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A survey of the implementation of therapeutic hypothermia following cardiac arrest by Polish emergency medical services

Ocena skali zastosowania hipotermii terapeutycznej po zatrzymaniu krążenia w zespołach ratownictwa medycznego w Polsce

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Abstract. Therapeutic hypothermia (TH) is an intervention method that improves survival and neurological outcome after cardiac arrest. Resuscitation guidelines recommend TH in unconscious patients after return of spontaneous circulation regardless of cardiac arrest location or rhythm. Assesses knowledge of TH among emergency medical service members and evaluates their HT implementation in Poland. From August to October 2013, an anonymous survey on HT use in prehospital care was carried out among the Emergency Medical Service (EMS) members. Information was obtained from 138 EMS employees, with 11% (16/138) using TH in prehospital care. HT is not commonly used in prehospital care by Polish EMS. The main obstacles are lack of equipment and appropriate protocols.
Key words: post-resuscitation care, prehospital implementation of therapeutic hypothermia

Streszczenie. Wstęp: Hipotermia terapeutyczna (HT) jest interwencją poprawiającą przeżywalność oraz status neurologiczny pacjentów po zatrzymaniu krążenia. Wytyczne resuscytacji zalecają stosowanie tej metody leczenia u nieprzytomnych pacjentów, u których doszło do powrotu spontanicznego krążenia niezależnie od miejsca zdarzenia oraz rytmu powodującego zatrzymanie krążenia. Cel: Określenie wiedzy na temat HT wśród pracowników zespołów ratownictwa medycznego (ZRM) oraz ocena zastosowania HT przez ZRM w Polsce. Próba identyfikacji barier dotyczących wdrożenia HT. Metoda: W okresie od sierpnia do października 2013 wśród przedstawicieli ZRM przeprowadzono anonimową ankietę dotyczącą zastosowania HT w opiece przedszpitalnej. Wyniki: Ankietę wypełniło 138 pracowników ZRM. 11% z nich (16/138) deklarowało indukowanie HT w warunkach przedszpitalnych. Wnioski: HT nie jest powszechnie stosowana przedszpitalnie w polskich ZRM. Głównymi przeszkodami w stosowaniu tej metody są brak sprzętu i odpowiednich protokołów.
Słowa kluczowe: hipotermia terapeutyczna w warunkach przeszkodami zamienić na ograniczeniami, opieka poresuscytacyjna

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Introduction

Therapeutic hypothermia (TH) is defined as controlled lowering of body core temperature to the range 32–34°C for 12-24 hours, followed by gradual raising of the temperature to the physiological level. This intervention is one of few procedures improving the survival and neurological status of patients following cardiac arrest NNT = 6 (number needed to treat) [1]. Resuscitation guidelines recommend this method in unconscious patients after return of spontaneous circulation (ROSC), regardless of the site of the event (in or outside hospital) or the cardiac rhythm. TH reduces systemic inflammatory response of the body associated with post-resuscitation syndrome. With a reduction of body temperature by 1°C, brain oxygen consumption rate decreases by 6% [2]. This procedure consists of three phases: induction, maintenance and warming-up phase. There is strong scientific evidence for the effectiveness of this

method, although unequivocal data regarding the optimal time of therapeutic hypothermia induction are not available.

Aim of the study

To establish the level of knowledge about TH and implementation of this procedure by Emergency Medical Services (EMS) teams in Poland. To identify barriers for implementation of TH.

Material and methods

In the period August to October 2013, an anonymous survey was conducted regarding implementation of TH by EMS employees (paramedics, physicians, and nurses), including Medical Air Rescue teams in Poland. The questionnaire, consisting of 9 questions, was sent to EMS members in various regions of the country. For questions 4, 6 and 10 multiple answers were allowed.

1. Do you know the term "therapeutic hypothermia"?
2. Do you use therapeutic hypothermia in Emergency Medical Services teams?
3. How does therapeutic hypothermia affect the improvement of a patients' neurological condition at hospital discharge, or 6 months following a cardiac arrest episode outside hospital?
4. What are the indications for therapeutic hypothermia in an adult person?
5. When should one start therapeutic hypothermia?
6. How can therapeutic hypothermia be induced by Emergency Medical Services teams?
7. What is the target temperature in therapeutic hypothermia?
8. Is the center to which the patient is transported by the Emergency Medical Services team following cardiac arrest prepared to continue therapeutic hypothermia?
9. Do you think it is possible to induce therapeutic hypothermia by an Emergency Medical Services team?
10. What are the obstacles in implementing therapeutic hypothermia in prehospital care?

Results

The survey involved 138 members of EMS in Poland, including ground based teams and Medical Air Rescue services. For 95% (131/138) of those surveyed the concept of TH is known, 11% (16/138) of EMS teams in the study initiate TH during prehospital care, 92% (127/138) declare that TH positively affects final neurological condition at hospital discharge or 6 months following cardiac arrest (CA), 2% (3/138) claim that it demonstrates adverse effects, whereas 6% (8/138) claim that the procedure is of no significance. 35% (48/138) answered that TH should be implemented in ROSC after CA in ventricular fibrillation or pulseless ventricular tachycardia, and 34% (47/138) suggested implementation of TH after CA in pulseless electrical activity/asystole (of which 61% [85/138] indicated a necessity to use TH in defibrillable and non-defibrillable rhythms). Additionally, 16% (22/138) answered that TH is induced in patients with cerebral stroke, and 15% (20/138) at a temperature of >39°C. Determining the time of TH induction, 26% (36/138) of respondents answered: during cardiopulmonary resuscitation (CPR). 35% (48/138) of subjects indicated that TH induction should be started immediately after return of spontaneous circulation, 19% (26/138) that the therapeutic slot for TH induction is 4 hours, and 20% (27/138) that there are no unequivocal time limits. The majority of the study subjects, i.e. 66% (91/138) were of the opinion that for prehospital TH induction external methods can be used, e.g. bags of ice or cooling mats or blankets, or internal methods, e.g. transfusion of 0.9% saline solution or lactated Ringer's solution at 4°C. 23% (32/138) indicated only the external method, whereas 7% (10/138) only the internal method. The remaining 28% (38/138) suggest starting TH with the use of special TH-inducing nasal catheters. Target temperature: 61% (84/138) of the respondents indicated the correct temperature range of 32–34°C. 31% (43/138) of centers are ready to continue TH in hospital conditions after admitting the patient. 40% (55/138) did not have sufficient knowledge on the subject, and 39% (54/138) think it is possible to introduce the TH induction protocol in the prehospital phase. The most often reported obstacles to implementation of the procedure included: lack of proper equipment 35% (48/138), lack of knowledge/protocols 37% (51/138) and lack of experience 26% (36/138).

Discussion

The survey results demonstrate that the rate of prehospital application of TH was 11%. This is not much compared to observations in the Czech Republic, where therapeutic hypothermia induction in prehospital conditions in 2010 was declared by 41% of Emergency Medical Services teams [3]. Unfortunately, in Poland only Medical Air Rescue teams have sets for inducing therapeutic hypothermia. It should be emphasized that in prehospital care TH induction is usually possible. Spontaneous lowering of temperature (absence of warming) is not enough to initiate the procedure in prehospital conditions [4]. Presently, no research observation results are available that unambiguously indicate benefits of early prehospital TH induction; however, studies in other countries confirm that prehospital TH is safe and effective [5]. Before TH is induced, it is important to know if the procedure may be continued in the center

to which the patient with ROSC is transported, as high temperature fluctuations or discontinuity may adversely affect the prognosis of patients after cardiac arrest. In 2010, 21% of intensive care units in Poland declared they use this procedure [6]. The results provided by the survey subjects suggest that up to 31% of centers may continue hypothermia initiated in prehospital conditions. When should TH be induced? There are reports demonstrating that TH induction with the use of special nasal catheters or by cold fluid transfusion is possible already during CPR [4, 7]. "Cooling should start immediately after ROSC" – this recommendation is included in the European Society of Cardiology (ESC) guidelines [8]. Studies conducted in 2002 prove that cooling is effective (i.e. a positive neurological treatment outcome was obtained) even if it is applied 4-6 hours after return of spontaneous circulation [9]. Clinical studies and studies on animals emphasize the benefits of early TH implementation, but so far it has not been demonstrated that the speed at which the target temperature is reached results in better treatment outcomes in humans [10]. In 2011, data was published suggesting that each hour of delay in TH induction increases the risk of patient's death after cardiac arrest by 20%. Based on these reports, for 3 years (2006-2009) of following the COOL IT protocol in certain regions of the United States it was possible to reduce the time of TH implementation by up to 90 minutes [11]. However, until now a consensus has not been developed regarding optimal time of TH implementation in patients with ROSC. Also, it has not been demonstrated that prehospital TH increases survival or improves neurological status of patients in comparison to TH supplied in patients with ROSC in hospital conditions [12]. All the data obtained in studies confirm that prehospital TH is possible, effective and safe. Inducing TH with the use of internal methods, 30 ml/kg of crystalloids should be transfused, at 4°C. Such volumes may be used safely, as studies demonstrate that transfusion of even 2-3 liters of fluids is not associated with additional adverse effects (e.g. pulmonary edema) [5]. By transfusing large volumes of cold fluids (30 ml/kg 4°C of physiological NaCl solution), the temperature may be lowered <35°C in 41% of patients [13]. It was demonstrated that transfusions of small quantities, 15-20 ml/kg, also effectively reduce temperature in prehospital conditions. The same study demonstrated reduced need for catecholamines during transportation in patients who had TH induced with small volumes [14]. A case of a 2-year-old boy shows that cold fluid transfusion is possible also with intraosseous access. 225 ml (16.7 ml/kg), 4°C, of 0.9% physiological NaCl solution was transfused to an unconscious child with ROSC, using EZ-IO. It enabled the lowering of temperature measured at the tympanic membrane from 33.5 to 32.0°C in the prehospital phase; the procedure was continued at an intensive care unit for 48 h [15]. The child was discharged without any neurological damage. It should be remembered that TH implementation in prehospital conditions is affected by many factors:

- ambient temperature – the temperature of 4°C physiological NaCl solution after 6 minutes from taking out of the fridge rises to 12°C, so using small packages of the solution (250 ml) seems to be more effective [16],
- time of arrival at an emergency department or invasive cardiology department,
- patient's response to temperature lowering; cooling unconscious patients may cause muscle spasms, so certain protocols recommended routine use of midazolam, or even muscle relaxants to avoid them [12].

During the therapeutic hypothermia maintenance phase a measurement of core temperature is required (temperature measured in the esophagus or urinary bladder). In prehospital conditions only Medical Air Rescue teams have proper equipment for such measurements. Numerous studies indicate that in the prehospital phase external temperature control (e.g. at the tympanic membrane) is sufficient and safe [11].

The survey demonstrated that EMS members are familiar with TH. 11% (16/138) of the EMS members declare inducing TH in prehospital conditions, but only Medical Air Rescue teams have proper equipment and protocols. Among the obstacles to TH induction in prehospital conditions the subjects mentioned: lack of proper equipment 35% (48/138), lack of knowledge/protocols 37% (51/138), and lack of experience 26% (36/138).

Study limitations

The study did not take into account regionalization of the subjects. Medical Air Rescue teams are not presented separately. It was not marked if the questionnaire was completed by a paramedic, physician or nurse. Estimates indicate that in Poland there are 890 basic EMS teams, 600 specialist EMS teams, and 17 Medical Air Rescue bases. Approximately 15,000 paramedics are employed in the system. Seasonal bases should also be considered (e.g. Medical Water Rescue teams), thus the group of 138 survey subjects represents only a small percentage of the National Emergency Medical Services system.

Prior to the publication of this study, an article appeared whose authors suggest that early TH does not improve survival or neurological status of patients with ROSC [17].

Conclusions

The studies presented above demonstrate that implementation of therapeutic hypothermia is possible and effective during prehospital care, and it does not require complicated equipment or procedures. In patients whose circulation was returned, optimization to obtain adequate perfusion and organ oxygenation is a priority procedure. In the light of currently available scientific evidence, prehospital TH implementation should be considered in case of prolonged transportation of patients with ROSC, if the destination center is far from the site of the event. It would require proper protocols, legal regulations and collaboration between centers. 11% of the survey subjects apply TH in prehospital conditions. The existing barriers include lack of proper equipment, experience or protocols. Their identification will help to introduce more effectively this method of treatment in situations in which it is required, after indication of the optimal cooling period. Further studies on the optimal TH induction time will also be of assistance.

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Evaluation of coronary pain treatment by emergency teams and primary health care physicians

Ocena leczenia bólu wieńcowego przez zespoły ratownictwa medycznego i lekarzy podstawowej opieki zdrowotnej

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Abstract. In 1995, the American Society of Pain Management included pain as a life parameter. Therefore, pain should be evaluated, monitored and treated. It is therefore necessary to train doctors, system nurses and emergency medical technicians in treating pain as a vital parameter which can significantly affect the assessment of the quality improvement of patient care. Coronary pain is caused by heart ischemia, or reduction in the amount of oxygen supplied by the blood to the heart and usually occurs in situations of increased myocardial oxygen demand. It is usually felt as burning, tightness in the chest and may radiate. Cardiac arrhythmias, signs of left ventricular failure, tachycardia, and high or low blood pressure often appear, causing a feeling of emotional arousal and life-threatening situation. As such, pain should be properly recognized, evaluated and treated by emergency teams. The aim of this study was to assess the use of analgesia in the treatment of coronary pain by mobile teams of the Świętokrzyskie Medical Emergency Center, carried out on the basis of the medical records of patients treated for ACS in the Center for Invasive Cardiology, Angiology and Electrotherapy in Ostrowiec Świętokrzyski.
Key words: coronary pain, emergency ambulance service, treatment

Streszczenie. Amerykańskie Towarzystwo Leczenia Bólu już w 1995 roku uznało ból za parametr życiowy. W związku z tym ból należy oceniać, monitorować i leczyć. Konieczne jest więc szkolenie lekarzy, pielęgniarek systemu i ratowników medycznych, by traktowali ból jako parametr życiowy, co wydatnie może wpływać na poprawę oceny jakości opieki nad pacjentem. Ból wieńcowy spowodowany jest niedotlenieniem serca, czyli zmniejszeniem ilości tlenu dostarczanego wraz z krwią do serca, pojawia się on zazwyczaj w sytuacjach zwiększonego zapotrzebowania serca na tlen. Ma on najczęściej charakter pieczenia, ucisku w klatce piersiowej, może promieniować. Często występują zaburzenia rytmu serca, objawy niewydolności lewokomorowej, tachykardia, podwyższone lub obniżone ciśnienie tętnicze krwi. Powoduje uczucie pobudzenia emocjonalnego i zagrożenia życia. Jako taki powinien być prawidłowo rozpoznawany, oceniany i leczony przez zespoły ratownictwa medycznego. Celem pracy była próba oceny stosowania analgezji w leczeniu bólu wieńcowego przez zespoły wyjazdowe Świętokrzyskiego Centrum Ratownictwa Medycznego, przeprowadzona na podstawie dokumentacji medycznej pacjentów leczonych z powodu ostrego zespołu wieńcowego w Centrum Kardiologii Inwazyjnej Elektroterapii i Angiologii w Ostrowcu Świętokrzyskim.
Słowa kluczowe: ból wieńcowy, leczenie, pogotowie ratunkowe

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Introduction

Pain is considered to be a subjective, difficult to define sensory impression, arising due to stimuli which damage the tissue. Everybody feels pain in their own way. The way we sense pain may be influenced by many factors of mechanical, physical, mental or cultural origin. Usually pain is perceived as an unpleasant and negative sensation. We acknowledge the positive aspect of pain when it is a symptom allowing the diagnosis of a disease. Since pain, like other parameters referred to as "vital", is a sign of pathological processes taking place in the organism, it should be observed, evaluated and monitored [1]. Therefore, the American Society of Pain Management as early as 1995 considered pain to be the fifth vital parameter.

To evaluate the level of pain severity many scales are used, based on interpretation of the patient's sensations. They are used to determine the level of pain intensity and effectiveness of implemented anesthetic pharmacotherapy. The most frequently used method in adult patients is the visual analogue scale, as well as verbal or numerical scales. The Visual Analogue Scale (VAS), is a numerical scale featuring a 10 cm line on which the patient marks the intensity of the pain experienced. The ends of the line are the extreme positions in pain: point "0" signifies a lack of pain (no sensation of pain), point "10" denotes maximum pain (the strongest possible pain). This line, may also be used to verbally describe pain intensity as mild, moderate, or strong pain [2].

Pain in the chest is the symptom most frequently described by patients to the primary care physician, emergency medical services and at the emergency department. Chest pain requires rapid diagnostics in order to exclude pain associated with sudden and threatening pathologies such as myocardial infarction, dissecting aortic aneurysm or pulmonary embolism.

Pain related to the cardiovascular system is referred to as angina or coronary pain (lat. *stenocardia*). It is usually located behind the sternum, it is short-term and disappears after several minutes or following administration of nitroglycerin (persistent pain or absence of response to the drug suggests myocardial infarction), it increases with effort, stress, low temperature, after a meal or in case of tachycardia. It is felt as burning, expansion or tightness, radiating to the shoulders, neck, and jaw. This is typical coronary pain. Atypical coronary pain may resemble other diseases and occur in lower regions of the chest or in the abdominal cavity, particularly in the upper abdomen [1].

Myocardial infarction and its complications are the main cause of deaths in Poland. In approximately 90% of patients the direct cause of myocardial infarction is arterial occlusion with a thrombus resulting from a break of atherosclerotic plaque which reduces the lumen of the coronary artery. Recently, we have witnessed immense progress in the diagnostics and treatment of cardiovascular diseases; however, the annual mortality rate associated with myocardial infarction is still over 40%, of which 23-35% of patients die in the prehospital phase, and the largest number of people die within 1 hour from the onset of symptoms. Therefore, patients suffering from ischemic heart disease as well as those at high risk of myocardial infarction should be educated so that they never hesitate to call an ambulance. Only the timely intervention of professional medical services may save human lives [3].

In the diagnostics of acute coronary syndromes (ACS), depending on the clinical symptoms, electrocardiographic changes and markers of cardiac necrosis (such as: glycogen phosphorylase, myoglobin, troponin, or creatine kinase), two forms of ACS are distinguished: STEMI (ST Elevation Myocardial Infarction) – acute coronary syndrome with elevated ST segment, corresponding to the term "myocardial infarction", and NSTE ACS (No ST Elevation Acute Coronary Syndrome), corresponding to the formerly used term "unstable coronary disease".

Presently, NSTE ACS, depending on the markers of cardiac necrosis, is divided into: UA (Unstable Angina) – unstable coronary disease in which, despite characteristic clinical symptoms of cardiac ischemia, usually without electrocardiographic changes or increase in the values of cardiac necrosis markers, and NSTEMI – myocardial infarction without ST segment elevation, corresponding to the formerly used terms "subendocardial myocardial infarction" or "non-Q wave myocardial infarction", in which biochemical markers of cardiac necrosis are present, but no elevation of the ST-segment is observed. However, the ECG may reveal other characteristics of myocardial ischemia [4, 6].

It should be emphasized that the underlying cause of the above forms of ACS is the same, that is reduced coronary flow, and they differ only in the extent of that reduction. A smaller reduction of blood flow in coronary vessels leads to the development of UA or NSTEMI, while complete arrest of the flow or its considerable impairment by a thrombus results in STEMI.

The most effective method of ACS treatment is PCI (Percutaneous Coronary Intervention), a procedure consisting in the fast removal of the coronary vessel occlusion and restoration of the blood flow, which reduces the area of necrosis and the risk of health complications, some of them potentially life-threatening. In the economic aspect, the procedure shortens the time of hospitalization and reduces the costs of treatment [4]. At present there are over 150 invasive cardiology centers in Poland, of which approx. 130 function 24 h a day; this makes Poland one of the leading countries in Europe in that respect.

The majority of laboratories offer telephone telemetry consultations [5].

The condition of successful myocardial infarction treatment in an interventional cardiology center is the maximum reduction of the time between the onset of symptoms and the removal of the vessel occlusion and restoration of normal blood flow. A delay in arriving at the surgical cardiology center may be due to various factors, e.g. patients postponing the decision to call EMS and the current organization of the Emergency Medical Service System [6].

The Act on National Emergency Medical Services defines in detail the principles of the system operation and qualifications of rescue services, whereas its executive acts determine the standards of education, competences and powers of the physician, system nurse and paramedic. The current regulations provide legal basis for using pharmacotherapy of pain in myocardial infarction by EMS teams if ACS is suspected, based on the patient's clinical condition and ECG record. The primary anesthetic is morphine, administered intravenously at a dose of 5 mg in 5 minutes, then 2 mg every 5 minutes, with simultaneous monitoring of frequency and depth of breathing, blood pressure and heart rate until the pain subsides, or adverse events occur. Moreover, the patient should receive acetylsalicylic acid orally at a dose 300 mg, if not contraindicated. In case of hypoxemia, oxygen therapy is indicated [7, 8].

According to the ERC (European Resuscitation Council) guidelines and European Society of Cardiology STEMI 2 0 1 2 guidelines, a patient diagnosed with ACS should be transported in less than 60 minutes to the nearest center where primary PCI can be performed. Each patient should receive an antiplatelet drug blocking the ADP receptor (clopidogrel, ticagrelor, and prasugrel) [8].

Treatment of ACS is a complex and multi-phase process, in which each stage is important. Early diagnosis and implementing antiplatelet pharmacotherapy, fast transportation to a hemodynamics laboratory and unblocking of the coronary artery are the elements contributing to success, i.e. saving and improving the patient's life.

Aim of the study

The aim of this study was to assess the treatment of coronary pain by mobile teams of the Świętokrzyskie Medical Emergency Center and Primary Health Care in patients with ACS treated at the Center for Invasive Cardiology in Ostrowiec Świętokrzyski.

Material and methods

The study was conducted on the basis of Emergency Medical Activities charts appended to the medical records, from which the information on the pharmacotherapy of angina by a mobile EMS team was derived. In case of patients referred from other medical institutions, the Hospital Referral forms were analyzed. To evaluate the pain intensity, a Pain Monitoring and Treatment Chart was used from the Center for Intensive Cardiology, Electrotherapy and Angiology. The first assessment of coronary pain intensity using the VAS scale measured angina pain felt by the patient at the moment of occurrence and during transport to a treatment facility. The study was conducted from 1 January 2011 to 31 August 2013.

In this period the medical records of 924 patients were analyzed. The study population was predominantly male (63%). Patients included in the study were aged from 33 to 88 years old.

Results

Ischemic heart disease affects both men and women. However, men suffer from myocardial infarction more often, and at a younger age. Women, protected by estrogens, usually become ill after the menopause. Figure 1 presents the structure of the study group according to gender.

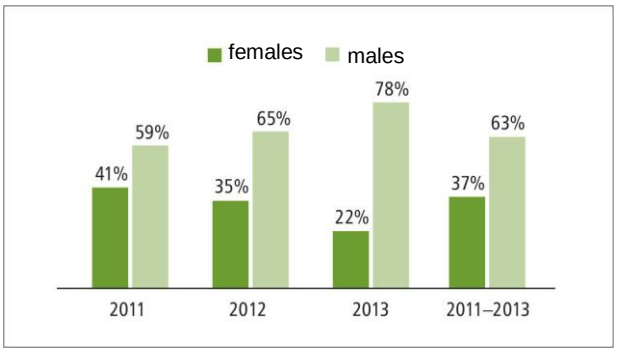

Figure 1. Respondents by gender

Rycina 1. Badani według płci

In the study population, males more frequently suffered from myocardial infarction. Considering the entire study period, 63% of the patients with myocardial infarction were males.

The analysis revealed that in the study population the most frequent form of ACS was NSTEMI (Fig. 2).

Considering the entire study period, NSTEMI ACS was found in 55% of the study subjects.

For the purpose of this study, particular attention was paid to pain described by the participants as having the intensity of 5 to 10 points on the VAS scale, and referred to as "acute pain" (Tab.1).

Analysis of the material collected throughout the study period revealed that 80% of study subjects at the moment when burning pain occurred in the chest, which is the first symptom of myocardial infarction, determined its intensity as 5 to 10 points on the VAS scale. Moreover, the subjects experienced strong

anxiety and fear for their health and life. It was the persistent pain and fear that motivated them to call an EMS team.

The opinion of the study subjects on experienced pain symptoms suggesting myocardial infarction overlap with descriptions in the literature. It proves that pain which occurs at the moment of myocardial infarction requires a specific therapeutic procedure, as well as fast transport to a center with a 24 h hemodynamic laboratory (Fig. 3).

