particular merit to the homeland, and the Lviv Defence Cross marking them (subject to the family's approval, of course) would be a distinction and a reference to the custom adopted in Lviv, where each tombstone at the Cemetery of the Defenders of Lviv carried the inscription "Defender of Lviv", which was the greatest ennoblement for any resident of Lviv.

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