Analysis of the research material demonstrates that in the study period only 32% of study subjects diagnosed with myocardial infarction and transported to an invasive cardiology department by an EMS team received analgesic treatment. As for the patients in which ACS was recognized in Primary Health Care institutions, only 25% received analgesics used in the treatment of pain due to myocardial infarction.

The standard for the treatment of pain in myocardial infarction lists drugs which should be used in a patient with ACS. The primary drug indicated in the standard is morphine administered intravenously. Other medications include nitroglycerin, ASA and oxygen. If the patient is transported to a center with hemodynamics laboratory, it is important to administer an ADP blocking drug, e.g. clopidogrel, in preparation for PCI procedure (Tab. 2).

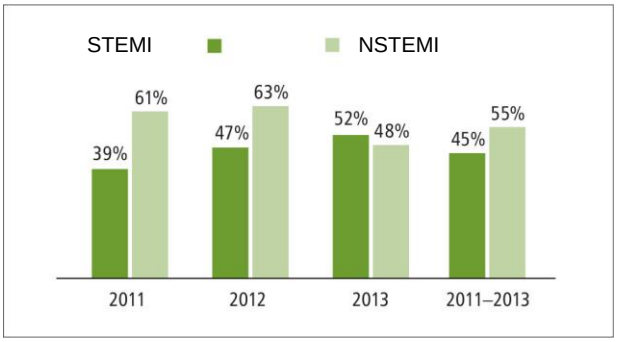

Figure 2. The frequency of acute coronary syndromes

Rycina 2. Częstość występowania postaci ostrych zespołów wieńcowych

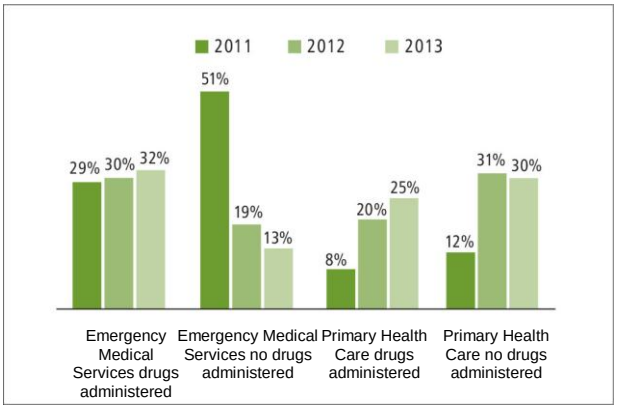

Figure 3. The frequency of drug administration by emergency teams and primary health care physicians

Rycina 3. Częstość podania leków przez zespoły ratownictwa medycznego i lekarzy podstawowej opieki zdrowotnej

The conducted analysis indicates that in the study period only 33% of patients received morphine, 47% received nitroglycerin, and 13% received oxygen. Considering the fact that patients were transported to hospital for invasive treatment, it deserves appreciation that 70% of the study subjects received ASA, 64% clopidogrel, and 37% heparin.

Table 1. Pharmacotherapy used by emergency teams and primary health care
Tabela 1. Farmakoterapia stosowana przez zespoły ratownictwa medycznego i podstawową opiekę zdrowotną

	MF	ASA	clopidogrel	heparin	NTG	oxygen
2011	20%	96%	51%	27%	40%	4%
2012	36	100%	66%	36%	51%	18%
2013	47%	100%	81%	55%	47%	19%
2011–2013	33%	70%	64%	37%	47%	13%

Table 2. Subjective assessment of pain by patients in the Visual Analogue Scale
Tabela 2. Subiektywna ocena odczuwania bólu przez pacjentów w skali wzrokowo-analogowej

	10	9	8	7	6	5	4 to 1
2011	8.3%	9.2%	17.8%	15.2%	16.9%	8.0%	24.9%
2012	3.7%	7.3%	26.3%	15.3%	18.6%	13.6%	15.3%
2013	4.5%	8.6%	20.8%	19%	13.2%	14.9%	19%
2011–2013	5.6%	8.3%	21.6%	16.1%	16.6	11.8%	19.8%

Discussion

Alleviation of pain is one of many tasks of modern medicine, and is included in Polish and international legal standards, as well as in the Doctor's Oath and Doctor's Code of Ethics. As early as 2,500 years ago the father of medicine, Hippocrates, said: "An hour of pain is as long as a day of pleasure".

Medicine provides knowledge about and means to treat different pain symptoms effectively, including pain in myocardial infarction. Therefore, there is no reason for a patient transported by qualified medical services, equipped with medications, to suffer and experience acute pain or fear. The Act on National Emergency Medical Services and its executive acts define in detail the qualifications and competences of the physician, system nurse and paramedic. It lists a wide array of drugs which a paramedic may administer to a patient, clearly after an interview (if possible) and assessment of the clinical condition. EMS teams are also equipped with diagnostic and therapeutic devices which enable basic tests and procedures to be performed. Thus, a patient may and should be safely transported to an in-patient treatment facility.

Evaluation, monitoring and proper treatment of coronary pain is an element of quality of care assessment, therefore a standard for evaluation and monitoring of pain in myocardial infarction should be implemented in the practice of rescue services. Pharmacotherapy of pain in myocardial infarction is supported by research results, which provided basis for the standard of treatment recommended by the Polish Cardiac Society, it should only be used to a wider extent, with benefit for patients.

It is important to make an effort to convince EMS teams about the necessity of applying, in justified cases, the standard for treatment of pain due to myocardial infarction.

Conclusions

1. The majority of patients with ACS are transported to a Department of Intervention Cardiology by mobile EMS teams.
2. Half of the patients do not receive analgesic treatment on their way to a center which offers the possibility of invasive treatment in the form of unblocking the infarct-related artery: PCI.
3. Only a few patients referred by Primary Health Care received analgesic and antiplatelet therapy.
4. Over 75% of patients described the angina pain they experienced as 5-10 points (VAS scale), which is acute pain.
5. The reason behind the limited use of treatment of pain in myocardial infarction by EMS teams should be identified, and actions should be taken to help reduce pain in patients with ACS on their way to a center of invasive cardiology.

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Paramedics in Poland. Past, present and future

Ratownik medyczny w Polsce. Przeszłość, teraźniejszość, przyszłość

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Abstract. The profession of paramedic was introduced in Poland in the early 1990's. The first steps in training paramedics were carried out at two-year post-secondary medical schools. In 2000, training began at the bachelor level. It was not until the provisions of the Act of 8 September 2006, concerning the State Emergency Medical Services, that the profession was legally sanctioned within the system. The legal regulations have introduced a closed list of emergency medical procedures that can be performed by paramedics independently and under supervision of a doctor. Additionally there is a list of drugs which may be administered by paramedics to patients if a state of sudden health hazard has been defined. An important step towards improving the quality of paramedic rights was the new legal regulations concerning training conducted in its various forms. For some time there has been a substantive discussion concerning further expansion of the rights of paramedics to extend the catalog of drugs and medical rescue procedures that can be applied and administered by paramedics without supervision of a doctor.
Key words: emergency medical procedures, emergency medical services, training

Streszczenie. Zawód ratownika medycznego w Polsce powstał na początku lat 90. ubiegłego wieku. Pierwsze kroki w kształceniu ratowników medycznych realizowano na poziomie dwuletnich policealnych szkół medycznych. W 2000 r. uruchomiono z kolei kształcenie ratownika medycznego na poziomie studiów pierwszego stopnia. Dopiero wejście w życie zapisów ustawy z 8 września 2006 r. o Państwowym Ratownictwie Medycznym w pełni usankcjonowało prawnie funkcjonowanie tego zawodu w systemie. Regulacje prawne doprowadziły do powstania zamkniętego katalogu medycznych czynności ratunkowych, które mogą być wykonywane przez ratownika medycznego samodzielnie i pod nadzorem lekarza oraz powstania wykazu leków, które ratownik medyczny może podawać pacjentom w stanie nagłego zagrożenia zdrowotnego w ramach systemu. Istotnym krokiem w kierunku podnoszenia jakości wykonywania przez ratownika medycznego jego uprawnień zawodowych stały się również regulacje prawne dotyczące doskonalenia zawodowego realizowanego w różnych formach. Od pewnego czasu toczy się merytoryczna dyskusja na temat dalszego rozszerzania uprawnień zawodowych ratowników medycznych w zakresie zwiększenia katalogu leków oraz medycznych czynności ratunkowych, które ratownik medyczny może wykonywać samodzielnie.
Słowa kluczowe: kształcenie, medyczne czynności ratunkowe, ratownictwo medyczne

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Past

Discussions on creating a new medical profession in Poland, that of paramedic began in the late 1980s and early 1990s. The purpose was to provide a professional character to emergency care. A paramedic was intended to substitute, as a qualified medical staff member, the orderlies and stretcher bearers who worked in the emergency services, and in the target model, as in the western model, to be a member of a rescue team lacking a physician. It is worth remembering that neither orderlies nor stretcher bearers had any training based on a systemic training or education model.

The efforts made towards establishing the new profession formally started with appointment of a team supervised by Prof. Witold Jurczyk, a long-time national consultant in anesthesiology and intensive care. The team's task was to develop an original teaching program for the paramedic profession. The program prepared by the team was sent to the Center for Methodology and Development of Teachers in Secondary Medical Education in Warsaw and to the Secretary of State in the Ministry of Health and Social

Care, Ms. Krystyna Sienkiewicz. Minister Sienkiewicz appointed the first Curriculum Committee to develop the final assumptions necessary to start the professional training. The committee members included: head of the committee Prof. Witold Jurczyk – Institute of Anesthesiology and Intensive Care, Medical Academy in Poznań, secretary Krystyna Wolska-Lipiec – Center for Methodology and Development of Teachers in Secondary Medical Education in Warsaw, Michał Borkowski – head of the Voivodeship Emergency Medical Service Station in Warsaw, Elżbieta Buczkowska – Emergency Medicine School, Emergency Medical Service Station in Poznań, Krystyna Cichecka – Medical Education School Complex No. 2 in Warsaw, Jacek Formański – Center for Methodology and Development of Teachers in Secondary Medical Education in Warsaw, Andrzej Gil-Wrzesiński, PhD, MD – Voivodeship Emergency Medical Service Station in Kielce, Kazimiera Grzesiak – PCK Medical Vocational School in Poznań, Andrzej Łakomy, PhD, MD – Institute of Anesthesiology and Intensive Care, Medical Academy in Poznań, Jacek Marciniak, PhD, MD – Health Department, Voivodeship Office in Poznań, Zofia Parfiniewicz, PhD in human sciences – Center for Methodology and Development of Teachers in Secondary Medical Education in Warsaw, and Krzysztof Panufnik – Emergency Medicine School, Emergency Medical Service Station in Poznań.

The Curriculum Committee completed their work on 22 May 1992, creating a trial curriculum for the profession of paramedic. The Ministry of Health and Social Care, in co-operation with the Ministry of National Education, referred the curriculum documentation for trial implementation, based on a decision of 23 March 1993 [1].

The first recruitment for the new vocational scheme took place in 1992 in Poznań, Kielce and Szczecin. The first paramedics who completed a two-year vocational training received their diplomas on 21 June 1994. The training process and the curriculum were approved, and as a consequence, new faculties were created all over the country.

Another important step in the history of the paramedic profession in Poland was starting education on a bachelor level. The first recruitment took place in fall of 2000 at the Silesian Medical Academy, and first graduates (33) completed their studies in 2003.

Education of paramedics was then implemented on two levels: in 2-year post-secondary medical schools, and BA studies at medical universities. The number of hours for 2-year post-secondary schools was 1,706 hours, or 80% of the total number of hours for the education cycle, with 20% left for the authors of the teaching programs to use. This system of education resembled most closely the standards of teaching paramedics in the USA. It should be emphasized that presently the recruitment of candidates for the two-year cycle is closed. BA education studies comprise at least 3,800 hours, and are quite unique in the world [2].

It is difficult to start an unequivocal polemic on the model of education of paramedics in Poland comparing it to solutions in other countries, where, despite much more extensive experience in the functioning of paramedics, the number of basic teaching hours was not increased. For instance, in the USA EMS personnel are educated on four levels: providing first aid (first responder), emergency medical technician – Basic (EMT-B), emergency medical technician – intermediate (EMT-I) and emergency medical technician – paramedic (EMT-P). It is also worth noting that the system of emergency medical services is based, in a simplified form, on two standards: ALS and BLS [3]. Paramedics acquire further qualifications after completing specialist courses. The Polish model has been developed by the Ministry of Health and academic circles.

Present

The legal basis for the profession of paramedic in Poland is Act of 8 September 2006 on the National Emergency Medical Services (NEMS). This act is a systemic one, as it establishes a system of emergency medical services in Poland by defining the administrative bodies responsible for its functioning, describes the principles of system organization and operation, the financing, indicates the system's entities and collaborating units, defines the terms, establishes the rights and requirements for professions involved in the system and paramedics co-operating with the system.

The paramedic, as a medical profession, is defined in this act, and acquires professional qualification. Article 10 of the Act specifies who may perform the profession of paramedic.

The profession of paramedic may be performed by a person who:

- has full legal capacity;
- whose health allows work in this profession;
- knows the Polish language sufficiently to work in the profession;
- meets the following requirements:
  - completed higher education course in emergency medical service or
  - graduated from a public post-secondary school or a non-public post-secondary school with public school accreditation, and has a diploma confirming the profession title of "paramedic", or
  - has a diploma issued in a country other than: EU member state, Swiss Confederacy or European Free Trade Association (EFTA) member state – a party to the of European

Economic Area Agreement considered in the Republic of Poland as equivalent to the diploma received in the Republic of Poland, confirming the professional title of a paramedic, or

– is qualified to perform the profession of a paramedic acquired in a European Union member state, Swiss Confederacy or the European Free Trade Association (EFTA) member state – a party to the European Economic Area Agreement acknowledged in the Republic of Poland, following the act of 26 April 2001 on the Principles of Acknowledgement of Qualifications for Regulated Professions Acquired in the European Union Member States (Official Journal of Laws No. 87, Item 954, with amendment 5).

Article 11 specifies what working in the profession of paramedic involves. Working as a paramedic consists in:

- ensuring safety of persons at the place of event and undertaking actions to prevent an increase in the number of casualties or in environmental degradation;
- evaluating the health condition of individuals at sudden health risk, and performing emergency medical procedures;
- transportation of individuals at sudden health risk;
- communicating with the person at sudden health risk and providing mental support in a situation of sudden health risk;
- organizing and teaching classes in first aid, qualified first aid and emergency medical procedures [4].

Provisions of Art.11 of the Act generally specify what working as a paramedic involves. More detailed description is available in the Ministry of Health regulation of 29 December 2006 on emergency medical procedures performed by a paramedic. The regulation covers three important areas. It describes emergency medical procedures which a paramedic may perform unassisted within the system:

- evaluation of a patient's condition to determine treatment and decide if emergency medical procedures are to be performed or not,
- placing a patient in a proper position according to the patient's condition or injuries suffered,
- initiation and continuation of basic and advanced cardiopulmonary resuscitation in adults and children according to standards presented in an announcement published on the basis of Art. 43 of the Act of 8 September 2006 on the National Emergency Medical Services,
- restoration of airway without the use of devices,
- restoration and securing airways using airway devices, in particular:
  – oropharyngeal tube,
  – nasopharyngeal tube,
  – laryngeal mask,
  – laryngeal tube,
  – needle cricothyroidotomy,
- respiratory suction,
- initiation of passive oxygen therapy or supporting respiration or substitute ventilation with air or oxygen:
  – manually, using a facial mask or a unidirectional valve and a respiratory bag,
  – mechanically, using a respirator.
- endotracheal intubation is direct laryngoscopy in sudden cardiac arrest through the mouth or nose, without using muscle relaxants, and performing substitute ventilation,
- manual defibrillation based on ECG,
- automated defibrillation,
- performing ECG,
- monitoring of the respiratory function,
- monitoring of the circulatory function with noninvasive methods,
- cannulation of peripheral veins in the upper and lower limbs, and of external jugular vein,
- intraosseous access using a ready-to-use kit,
- intravenous, intramuscular, subcutaneous, endotracheal, oral, rectal, inhalation and intraosseous (using the use of ready-to-use set) administration of drugs,
- reducing tension pneumothorax by puncture of the pleural cavity,
- collecting vein blood and capillary blood for laboratory tests,
- determination of critical parameters with the use of available equipment, in particular:
  – blood serum glucose,
  – blood serum electrolytes,
  – capillary blood gasometry,
- wound care,

- bleeding control,
- immobilization of fractures, sprains and twists,
- immobilization of the spine, especially the cervical segment,
- managing urgent delivery out of hospital,
- triage,
- taking protection measures to limit the health-related effects of an event,
- preparing a patient and medical care during transportation,
- administering drugs listed in the table.

The regulation also specifies emergency medical procedures which a paramedic may perform under the supervision of a system physician:

- endotracheal intubation is direct laryngoscopy in situations other than sudden cardiac arrest, with the use of muscle relaxants,
- performing electric cardioversion and external electrostimulation,
- assisting with minor surgical procedures (suturing wounds, placing drains) and other medical procedures,
- catheterization of the urinary bladder,
- placing a stomach probe,

Table. Drugs allowed to be administered by a paramedic unassisted, during rescue activities within the system
Tabela. Leki, które ratownik medyczny może podawać samodzielnie w zakresie medycznych czynności ratunkowych wykonywanych w ramach systemu

Item no.	Drug name*	Form
1.	*Acidum acetylsalicylicum*	tablets from 0.3 to 0.5 g
2.	*Amiodaroni hydrochloridum*	solution for injection (150 mg / 3 ml)
3.	*Atropini sulfas*	solution for injection (0.5 mg/ml; 1 mg/ml)
4.	*Captoprilum*	tablets 12.5 mg
5.	*Clemastinum*	solution for injection (2 mg / 2 ml)
6.	*Clonazepamum*	solution for injection (1 mg/ml)
7.	*Diazepamum*	solution for injection or rectal infusion (up to 10 mg / 2.5 ml)
8.	*Drotaverini hydrochloridum*	solution for injection (20 mg/ml)
9.	*Epinephrinum*	solution for injection (1 mg/ml)
10.	*Flumazenilum*	solution for injection (0.5 mg / 5 ml)
11.	*Furosemidum*	solution for injection (20 mg / 2 ml)
12.	*Glucagon hydrochloride*	solution for injection (1 mg/vial + solvent)
13.	*Glucosum 20%*	solution for injection (200 mg/ml)
14.	*Glucosum 5%*	solution for intravenous infusion (50 mg/ml)
15.	*Gliceroli trinitras*	tablets 0.5 mg; aerosol for sublingual use
16.	*Hydrocortisonum* or *Methylprednisolonum*	solution for injection (*Hydrocortisonum* 100 mg/ml; 250 mg/2 ml); (*Methylprednisolonum* 500 mg/vial; 1 g/vial)
17.	*Ketoprofenum*	solution for injection (100 mg / 2 ml)
18.	*Lidocaini hydrochloridum*	solution for injection (100 mg / 2 ml)
19.	*Magnesii sulfas*	solution for injection (200 mg/ml)
20.	*Metoclopramidum*	solution for injection (10 mg / 2 ml)
21.	*Midazolamum* after consultation with a physician	solution for injection (5 mg/amp.)
22.	*Morphini sulfas*	solution for injection (10 mg/ml; 20 mg/ml)
23.	*Naloxoni hydrochloridum*	solution for injection (0.4 mg/ml)
24.	*Natrii chloridum 0.9%*	solution for intravenous infusion
25.	Physiological fluid, multielectrolyte, isotonic	solution for intravenous infusion
26.	*Salbutamolum*	inhalation aerosol in solution for nebulization
27.	*Solutio Ringeri*	solution for intravenous infusion
28.	Medical oxygen	gas

- administration upon physician's orders of other drugs than those listed in Appendix no.1 to the regulation.

The table appended to the regulation lists drugs which a paramedic may administer unassisted as part of emergency medical procedures performed within the system (Tab.) [5].

The Act on NEMS, as mentioned before, provided legal framework for the profession of paramedic, also by imposing obligatory professional improvement.

Paramedics, on the basis of detailed provisions of the Ministry of Health regulation of 14 June 2007 on professional improvement of paramedics can fulfil this obligation through three forms of education:

– training course,
– seminar,
– self learning.

Training course is a form of education which lasts at least 30 school hours, and it extends and updates knowledge and skills related to emergency medical services. The course is conducted on a basis of a teaching program approved by minister responsible for health. The condition for completion of the course, conducted in a full-time or part-time form, is passing an exam on the knowledge and skills included in the teaching program. The seminar is a form of education which covers at least 5 course hours, and its program needs to be approved by a voivodeship consultant in emergency medicine, competent in the area of the organizer's offices. The last form of professional training is self-learning, which includes:

- preparation and presentation of a paper during a congress, meeting, conference or scientific symposium, or presentation of a communication or a poster,
- participation in training sessions of a scientific society or a professional association,
- preparation and presentation of a paper at a training session of a scientific society, professional association, or presentation of a communication or a poster at this meeting,
- participation in congresses, meetings, conferences or scientific symposiums,
- participation in training workshops and other forms of education organized by employers,
- participation in on-line educational programs,
- publication as author or co-author of: a science book, a popular science book, an original scientific article, a reference article, a chapter in a science or popular science book, a popular science article, a multimedia program or communication about research study, translation of a science or popular science book or article.

The legislator, imposing obligatory professional training on paramedics, specified that it should be implemented in 5-year periods, called education periods, and a paramedic at that time needs to obtain 200 educational points, of which at least 120 for participation in a training course ending in an exam [6].

Presently, approximately 14 thousand paramedics are working in the emergency medical services. They mostly work in specialist and basic emergency medical service teams, medical air rescue teams, hospital emergency departments and medical dispatch centers. Paramedics also find employment outside the NEMS system, e.g. in the structures of the Polish Armed Forces, National Fire Brigade, Mountain Voluntary Rescue Service, Water Voluntary Rescue Service or other special units. In this context, it should be emphasized that outside the NEMS system, paramedics cannot legally perform emergency medical procedures, which significantly reduces the possibility to use their knowledge and skills.

Future

The profession of paramedic, functioning in Poland since 1994 when the first graduates of 2-year post-secondary schools appeared, introduced a new quality of emergency medical services. Continuously improved quality of education and professional training of paramedics, presently only on the level of BA studies in higher education institutions, justifies the question: how should this profession should function in our country? Does not long-term experience and observations of paramedics justify extending their autonomy regarding emergency medical procedures? Are legal changes required to specify performing this profession outside the system units? These questions may and do cause different reactions, which partially result from fragmentary knowledge about the education of paramedics, and in this context about the teaching program which prepares graduates to perform certain medical procedures, and partially from fear whether the time for change has really come. It is true that very often a paramedic working in a basic emergency medical team could be more effective in helping patients at sudden health risk, but does not, although capable of it, because legal regulations do not allow it. This area requires serious reflection and substantiated discussion: should not paramedic autonomy be extended in the situation where the system is equipped in advanced technical tools which enable, such as through teletransmission, consultation with a physician concerning further therapeutic steps. Paramedics who work daily in the National Emergency Medical Services system, postulate extending the catalogue of drugs which they could administer to patients at sudden health risk to include dopamine, norepinephrine, clopidogrel, heparin, fentanyl, theophylline, atrovent, betaloc, paracetamol, and pyralgin. It seems that such extension could be made, provided that standard procedures for paramedics to be applied in different states of sudden health risk were developed. Another area which in many cases would enable paramedics to provide more effective assistance would be extending their autonomy to allow performing percutaneous electrostimulation and cardioversion on the basis of teletransmission, following the diagnosis has been confirmed by a specialist doctor. The inability to perform these procedures in practice leads to situations where a basic team calls a specialist team with a physician, or transports a patient to the nearest hospital. In both cases there is only one conclusion:

valuable time is wasted. The argument that performing these medical procedures and administering a wider range of drugs may be dangerous for the patient raises the question: should not specialist training be prepared for paramedics, managers of the emergency medical teams, to minimize the risk of making a mistake?

Many other actions can be taken to improve professionalism of paramedics, e.g. introducing a national examination in emergency medical service for new graduates, whose passing would be obligatory to obtain the license to work in the profession; introducing vocational training for paramedics; adopting new legal regulations regarding the profession of paramedic; specifying the problem of teleconsultations between paramedics and physicians; improving surveillance over the quality of professional training of medical personnel working within the system, also in the context of companies conducting such training. The conclusion of the above discussion leads to a question-hypothesis: are we not wasting the potential of paramedics?

The skills obtained in the education process, professional training and specialist training may be used also by paramedics functioning in various units of the Polish Army. It is particularly important in the view of missions in which Polish Army participates. Changing the status quo requires modification of the law. Therefore, during the next amendment of the Act on the National Emergency Medical Services, it will be justified to add delegation to the regulation for the Minister of Defence who will define the scope of rights of paramedics functioning in the Polish Army. A similar solution should also specify the rights of paramedics functioning in the units subject to and supervised by the Ministry of Internal Affairs.

Summary

The adopted model of functioning of emergency medical services in Poland introduced the profession of paramedic into the system. The profession, which in the course of education is oriented to recognize sudden health risks and perform emergency procedures professionally to restore and maintain vital functions. This is a narrow characterization of a paramedic. It is a fact that out of 1450 emergency medical teams functioning within the National Emergency Medical Services in Poland, over half are basic teams in which paramedics work. Their knowledge and skills determine the level of medical assistance provided to people at sudden health risk. Observations of the work of paramedics, progress due to professional improvement and constantly growing level of responsibility in this professional group lead to a conclusion that the potential of paramedics needs to be used to a greater extent than as it results from current provisions of law.

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Emergency medical team procedures with dealing with patients with suspected myocardial infarction

Postępowanie zespołów ratownictwa medycznego z pacjentem z podejrzeniem zawału serca – przegląd wytycznych oraz przepisów prawa

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Abstract. The article is an analysis of key factors determining the implementation of procedures for dealing with patients with suspected myocardial infarction (MI) by emergency medical teams, such as the current guidelines (European Resuscitation Council, European Society of Cardiology ESC STEMI 2012) and regulations of the Polish legal system**.** The discrepancies between these regulations may hinder the implementation of prehospital procedures by emergency teams, leading to ambiguity in the MI NSTEMI procedures and to proper pharmacological treatment. Standardization of the guidelines and adjustment of the legal regulations to suit current medical knowledge is essential to improve the quality of prehospital care of ACS patients.
Key words: acute coronary syndrome, emergency medical services

Streszczenie. Praca stanowi analizę kluczowych czynników wpływających na postępowanie zespołów ratownictwa medycznego z pacjentem z podejrzeniem zawału serca, takich jak obowiązujące wytyczne (Europejskiej Rady Resuscytacji, European Society of Cardiology ESC STEMI 2012) oraz przepisy prawa. Zawarte w nich różnice mogą utrudniać ratownikom medycznym działania na etapie przedszpitalnym, wprowadzając niejasności np. w kwestii postępowania z ostrym zespołem wieńcowym (OZW) NSTEMI czy zakresu odpowiedniej farmakologii. W celu poprawy opieki przedszpitalnej w OZW konieczne jest ujednolicenie wytycznych i dostosowanie przepisów prawa do aktualnej wiedzy medycznej.
Słowa kluczowe: ostry zespół wieńcowy, ratownictwo medyczne

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Introduction

Due to organizational changes, technological progress and improved financing, Poland has become European leader in the treatment of acute coronary syndrome (ACS). Since 1991, the number of deaths caused by acute myocardial infarction in Poland has been decreasing, which may result from implementation of advanced reperfusion therapy, percutaneous coronary intervention (PCI). In the 1990s, most cases of myocardial infarction were treated thrombolytically, but due to the growing number and accessibility of hemodynamic laboratories the percentage of patients treated with invasive methods has increased. In the treatment of ACS, the time in which it is available to the patient is of utmost importance, hence the significance of the rapid and proper management of a patient with chest pain by the emergency medical services teams (EMS). The procedure should be clear and unambiguous for the emergency services personnel; therefore, the recent efforts of cardiologists, paramedics and the Ministry of Health to regulate and unify procedures in ACS deserve appreciation. The aim of the study was to analyze the key factors contributing to the implementation of procedures by the emergency medical teams managing patients with suspected myocardial infarction. Recommended guidelines, possibility of their implementation by basic emergency medical teams, and valid law regulations have been

reviewed. For patients with ACS, the paramedic finds valid recommendations regarding proper procedures e.g. in the European Resuscitation Council (ERC) and European Society of Cardiology (ESC) guidelines, which have been analyzed with particular emphasis on the usefulness of the information they contain for members of emergency medical teams, on the guidelines compliance with pragmatic aspects of EMS team work, as well as on the technical and legal possibilities of their implementation. The study also contains scientific reports demonstrating procedures of Polish emergency medical services teams in the management of patients with ACS.

Description of emergency medical system in Poland

Emergency medical systems in the world are constantly changing and evolving. One of the main directions of this change is orienting the emergency medical systems to provide instant assistance to people in a health emergency. As a result, it is emphasized that the time of reaction / arrival of the emergency medical units should be adequate, and their procedures based on current guidelines. Experiences from other countries were transposed to the Polish situation through the Act of 8 September 2006 (Official Journal of Laws of 2006, No. 191, Item 1410). This legal act led to the formation of two types of emergency medical services teams within the National Emergency Medical Services (NEMS):

- specialist teams (S), consisting of a system physician, qualified to work in such team, and two paramedics or emergency nurses,
- basic teams (P), consisting of at least two paramedics or two emergency nurses [1].

The number of emergency medical teams according to their type, based on the Main Statistical Office data from 2011, is presented in the figure. In estimating the current number of emergency medical teams, it is worth noting that some of them are seasonal in nature, e.g. water rescue emergency medical teams or air emergency medical services.

Cardiological guidelines demonstrate the crucial role of time between the first symptoms of ACS and reperfusion therapy. Within the NEMS system, the time between reporting chest pain on the alarm number and the moment of passing the patient on to the hospital personnel, as in any EMS team intervention, is documented. For instance, in the dispatch center in Kraków, the time of reception of notification is 10 seconds for 97.35% of calls received [2]. In compliance with Art. 25 of the Act on NEMS, the voivode is responsible for organizational solutions to ensure suitable time parameters of EMS team arrival at the site of the event. According to these parameters, the median time of arrival in each month cannot be more than 8 minutes within a city with a population of more than 10,000 people, and 15 minutes outside a city with a population of more than 10,000 people. The third quartile of the time of arrival in each month should not exceed 12 minutes within a city with a population of more than 10,000 citizens, and 20 minutes outside a city with a population of more than 10,000 citizens, and the maximum time of arrival cannot exceed 15 minutes within a city with a population of more than 10,000, and 20 minutes outside a city with a population of more than 10,000 [1]. In case of the EMS in the Małopolskie region, the above criteria are met in majority of cases [3], and they may be treated as the time of reaction of the NEMS units to "chest pain" notifications as well.

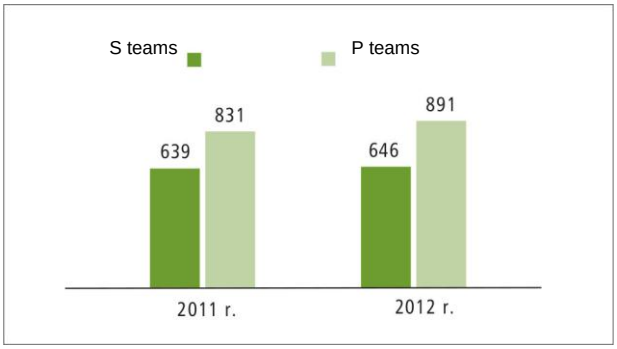

Figure. The number of medical rescue teams in Poland according to the Central Statistical Office [2]

Rycina. Liczba zespołów ratownictwa medycznego według Głównego Urzędu Statystycznego [2]

Functioning of the National Emergency Medical Services units is regulated by the above mentioned Act and its regulations. Paramedics in basic teams (P) perform a range of emergency medical activities defined in the regulation, using a limited catalogue of drugs listed in the Ministry of Health regulation of 14 January 2009. In the context of patients with ACS, only the following may be administered independently: morphine, oxygen, nitroglycerin and aspirin [4]. The mentioned group of drugs and authorizations does not include other medications currently recommended by the European Resuscitation Council (ERC) and European Society of Cardiology (ESC). Importantly, according to the position of the Minister of Health, a paramedic has no right to undertake any actions outside the defined scope, even if instructed to do so by the physician on call in the hemodynamics laboratory, in a telephone call following an ECG teletransmission [5]. The Polish Cardiac Society emphasized this problem in the Management Board's position of 12 May 2013 [6].

ECG teletransmission

According to the Polish Ministry of Health data, depending on the voivodeship, 80-100% of the NEMS ambulances can provide ECG teletransmissions [7]. At the same time there are 154 hemodynamics laboratories in Poland [8]. Their locations usually do not correspond to the network of hospital emergency departments. The addressees of ECG teletransmissions are primarily physicians on call in hemodynamics laboratories, although there are also systems, such as in the Masowieckie Voivodeship where one reception station may be located at the office of the EMS team authorizing officer, or at the emergency call center, and is operated by a physician designated to this particular task. In this model, all the EMS teams in a given operational region or regions send ECG teletransmissions to a given reception station, which is simultaneously in contact with hemodynamics laboratories and intensive cardiac care units, to have current information regarding the possibility of admitting a patient with suspected ACS to these organizational units. In analyzing the possibility of ECG teletransmission, one should also consider temporary technical problems due to lack of reception. They are particularly troublesome in the southern, mountainous regions of the country, as well as in places not covered by the GSM network, which according to the report of the Office of Electronic Communications constitute approx. 8% of towns and villages in Poland, mostly those with a population of under 100,000 [9].

EMS team procedures – guidelines and reality

Paramedics base their ACS procedures on current ERC and ESC STEMI 2012 guidelines. Also important for the functioning of EMS teams in this area is the "Position of the Management Board of the Polish Cardiac Society and National Specialist Surveillance regarding standards of emergency medical team procedures in patients with suspected myocardial infarction (Acute Coronary Syndrome)". ACS includes:

- unstable angina pectoris,
- non-ST elevation myocardial infarction,
- ST-elevation myocardial infarction [10].

According to the studies, "primary percutaneous coronary intervention (PCI) is the best treatment method in ST elevation myocardial infarction (STEMI), ensuring reduced mortality and morbidity of patients in comparison to traditional conservative treatment or fibrinolytic therapy (ESC recommendation class IA)" [11-13]. "Similar benefits from early intervention (<24 h since the onset of the symptoms) for patient prognosis were observed in the group of high risk patients with acute non-ST elevation coronary syndrome, primarily with non-ST elevation myocardial infarction (NSTEMI)" [14]. According to the above, the time from the first medical contact to providing patency for the artery responsible for infarction should not exceed 90 minutes, or 60 minutes in special cases, such as:

- high-risk patients,
- patients with extensive anterior wall infarction,
- patients with symptoms lasting <2 hours [15].

Possession of a system for ECG teletransmission by the EMS team may be of additional help in selecting the procedure and location of patient transport. This applies especially to basic teams, in which emergency medical procedures are undertaken independently by paramedics and/or system nurses [6].

Cardiologic guidelines emphasize the time criterion. After first medical contact, 12-lead ECG should be performed and interpreted as soon as possible [16]. "Even at a very early stage of myocardial infarction, the ECG record is rarely normal. Typically, ST elevation is found in AMI, measured at the J point in two adjacent leads, of ≥0.25 mV in males under 40 years of age, ≥0.2 mV in males over 40 years of age, and ≥0.15 mV in females, in leads V2-V3 and/or ≥0.1 mV in other leads (without left ventricular hyperplasia [LV] or left bundle branch block [LBBB])" [17]. "In patients with inferior wall myocardial infarction, a record from the right ventricular precordial leads is recommended (V3R and V4R), in which ST elevation should be sought to confirm coexisting right ventricular infarction" [17,18]. "Similarly, depression of the ST-segment in leads V1-V3 suggests ischemia of the cardiac muscle, especially in case of positive T waves (equivalent of ST-segment elevation), which may be confirmed in the record of leads V7-V9 with visible ST elevation >0.1 mV" [17].

ESC STEMI 2012 guidelines emphasize the fact that the entire personnel of an emergency medical services ambulance should be trained to:

- alleviate pain using titrated doses of opioids,
- administer oxygen to patients with hypoxia (SaO_2 <90%), breathlessness or cardiac failure,
- provide first aid [15],
- initiate as soon as possible double anti-platelet treatment with acetylsalicylic acid (ASA) and ADP receptor antagonists. Oral administration of ASA is preferred (preferably at a dose of 150-300 mg), and if it is impossible, a bolus within the range of 80-150 mg i.v. Preferred ADP receptor antagonists are prasugrel (loading dose of 60 mg *p.o.*, maintenance dose of 10 mg) or ticagrelor (loading dose of 180 mg *p.o.*) [15].

ESC STEMI 2012 guidelines present the possibility of implementing thrombolysis, also by paramedics in case transportation is prolonged [15].

In case of ACS NSTEMI, literature data important for EMS teams apply to patients qualified to the NSTE-ACS (non-ST elevation acute coronary

syndrome) group. In these patients it is urgent that a coronarography should be performed within <2 h, which may require fast transport from the site of the event to a specialist center.

Therefore, specifying the group of high-risk patients to whom this procedure applies is of particular importance for EMS teams. This is a heterogenous group, thus difficult to define; however, according to literature data, urgent coronarography within <2 h in NSTE-ACS patients is recommended in patients at a very high risk of ischemic events, e.g. in case of:

- persistent or recurrent angina with or without St-segment changes of ≥2 mm , or deep, negative T waves, resistant to antianginal treatment,
- clinical symptoms of cardiac failure or increasing hemodynamic instability,
- life-threatening ventricular arrhythmias [19].

However, according to the guidelines, identification of those patients may be difficult, and such decision should be made in consultation with an experienced physician. It may indicate the necessity of ECG teletransmission in each case, and consultation of the patients with ACS NSTEMI from a given group, both by the physicians from specialist teams, and paramedics or nurses from basic teams.

ERC guidelines seem to emphasize recognizing STEMI by physicians, paramedics and emergency nurses, defining it as "elevation of the ST-segment by ≥0.1 mV in at least two adjacent limb leads or >0.2 mV in at least two adjacent precordial leads". This group includes also the patients with recent left bundle branch block (LBBB). The authors of the guidelines also note that: "trained members of emergency medical services teams (emergency physicians, paramedics, nurses) can recognize with high specificity and sensitivity comparable to that of hospital environment…" such defined STEMI [10]. Therefore, the ERC guidelines place more emphasis on proper training of paramedics than on teletransmission. They also classify unstable angina pectoris and NSTEMI under one group of "non-ST elevation ACS", in which the procedure depends on the risk factors present [10].

The European Resuscitation Council recommends in general treatment of ACS administration of:

- intravenous morphine – in fractionated doses, so that the symptoms are controlled, but sedation is avoided, with emphasis on the importance of the anesthetic effect,
- oxygen – to maintain 94-98% saturation,
- sublingual nitroglycerin – if the patient is not hypotensive and extensive myocardial infarction of the right ventricle is not suspected,
- aspirin – 300 mg orally, crushed for chewing,
- clopidogrel 300-600 mg or prasugrel 60 mg orally, depending on local protocols,
- considering administration of intravenous heparin [10].

Thus Polish EMS teams receive from both sources a clear, although slightly different, information on the procedure in case of ACS STEMI. It may be unclear for paramedics at what moment the ECG transmission should take place and the location of transport for a patient with ACS NSTEMI / NSTE-ACS. It may be helpful to determine risk factors for those patients, as well as when teletransmission and consultation with a hemodynamics laboratory should be performed.

There are ongoing studies on ACS management in prehospital phase in Poland. A study on the treatment of coronary pain, conducted by Maciąg and Cichońska, demonstrated that more than 60% (552) of patients were brought by NEMS teams. The study was conducted on the basis of the analysis of Emergency Medical Activity Charts, or hospital referral forms for the patients treated in the Center of Invasive Cardiology in Ostrowiec Świętokrzyski. "Only 50% (278) of the patients transported in an ambulance were found to receive pharmacotherapy," and "only a few patients referred by primary healthcare receive anesthetic therapy." Complete MONA treatment was provided to 13% of patients. As the authors state, "the highest number of patients, 70%, received ASA, sublingual nitromint was administered to 47%, morphine to 33% and oxygen only to approx. 13% of patients. Anticoagulation therapy in the prehospital period was applied to 64% (180) of patients, and heparin was administered to 37% (105) of patients [20]. The study result could be affected by the absence of morphine, observed by the Social Paramedics Committee in the basic teams of the Świętokrzyskie Center of Emergency Medical Services For unknown reasons, the management of Świętokrzyskie emergency medical service decided to withdraw this medication.

Applicable laws

Polish legislation unambiguously determines who is authorized to decide about direct transportation to the hemodynamics laboratory. In the commentary to the Act on National Emergency Medical Services [21], Art. 45 regarding the problem of transportation, it is approached in the following manner: "On one side, the fundamental indication is 'transportation to the nearest, considering the time of arrival, A&E department'. On the other side, the catalogue of possibilities in case of necessary specialist treatment, e.g. in trauma centers, is extended (Art. 45, Section 1). Important is also the fact of providing the 'system physician present at the site of the event' with proper authorization. He is also authorized to determine the proper treatment center, considering the patient's health condition" [21]. Therefore, only the system physician at the site of the event may take a decision

regarding direct transportation defined by the provisions of law.

Art. 44 of the Act on NEMS mentions transporting the patient to the nearest, considering the time of arrival, accident and emergency department, or to the hospital indicated by medical dispatcher or by emergency coordinating physician. This provision makes transportation to the A&E department obligatory, whereas paramedic or emergency nurse are not indicated as authorized for direct transportation. However, a medical dispatcher asked by a paramedic may indicate a different site, such as a hemodynamics laboratory, as the place to transport for a patient with ACS. Everyday practice demonstrates that "P" teams in case of patients with ACS STEMI often ignore both the requirement of consulting the dispatcher, and mandatory transportation to an A&E department, transporting patients independently directly to the laboratory. However, efforts should be made to immediately change the regulations, so that the individual decision to transport the patient directly to the center is possible, and formal and legal obstacles are removed.

Transporting a patient from an A&E department

The greatest delays are found in case of patients who arrived at an A&E department complaining of chest pain. This is a result of delays associated with the necessity of providing transport to the hemodynamics center. According to applicable regulations, "medical transportation between treatment facilities performed by NEMS teams is unacceptable, as it would prevent such team from remaining ready to provide emergency services in the assigned operational area. Transports between treatment facilities should be performed using means of transportation other than "systemic" ones. The obligation to perform medical transportation and the means of its financing are defined in the Act on Publicly Funded Health Care Services (u.ś.o.z.). According to this act, a health care service is a health service, benefit in kind, and incidental service – the last group includes medical transportation" [21]. The Ministry of Health position may be controversial, but it is right and necessary to maintain the operational readiness of the system, and ensure availability of EMS teams for urgent events during the prehospital phase. However, it is possible to arrange this area by imposing a proper standard of medical transportation and maximum time of transport, depending on the status determined by the service provider's physician, on the basis of applicable law.

Summary

Cardiology is one of the best developed fields of medicine in Poland, and the network of hemodynamics laboratories is one of the best in Europe. The elements which may affect the procedures of EMS teams in the management of patients with ACS include certain differences in procedures proposed by the ERC and ESC guidelines, crucial for paramedics, as well as certain legal restrictions. For EMS team members it may also be unclear what the prehospital procedure is in case of non-ST elevation ACS. The current provisions of law make it impossible for members of basic EMS team to administer drugs outside the list presented in the Ministry of Health regulation on the detailed scope of emergency medical activities which may be performed by a paramedic, which may be contrary to the ERC or ESC recommendations. This applies particularly to proposed ADP receptor antagonists (antagonist of adenosine diphosphate receptor). In the legal context, it should also be noted that the Act on National Emergency Services (PRM) does not clearly indicate paramedics as persons authorized to determine 'direct' transportation. It was also established that, despite complete coverage of the country area by the teletransmission system network, the network reception enabling teletransmission is not available throughout Poland. Efforts to regulate EMS team procedures in ACS may accelerate and facilitate implementation of the proper treatment in this group of patients. With the above in view, it is worth considering:

- regulating and unifying recommendations regarding EMS team ACS procedures, taking into account precise determination of the time and target site of teletransmission for basic teams, as well as precise determination of risk factors in non-ST elevation ACS to assist members of all EMS teams in deciding when to perform teletransmission and consult a hemodynamics laboratory,
- preparing standard procedure in ACS, or updating provisions of the Act on NEMS so that they indicate a paramedic as a person responsible for direct transportation to an invasive cardiology center,
- proper implementation of the developed treatment model in the everyday operations of EMS teams,
- modification of provisions regarding teletransmission and teleconsultations which would enable use of the system based on the decision of the person supervising the emergency medical procedures in case of observing recent changes in the ECG, or certain risk factors related to ACS NSTEMI/ NSTE-ACS,
- the necessity to update provisions so that hospitals are obliged to provide transport in a given time and

standard, but are not limited as to the manner they carry out this obligation.

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Procedures in patients with sudden cardiac arrest during hypothermia – analysis of the emergency medical team procedures

Postępowanie ratunkowe u pacjenta z nagłym zatrzymaniem krążenia w przebiegu hipotermii – analiza działań zespołów ratownictwa medycznego

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Abstract. The implementation of the advanced life support (ALS) algorithm in adults is very important in surviving cardiac arrests (SCA)**.** The correct procedure in SCA related to one of its reversible causes: hypothermia, requires one to perform specific emergency procedures related to core body temperature. It is essential for the proper application of electro- and pharmacotherapy. The aim of this study was to evaluate the effectiveness of conducting cardiopulmonary resuscitation (CPR) by 34 emergency medical service teams in a patient with SCA in hypothermia. Core body temperature was evaluated immediately before the electro and pharmacotherapy only by 18 (52.94%) of the emergency teams, while 10 (29.41%) correctly doubled the intervals between epinephrine doses. The results, particularly the analysis of the correct ALS algorithm in hypothermic patients, are less than satisfactory. More stress should be put on the topic of hypothermia during training of emergency personnel.
Key words: hypothermia, sudden cardiac arrest

Streszczenie. Wdrożenie jednolitego algorytmu zaawansowanych zabiegów resuscytacyjnych (ALS) u osób dorosłych ma szczególne znaczenie w przeżywalności nagłych zatrzymań krążenia (NZK). Prawidłowe postępowanie, w sytuacji NZK związanej z jedną z odwracalnych przyczyn, jaką jest hipotermia, obarczone jest koniecznością wykonywania poszczególnych procedur ratowniczych w odniesieniu do temperatury głębokiej ciała. Jest to kluczowe w prawidłowym zastosowaniu elektro- i farmakoterapii. Celem pracy była ocena skuteczności prowadzenia akcji resuscytacyjnej przez 34 zespoły ratownictwa medycznego u pacjenta z NZK w stanie hipotermii. Przeprowadzenie oceny temperatury głębokiej ciała bezpośrednio przed wdrożeniem elektro- i farmakoterapii wykonało zaledwie 18 (52,94%) zespołów, 10 (29,41%) zespołów w sposób prawidłowy dwukrotnie wydłużyło czas do podania kolejnej dawki epinefryny. Ocena badanej grupy, a w szczególności analiza prowadzenia prawidłowego algorytmu ALS u pacjentów w hipotermii jest niezadowalająca. Podsumowując uzyskane wyniki, można stwierdzić, iż należy zwiększyć nacisk na tematykę związaną z wychłodzeniem organizmu podczas prowadzenia szkoleń personelu ratownictwa medycznego.
Słowa kluczowe: hipotermia, nagłe zatrzymanie krążenia

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Introduction

Sudden cardiac arrest (SCA) is among the most frequent causes of death in adults [1]. Depending on etiology, 350,000-700,000 cases are diagnosed annually in Europe alone [2]. SCA in adults may have a multifactorial etiology, associated with internal and external determinants [3]. One of the factors which may lead to SCA is accidental hypothermia [4]. In the United States alone there are approximately 600 cases of SCA due to hypothermia every year [5].

Considering lowered body core temperature as an immediate threat to health and life, hypothermia may be divided into three basic types: mild hypothermia (32-35ºC), moderate hypothermia (28-32ºC) and severe hypothermia (<28ºC) [6, 7].

Early assessment of core temperature is crucial, and constitutes a basic criterion for modification of the advanced life support (ALS) algorithm [8, 9]. Changes in the ASL algorithm apply to several prime areas of resuscitation, such as electrotherapy, pharmacotherapy and the necessity to implement various techniques for rapid warm-up. Differences in pharmacotherapy depend on the body's core temperature. If the temperature is below 30ºC, drugs are not effective, whereas within the range of 30–35ºC, the time intervals between consecutive drug doses should be doubled [10]. Changes in electrotherapy include performing three defibrillations at most in patients with a body core temperature below 30ºC [11]. Equally important in emergency treatment are the methods of warming the patient, to optimize the body's core temperature. Current therapeutic and rescue options enable implementation of various methods of active warming-up, during the prehospital care stage. They include: administration of warmed oxygen, infusion of warm fluids or lavage of body cavities. Conducting these activities directly translates to faster normalization of the patient's body temperature [12].

Understanding of modified ALS algorithm and the ability to implement it in patients with hypothermia-induced SCA seems to be crucial for improving their prognosis. The authors of this study decided to determine the effectiveness of the modified ALS algorithm and the awareness of it among emergency medical teams.

Aim of the study

The aim of this study was to assess the effectiveness of resuscitation actions performed by Emergency Medical Services (EMS) teams in a hypothermic patient with SCA. Special attention was paid to proper modification of the ALS algorithm and correct treatment of hypothermia.

Material and methods

The study involved 34 EMS teams of three, comprising paramedics and/or system nurses, participating in the 8th International Winter Emergency Medical Services Championships – Szczyrk 2013. The teams' actions were carefully evaluated during a 10-minute simulation of resuscitation with the use of a Laerdal VitalSim manikin imitating a patient with hypothermia-induced SCA. All the teams participating in the study were evaluated according to an evaluation card compliant with applicable guidelines of the 2010 European Resuscitation Council.

Before arrival at the site of the task, the team received brief information about the need to assist an unconscious 45-year-old male who was not breathing. While viewing the site of the event, the team was informed by witnesses that the unconscious male had been exposed to low temperatures for several hours (he was lying in snow), and several minutes earlier he was transferred to a building, where it was found he was not breathing. After collecting detailed interview, the team was informed that the injured man had consumed an unknown quantity of alcohol, and that he is treated for diabetes.

The team members during the test received detailed current information about the patient's vital parameters. The patient's core temperature initially was 34.8ºC, and by the end of simulation it had not risen to 35ºC. During the first three heart rate assessments, performed at 2-minute intervals, the monitor showed a sinus rhythm without hemodynamic response of 30 to 50 beats per minute (PEA). With the next heart rhythm assessment, conversion to asystole (ASY) was observed, which persisted until the end of the simulation. The patient's blood glucose was approx. 112 mg%.

According to the guidelines of the 2010 European Resuscitation Council for hypothermic patients with SCA, all the teams were evaluated for correct performance of subsequent procedures. After simultaneous examination of breathing and pulse, and instant initiation of pressing on the chest, the heart rhythm was to be assessed immediately. After PEA was found and body core temperature had been measured, the team should decide to administer 1 mg of intravenous (*i.v.*) or intraosseous (*i.o.*) epinephrine. During the next two heart rhythm evaluations, which should be performed every two minutes, the team should check the pulse of the carotid artery and assess the rhythm as PEA. When the rhythm changed to ASY, the team should make sure the record was correct (check if the chest electrodes were properly mounted, raise the feature, change leads on the cardiomonitor). Taking the body core temperature was especially important. As the temperature initially oscillated around the limit value of 35ºC, only after measuring the body temperature can any decision

about further pharmacotherapy be taken. The teams were evaluated for rapidly securing airway patency with airway devices, which enabled asynchronic resuscitation. The evaluation card also included early blood sugar measurement. The teams were evaluated both for the ability to provide thermal comfort to the patient, and to implement methods of hypothermia prevention.

Results

The study involved 34 (100%) basic teams (P) of emergency medical services. An analysis of the actions during the simulation showed that only 18 (52.94%) teams measured body core temperature immediately before applying electro- and pharmacotherapy. The analysis demonstrated that 7 (20.59%) teams did not administer epinephrine during the task. 11 (32.35%) teams administered the first dose of epinephrine without assessment of core temperature. Only 16 (47.06%) teams implemented pharmacotherapy with epinephrine immediately after taking the body core temperature (Fig. 1).

Further analysis of actions of the EMS teams showed that only 10 (29.41%) teams correctly doubled the time between epinephrine doses, and this decision was taken after another measurement of the core temperature. The other 24 (70.59%) teams did not extend the time between the consecutive epinephrine doses, or extended it, but without prior body temperature control. Only 23 (67.65%) teams administered the next epinephrine dose, whereas 11 (32.35%) did not use it at all.

Evaluating the methods of fighting hypothermia, it was found that 16 (47.06%) EMS teams used five or more different methods of raising the patient's core temperature. 9 (26.47%) teams implemented four methods, 4 (11.76%) teams used three methods of warming, and 5 (14.71%) teams only two methods of warming the patient. Fortunately, all the teams made effort to prevent cooling of the patient.

Discussion

The results of the study illustrate the significance of suitable advanced life support procedures in patients with cardiac arrest in hypothermia. Literature sources emphasize the need for early assessment of temperature in patients with suspected hypothermia [8, 9]. In this study only 18 (52.9 4%) teams performed early assessment of core temperature. Since temperature control determines proper performance of further rescue procedures, the other teams apparently did not follow the ALS algorithm for patients with hypothermia-induced SCA. Such behavior translated directly into the quality of the rescue procedures, and the effectiveness of resuscitation. It is worrying that 7 (20.59%) teams did not use epinephrine during

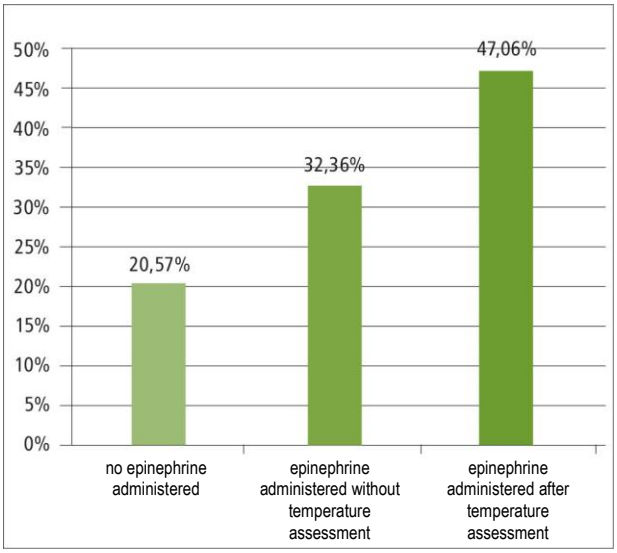

Figure. Percent composition of the first dose of epinephrine administered by emergency medical teams (EMT), based on measurement of core body temperature

Rycina. Zestawienie procentowe podaży pierwszej dawki epinefryny przez zespoły ratownictwa medycznego, w zależności od wykonania pomiaru temperatury głębokiej ciała

resuscitation. Tests on animals and analysis of short-term SCA survival in humans clearly indicate that administration of epinephrine to patients during ALS is necessary [13, 14]. Another 11 (32.35%) teams implemented treatment with adrenaline without prior temperature control. Peel [10] demonstrates in his studies that the heart of hypothermic patient may not respond to pharmacotherapy, and drug metabolism is slower. Administration of multiple doses in this situation may result in toxic plasma concentration. Therefore, epinephrine had to be administered at double intervals [4], only undertaken by 10 (29.41%) teams. It is worth remembering that administration of adrenaline without prior core temperature control, or to neglect to double the time of administration, might adversely affect the patient's further prognosis. Based on specialist reports, adrenalin during resuscitation should be administered at 3-5-minute intervals, which means two 2-minute loops of pressing on the chest. In a hypothermic patient with SCA, the next adrenaline dose should be administered after 4 cycles of 2-minute pressing, which only 23 (67.65%) teams applied correctly [4].

Considering the reports of researchers about the need to immediately implement the methods of warming in order to improve the patient's condition [15], all the teams performed warming procedures; however, complete thermal comfort, available in prehospital care, was achieved only in 16 (47.06%) cases, which is not entirely satisfactory.

Conclusions

The analysis of the study results demonstrates that awareness of the treatment of hypothermic patient with cardiac arrest is insufficient. Implementation of a suitable algorithm is difficult and requires very good understanding of accepted procedures. However, to increase survival rate and improve the patient's prognosis, a rescue action should follow a designated algorithm. In the view of the study results, the knowledge about resuscitation of hypothermic patients should be improved among EMS members.

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Assessing the most frequent errors made by emergency medical teams in the prehospital treatment of pediatric patients

Najczęstsze błędy w postępowaniu przedszpitalnym zespołów ratownictwa medycznego wobec pacjenta pediatrycznego – na podstawie obserwacji własnych

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Abstract. A child is a very specific patient**.** Medical staff lacking experience with children usually feel unconfident while dealing with them. Emergency team members often apply the "scoop and run" rule to children even in situations when it is clearly not the best solution, especially when a hospital is a long distance away. The aim of the study was to expose problems that emergency medical teams have with child patients due to a lack of experience. The aim is also to give some practical hints for the better medical care of children. The first part is based on interviews with 12 staff members from the Emergency Department of the University Children's Hospital in Kraków. The second part deals with the analysis of medical data that emergency medical teams pass to the admission room staff. The quality of prehospital treatment of child patients requires improvement. The main issues involved the placing of venous catheters, usage of analgesics and antipyretics and completing the medical data. Emergency teams should attempt to place a venous cannula in those children requiring it. Analgesics and antipyretics should be applied during prehospital treatment. The professional conduct of the emergency medical team requires the completion of the medical history, essential rescue procedures, complete medical data and appropriate handover of the patient to the hospital staff.
Key words: child, emergency medical team, paramedic, prehospital treatment

Streszczenie. Wstęp: Dziecko to pacjent specyficzny. Personel medyczny, który nie ma doświadczenia w pracy z dziećmi najczęściej czuje się niepewnie, gdy musi zająć się tym szczególnym pacjentem. Zespoły ratownictwa medycznego (ZRM) w postępowaniu z dzieckiem często postępują według zasady „bierz i pędź". Zasada ta nie zawsze stanowi najlepsze rozwiązanie dla pacjenta, szczególnie jeżeli miejsce zdarzenia jest znacznie oddalone od szpitala. Cel pracy: Praca ma na celu ukazanie wynikających z braku doświadczenia problemów, jakie ZRM mają w pracy z dziećmi. Celem jest również udzielenie wskazówek, którymi należy się kierować podczas udzielania pomocy dzieciom. Materiał i metoda: Pierwsza część badania jest oparta na wywiadach z 12 osobami pracującymi w Izbie Przyjęć Uniwersyteckiego Szpitala Dziecięcego w Krakowie. Druga część badania polega na analizie dokumentacji medycznej ZRM pozostawionej wraz z pacjentem przywiezionym do Izby Przyjęć (IP). Wyniki: Jakość opieki przyszpitalnej względem dzieci wymaga udoskonalenia. Główne problemy dotyczą zakładania wkłucia dożylnego, podaży leków przeciwbólowych i przeciwgorączkowych oraz wypełniania dokumentacji. Wnioski: Konieczne jest podjęcie próby założenia wkłucia obwodowego u dziecka, którego stan tego wymaga. W opiece przedszpitalnej powinno się rozpocząć leczenie przeciwbólowe oraz obniżać gorączkę. Profesjonalne zachowanie ZRM to dokładne zebranie wywiadu, wykonanie niezbędnych działań ratunkowych, staranne wypełnienie dokumentacji oraz umiejętne przekazanie pacjenta personelowi szpitala.
Słowa kluczowe: dziecko, postępowanie przedszpitalne, ratownik medyczny, zespół ratownictwa medycznego

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Introduction

In Poland today, prehospital emergency care regarding the entire population is satisfactory [1]. Emergency medical teams (EMT) can use an extensive range of medical equipment, and can properly secure a patient at the site of intervention, and during transportation to a hospital [2]. In the case of a child patient, certain procedures such as placing a venous catheter or administration of drugs are not being performed in those patients who require them as part of prehospital care. A child at risk of life and health usually is taken to hospital, according to the "scoop and run" rule, which consists in renouncing or reducing to a minimum any emergency procedures at the site of the event, and focusing on fast transportation to a hospital [3]. It seems that such behavior can sometimes be incorrect, and often results from fear of intervention in a young child. In certain situations it is necessary to undertake emergency medical procedures before arrival at a hospital, and the patient should not be put in danger due to transportation without proper intervention.

Aim of the study

This study underlines problems frequently encountered by hospital personnel while taking over a patient from EMT. Child treatment in prehospital care is sometimes insufficient. The manner in which the patients are handed over by EMT to the hospital personnel is also inadequate, usually due to inaccurate medical record data. The dialogue between the medical staff working in EMT and in the hospital is of great importance for effectiveness of work, as well as for patients. The study presents suggested procedures which will improve the quality of prehospital care over pediatric patient. The study also focuses on the perception of a paramedic by representatives of other medical professions and by society through the prism of professionalism at work. The article demonstrates that paramedics both by their professional actions and behavior may increase social trust, and gain the respect of the other professional groups with whom they collaborate (nurses, physicians, policemen etc.).

Material and methods

The study uses information obtained from interviews conducted with 12 workers (7 nurses, 2 paramedics and 3 physicians) of the admission room (AR) of the University Children's Hospital in Kraków. The interview with each employee consisted of a conversation lasting approximately 30 minutes, during which answers to questions were collected. The observations of the employees, expressed as their own views on the subjects discussed in the interview, were also recorded. Questions asked in the interviews concerned collaboration with EMT. Special attention was paid to the aspects which, in the opinion of interviewees, were incorrect and needed changing. The following questions were asked:

- Do you think that EMT the prehospital treatment of infants and young children, as well as teenagers, is adequate?
- How do you evaluate the practical child treatment skills of EMT?
- Do you think that prehospital care provided to a child by the emergency medical personnel is sufficient?
- Are the patients transported in ambulances usually at life risk?
- Are the children, who are not at life risk, transported directly from the site of the event provided with adequate prehospital care?
- Do seriously ill children who require hospitalization and are transported to an admission room by EMT directly from the site of the event receive medical procedures adequate to their needs?
- Do EMT perform intravenous cannulation in pediatric patients with indications for this procedure?
- Do children receive prehospital drugs from EMT in cases when it is indicated?
- Which drugs indicated in prehospital care are avoided by EMT?
- How do you assess completion of medical documentation (Emergency Medical Procedures Chart) handed over by the team leader?
- Is the medical documentation complete and does it contain significant data describing medical history, physical examination and prehospital procedure implemented? If not, which necessary data are missing most often?
- How do you assess the ability to hand the patient over to the hospital staff by the EMT leader?
- What is your opinion of the professionalism of people working in EMT?
- What is your general assessment of the work of emergency medical teams?
- Do you think that changes need to be introduced in the prehospital care of children as provided by EMT?

The most important answers are presented in the study.

The documentation was also analyzed. 44 Emergency Medical Procedures Charts (EMPC) were analyzed, which document prehospital procedures in randomly selected patients transported by EMT to the University Children's Hospital in Kraków in September 2013. The content correctness, as well as orthography and punctuation of the documentation were verified. In the EMPC analysis the adequacy of procedures implemented by the team was not assessed.

Results

The quality of prehospital care of children varies, depending on experience of the EMT, and primarily on the age of the patient. In case of teenagers transported to AR in ambulances, the personnel questioned in 83% confirmed that EMT provide correct treatment and implement most of the required procedures in prehospital care. Other respondents (17%) reported irregularities in the work of EMT, also in the case of older children. All the persons expressing their opinion (100%) declared that in case of young children, particularly infants, the treatment is incorrect or insufficient. It seems that in the case of teenage patients, since they resemble adult patients, EMT implement proper treatment. This is probably due to the more extensive experience of EMT with adult patients, which results from significantly higher number of calls regarding adults than children. The interviewees were asked to assess the practical skills of EMT in the treatment of children. The respondents evaluated those skills as poor: none of the persons interviewed evaluated the practical skills as good, only 33% described them as satisfactory, 50% as definitely insufficient, and 16% had no opinion.

Asked if the quality of prehospital care provided by EMT is sufficient, 25% answered yes while 75% decided it was insufficient. Concerning the health condition of children transported usually to the admission room by EMT, 83% of respondents answered that the children were usually not at life risk. It seems that the status quo results from excessive calls for ambulances by society to events which do not require it, and the absence of proper treatment procedures in patients whose lives are not at risk. It was determined that the group of patients who are not at life risk was usually properly treated in prehospital care; this being the opinion of 83% of AR employees participating in the study. It appears that this results from a limited need to implement emergency procedures in patients who are not at life risk. Comments of the personnel indicate that the greatest reservations regarding proper treatment are associated with seriously ill children who require hospitalization. Eleven out of the twelve respondents asked (91%) declared that in case of those patients the emergency medical teams did not provide prehospital care adequate to the needs. 83% of respondents believed that EMT did not perform peripheral cannulation in children who required this procedure. Paramedics and nurses admitted that they usually start taking over a patient in moderate or severe condition from an EMT from cannulation of a peripheral vessel. Three study participants emphasized that according to their observations the absence of cannulation was not associated with a failed attempt to place a cannula, but with the lack of such attempt. In answers regarding the administration of drugs or placing IV drip when indicated, the opinion that the procedures were not performed slightly dominated. 58% of respondents were of that opinion, the rest declared that patients usually receive the necessary drugs. The respondents strongly emphasized the frequent failure to administer analgesics (83%) and antipyretics (75%). The respondents added that the greatest deficit they noticed were the absence of anesthetic treatment in patients with burns. The AR personnel declare that many children with fever did not receive antipyretics or were not cooled mechanically during prehospital care. This creates the risk of fever spasms [4].

Medical documentation was another subject discussed during the interviews. The respondents determined the correctness of completing EMPCs; only 17% thought that documentation was completed correctly, 83% declared that documentation was completed sketchily, and often important information was missing. The respondents listed many reservations regarding EMT documentation. Four respondents (25%) noticed an incomplete medical history, six (50%) observed that charts rarely contained information about a physical examination, 67% noticed shortcomings in the form with missing information about the patient's vital parameters controlled in prehospital conditions, and 7 (68%) mentioned missing data regarding drugs administered, their doses or time of administration. Handing the patient over by EMT to hospital staff was another aspect discussed in the interviews. 67% of statements regarding the ability to hand over a patient by the EMT leader were positive, while the remaining staff members assessed this competence poorly. Half of the respondents answering this question noticed a maneuver applied by some EMT leaders. Instead of handing over the collected medical history, the emergency medical team leader asks the child's guardians to describe the patient's health situation. The question about the professionalism of EMT members produced considerably varied answers. Eight respondents (67%) declared that teams present different levels of professionalism, from low ("the ambulance personnel behave more like a non-medical transport company; they might go to the site of the event in flip-flops") to very high ("it is hard to have any objections about the team's behavior"). One respondent (8%) thought that most EMT members were not professional, while 3 (25%) evaluated their professionalism highly. In the summarizing questions regarding the general evaluation of EMT work and need for changes, the hospital personnel rather unequivocally declared that the quality of prehospital care over children varied, and conditional upon the experience of the EMT. Each of the employees could, without giving it much thought, describe situations in which the EMT handed over a patient in need of certain prehospital procedures which had not been

performed. The personnel found that the prehospital treatment of children by the EMT needs to be improved. This position was shared by all the employees of the admission room.

In the second part of this study, the documentation handed over by EMT was analyzed. The Emergency Medical Procedures Chart (the only document describing EMT activities and the patient's condition before arrival at the hospital) is often completed negligently, lack sufficient information, and contains numerous orthographic or punctuation mistakes. Among all the analyzed charts, 30 (68%) were completed almost correctly regarding the content. Rather striking was the fact that 35 charts (80%) contained many spelling, punctuation and orthographic errors. In 5 charts (11%) the medical history was missing, and instead only a general diagnosis was provided, e.g. "fainting – dyspnea". Some EMT leaders did not use capital letters, punctuation marks or Polish letters in the medical documentation, which does not affect the information content, but gives an impression of negligence. The problem of careless completion of documentation in the analyzed material applied to physicians as well as paramedics. The charts completed by emergency nurses (14% of all the studied EMPC) were exceptional compared to the others in that they were mostly properly completed (67%).

Discussion

Based on the experience of employees of the admission room, in the case of a child patient it often happens that certain procedures, such as peripheral cannulation, administration of fluids or drugs, were not performed during prehospital care. A child is taken to hospital according to the "scoop and run" rule, which consists in renouncing or significant reduction of emergency procedures at the site of the event, and fast transportation to a hospital [3]. This principle seems to be overly used in the case of children, and this results primarily from fear about pediatric patients as well as from an absence of treatment algorithms [5].

In order to better illustrate these problems, two cases of patients transported by EMT are presented.

Case 1

A 6-year-old patient was brought to the emergency hospital department before noon. A paramedic entered the triage room carrying the girl in his arms, saying that the team leader, a physician, was completing the documentation and that he would soon join them. The child was laid on a bed. The patient's appearance was disturbing in the opinion of the nurse and paramedic. The girl was drowsy, breathing rapidly, very thin, complexion was pasty, skin clearly dry, and the child was dehydrated. When the personnel asked about the preliminary diagnosis, they were informed that none had been made. Similarly, no detailed information was provided regarding potential chronic diseases, suggested by the child's appearance and condition. The paramedic said: "According to what we've determined, she has no chronic diseases. She looked so bad, that we brought her directly here". When the team leader entered the emergency department, an intravenous cannula was being placed (as it had not been inserted during prehospital care) and fluids administered. The team was asked about possible determination of blood glucose and, due to a negative response, the test was performed immediately at the bedside. The glucometer showed a result beyond the scale, i.e. over 600 mg%. Basic tests were also conducted. Blood pH in gasometry was below 7.0. The girl was diagnosed with diabetes and immediately placed in the intensive care unit, where the treatment was continued.

The greatest objections regarding EMT procedures in this case were caused by the lack of intravenous catheter, or even an attempt to place one.

Peripheral cannulation in a child, compared to an adult, requires taking into consideration the difference in the size of vessels, proper catheter selection, and a very important element: a lack of co-operation between the child and personnel, which means that two people must perform the procedure. In children, the best cannula size is 22G (blue venflon), and in case of neonates, infants, as well as children with chronic diseases, who are often injected, size 24g (yellow) may be used [5, 6].

In the University Children's Hospital in Kraków, intravenous cannulation in a child is performed in a manner developed by experienced personnel.

Intravenous cannulation in a child requires the participation of two people: one of them stabilizes the limb for the moment of injection, stasis and pulling the patient's skin, which makes the veins visible. The other person, keeping and stabilizing the limb distally, inserts the cannula [7]. The intravenous catheter needs to be properly secured, as the child may remove it, deliberately or incidentally. It is best to use two adhesives: one should cover the top, the other the bottom of the cannula, then the venflon should be covered with a bandage to enable administration of drugs and fluids, but securing the device against manipulation by the child [6, 7]. The scheme of intravenous cannulation is presented in Figures 1-5.

According to the authors, providing intravenous access in the prehospital phase is particularly important if:

- the child's condition is severe,
- the child's condition is stable, but we can expect its deterioration during transportation (is especially applies to children after a serious injury, burns,

with anaphylactic reaction, with consciousness disorders, or following spasms),
- immediate administration of fluids or drugs is required (children who are dehydrated, burned, during extended seizures, or in need of analgesics).

Figure 1. Appearance of the limb of patient “A”. Vaguely visible venous vessels

Rycina 1. Wygląd kończyny pacjenta A. Naczynia żylne mało widoczne

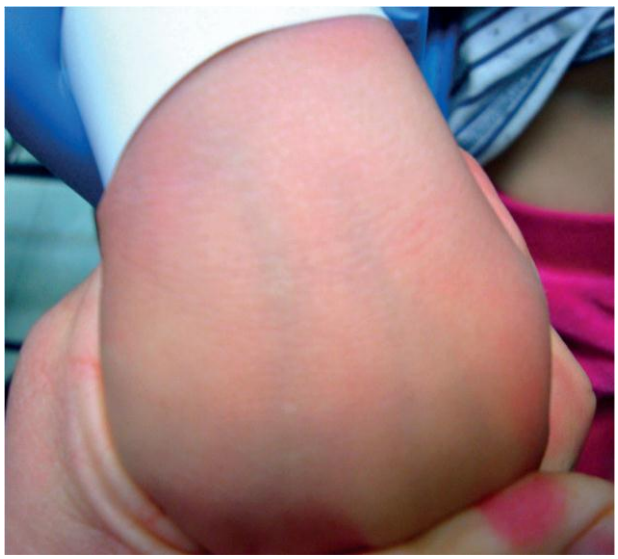

Figure 2. Appearance of the limb of patient “A” held by a nurse. Easily visible venous vessels

Rycina 2. Wygląd kończyny pacjenta A podczas trzymania przez pielęgniarkę. Dobrze widoczne naczynia żylne

In case of the above conditions, at least an attempt to place a cannula is necessary. The valid principles of intravenous cannulation in urgent conditions is worth remembering here. If a child is at life risk, intravenous cannulation is necessary. If three attempts to place a venflon fail, or if the child's condition is critical and the attempt to place the cannula lasts longer than a minute, an intraosseous catheter should be placed [8]. It is unacceptable to transport a child at life risk without intravenous or intraosseous catheter, and particularly, to avoid performing cannulation.

Another problem in the prehospital treatment of children by emergency medical services is the administration of drugs. According to questioned personnel, the most common urgent conditions in children which require early administration of drugs included fever of various causes, strong pain symptoms (e.g. in burns), and respiratory infections

Figure 3. Appearance of the limb of patient “B”. Venous vessels are visible

Rycina 3. Wygląd kończyny pacjenta B. Widoczne naczynia żylne

Figure 4. Appearance of the limb of patient “B” held by a nurse. Easily visible venous vessels

Rycina 4. Wygląd kończyny pacjenta B po przytrzymaniu przez pielęgniarkę. Dobrze widoczne naczynia żylne

with dyspnea. In case of dyspnea, EMT usually used oxygen administration and inhalations during transportation to hospital, which normally are sufficient. However, in the case of pain and fever treatment, it was found that prehospital pharmacotherapy was rarely implemented by EMT. Therefore, analgesics and antipyretics should be discussed here. A paramedic is authorized to administer the drugs listed in the Regulation of the Ministry of Health of 14 January 2009 amending the regulation on the detailed scope of emergency medical procedures which may be performed by a paramedic [9]. To obtain an analgesic effect in a child, according to the regulation, a paramedic may use morphine [9] at doses of 0.1-0.2 mg/kg body weight. This drug may be administered intravenously, which starts working after 2-3 minutes, or in intramuscular or subcutaneous form, which starts working after approx. 15 minutes [10]. Paramedics may also administer Ketonal [9]. However, it should not be used in children below 15 years of age [11]. Another legal document associated with drug administration is a reference regarding first aid in the Act of 8 September 2006 on the National Emergency Medical Services [11]. In article 3, section 7, the term first aid is defined as "a set of activities performed in order to rescue a person at sudden health risk by a person present at the site of the event, also with the use of commercially available medical devices and medicinal products" [11]. Unfortunately, the act does not specify the first aid procedures performed by a paramedic. It only mentions authorization to perform emergency medical procedures. If paramedics were considered authorized to provide first aid, it would be possible for them to administer analgesics and antipyretics in the form of syrup, tablets or suppositories.

Drugs which may be used during first aid procedures are paracetamol and ibuprofen. Paracetamol is used at a dose of 10-15 mg/kg b.w. until the antipyretic effect is obtained. As an analgesic, the drug is used at a dose of 10-20 mg/kg b.w. [10]. Ibuprofen used as an analgesic or antipyretic drug is administered at a maximum dose of 20-30 mg/kg b.w. in 3-4 divided doses [10].

Analgesic and antipyretic treatment in patients with those symptoms should be implemented in EMT procedures. In children with fever, if antipyretic drugs are not available, the child should be minimally covered (without a thick blanket), and a cold compress should be placed, e.g. on the abdomen or groins, for the time of transportation to hospital.

If the patient transported is in a severe condition, EMT should inform the hospital to which the patient is transported. It is of particular importance if the "scoop and run" principle is applied, and the patient has not been treated properly. The hospital personnel, when informed about the arrival of a patient in severe condition, can then prepare for it. In such cases, the hospital mobilizes its forces to admit the patient, having properly prepared the patients already being treated in the emergency department. Next, an appropriate physician is informed, a place in the intensive care unit is prepared, and personnel performing image diagnostics are warned. Due to these procedures admitting the patient, performing diagnostics and placing with the right department is more effective than when a patient in severe condition arrives unexpected.

Figure 5. Patient “B” during inserting of venous cannula

Rycina 5. Pacjent B podczas zakładania kaniuli żylnej

The second case illustrated the above problems.

Case 2

Specialist EMT brought a 14-month-old girl to the Admission Room at the University Children's Hospital. The girl had poured a pot of boiling water on herself at home. The burns covered the face, neck, chest and both upper limbs. The event took place 40 km from the hospital, which meant 30-40 minutes of fast driving to the destination hospital. The hospital was

not informed about the impending arrival of the patient. No attempt to place an intravenous catheter was made. Neither the parents, nor the EMT physician administered an analgesic. The child was brought covered in wet clothes and gauze, metal earrings were not removed from her ears. Analgesics were not administered, which was justified: "The child during transportation was very calm and did not require analgesics. We have no experience in treating children". At the emergency hospital department at the arrival the child was partially conscious, the limbs were already swollen, the skin was cool, marble-like, the pulse oscillated around 130-150 beats per minute. The burned area was estimated at 20% TBSA. The hospital personnel immediately implemented emergency procedures. A paracetamol suppository was administered, the earrings and wet clothes were removed. Intravenous cannulation was performed which, due to the child's poor condition at the arrival at the hospital, was successful only after a few attempts. Warmed saline solution and morphine was administered. The child was admitted to the Children's Burns Center, where the treatment was continued for several weeks.

This example proves not only the lack of knowledge about the treatment, but also lack of the ability to assess the child's condition properly – a child with consciousness disorders might not cry. Not performing procedures at the site of the event (administration of analgesics, intravenous cannulation, fluid infusion, protection against cooling) resulted in fast deterioration of the child's condition, including shock.

This example is presented to emphasize how important implementation of appropriate prehospital treatment is. Description of the case involving a burned child is, regrettably, the quintessence of inappropriate behavior of EMT. Not performing procedures at the site of the event, such as administration of analgesics, intravenous cannulation, fluid infusion or protection against cooling, resulted in fast deterioration of the child's condition, and could have had tragic consequences. This ends discussion of peripheral catheter placing and prehospital administration of drugs.

Another problem which requires attention is collecting medical history and handing the patient over in hospital. The authors' observations indicate that when EMT is called to a child subsequently transported to a hospital, the medical history is very general. EMT leader often does not have the basic information which should be obtained during an interview. Sometimes, while handing the patient over to the hospital personnel, the EMT leader instead of presenting the medical history and physical examination results, relies on the child's parent present and very briefly informs about the health problem, stating that "The parent will explain everything". In most cases such behavior does not affect the child's health condition significantly, but is a proof of the unprofessional attitude of the EMT leader. Even when called to a minor case, when the patient's life is not at risk, the EMT leader is obliged to collect the medical history and properly hand over the patient. Professional behavior is crucial to ensure respect for the paramedic profession from members of other professions collaborating with EMS (physicians, nurses, police officers) and from society.

Continuing the issue of professional behavior, the problem of completing medical documentation by the EMT leader should be discussed. Our analysis demonstrates that EMPC is not always completed correctly and with due diligence. It seems that EMT leaders do not pay much attention to proper completion of this obligatory document. The Emergency Medical Procedures Chart is the only document which EMT is obliged to submit while handing the patient over to hospital staff. The chart is included in the patient's hospital medical documentation, and is stored throughout the patient's stay [12]. Therefore, many people taking care of the patient read this documentation. EMPC may be considered a particular showcase of the emergency medical team. Moreover, in case of potential legal doubts as to the patient treatment, information documented in the EMPC are considered in the court procedure. Thus, all EMT leaders should remember to complete the documentation with due diligence.

Conclusions

1. A child to whom an EMT was called usually requires administration of drugs or infusion fluids, so an attempt to insert a cannula into a peripheral vein before transportation to a hospital should be made.
2. In the case of a child's life risk, three attempts at peripheral cannulation should be made. If they fail, an intraosseous catheter should be inserted.
3. Prehospital administration of analgesics in children with pain symptoms is necessary, especially those with burns, and antipyretics need to be administered those with fever. Alternatively, the temperature may be lowered with physical methods.
4. The paramedics training should focus more on practical skills associated with intravenous cannulation in children.
5. EMPC should be completed carefully, and an exhaustive medical history should be collected.
6. The professional behavior of EMT members affects the respect of other professional groups and social trust for paramedics.

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Professionalism in the paramedic profession – pilot survey

Profesjonalizm w zawodzie ratownika medycznego – badanie pilotażowe

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Abstract. This study aims to identify elementary attitudes of professionalism in the paramedic profession in Poland. A questionnaire type survey was conducted among paramedic students (full time undergraduate studies and extramural undergraduate studies), working paramedic staff (not specially trained in professional attitudes) and representatives of professions closely involved with emergency medicine in Poland (fire services and emergency department staff). The survey questions used the five-point Likert scale to measure attitudes of professionalism and specific behavior important in the paramedic profession. All attitudes and behaviors in the paramedic profession defined by the author as professional are notable in avoiding the lowest degree in Likert scale. It is necessary to conduct further research on a larger group and to refine the research tool.
Key words: medical professionalism, paramedic

Streszczenie. Cel pracy to identyfikacja cech profesjonalizmu ratownika medycznego w Polsce. Materiał i metoda: Przeprowadzono badanie ankietowe w grupie studentów ratownictwa medycznego (studia licencjackie stacjonarne i niestacjonarne), czynnych zawodowo ratowników medycznych (żadna z wyżej wymienionych grup nie została poddana szkoleniu mającemu na celu pracę nad profesjonalizmem w zawodzie) oraz przedstawicieli grup zawodowych najbliżej współpracujących z systemem ratownictwa medycznego w Polsce (straż pożarna, pracownicy szpitalnych oddziałów ratunkowych). Ankieta zawiera pytania z szacunkową skalą Likerta pomocną do oceny wagi poszczególnych cech profesjonalizmu i wyszczególnionych zachowań w pracy ratownika medycznego. Wyniki: Wszystkie zachowania i postawy zdefiniowane przez autorkę kwestionariusza jako profesjonalne są ważne w pracy ratownika medycznego poprzez unikanie wartościowania w najniższych stopniach skali Likerta. Wnioski: Konieczne jest przeprowadzenie badań na większej grupie badawczej i udoskonalenie narzędzia badania.
Słowa kluczowe: profesjonalizm medyczny, ratownik medyczny

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Introduction

In today's fast-paced world, certain ideals which used to guide medical professionals seem to be forgotten. The Hippocrates oath and selflessness toward a patient seem to be relegated to a secondary effort, neglected by medical staff [1]. Limited patient satisfaction from prehospital assistance is a phenomenon observed not only in Poland. Increasingly often media publish articles which negatively assess the functioning of the health services, revealing irregularities or negligence on the part of medical personnel. On the basis of press articles one may have an impression that positive opinions regarding medical environment are rare; unfortunately, those opinions apply also to the members of the paramedic profession. Despite such presentation of the reality, patients and their families in the situation of health or life risk expect implementation of health services in a competent and highly professional manner [2].

Since the introduction of the Act on the National Emergency Medical Services (2006), the paramedic community considers gaining social trust and obtaining better education to be the primary goals of the paramedic profession. From 2013/2014, the professional title of paramedic will be available only for graduates of higher education institutions – those who receive an undergraduate diploma. Social trust until today has not improved significantly. It is necessary to constantly improve the qualifications of paramedics and to strive for the professionalism expected by the society in everyday emergency procedures.

Professionalism as a term used in the context of medical education appeared in the literature approximately 25 years ago. From an abstract and elusive idea it evolved to a concept of much importance to the development of education. However, defining it or putting it into operation proved to be a challenge. Globalization moved discussion and research on medical professionalism from Anglo-Saxon countries, in which it originally flourished [3-7].

In 2011, a study was published by the International Ottawa Conference Working Group on Professionalism consisting in the analysis of the most important articles on professionalism [8]. They focused on the following aspects: professionalism depends on historical and cultural context; in the context of medical professions it is inadvertently correlated with social responsibility; definition of professionalism and teaching it should be based on a dialogue with society; attempts to transfer the concept of professionalism to other cultures should be made with care.

In the USA approximately 15 years ago 12 areas of professionalism were distinguished, included in 1998 in the national education curriculum for paramedics (Emergency Medical Technicians – EMT), whose competences largely correspond to those of Polish paramedics [9]. In a study conducted in 2005, which consisted in evaluation of paramedics by their partners on-call, professional behavior of paramedics was classified as follows, starting with features of the highest importance: integrity, image, patient support, empathy, self-confidence, careful service performance, respect for a patient, interpersonal skills, time-management skills, group-work skills, personal motivation.

In Polish academic literature there are not many studies on professionalism. Few publications mention the problem of doctor's professionalism; if they discuss emergency medical services, only a small part of the problem area is covered. This pilot survey and study only attempt to explore the problem and begin related research, important not only for health care.

Aim of the study

The aim of the study was to define the most elementary characteristics of medical professionalism in the paramedic profession. The survey was supposed to demonstrate the differences in perception of Polish professionalism in the context of standards adopted in other countries, and present autonomous characteristics typical of this profession in Poland. It is possible that selected features of professionalism, behaviors or attitudes will be promoted among paramedic personnel, but first and foremost, the most constitutive ones may be incorporated in educational programs.

Material and methods

The survey questionnaire involved a group of 97 respondents in the period August to October 2013. 40% of the survey subjects were employed in Emergency Medical Services teams, emergency hospital departments and admission rooms as paramedics, physicians, or nurses. 37% of the questionnaire addressees were first or second year students of full time and extramural paramedic studies at Andrzej Frycz Modrzewski Kraków University. The remaining group were paramedics who currently are not employed within the structures of the National Emergency Medical Services, and fire brigade officers or students at a police school. The original survey questionnaire was developed on the basis of knowledge about medical professionalism researched abroad, with consideration of Polish specificity and the realities of the paramedic profession. The questionnaire contained 27 behaviors/attitudes, and respondents were supposed to assess how important they are in the work of a paramedic (Table). All respondents were informed about the aim of the study and the use of the obtained data and analysis results.

Results

Many respondents reported difficulty in deciding which of the listed features may be considered as less important in the everyday performance of the paramedic profession, which was reflected in the study results. Only 13% of the answers evaluated behaviors as completely insignificant or of little importance (the first two degrees in the Likert scale adapted). The best evaluated behavior in the survey was: "ensures that the patient receives the most efficient help in a given situation". 82% of study subjects assessed this attitude as very important in the work of a paramedic. "Is aware of great responsibility associated with the profession" is the second highest evaluated feature; 74% of the study subjects deciding it was very important. Next highly evaluated attitudes associated with medical professionalism in the work of a paramedic were: "Does not criticize a member of his/her team in the patient's presence" (72% of the survey subjects considered this to be very important) and for 70% of the subjects "Performs his/her duties in the emergency rescue team with confidence and without hesitation" was important. Interestingly, only 2% less (68%) indications were given to "Takes care of cleanliness and disinfection of the equipment used and follows the procedures", and 3% less (67%) to the feature describing appearance: "Maintains personal hygiene".

Table. Professional behaviors/attitudes investigated in the survey
Tabela. Zachowania/postawy profesjonalne badane w kwestionariuszu

	Answers according to the Likert scale				
	1	**2**	**3**	**4**	**5**
Stands for his/her opinion and is not easily influenced	4	2	10	55	26
Performs his/her duties in the emergency rescue team with confidence and without hesitation.	0	0	0	29	68
Is assertive in case of unjustified demands of patients and their families.	1	1	6	55	34
Shows emotional support to every patient.	0	0	11	36	50
Ensures that the patient receives the most efficient help in a given situation.	0	0	2	15	80
Does not criticize a member of his/her team in the patient's presence.	0	1	0	26	70
Behaves in the same way towards all patients, regardless of their nationality, race, social or financial status.	0	1	9	32	54
Shows understanding for patients' attitudes based on religion or culture.	1	2	11	51	32
Immediately, without undue delay, reacts to calls for intervention or from patients who require assistance.	0	0	4	37	56
Safely and without abusing the privileges of an emergency vehicle transports the patient to a hospital.	1	4	6	42	44
Takes care of cleanliness and disinfection of equipment used, follows the procedures.	0	0	0	31	66
Maintains personal hygiene.	0	0	1	31	65
Looks presentable and wears proper clothing, adequate to professional requirements.	0	1	4	45	47
Effectively communicates and exchanges information with other team members during medical events.	0	0	1	31	65
Can communicate effectively with patients and their families.	0	1	5	45	46
Can provide convincing arguments.	0	0	8	49	40
Arrives at work on time.	0	1	5	48	43
Can use the on-call time well to perform additional duties, such as cleaning, drug control, and disinfection.	0	1	18	61	17
Can organize well his/her work time according to the current situation and patients' need.	0	0	9	60	28
Knows his/her role in the team and performs it with very carefully.	0	0	1	40	56
In case of urgent need, substitutes for a team member unable to perform his/her duties.	0	0	0	43	54
Is aware of great responsibility associated with the profession.	0	0	5	20	72
Improves his/her knowledge and skills, e.g. through additional training or participation in related conferences.	0	0	8	38	51
Shows compassion to patients and their families.	1	2	11	55	28
Knows his/her own limitations and knows when to ask for help of a more experienced colleague or physician.	0	0	2	36	59
Maintains professional confidentiality.	0	0	5	31	61
Respects patient's intimacy and autonomy.	0	0	4	33	60

Likert scale: 1 – completely insignificant, 2 – of little importance, 3 – indifferent, 4 – important, 5 – very important

Among the attitudes assessed by the survey subjects as less important or indifferent (evaluated as 3 or 4 at the adopted Likert scale) were attitudes such as: "Can use the on-call time well to perform additional duties, such as cleaning, drug control, and disinfection", which received 82%, "Stands for his/her opinion and is not easily influenced" ”– 73%, "Can organize well his/her work time according to the current situation and patients' need" – 71%, and the same rate for "Shows compassion to patients and their families". Interestingly, 67% of respondents also believes that the attitude: "Shows understanding for patients' attitudes based on religion or culture" is less important or indifferent. Detailed results are presented in the Table.

The analysis of responses, divided according to groups of respondents, reveals that the answers assessing attitudes/behaviors were similar, and analyzing each of the groups separately was not necessary.

Discussion

Due to the specificity of the paramedic profession, it is impossible to compare professionalism in this profession to other medical professions, e.g. physician or physiotherapist; therefore, the analysis of literature and reports on other medical professions was not performed. The study results demonstrated that professionalism in the paramedic profession seen by emergency medical services personnel, paramedic students and formations collaborating with emergency medical services in Poland differs from those presented in studies conducted in the United States.

Comparing the results of this study with EMT research conducted in 2006 in the USA, it is worth noting that we consider engagement at work and sense of responsibility as the most important aspects in the work of paramedics [9]. These two features of professionalism are absent in the categories considered in the American study. It is also worth noting, that we do not consider empathy and tolerance for patients as very important elements of work, whereas in the American study respect and empathy were among the highest ranked features. Other differences cannot be demonstrated, as the EMT study in the USA had different objectives than evaluating characteristics of professionalism.

The analysis of world's literature demonstrates the need to perceive professional behaviors as crucial for the functioning of all health care disciplines; whereas in Poland it seems that promoting the concept of professionalism is not considered important. Evaluation of professional behaviors among physicians, paramedics and other professions significantly associated with medicine is very difficult [9]. As a consequence of these analyses, the question should be asked: who should be held responsible? Surveillance over emergency rescue teams during their field work is not possible. Even in emergency hospital departments, employer surveillance is limited, and verification of professionalism would require additional, special and directed financial expenditures and tools. Higher education institutions responsible for students training are not, even after the introduction of the new Higher Education Act, prepared to evaluate social competences including professional attitudes. It seems that the only way to form proper attitudes and to increase the significance of professionalism as an important professional feature is to introduce these concepts to the study curriculum, and demand that the personal models functioning in the paramedics' environment be followed. It is possible to show a student, as well as a health care professional, that they can be better paramedics by creating positive models of behavior and following the footsteps of those who provide good example through their work. Professional training which, according to the Ministry of Health regulation is obligatory for all paramedics, could also be extended to include forms emphasizing professional attitudes/behaviors, not only medical content and practical skills.

Conclusions

The results confirm that medical professionalism expressed by attitudes and behaviors in the work of a paramedic is very important and needed. It should be promoted and popularized, in order to provide more effective functioning of all the medical rescue structures, improving the image and social trust.

It has been confirmed that medical professionalism in the Polish environment is characterized by other features than in other countries, reflecting the conditions specific for this country, needs and expectations,

This survey should be considered as a pilot study, so it should be continued with participation of a larger and more varied research group, including other socially engaged parties associated with the National Emergency Medical Services.

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Prehospital procedures in respiratory infections in children

Postępowanie przedszpitalne w infekcjach dróg oddechowych u dzieci

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Abstract. The aim of the paper was to present and discuss the most common respiratory infections among children faced by National Emergency system staff in order to facilitate their diagnosis, particularly during prehospital treatment. An additional aim is to educate the guardians/parents of children in the prehospital treatment of respiratory infections among children. A statistical review was made of individual disease units (International classification of Diseases) recorded in the admission room of the University Children's Hospital in Kraków in October 2013. The author's work experience was also used. Respiratory infections among children are one of the most common causes of their hospitalization. Prehospital treatment is a very important link in the treatment chain. Early introduction/application of suitable prehospital treatment delays the need for hospitalization or, in some cases, may make hospitalization unnecessary. Suitable treatment should be implemented immediately, both those prehospital procedures intended to be followed by parents and those by paramedics. The guardians of children need to be educated in the prehospital treatment of children's respiratory infections.
Key words: obstructive bronchitis, acute laryngitis, child, medical rescue, pediatrics, pneumonia, respiratory infection

Streszczenie. Cel pracy: Celem pracy było przedstawienie i omówienie najczęstszych infekcji dróg oddechowych u dzieci, z którymi mają do czynienia pracownicy systemu Państwowego Ratownictwa Medycznego, co ma ułatwić ich rozpoznanie zwłaszcza w warunkach przedszpitalnych. Dodatkowym celem jest również edukacja rodziców (opiekunów) w zakresie postępowania przedmedycznego z dzieckiem z infekcją dróg oddechowych. Metody: W pracy dokonano przeglądu statystycznego poszczególnych jednostek chorobowych rejestrowanych w Izbie Przyjęć Uniwersyteckiego Szpitala Dziecięcego w Krakowie w okresie 1–30 IX 2013, jak również wykorzystano analizę doświadczeń własnych, związanych z pracą jako ratownik medyczny we wspomnianej jednostce. Wnioski: Infekcje dróg oddechowych u dzieci są jedną z częstszych przyczyn ich hospitalizacji, a postępowanie przedszpitalne jest ważnym ogniwem w łańcuchu leczenia infekcji dróg oddechowych. Wnioski: W postępowaniu przedszpitalnym wczesne wdrożenie leczenia spowalnia i umożliwia odroczenie, a w niektórych przypadkach nawet brak konieczności hospitalizacji. Wdrożenie postępowania jest konieczne jak najszybciej i dotyczy postępowania przedmedycznego przeznaczonego dla rodziców i postępowania medycznego dla zespołów ratownictwa medycznego. Opiekunowie dzieci wymagają edukacji w obszarze postępowania przedmedycznego w infekcjach dróg oddechowych u swych podopiecznych.
Słowa kluczowe: dziecko, infekcja dróg oddechowych, ostre zapalenie krtani, obturacyjne zapalenie oskrzeli, pediatria, ratownictwo medyczne, zapalenie płuc

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Introduction

Children's infectious diseases are one of the most common health problems in the paediatric population. One of the causes is the immaturity of a child's immune system. Apart from this, there are certain topographic and anatomic differences between organs and systems in an adult and a child, which account for different susceptibility to infections. Respiratory infections are special, since as a result of differences in the structure of the respiratory system, the same disease in a child poses a greater health or even life hazard than in an adult patient. Three diseases are reviewed/discussed in the study: acute laryngitis (J04), pneumonia (J18) and obstructive bronchitis (J20) [1]. The reason the above disease units were chosen is that their exacerbated forms are life-threatening in children and that they occur very often, the latter being confirmed by statistical data of the Admission Room at the University Children's Hospital (IP USD); the diseases were causes of 117 of 841 visits by patients who required pediatrician's intervention in the study period. The diseases are quite characteristic, so any member of an emergency

medical team should be able to recognize them: physician, system nurse or paramedic. Diagnosis is based on medical history obtained from the child's parents (guardians). The interview alone sometimes provides information suggesting a given disease. Completion of the proper procedure involves, for example, a physical examination confirming the presence of respiratory effort, level of hemoglobin oxygen saturation measured with pulse oxymeter, presence of respiratory murmurs detected with a stethoscope. After careful collection of the medical history from the parents and examining the child, the emergency medical team may implement a suitable procedure, depending on the symptoms observed and suspected disease.

Aim of the study

The aim of this study was to identify and analyze the following diseases in children: acute laryngitis, obstructive bronchitis and pneumonia, associated symptoms and prehospital procedures. The choice of subject is related to the authors' workplace and their observations regarding patients in the Admission Room at the University Children's Hospital.

The aim is to answer the following questions:

- What prehospital procedures should be implemented by Emergency Medical Services teams in children with exacerbated respiratory infections?
- Can a parent/guardian without any medical training help their child?
- Does each exacerbation of a respiratory infection require an EMS team or a visit to an emergency hospital department?

Material and methods

The study was based primarily on the analysis of our own experience and statistical review of the following disease units: J04, J18, J20 in children registered at IP USD in Kraków in the period 1-30 September 2013. The clinical symptoms and differential diagnoses were discussed, and prehospital procedures and treatment were presented. The statistical analysis included those patients who arrived at the hospital on their own and those transported by EMS teams. 117 cases were analyzed of children who came to the hospital due to respiratory infection symptoms. Descriptive statistical analyses of the sample were performed. The assessments were made with the use of Statistica 10 software.

Conclusions

Emergency procedures in respiratory infections in children regarding the three diseases discussed: acute laryngitis, pneumonia and obstructive bronchitis, can and must be performed at the prehospital stage by EMS teams. Initial recognition and diagnosis is made after an examination consisting of collecting the medical history including information about other symptoms (temperature, cough, pain etc.) and a physical examination, with particular focus on auscultation. Certain symptoms may suggest severe disease units, therefore efforts should be made to eliminate errors. Depending on the diagnosis, suitable procedures and treatment should be implemented. Some necessary and simple procedures include administration of moisturized oxygen, analgesics and fever-reducing drugs.

However, in the case of disease, a pediatric patient may need assistance before professional personnel arrives. Such assistance should be provided by the child's parents (guardians), who, unless it is the first incident, usually know what to do. Unfortunately, sometimes the child does not receive any premedical help, which deteriorates his/her condition and increases suffering, as illustrated by the necessity to introduce antipyretic treatment, which should be implemented by the parents (guardians) at home. Out of a total of 2,455 patients attending the admission room in the period 1-30 September 2013, 847 patients required examination by a pediatrician, and 117 were diagnosed with the infections discussed in this study. The difference between 2,455 and 847 is the number of patients with surgical or orthopedic problems. In the analyzed group of 117 of the 847 children who attended the admission room due to respiratory infection symptoms, almost half (43%) of the patients were sent back home with recommendation to return for an assessment at the primary health care institution, which suggests an unnecessary visit to the hospital: the child required examination by a physician, but in a place other than a hospital. The sample consisted of 117 children, of which 38 (32%) were diagnosed with acute laryngitis, 50 (43%) with pneumonia and 29 (25%) with obstructive bronchitis. The majority of this group, 75 (64%) patients, were males; mean age slightly over 3 years old. 23 patients were transported by EMS teams, which constituted 19.6% of all the patients with these diagnoses. 17 children were hospitalized.

Discussion

Exacerbation of respiratory infection in a child may be life-threatening, thus correct diagnosis and early implementation of suitable treatment, including by EMS teams, is crucial. The child's condition may improve due to the suitable approach of the parents who, instructed by a medical dispatcher for example, may use over-the-counter products or apply non-pharmacological methods.

In the prehospital phase, EMS team members apply symptomatic treatment. The symptoms of different diseases can be quite specific, e.g. laryngeal cough in case of laryngitis, auscultatory changes in case of pneumonia or obstructive bronchitis. However, certain symptoms may suggest many diseases (fever). The basis for correct diagnosis of respiratory infection is medical history collected from the parents regarding the type of observed symptoms and timing of their presence (e.g. barking cough, specific for laryngitis, occurring in the evening or at night). The next stage is examining the patient, initially at a distance, using the Pediatric Assessment Triangle (PAT), which enables a fast and non-invasive evaluation of the child's general condition, considering, for example, the presence of respiratory effort such as in the form of head ballooning, movement of nostrils or retraction of intercostal spaces, suprasternal notch or diaphragm attachments [2]. The next phase of the procedure consists in approaching the child and performing a physical examination, evaluating e.g. level of hemoglobin oxygen saturation or presence of respiratory murmurs. In some cases a characteristic sound can be heard even without the stethoscope and at a distance from the patient (e.g. wheezing in a child with bronchial obstruction). However, to confirm the diagnosis, auscultation of the lung fields and neck at the level of trachea and larynx must be performed. To ensure correct diagnosis, the interview and physical examination needs to be extended. Also, differential diagnosis of various diseases should be taken into consideration, such as dyspnea caused by the presence of a foreign body in the respiratory tract. Depending on the suspected disease, suitable procedures and pharmacological treatment should be implemented.

Exacerbated respiratory infection should be treated as soon as possible, and procedures which improve the patient's condition or prevent deterioration do not always require professional medical assistance. In each of the diseases discussed in this study the most important aspect in prehospital care is remaining calm. A child who experiences difficulty breathing and feels pain is very scared, so calming him/her by parents is recommended and does not intensify dyspnea. Respiratory infection may be accompanied by fever which should be controlled, and shouldn't exceed 38.0°C, to avoid fever seizures. Often mechanical cooling, using cool compresses or bath and dressing the child in not too warm clothes improves the patient's condition, and the temperature does not rise so high. When this does not help, pharmacological treatment is necessary with commonly available fever-reducing drugs. The most popular are products containing paracetamol and ibuprofen. They are available in tablet form, and for younger children as syrup or suppositories. Dosage for paracetamol is 10-15 mg/kg b.w., at least at 6 hours intervals, and for ibuprofen it is 20-30 mg/kg b.w./24 h in 3-4 divided doses [3]. If the child falls ill at night or on a holiday, such treatment may postpone the doctor's visit until the working hours of the primary health care unit. However, sometimes parents stressed by a developing infection may instead of administering the drug on their own call an EMS team or go to an emergency department, where the child receives under stressful conditions a fever-reducing drug in the same form, dosage and route of administration as would be possible at home. This situation also adversely affects the entire healthcare system, as it burdens the National Emergency Medical Services system and may extend the waiting time for an ambulance, as well as the waiting time at the emergency department for all the patients, including those who should not wait too long [4]. Antipyretic drugs should be always present in everyone's drug cabinet. It is also advisable to have an inhaler at home, especially if the child often has respiratory infections or if his/her respiratory system is strained due to other problems. This is still a prehospital procedure which does not require professional medical help, yet improves the patient's condition.

In case of other symptoms, e.g. laryngeal cough suggesting acute laryngitis, the parents at home may allow the child to breath in cool air by opening a window or going outside, or, if they have an inhaler, to inhale moisturized air. Such treatment reduces the swelling of the laryngeal mucosa. It is important, as inflamed larynx in a child, due to its proportionately narrow lumen, may quickly lead to life-threatening dyspnea. A 1% increase in the swelling of the laryngeal mucosa reduces the lumen by 50% [5]. Breathing difficulties in a child will probably result in calling a medical rescue team. In case of acute laryngitis, auscultatory changes over the lung fields usually do not occur, they appear when the airway is considerably narrowed, and instead of normal alveolar murmur laryngeal wheezing is heard, initially inspiratory, and as the obstruction progresses, both inspiratory and expiratory. The saturation values read from the pulse oxymeter may be normal, as gas exchange in the pulmonary alveoli is maintained at a normal level. A specific cough is heard, described as "barking", or often referred to as "seal cough".

Auscultation of the larynx may also be performed, where in advanced infection the sound of inspiratory dyspnea is heard. Information obtained during the interview, that is a sudden onset (a few hours before the child seemed healthy to the parents), the child's age (usually 2–5 years old), time of the onset of the disease (night) complete the picture, which is a typical presentation of laryngitis (J04) [6, 7]. In case of acute laryngitis the procedures performed by EMS teams may be similar to premedical treatment: they will involve inhalation with medical oxygen with adrenaline in a physiological NaCl solution (1 mg adrenaline + 3 ml 0.9% NaCl). Moderate dyspnea occurring at rest, when the child is calm, and which does not subside despite treatment, requires steroid therapy (dexamethasone, hydrocortisone), but hospitalization is not necessary if the symptoms begin to subside after administration of the drugs. Only dyspnea which does not disappear after pharmacological treatment, referred to as severe, requires transporting the child to hospital. A physician, if it is a specialist team, may order the administration of steroids; in this situation, dexamethsone at a dose of 0.3 mg/kg b.w. *i.m.* is recommended [3]. In case of a basic team, according to the Ministry of Health regulation on detailed scope of emergency medical procedures which may be performed by a paramedic, hydrocortisone at a dose of 5-10 mg/kg b.w. may be administered [3]. Very rarely in such cases more radical and invasive procedures, e.g. endotracheal intubation, are necessary.

In pneumonia in children the following symptoms occur: sudden, high fever, weakness, cough (initially dry, then mucous or purulent), sometimes dyspnea. On auscultation crackling sounds are heard over the lung fields, then medium and fine rales, with concurrent wheezing and whirring sounds. If fluid is present in the pleural cavity, the percussion sound is damped, and respiratory murmur is weakened. Only one lung, or even one lobe may be inflamed. The changes will be audible only over the diseased areas, which does not affect the prehospital procedure [8]. In such situation, the parents should remain calm and start, if necessary, antipyretic treatment. In case of suspected pneumonia, the condition needs to be evaluated by the physician who will implement the treatment, e.g. antibiotic therapy. The parents should take the child to a primary health care institution, or if the disease starts on a holiday or in the evening / at night, to a night and holiday health care clinic. Calling an EMS team or going to an emergency department is justified only if breathing difficulties occur. In the case of a child with pneumonia, the emergency rescue team cannot use or recommend antibiotic therapy, and to introduce it they often take the patient to an emergency department. If dyspnea occurs, the team will administer oxygen therapy, or will consider using steroids. In case of fever, the EMS team should administer antipyretic drugs, but emergency rescue team consisting of paramedics and/or a system nurse cannot administer paracetamol and ibuprofen in any form, as these drugs are not listed in the Ministry of Health regulation on the scope of emergency medical procedures [9, 10].

Obstructive bronchitis, similarly to pneumonia, presents flu-like symptoms, but often is more severe, involves respiratory difficulty in a child, which results in calling the EMS team or taking the child to an emergency department. Quite often fever, muscle pains and weakness occur, and the parents are anxious about the wheezing cough and accelerated breathing. Both inspiratory and expiratory dyspnea may occur, as well as symptoms from the upper respiratory system (pharyngitis, laryngitis). Respiratory effort symptoms may be visible, primarily in the form of retraction of intercostal spaces, suprasternal notch or diaphragm attachments. Expiratory wheezing is observed on auscultation [8]. Premedical procedures consist in symptomatic treatment, e.g. antipyretic, in the case of dry cough, cough suppressing products are used, while in the case of wet cough, expectorant drugs are used. Depending on the severity of dyspnea, the EMS team will apply oxygen therapy, they may administer salbutamol in oxygen nebulization (2.5-5 mg of salbutamol), or consider using steroids [3].

In the study the authors analyzed patients registered in the Admission Room of the University Children's Hospital in the period 1-30 September 2013. Pediatric patients formed 34.5% of all the patients who visited IP USD at that time. Among the patients examined by a pediatrician, 13.8% were children finally diagnosed with: acute laryngitis and tracheitis (J04), pneumonia (J18) or obstructive bronchitis (J20). In this group pneumonia (43%) was the most frequent, and obstructive bronchitis (25%) the least. 32% of children were diagnosed with acute laryngitis. Among the patients diagnosed with J04, J18 or J20, 19.6% were transported to IP USD by EMS teams, of which 82.6% were hospitalized, which indicates that calling the EMS teams was justified. In case of patients visiting the Admission Room of the University Children's Hospital on their own, almost half (43%) of the patients were sent back home with the recommendation to attend a primary health care institution for an assessment, which suggests unnecessary visits to hospital: the child requiring examination by a physician, but in a place other than hospital, e.g. a primary health care institution or a 24-hour health care facility. Hospitalizations and transportation by EMS teams according to the disease are shown in the figure.

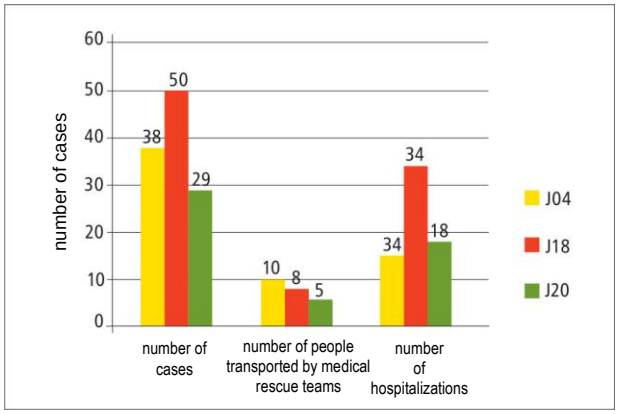

Figure. The number of cases, number of people transported by medical rescue team, number of hospitalization in particular diseases

Rycina. Liczba przypadków, transportów ZRM i hospitalizacji w poszczególnych jednostkach chorobowych

Conclusions

1. Early initiation of symptomatic treatment at the prehospital stage is crucial due to possible slowing down, or even stopping of the disease process in respiratory infections in children. However, it does not eliminate the need of a visit to a primary health care doctor.
2. Premedical procedures enable postponing and, in certain cases, even avoiding immediate treatment in a primary health care institution. However, a visit to a physician is still required.
3. Educating parents (guardians) about premedical assistance in respiratory infections is necessary.
4. The child's parents (guardians) must be instructed as to which situations require a visit to an emergency department or admission room, or calling an EMS team. If the situation is not life-threatening, they should seek assistance within the primary health care system, or at a night and holiday health care institution.

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Airway management using S.A.L.T., oropharyngeal and nasopharyngeal airways in simulated combat conditions

Udrażnianie górnych dróg oddechowych za pomocą S.A.L.T., rurki ustno-gardłowej i nosowo-gardłowej w symulowanych warunkach pola walki

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Abstract. Current literature lacks studies to define which airway devices minimize the risk of introducing air into the stomach during ventilation of a trauma patient, and which methods are the quickest and have the greatest chance of successful placement on the first attempt. This paper attempts to objectively evaluate the use of S.A.L.T., oropharyngeal airway (OPA) and nasopharyngeal airway (NPA) on the battlefield. A prospective study was conducted with 45 soldiers of the Polish Armed Forces. They ventilated a manikin using the devices several times, and then a mean and a median were defined for all measurements. Flowmeters were used to assess all air volumes. A total of 135 device placements and 270 ventilations using a bag valve mask were performed and evaluated. The mean time required for placement was 11.73 s for S.A.L.T., 12.94 s for NPA, and 8.82 s for OPA ($p<0.05$). Mean volumes of air entering the lungs and stomach during ventilation were 200.48 and 174 mL respectively for S.A.L.T., 222.36 and 206.43 for NPA, and 205.58 and 177.13 for OPA. Total volume of air entering the stomach using S.A.L.T. was the lowest among the three devices. The advantage of S.A.L.T. is the possibility of endotracheal intubation (ETI) by qualified medical personnel without the use of a laryngoscope.
Key words: difficult airway, nasopharyngeal tube, oropharyngeal tube, S.A.L.T., trauma

Streszczenie. Wstęp: Aktualne badania nie stwierdzają, które przyrządy do udrażniania dróg oddechowych minimalizują ryzyko wtłoczenia powietrza do żołądka podczas wentylacji pacjenta urazowego, a także, która z metod jest najszybsza, z największą szansą na skuteczne udrożnienie w pierwszej próbie. Cel pracy: Ocena wykorzystania S.A.L.T., rurki ustno-gardłowej (U-G) i nosowo-gardłowej (N-G) na polu walki. Materiał i metody: Badanie prospektywne przeprowadzono z udziałem 45 żołnierzy Polskich Sił Zbrojnych. Uczestnicy kilka razy wentylowali manekina z użyciem badanych urządzeń, następnie wyciągano średnią i medianę ze wszystkich pomiarów. Do oceny objętości powietrza wykorzystano specjalnie skonstruowane przepływomierze. Wyniki: Wykonano i oceniono podczas badania 135 umiejscowień przyrządów oraz 270 wentylacji workiem samorozprężalnym. Średni czas umiejscowienia S.A.L.T. wynosił 11,73 s *vs* 12,94 s dla N-G. Średni czas umiejscowienia U-G był najkrótszy (8,82 s) ($p <0,05$). Średnie różnice w objętości powietrza dostającego się do płuc i żołądka podczas wentylacji dla S.A.L.T. wynosiły (ml) 200,48 *vs* 174, dla rurki N-G 222,36 *vs* 206,43 oraz dla rurki U-G 205,58 *vs* 177,13. Wnioski: Suma objętości powietrza dostającego się do żołądka z zastosowaniem S.A.L.T. była najmniejsza spośród wszystkich trzech urządzeń. Atutem urządzenia S.A.L.T. jest możliwość wykonania intubacji dotchawiczej przez wykwalifikowany personel medyczny bez użycia laryngoskopu.
Słowa kluczowe: rurka nosowo-gardłowa, rurka ustno-gardłowa, S.A.L.T., trudne drogi oddechowe, uraz

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Introduction

Airway obstruction accounts for 6% of preventable deaths during activities in hazardous areas [1, 2]. Statistical analysis of deaths on the battlefield during combat in Iraq and Afghanistan reveals that 1% of soldiers die due to airway obstruction [3]. Assisting the casualty according to the Tactical Combat Casualty Care (TCCC) guidelines is associated with defining the blurred line between safety and lack thereof. Creating three action zones in the combat environment (Care Under Fire, Tactical Field Care, and Tactical Evacuation) allowed the establishment of a universal catalogue of activities to be performed on the casualty [4].

Optimal recommendations regarding prehospital methods of restoring the airway have not been determined yet [5, 6]. The methods for maintaining the airway in this environment, specific both for qualified paramedics and for ordinary soldiers, need to factor in the action zone, trauma mechanism, time necessary for intervention, stress, atmospheric conditions and skills.

The basic device for clearing the airway used on the battlefield and included in the Individual Medical Package (Polish Armed Forces – IPMed) and in the Individual First Aid Kit (IFAK – U.S. Army) is the NPA. It is an elastic tube intended to create a connection between the nostril and the nasopharynx. Another device is the OPA. It is used to provide airway between the base of the tongue and the oropharynx. Supraglottic airway devices, such as laryngeal mask airway (LMA) or laryngeal tube (LT) are very popular. The technique used when other methods fail or cannot be performed is coniotomy (SC).

Endotracheal intubation is the golden standard in providing airway, and in certain circumstances it may be a life-saving procedure [7]. Direct laryngoscopy (DL) intubation is a difficult technique, and it requires 50 attempts to obtain >90% efficiency [8]. Moreover, previous studies indicate that the effectiveness of the procedure without regular practice and experience deteriorates rapidly and considerably [9 ,10]. In prehospital care in civil environment alternative airway devices have been introduced. One of them is S.A.L.T. (Fig. 1).

Aim of the study

The aim of the project is to evaluate how the above devices, characterized by easy and quick placement, function in simulated conditions which a soldier or paramedic may encounter on the battlefield in a patient with head or facial injuries. Moreover, the volume of air which enters the lungs and the stomach during bag valve mask (BVM) ventilation was evaluated using flowmeters constructed especially for the study.

Material and methods

45 soldiers of the Polish Armed Forces participated in the prospective study. The study was divided into three stages: Stage one evaluated if a group of soldiers can effectively place a NPA, OPA and S.A.L.T. in the airway of a manikin with a difficult airway (Basic Life Support phase – BSL). The time for each attempt was registered with a stopwatch. Next, it was established if a group of soldiers can effectively ventilate a manikin with a BVM, and the volume of air entering the lungs and stomach during two ventilations was verified. The last stage of the study consisted in objective evaluation of the possibility of using S.A.L.T., NPA tube and OPA tube on the battlefield.

Completion of a 2-week Qualified First Aid course (QFA) organized by the Military Center for Medical Education (WCKM) in Łódź was the condition necessary to qualify for the study. The course curriculum included gaining the ability to provide patent airway using a NPA tube, OPA tube or BVM ventilation. In the final exam, each soldier was required to provide patent airway with the devices, using one of the techniques learned, and to present effective BVM ventilation on a manikin during

Figure 1. Supraglottic Airway Laryngopharyngeal Tube

Rycina 1. Urządzenie Supraglottic Airway Laryngopharyngeal Tube

simulated scenarios. Participation in the study was voluntary. Soldiers did not learn how to use the S.A.L.T. device during the course, and until the beginning of the study they did not come into any contact with this device.

A Simulaids Critical Airway Management Trainer manikin was used in the study. The airway and esophagus of the manikin were adjusted to actual organ size in an adult person. To make clearance of the airway and ventilation more difficult, the tongue of the manikin was filled with 20 ml of air, of which the study participants were not informed. During the test, the manikin was lying on a hard surface in a training room, with its head and neck in a neutral position for each attempt. During ventilation a 1,500 ml Rescue-7 bag valve mask was used. The flowmeters used in the study were based on the Coach®2 open spirometer (DHD Healthcare, PAT. NOS. 5 ,9 8 4, 8 73 D '4 0 3 ,7 6 9) of 2500 ml capacity, modified for the purpose of the study (Fig. 2). The devices were used to measure the air flow rate, subsequently converted into volume.

Before starting the test, each participant watched an instructional DVD video (verbal and visual instruction, duration of < 2 minutes) without any additional guidelines. The DVD material was created according to the standards of instructions for use developed by the manufacturer, with the use of the Simulaids Critical Airway Management Trainer. Immediately after viewing the instructional video and choosing proper equipment size, the participant began opening the airway with the indicated device. Each study participant had 2 minutes to place a given device. After 2 minutes the test (first attempt) was stopped. The participant received a second and a third chance. Success or failure in placing the device was evaluated by an expert each time. Three consecutive failed attempts disqualified the subject from further participation in the study. Proper placement of the device was considered the final stage of providing a sufficient airway, and successful completion of a trial. After the trial the participant was asked to express an opinion regarding the level of difficulty of placing a given device.

After each successful attempt to provide airway, the manikin was BVM ventilated. The volume of air which entered the lungs and the stomach during two effective BVM ventilations was evaluated using flowmeters constructed especially for the study. Success or failure of BVM ventilation was evaluated by an expert each time. All the calculations of the air volume parameters were performed after the dead spaces in the manikin and flowmeter systems were subtracted, with an accuracy of 5.6 ml.

Moreover, the following parameters were registered for the purpose of the study: history of previous experience in providing patent airway (particularly the experience from foreign missions), as well as comments of the study participants and

Figure 2. Manikin for difficult intubation (Simulaids Critical Airway Management Trainer) and flowmeters constructed to assess the volume of air entering the lungs and the stomach during bag valve mask ventilation

Rycina 2. Manekin do trudnej intubacji Simulaids Critical Airway Management Trainer oraz przepływomierze skonstruowane do oceny objętości powietrza trafiającej do płuc i żołądka podczas wentylacji workiem samorozprężalnym

examiners. The two sample Student t-tests with unequal variances was used for statistical analysis The data were collected using the Microsoft® Office 2010 Microsoft Excel spreadsheet, and analyzed with the use of Statistica version 10 software.

Results

135 placements of airway devices and 270 BVM ventilations were conducted and evaluated during the study. Each participant provided airway in a manikin with 3 different devices, and performed 6 BVM ventilations. No unsuccessful attempts to provide airway or to ventilate have been observed. Failed placements or attempts to conduct BVM ventilation were correctly recognized by all participants and immediately corrected.

All the study participants (100%) were able to place an S.A.L.T., OPA tube or NPA tube at the first attempt. The mean time for effective placement of S.A.L.T in the BLS phase was 11.3 sec, for effective placement of NPA tube was 12.94 sec, and mean time for effective placement of OPA tube in the study group was the shortest, 8.82 sec ($p<0.05$).

Each of the 45 study subjects (100%) was able to effectively ventilate the manikin with BVM after providing sufficient airway with one of the devices. The mean, maximum and minimum volume of air delivered to the lungs and stomach during ventilation are presented in Tables 1-3. The largest volume of air was delivered to the lungs with a NPA tube, but in comparison with S.A.L.T. and the OPA tube, the

difference was not statistically significant. The smallest volume of air was delivered to the stomach with S.A.L.T., but in comparison with NPA tube and OPA tube, the difference was not statistically significant.

Following completion of the QFA training, the soldiers were asked to fill in a questionnaire regarding previous experience in providing airway with airway devices on the battlefield. 6 out of 45 study subjects performed airway management using a NPA on a combat mission within the previous 24 months. 4 out of 45 study subjects had a chance to provide airway patency using an OPA tube within the previous 24 months. After completion of the practical part of the study, the participants were asked about general facility of use of the airway devices in the study (Tab.4).

Discussion

Many casualties with isolated maxillo-facial injury can protect their airway by simply sitting, bending forward or spitting out blood from the airway, and continuing to breathe in this position. Providing airway patency with airway devices should be restricted to cases in which the above strategy is not successful [11]. A study by Lairet et al. [12] reports 1,003 casualties on a battlefield treated in 6 USA surgical units in Afghanistan in the years 2009-2011. The aim of the study was to indicate frequency and effectiveness of life-saving procedures performed or omitted in prehospital care. This prospective study demonstrated that among all the life-saving procedures which had not been performed, 252 were associated with providing sufficient airway and performing chest decompression by puncture. A study conducted by Adams et al. [13] evaluated frequency of using airway devices in prehospital conditions during the "Iraqi Freedom" operation in the years 2005-2007. Among 6,875 studied patients, in 293 (4.2%) the airway was considerably patent, and 282 (97.3%) were trauma patients. Prehospital methods of providing airway patency involved: 253 intubations (86.6%), 23 (7.5%) supraglottic devices, 17 coniotomies (5.8%).
A retrospective review of combat casualties transported by United States Air Force Critical Care Air Transport Teams in the years 2007–2008 revealed that among 425 trauma patients 318 (75%) required using airway devices and mechanical ventilation during air transportation [14].

The ability to perform effective ventilation using BVM is very important in any conditions. If the bag is used with facial mask, it is often difficult to secure seal between the mask and the patient's face, at the same time providing airway with one hand [15]. Any major air leak will result in hyperventilation, and if the airway is obstructed, the air may be pushed into the stomach. It would additionally reduce ventilation, and

Table 1. The volume of air delivered to the lungs and stomach using S.A.L.T.
Tabela 1. Objętość powietrza podawanego do płuc i żołądka za pomocą S.A.L.T.

characteristics	lungs (ml) (n = 45)	SD*	stomach (ml) (n = 45)	SD
mean	200.48	132.42	174	128.8 4
maximum	538		495.5	
minimum	38		6.75	

*SD – standard deviation

Table 2. The volume of air delivered to the lungs and stomach using OPA
Tabela 2. Objętość powietrza podawanego do płuc i żołądka za pomocą rurki U-G

characteristics	lungs (ml) (n = 45)	SD	stomach (ml) (n = 45)	SD
mean	205.58	133.23	17 7.13	135.67
maximum	663		651.75	
minimum	6.75		11.25	

Table 3. The volume of air delivered to the lungs and stomach using NPA
Tabela 3. Objętość powietrza podawanego do płuc i żołądka za pomocą rurki N-G

characteristics	lungs (ml) (n = 45)	SD	stomach (ml) (n = 45)	SD
mean	222.36	167.8 4	206.43	173.07
maximum	756.25		745.5	
minimum	38		26.75	

Table 4. Assessment by participants
Tabela 4. Ocena uczestników badania

providing patency	S.A.L.T. (n = 45)	OPA (n = 45)	NPA (n = 45)
easy	32	40	37
complicated	13	5	8
difficult	0	0	0
very difficult	0	0	0

significantly increase the risk of regurgitation or aspiration [16].

The register of patients admitted to the military hospital following emergency airway management reveals that military paramedics are reluctant to conduct advanced airway management in prehospital conditions [5]. Moreover, numerous studies have demonstrated that maxillo-facial injuries should not be regarded by the healthcare professional as automatically requiring surgical airway management, without an attempt to provide patency with simpler methods [6, 11, 17]. On the other side, visible head and facial injuries should evoke in a soldier next to the casualty a reflex for airway management, if there is the slightest chance that the airway could be obstructed or be at risk of obstruction.

Our study demonstrates the ability of providing airway patency using S.A.L.T., OPA or NPA in a manikin with difficult airway can be easily understood and learned. BVM ventilation was also effective and properly performed. In our own study, the time of OPA placement (8.82 sec.) was much shorter than in the case of S.A.L.T. (11.73 sec.) or NPA (12.94 sec.). All the obtained time results are certainly slower than those which could be achieved in less severe conditions in a non-trauma manikin. The number of attempts to place the device and to ventilate using BVM did not differ significantly. It might be expected that using S.A.L.T. would be more difficult to learn than other devices, with which the study participants could practice for 2 weeks. The speed of S.A.L.T. placement demonstrates that the device is relatively easy to use.

Current studies do not determine which airway device commonly used on the battlefield minimize the risk of introducing air into the stomach during BVM ventilation of the trauma patient, or which method is the fastest, providing the greatest chance of effective airway management at the first attempt. Due to high risk of airway obstruction in an injured soldier, we attempted an objective evaluation of the possibility of using S.A.L.T., OPA and NPA on the battlefield.

Orophanryngeal airway tube

Despite a widespread use of OPA tubes in civil conditions on various levels of healthcare, its application is prehospital care on the battlefield is very limited [15]. If the oropharyngeal and laryngeal reflexes are preserved, introducing the tube may cause vomiting or glottal spasm. Recognizing deep unconsciousness and proper reaction in case the oropharyngeal reflex occurs is not easy for a soldier without medical training during combat. Additional difficulty is caused by potential obstruction of the tube lumen, when part of the tongue blocks the end of the tube, if the end of the tube is trapped in the laryngeal recess, or if the glottis closes the tube [18]. The OPA tube, except for the shortest time and highest facility of placement (introducing the OPA has been evaluated as easy by 88% of the study participants, 12% considered placement of the device to be difficult), does not demonstrate any clinically significant advantage over the other devices. The short fitting time and slight differences in the volume of air entering the lungs and the stomach during ventilation (205.58 vs 177.13) may be potential benefits of using it for other purposes during military medical activities at further levels.

Nasopharyngeal airway tube

Following the TCCC guidelines and the STANAG 2126 standard (Medical First Aid Kits), the NPA tube is the basic airway device in the IPMed package and IFAK [4]. Casualties who are not deeply unconscious tolerate the NPA better than the OPA. The NPA may save the life of an injured soldier in case of trismus or maxillo-facial injuries, when placing the OPA tube is impossible. Incidental introduction of the tube through the fracture into the cranial cavity is extremely rare [19]. The method of size selection (measurement against the little finger or nares) is not reliable [20]. Tube placement may result in damage to the nasal mucosa and bleeding in up to 30% of cases [21]. If the tube is too long, it may cause oropharyngeal and laryngeal reflexes, and provoke laryngeal spasm or vomiting. A study conducted by Fisher et al. [22] analyzed the US Federal Bureau of Investigation (FBI) data regarding mortal airway injuries among police officers killed during service in the years 1998-2007. 42 police officers out of 553 killed, who died within an hour of a penetrating injury to the face or neck, were qualified for the study. All the officers died from gunshot wounds. 29 autopsy reports suggest that acute airway obstruction secondary to the penetrating injury rarely seems to be the cause of preventable deaths among the police officers. Based on the specificity of the injuries, it does not seem that NPA tubes could be sufficient to provide airway patency. According to our observation, the facility of device placement (NPA introduction was evaluated as easy by 82% of the study participants, 18% considered placement of the device to be difficult), and low risk of complications do not correlate with the benefits during BVM ventilation. The difference between the volume of air entering the lungs and the stomach is very small (222.36 vs 206.43), thus considerably increasing the risk of regurgitation. Additional studies should be considered.

Supraglottic Airway Laryngopharyngeal Tube

After placement, S.A.L.T. quite firmly lies on the larynx, the distal end of the device too large to enter the trachea or esophagus. A study conducted by Bledsoe et al. [23] demonstrated that healthcare professionals at all levels of qualification were very effective in placing S.A.L.T. in a human corpse model (BLS phase). Among 22 study subjects, 21 (96%) were able to effectively place S.A.L.T. and ventilate the corpse. 19 (86%) of them were able to place the device at the first attempt. The mean time of airway management using S.A.L.T. was 12 sec. In our study, 45 participants (100%) were able to place S.A.L.T. and ventilate the manikin with a difficult airway at the first attempt. The success of this study group is extraordinary, considering variety of participants, lack of experience or training opportunities. The mean time of S.A.L.T. placement we obtained in our own study was 11.73 sec., which is comparable to the result reported in the literature. Regarding the other two devices, it is astonishing that despite the lack of access to S.A.L.T. or the opportunity to practice using the other devices by the participants, the time of S.A.L.T. placement was shorter than the time of NPA tube placement by 1.21 sec., and longer by only 2.91 sec. than that of OPA tube. Introducing S.A.L.T. was assessed as easy by 71% of the study participants, 29% considered introducing the device to be difficult.

Comparing the volumes of air entering the lungs and the stomach during two ventilations with BVM, S.A.L.T. is particularly noteworthy, as it obtained the lowest value of air entering the stomach among all the three devices. Other parameters summarizing ventilation values were similar (200.48 vs 174). Improvement in S.A.L.T. allowing it to connect it directly to BVM may increase effectiveness of ventilation and minimize the volume of air delivered into the stomach. Additional studies should be considered.

Endotracheal intubation using S.A.L.T.

Advanced methods of airway management create a set of activities potentially difficult to perform for the personnel in prehospital care. The advantage of S.A.L.T. is the possibility to be used "blind" ETI by qualified medical personnel, without the use of a laryngoscope. A study conducted by Katzenell et al. [6] assessed the rationale of performing ETI in prehospital care on the basis of Israel Defense Forces Trauma Registry database. Among 406 casualties qualified for the study, successful ETI was conducted in 317 (78%) patients, regardless of the number of attempts. ETI was successful in 45%, 36% and 31% at the first, second and third attempt, respectively. The authors report that after the first ETI attempt, the efficacy of the following attempts significantly deteriorates, with the mean effectiveness for all the intubation attempts being 28%. To compare, the effectiveness of ETI with the use of S.A.L.T. at the third attempt is 96% [24].

A study conducted by Bledsoe et al. [23] demonstrated that healthcare professionals at all levels of qualification were very effective in placing the intubation tube using S.A.L.T. as a guide in a human corpse model. Among 22 study subjects, 20 (91%) were able to effectively place the intubation tube using S.A.L.T. 13 (59%) of them were able to place the tube in the trachea at the first attempt. The mean time of placement of the intubation tube using S.A.L.T. was 14 sec. An article presented at the 2011 International Meeting of Simulation in Healthcare in New Orleans by Huffstutter P. demonstrated the results of the study conducted with the use of S.A.L.T., involving 125 healthcare professionals [24]. The effectiveness of intubation performed with the use of S.A.L.T. was 96% when the participants were allowed to make three attempts. 66.4% of intubations were successful at the first attempt. 92% effectiveness was obtained when the participants were allowed to make two attempts.

Summary

The study was conducted without randomization, using a convenient research sample. Educational sessions were different in each type of group. The classes were run by different instructors. The study critics may stipulate that the study could be more attractive and realistic if it were conducted in an operating room on live patients, using the full potential of S.A.L.T. Such study is being considered at the moment; however, operating room and patients under general anesthesia do not reflect the conditions which a soldier or paramedic may encounter on the battlefield. Algorithms for the methods of airway management for military medical personnel and for soldiers should consider casualties found on the battlefield, and not patients with circulatory arrest, dominating in civil conditions. Our study was conducted on a manikin with a difficult airway; therefore, the results may be similar to those which could occur during war. S.A.L.T. cannot be used in a casualty in a state of shallow unconsciousness. Therefore, using S.A.L.T. by an ordinary soldier may be problematic. In case of using S.A.L.T. by a qualified medical professional, the situation is different. In the "Combat Casualty Evacuation Care" phase, the patrol may be transferred by navy vessel, ground vehicle or aircraft staff. Evacuation vehicles may provide additional equipment and qualified medical personnel. A higher level of care over the casualty is provided. Using S.A.L.T. may minimize exposure of the medical professional in the tactical environment by reducing the time and number of intubations in unfavorable conditions. Additional studies are required to compare the efficiency of S.A.L.T. with other airway devices.

1. Polish Armed Forces soldiers easily learned how to achieve airway patency in a trauma manikin using S.A.L.T., OPA tube and NPA tube.
2. The total volume of air entering the stomach following the use of S.A.L.T. was the lowest of all the three devices.
3. The OPA tube demonstrated no clinically significant advantage.
4. Facility of NPA placement and low risk of complications do not correlate with the advantages regarding ventilation volume.
5. The advantage of S.A.L.T. is the possibility to perform "blind" endotracheal intubation by qualified medical personnel, without the use of laryngoscope. The results may be clinically significant. Additional studies should be considered.

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The sense of self-reliance in the opinion of professional paramedics

Poczucie samodzielności w opinii czynnych zawodowo ratowników medycznych

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Abstract. Legal regulations define in detail the rescue operations which paramedics may undertake independently or under medical supervision**.** The aim of the study was to assess the degree of self-reliance of professionally active paramedics. The study was carried out by using the author's own survey covering 126 professionally active paramedics in the Świętokrzyskie region. The subjects were mostly male, aged 31–40 years and 41–50 years, had completed post-secondary school education, and had over 20 years of professional experience. The analysis of the collected material has shown that most paramedics were able to perform the rescue operations defined by the legal regulations. Paramedics, most often carry out without assistance reactive oxygen therapy, CPR, airway restoration, defibrillation, cardiovascular system monitoring with non-invasive methods and medication provision. Most of the paramedics felt fully prepared for their assigned activities and had no fear of carrying them out, while most employers respected their rights. However, in some workplaces, there were internal rules that forbade them to carry out certain activities or provide medication without assistance.
Key words: emergency procedures, paramedic, professional independence

Streszczenie. Akty prawne regulują szczegółowo zakres czynności ratunkowych, które może podejmować ratownik medyczny samodzielnie lub pod nadzorem lekarza systemu. Celem pracy była ocena stopnia poczucia samodzielności czynnych zawodowo ratowników medycznych. Materiał i metoda: Badanie zrealizowane z użyciem autorskiej ankiety objęło 126 czynnych zawodowo ratowników medycznych regionu świętokrzyskiego. Badani to w przeważającej części mężczyźni, osoby w wieku 31–40 lat i 41–50 lat, które ukończyły szkołę policealną, z ponad 20 letnim stażem pracy. Wyniki: Analiza zgromadzonego materiału pozwoliła stwierdzić, że przeważająca część ratowników ma możliwość samodzielnego wykonywania działań ratunkowych zagwarantowanych zapisem ustawy. Ratownicy najczęściej samodzielnie prowadzą tlenoterapię bierną, podejmują resuscytację krążeniowo-oddechową, przywracają drożność dróg oddechowych, defibrylują, monitorują czynności układu krążenia metodami nieinwazyjnymi oraz podają leki. Wnioski: W większości czują się w pełni przygotowani do przeznaczonych im działań i nie mają obaw przed ich podejmowaniem, a pracodawcy w przeważającej części respektują ich uprawnienia, chociaż w części zakładów istnieją przepisy wewnętrzne zabraniające samodzielnego wykonywania czynności lub podawania leków.
Słowa kluczowe: czynności ratunkowe, ratownik medyczny, samodzielność zawodowa

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Introduction

The paramedic profession gives authorization to perform within the system certain emergency medical procedures which include: ensuring the safety of persons at the place of event and undertaking actions to prevent an increase in the number of casualties or in environmental degradation, evaluating the health condition of individuals at sudden health risk, and performing emergency medical procedures, transportation of such persons, communicating with them and providing them with psychological support and organizing and teaching classes in first aid, qualified first aid and emergency medical procedures.

Legal acts (the Act and executive regulations) [1-3] specify in detail the scope of emergency procedures which may be performed by a paramedic unassisted or under the supervision of a system physician, and determine the list of medications which a paramedic may administer.

However, opinions about the rights of paramedics and the possibility to implement them in practice raise questions, particularly regarding the type and scope of paramedic self-reliance and his/her work under a physician's supervision [4].

These doubts were addressed in explanation by the Screener for Professional Liability at the Supreme Medical Chamber in 2011. This opinion unambiguously confirmed the scope of procedures to which a paramedic is entitled according to the Act of 8 September 2006 on the National Emergency Medical Services and Regulation of the Ministry of Health of 29 December 2006 on the detailed scope of emergency medical procedures which a paramedic may perform, authorizing a paramedic to perform the procedures unassisted or under the supervision of a system physician. The physician has the right and obligation to manage the paramedic's activities, and provide binding instructions as to the manner in which they should be performed. This depends on the level of complexity of the procedures, type of medications administered and medical devices used. The procedures within a paramedic's competences can be implemented under supervision, which is associated with the direct presence of a physician at the site of the event [4].

Doubts and divergent positions were the inspiration to evaluate the sense of self-reliance in professionally active paramedics.

Aim of the study

The aim of this study was to evaluate the degree of self-reliance in professionally active paramedics regarding actual implementation of emergency medical procedures and administration of medications within the competences of a paramedic according to applicable laws in practice.

Material and methods

The study involved 126 paramedics employed in the emergency medical services units in the Świętokrzyskie region. It was conducted in 2012, with the use of the author's questionnaire comprising 12 questions (mostly closed ones) which enables one to assess the opinions of the survey subjects on their sense of self-reliance.

The study population was predominantly male (100, i.e. 79.4% individuals), with females in the minority (20.6%, i.e. 26 individuals).

Among the paramedics who shared their opinion in the study, the dominant age groups were 31-40 years old and 41-50 years old (totaling 44 people, i.e. 34.9%). Subjects aged 20-30 years old constituted 22.2% (28 individuals), and those over 51 years old constituted 7.9% (10 individuals). The age structure of the subjects is presented in Figure 1.

The majority of the paramedics participating in the study graduated from a post-secondary school (72 individuals, i.e. 58.7%). Participants with a master's degree, who are system nurses, having a specialization or completed a qualification course, constituted 28.6% of the group (36 individuals). 20.6% of the subjects (26 individuals) had a BSc degree in paramedics. The educational structure of the paramedics involved in the study is presented in Figure 2.

The paramedics usually had over 20 years of work experience (44 individuals, i.e. 34.9%). Slightly less numerous groups are participants with 10-20 years of experience (36 individuals, i.e. 28.6%) and 5-10 years (32 individuals, i.e. 25.4%). The smallest group are paramedics with 0-5 years of work experience (14 individuals, i.e.11.1%). The work experience structure of the paramedics involved in the study is presented in Figure 3.

Gender, age, education and work experience of the subjects are the features which characterized the study population.

Results

According to 87.3% of the subjects (110 individuals) the provisions of the Act of 8 September 2006 are respected, while 9.52% (12 individuals) do not feel that way.

In the course of the study the paramedics were asked to express they opinion about the respect given by their employer to the act's provisions which enable performance of rescue procedures. Based on the opinions collected, 88.9% of the paramedics (112 individuals) evaluate the patient's health condition to determine treatment and perform or abstain from emergency medical procedures. 93.7% (118 individuals) can initiate and carry out basic and advanced cardiopulmonary resuscitation in adults and children, in compliance with the standards.

90.5% of the paramedics perform restoration of airway without the use of any devices, whereas 93.7% of the study subjects (118 individuals) use airway devices.

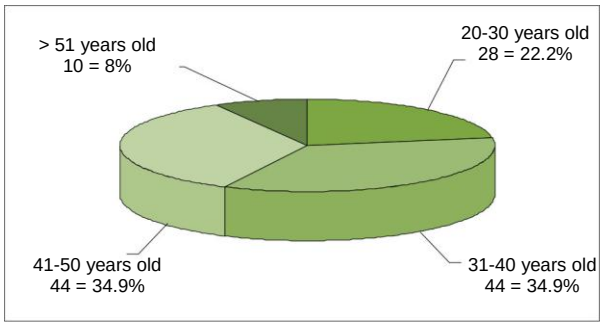

Figure 1. Structure of the paramedics' age

Rycina 1. Struktura wieku badanych ratowników

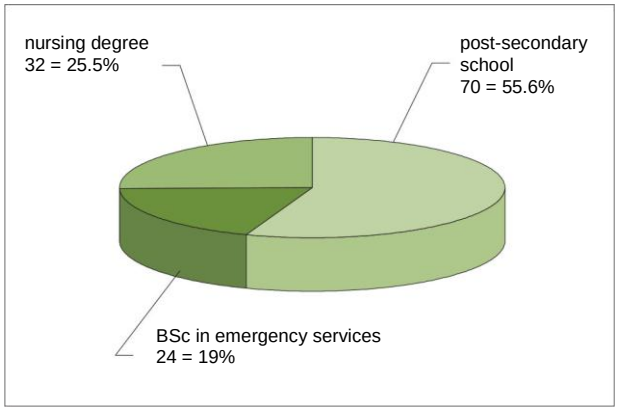

Figure 2. Educational structure of the paramedics involved in the study

Rycina 2. Struktura wykształcenia ratowników biorących udział w badaniu

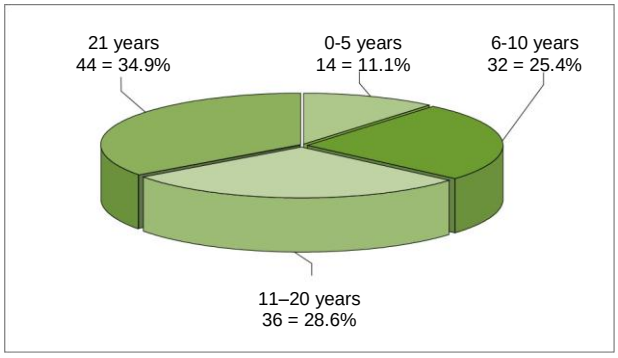

Figure 3. Work experience structure of the paramedics

Rycina 3. Struktura stażu pracy badanych ratowników

30.2% of the subjects (38 individuals) provide airway patency with the use of an oropharyngeal tube, 12.7% (16) with the use of a nasopharyngeal tube, 11.1% (14) with the use of a laryngeal mask, and 3.2% (4) by needle cricothyroidotomy.

Respiratory suction is implemented by 88.9% (112) of the paramedics, passive oxygen therapy, respiratory support or substitute ventilation with air or oxygen is performed by 96.8% (122), while 22.2% (28) conduct the procedure manually or with the use of face mask and bag valve mask, whereas 17.5% (22) do it mechanically, using a respirator.

79.4% (100 individuals) perform endotracheal intubation in sudden cardiac arrest through the mouth or nose, without using muscle relaxants, and substitute ventilation. Manual defibrillation on the basis of ECG was performed by 114 paramedics, i.e. 90.5%, and automated defibrillation was conducted by 70 paramedics, i.e. 55.6%.

88.9%, i.e. 112 paramedics perform ECG, 104, i.e. 82.5% monitor the respiratory function, and 90.5% (114 individuals) monitor circulatory function with noninvasive methods.

85.7% (108) perform peripheral vein cannulation in the upper and lower limbs and in the external jugular vein, while 49.2% (62) placed an intraosseous cannula. Within the emergency procedures, 90.5% (114 individuals) administer drugs by intravenous, intramuscular, subcutaneous, endotracheal, oral, rectal, inhalation and intraosseous route.

54% of the study subjects (68 individuals) reduced tension pneumothorax by puncture of the pleural cavity, and 49.2% (62) collect venous and capillary blood samples for laboratory tests.

Professional procedures performed by the paramedics include determination of the vital parameters. 63.5% (80) of the paramedics test serum glucose concentration, 39.7% (50) measure electrolytes, 3.2% (4) perform gasometry of the capillary blood. Other procedures, such as wound dressing, is performed by 87.3% (110 individuals), bleeding control by 88.9% (112), stabilization of fractures, sprains and twists and immobilization of the spine, especially the cervical segment by 85.7% (108).

A total of 88.9% (112) had undertaken an urgent delivery outside a hospital. 78.7% (96 individuals) of paramedics conducted medical triage, 75.4% (92) took protection measures to limit the health-related effects of an event, and 86.9% (106) prepared patients and provided medical care during transportation.

The study subjects self-assessed to what degree their preparation and work experience enabled them to perform unassisted the emergency medical procedures. 72 paramedics (57.1%) of the study subjects were fully prepared and are not afraid to perform procedures. 32 paramedics (25.4%) were afraid to take risks and perform procedures due to the possibility of making a mistake. 17.5% (22 individuals) preferred when the procedures in an emergency situation are managed by the physician present during their performance.

The paramedics' opinions about the respect their employers showed in practice concerning the provisions of the act allowing unassisted administration of medications depended on the type of drug. From the group of 24 medications which may be administered in the course of emergency procedures the paramedics most often mention multielectrolyte physiological fluid (95%), oxygen (93%), glucagon (92%), diazepam (90%), and less frequently flumazenil (21%) and morphine (26%). Detailed results regarding administration of individual medications which paramedics can administer is presented in Figure 4.

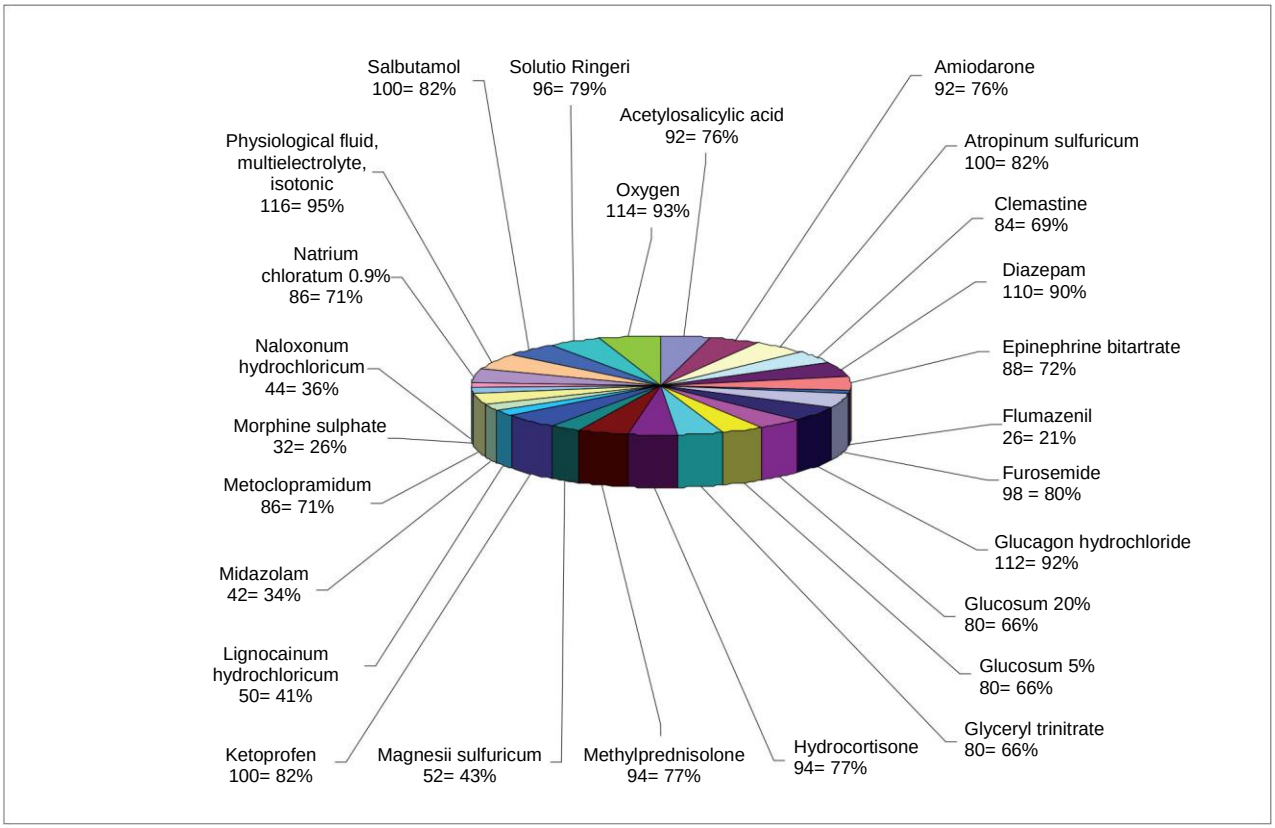

Figure 4. Structure of the list drugs, administered by paramedics

Rycina 4. Struktura podawania przez badanych ratowników leków z wykazu

60-90% of the paramedics administer, unassisted, 20 out of the 24 medications listed during their professional procedures.

In the area of preparation and experience enabling unassisted administration of drugs, 60.3% (76 individuals) declared that they were fully prepared and without fear take decisions regarding administration of the above drugs. 28.6% (36) paramedics were afraid to give medications without supervision, due to the possibility of making a mistake, whereas 20.6% (26) preferred if a physician orders drug administration and is present during the procedure.

The fear of unassisted performance of procedures expressed by a large group of paramedics may result from a lack of preparation, fear of responsibility or limited experience.

In the light of the study results demonstrating long work experience and the subjects' age (>40 and 50 years old), the fears may be caused by the fact that in the study group working as a paramedic and having qualifications may be associated with limited professional experience, due to gaining qualifications only recently, as a result of supplementary vocational training of previous ambulance workers (orderlies / stretcher bearers or drivers).

The analysis of the subjects' opinions about performing procedures guaranteed in the legal acts under a system physician's supervision reveals that 27% of the paramedics (34 individuals) declared that in those circumstances they performed endotracheal intubation in direct laryngoscopy, other than in case of sudden cardiac arrest, with the use of muscle relaxants.

14.3% (18) performed electrical cardioversion and external electrostimulation, another 22.2% (28) assisted with minor surgical procedures, such as suturing wounds, placing drains and other medical procedures. 87.3% of the paramedics (110) conducted urinary bladder catheterization, 28.6% (36) inserted a probe and performed gastric lavage, and 66.7% (84) gave patients medications other than those permitted for unassisted administration.

This means that paramedics most often perform urinary bladder catheterization and probing, and administer drugs other than those which they can give unassisted. The least frequently performed procedure is cardioversion.

Despite legal regulations specifying the paramedic profession and the scope of procedures, in 31.7% of 40 facilities there are internal regulations which forbid unassisted performance of procedures listed in the

legal acts. In 60.3% of facilities there are no such provisions limiting professional independence. However, they are present, according to 31.7% (40 individuals) of the paramedics, although none of the study subjects specified to which procedures or drugs these limitations applied.

The study also analyzed the problem of requirements imposed on paramedics by the Regulation of 14 June 2007 on professional improvement of paramedics. This legal act obliges paramedics to collect documentation regarding completed and performed professional improvement training.

85.7% of the paramedics in the Świętokrzyskie region (108 individuals) documented participation in different forms of training and self-education in their Professional Improvement Charts. 4.8% of paramedics did not collect such documentation. 8 individuals, i.e. 9.5%, expressed other opinions.

The study evaluates the paramedics' opinion regarding the effect of the Emergency Call Center on improving work organization and reducing the time of arrival of an Emergency Medical Services team to a patient. According to 54% (68 individuals) of paramedics, changes regarding the Emergency Medical Services facilities improved work organization and reduced the time of arrival and intervention. 31.7% (40) thought that the changes did not affect the situation.

14.3% (16) of paramedics had no opinion on the subject. Opinions regarding the changes in the system were the last ones collected for the purpose of the study.

Discussion

Emergency Medical Services constitute a new area, searching for solutions and operating models, and the comprehensive solutions are primarily to enable fast and effective emergency procedures, oriented not only to ensure survival of casualties, but also appropriate quality of their life afterward [5].

Treatment standards in emergency medical services directly stem from the current medical knowledge and are taught in the process of training paramedics, physicians and system nurses. Both treatment standards and the order of providing assistance to individual patients (triage), their transportation and psychological support are discussed and required in the educational process, as well as in further professional improvement of the Emergency Medical Services members [6].

Paramedics feel the need to extend their competences to areas outside the emergency medical teams, due to new opportunities in health care; therefore, through their professional association they suggest changes.

They initiate changes aimed to complete the current model of education and training with a professional exam, which would be organized regardless of the university. In their opinion, such a solution would protect patients against inadequately qualified personnel, and would motivate universities to ensure proper education in the field of paramedic studies. Moreover, they propose introducing a solution which functions well in other countries, that is correlating the degree of a paramedic's competences with his/her education, work experience, training and actually performed procedures. They also emphasize that current technological possibilities (teletransmission, data and image transmission, communications) enable introduction in the system of "indirect doctor's supervision" in the form of consultations.

The position of the profession may be strengthened by listing the paramedic profession in the act on the profession of a paramedic, introducing a professional license with a unique number, and establishing regional and national emergency medical service consultants [7].

Paramedics are constantly working on professional development and improvement of the environment, striving for changes. A draft of an act concerning the profession of a paramedic and professional association of paramedics is ready, and was presented on 30 August 2013 by a group of Members of Parliament from the Polish People's Party. The draft envisages, for example, extending the catalogue of emergency medical procedures, performing emergency medical procedures within and outside of the National Emergency Medical Services system, regulating legal issues, including: renouncing an emergency medical procedure if there is no chance of success, the right to access and prepare medical documentation, refusal to perform a physician's order if it poses a risk to a patient's life or health. The act is to specify professional accountability of paramedics, as well as establish an institution responsible for performance-related supervision over this professional group [8].

The results of the own study confirm striving of paramedics for professional development and gaining experience, as they are willing to perform new procedures whenever it is possible and conditions are favorable (14-87% of the paramedics perform additional activities for patients if they are permitted by law).

Another aspect of the paramedic profession is the necessity to improve and document participation in various types of training. The environment's initiative has been in use for several years, e.g. in a letter of 19.08.2010 to the Ministry of Health, together with providing opinion on the project of the act amending the Act on the National Emergency Medical Services, and some other acts, during various meetings at the

Ministry of Health, National Health Fund central office, or Parliament. This position is currently supported by paramedics and it will continue to be presented in the future, during various meetings which may affect the functioning of the National Emergency Medical Services system, as well as the paramedic profession.

This study confirmed that the majority of the paramedics (85.7% of the study subjects collect related documentation) accepted obligatory professional improvement, and they participated in training, courses and conferences. Considering constant changes in knowledge and the health care system, improvement and updating is a professional duty of each health care professional, as it enables providing responsible and up-to-date services, as well as assistance to patients and people in need.

The initiative to support obligatory improvement of paramedics' skills, and to promote its importance as a profession involving people who need to strengthen their self-esteem and reliance on their skills and knowledge, hence enabling them to provide better assistance to patients. In this study nearly 43% of the paramedics declared that they were afraid to administer medications unassisted, for fear of making a mistake, or because they preferred to perform procedures ordered by a physician, who is present during the activity.

At the same time the paramedics were aware that only a unified, unanimous position of all the paramedic organizations (unions, associations) could guarantee success in the subject matter [9, 10].

The community also explores the problem of educational dualism in case of paramedics, who have the same qualifications regardless whether they graduated from a post-secondary school, or received a BSc diploma. A separate legal act is missing which would regulate the paramedic profession, whereas the existing regulations do not specify clearly the legal status of a paramedic and the scope of procedures to be performed by representatives of this profession [11].

There are suggestions that post-secondary schools should be eliminated, as the number of education hours there is nearly half of that at undergraduate studies, and candidates for these schools do not even need a maturity exam to begin education, just a secondary school diploma. It has been proposed that, following the introduction of basic Emergency Medical Services teams, which may be composed exclusively of paramedics, without a physician, paramedics should be required to have a higher education degree [12]. This proposition is supported by the fact that post-secondary schools focus on practical classes, and enable one to master all the skills necessary for paramedics.

The emphasis on practical classes should be dictated at least by the fact that so far paramedics, contrary to nurses, are not required to have a professional experience scheme, although their competences in the National Emergency Medical Services system are identical. Post-secondary schools are usually free, or are much less expensive than other forms of study, so they provide a more convenient form of improving qualifications for ambulance drivers who need to supplement their education to continue working in previous positions.

This study seems to confirm this observation, as the study group involves people with work experience of 10-20 years and over 20 years, for the age groups of 31-40 years old and 41-50 years old, graduates of post-secondary school with the paramedic title.

The debate about future education of paramedics is still ongoing. The problem of bridge studies for post-secondary school graduates is still open. Presently, paramedics after a vocational school need to complete the entire three-year undergraduate studies cycle to obtain a degree [13].

However, there are also opinions that Polish paramedic courses take much longer to prepare a person for work in Emergency Medical Services than in most Western countries. For instance, in the United States only preparation courses are obligatory, the work is often voluntary, and competences are frequently at a minimum level. In Poland, the education of a paramedic takes 2 years (technician) or 3 years (BSc), which allows much better training and more effective results compared to paramedics in other countries [14].

The controversial issue of changes in the act regarding the education of paramedics is not the only problem encountered while creating the new system. Another problem is the functioning of women in Emergency Medical Services.

It is stipulated that women are not deprived of the opportunity to work in Emergency Medical Services, but only as first aid instructors, medical dispatchers or in emergency hospital departments, although the last suggestion is also controversial, due to the physical work involved in carrying patients or performing hygienic procedures [15].

Managers of facilities often refer to legal limitations [16-18], refusing employment to women, despite vacancies [19], and they point out that women cannot manually carry or lift loads weighing more than 12 kg in a permanent or casual job (up to 4 times/h). Even stronger restrictions apply to pregnant and breastfeeding women, who can lift or carry only 1/4 of the weight permitted for other women.

However, it is unacceptable for an employer to adopt a general rule of rejecting candidates for work merely on the basis of gender [20].

It is clear that employers in the Świętokrzyskie region, where the study was conducted, do not discriminate women in Emergency Medical Services, giving them the opportunity to work in field teams, as

nearly 21% of the paramedics involved in the study were women.

The introduction into the Act on the National Emergency Medical Services of the paramedic profession was certainly a good decision. Despite numerous controversies concerning new regulations, paramedics increased the professionalism of the emergency teams, substituting unqualified orderlies and ambulance drivers. However, changes are required in the regulations regarding Emergency Medical Services are required to eliminate all the doubts arising during implementation of provisions of the Act. The previous functioning of the system provides answers as to what modifications should be introduced by the legislator to improve the quality of Emergency Medical Services, and the professional situation of paramedics [13].

However, it may be declared with complete certainty that the paramedic is a profession with a future, and its representatives are characterized by professionalism, striving for development and improving the community, efforts towards its integration, openness to new solutions, and, first and foremost, the determination to improve the quality of patient care.

Conclusions

1. Most paramedics can perform unassisted emergency medical procedures guaranteed in legal acts.
2. Paramedics most often perform passive oxygen therapy, cardiopulmonary resuscitation, restore airway, conduct manual defibrillation on the basis of ECG, monitor circulatory function using noninvasive methods and administer medications.
3. Over half of the paramedics have administered 20 out of 24 medications from the list during their professional.
4. Paramedics feel that they are completely prepared for work, have all the necessary experience and are not afraid to perform medical procedures and administer medications.
5. As part of the professional procedures, paramedics often perform the following procedures under a physician's supervision: urinary bladder catheterization, administration of drugs other than those listed for unassisted administration, endotracheal intubation and cardioversion, inserting a probe and performing gastric lavage, as well as assisting during minor surgical procedures.
6. According to the study subjects, employers respect the right of paramedics to administer drugs without physician's orders, although in certain facilities there are internal regulations which prevent unassisted performance of procedures or administration of drugs; however the subjects did not specify to which procedures or drugs those limitations apply.
7. The majority of the paramedics collect documentation related to professional training.
8. According to the study subjects, organizational changes in the system improved organization and reduced the time of arrival to patients.

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Surgical procedures in combat trauma within the environment of a level 2 field hospital – experience of the Polish Field Hospital in Ghazni, Afghanistan

Postępowanie chirurgiczne w obrażeniach bojowych w warunkach szpitala polowego poziomu 2. – doświadczenie Szpitala Polowego Polskiego Kontyngentu Wojskowego w Ghazni w Afganistanie

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Abstract. The procedures for treating combat casualties in a war zone are based on a consensus between the limited resources of the military medical facility and the expected flow of mass casualties. The aim of the study was to assess the trauma profile, the treatment procedures (including damage control surgery) and the trauma team's activities performed in the Trauma Room. The analysis was based on 198 cases of Polish and Afghan combat casualties treated in the Polish Field Hospital at FOB Ghazni (Afghanistan) between January 2012 and February 2013. The majority of the patients were suffering from primary blast injuries (59.5% of the cases) and gunshot wounds (37.1%). The most frequent interventions were orthopedics (66.7% of the procedures). Life-saving interventions as well as damage control surgery procedures were performed in 98 (49.5%) cases. The trauma team performance was mainly concentrated on the rapid diagnosis and treatment of critical injuries in order to save lives and prevent future disabilities. The procedures followed by the trauma team as well as Trauma Room organization offer multiple solutions that can be practically applied to the performance of trauma teams working in civilian Trauma Centers.
Key words: battle injuries, damage control surgery, field hospital level 2

Streszczenie. Wstęp: Procedury leczenia poszkodowanych w strefie działań wojennych wynikają z konieczności kompromisu pomiędzy ograniczonymi zasobami wojskowej placówki medycznej a spodziewanym masowym napływem rannych. Cel pracy: Celem pracy była ocena profilu obrażeń, procedur podjętych u poszkodowanych, w tym działania w trybie damage control, jak również zasady postępowania zespołu urazowego w Trauma Room. Materiał i metody: Dokonano retrospektywnej analizy obrażeń bojowych, na podstawie dokumentacji medycznej pacjentów leczonych w Polskim Szpitalu Polowym FOB Ghazni od stycznia 2012 do lutego 2013 roku. Wyniki: W pracy dokonano analizy 198 przypadków urazów bojowych pacjentów polskich i afgańskich leczonych w Szpitalu Polowym Polskiego Kontyngentu Wojskowego w FOB Ghazni (Afganistan). Dominowały pierwszorzędowe obrażenia powybuchowe (59.5%) i zranienia postrzałowe (37.1%). Najczęstsze były interwencje ortopedyczne - stanowiły 66.7% wykonywanych zabiegów. Wobec 98(49.5%)poszkodowanych podejmowano działania ratujące życie oraz procedury związane z doraźnym chirurgicznym zaopatrzeniem obrażeń. Wnioski: Zadaniem zespołu urazowego szpitala polowego jest szybka diagnostyka oraz zaopatrzenie obrażeń krytycznych w perspektywie przeżycia oraz dalszej sprawności poszkodowanych. Procedury organizacji zespołu urazowego i działania Trauma Room przedstawiają szereg rozwiązań, które w praktyczny sposób mogą zostać wykorzystane w pracy zespołów Centrów Urazowych szpitali cywilnych.
Słowa kluczowe: *damage control surgery*, szpital polowy poziomu 2., urazy bojowe

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Figure 1. Trauma team in action

Rycina 1. Zespół urazowy podczas pracy

Figure 2. X-ray of lower legs after blast injury (IED)

Rycina 2. Radiogram obu goleni pacjenta po wybuchu IED

Introduction

The organization of medical support for the actions of the NATO coalition forces is based partly on the functioning of level 2 field hospitals, which treat patients who are ill or injured, mostly as a result of combat trauma suffered during participation in operations in the military zone [1, 2]. The role of surgical teams in field hospitals (Fig. 1) is to stabilize casualties initially and perform *damage control surgery* procedures, then to prepare them for evacuation to higher levels of medical support: Combat Support Hospital in the operation zone (level 3) and to hospitals outside the military theatre (level 4) [3, 4].

The work of surgical teams at level 2 is a significant organizational challenge, as they usually function within the active combat zone, their diagnostic and therapeutic resources are limited, the number of personnel is limited, and they are often confronted with mass casualty incidents (inflow of many casualties at the same time) [5-8].

An understanding of the specificity and profile of combat trauma enable surgical teams to be better prepared for action under battlefield conditions. Certain experiences, particularly related to the treatment of gunshot and fragmentation wounds, as well as the results of explosions, may be a valuable source of information which can be used in civil practice and in peacetime (Fig. 2) [9-12].

Aim of the study

The study is a retrospective analysis of combat injuries treated by the Medical Support Group (field hospital) of the Polish Military Contingent (PMC) in FOB Ghazni in eastern Afghanistan. It evaluates the flow of casualties and the medical procedures. The authors illustrate the problems and limitations of medical support which may affect the activities of the surgical teams.

Material and Methods

198 cases of battle injuries suffered by the patients hospitalized at the Polish field hospital, FOB Ghazni, were analyzed for the period January 2012 to February 2013. The casualties included both soldiers and civilian employees of the PMC, and representatives of Afghan security forces and Afghan civilians.

The only medical records analyzed were those of patients with combat injuries being the result of an explosion or other kinetic actions. Those cases where the injuries did not result from the combat actions or terrorist attacks were excluded. Standardized Trauma Records were analyzed.

Results

In the analyzed period, 198 patients meeting the criteria of body injuries suffered as a result of combat trauma were treated in the field hospital of the PMC Afghanistan. 76 casualties (37.1%) received gunshot wounds, 122 (59.5%) were hospitalized due to injuries caused by improvised explosive devices (IED), and 7 (3.4%) with gunshot wounds also suffering secondary blast injuries (caused by fragmentation) (Fig. 3).

Most of the casualties were male (195 persons). The mean age of the casualties was 27 years (age range: 5 to 50 years).

162 of the study group (82.0%) were soldiers and policemen, whereas 36 (18.0%) were civilians.

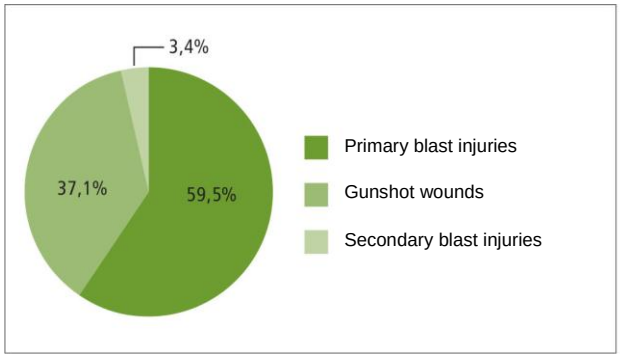

Figure 3. Cause of injuries

Rycina 3. Mechanizm urazów

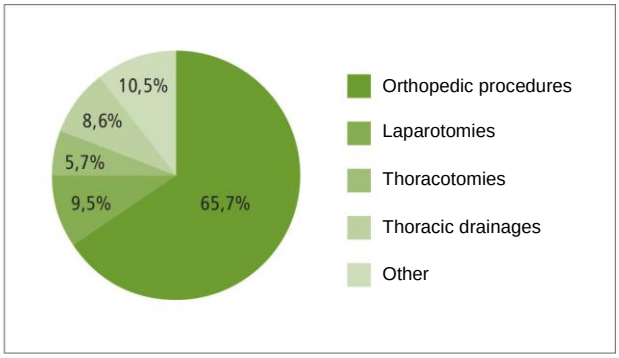

Figure 4. Undertaken surgical procedures

Rycina 4. Wykonane procedury chirurgiczne

78.0% of the casualties required medical evacuation (MEDEVAC) from the site of the incident to the hospital.

The average injury severity score according to the NISS scale was 23.2 point (ranging from 4 to 66).

For 98 casualties (49.5%), lifesaving actions and procedures associated with provisional surgical treatment of injuries were performed, i.e. 6 thoracotomies (5.7%), 10 laparotomies (9.5%) and 69 procedures on limbs, pelvis, soft tissue and bones (65.7%), 9 thoracic drainages (8.6%) and 11 (10.5%) other surgical procedures (limb amputations, vascular revisions and fasciotomies, revisions of head and neck injuries, Fig. 4).

For 21 casualties (10.6%), blood product transfusions were required, 3.5 units of packed red blood cells (PRBC) and/or fresh whole blood (FWB) were used on average, as well as 3 units of fresh frozen plasma (FFP).

The mean time between casualty arrival and initiation of surgical treatment was 45 minutes, mean time to prepare their readiness for further evacuation was 180 minutes.

During the rescue actions, 4 casualties (2.02%) died in the Trauma Room.

Discussion

Managing combat trauma in patients is one of the main tasks of level 2 field hospitals in the operation theatre. Diagnostic and therapeutic management is based on Advanced Trauma Life Support (ATLS) procedures, modified to the requirements of the battlefield, prioritizing fast and effective control of massive bleeding (particularly from the limbs and the areas where they join the torso – *functional junction)* before other emergency treatment [13]. Medical treatment focuses on preventing the three main and potentially reversible causes of death on the battlefield, i.e. bleeding from the limbs, tension pneumothorax and respiratory tract obstruction, by effective application of a tourniquet (tactical stasis) or hemostatic dressing on the wounded limb, drainage of tension pneumothorax by needle thoracocentesis, and decongestion of the respiratory tract, sometimes by conicotomy. Medical treatment involves the principles of the trauma team organization, triage of the casualties, diagnostic management and proceeding in the Trauma Room, as well as the principles of damage control surgery. The efforts of the trauma team at a level 2 field hospital are oriented towards ensuring a return to service of the highest possible number of casualties, and prioritizing life, limb and eyesight-saving procedures [3, 4].

It is also important to use unified emergency and medical management procedures at the prehospital level, on the basis of the Tactical Combat Casualty Care guidelines [14].

The analysis demonstrates that 61.6% of casualties suffered multi-site injuries as a result of explosions involving a combination of mechanisms (pressure mechanism, fragmentation mechanism, secondary injuries and burns). An important element of surgical treatment was to manage both the effects of penetrating wounds (frequently multi-site ones), and diagnosis and treatment of pressure injuries.

The crucial aspect in the functioning of field hospitals is the need to quickly implement all necessary medical procedures. The limited diagnostic resources, including portable x-ray machines, mobile ultrasound devices and laboratory equipment, pose a problem. This necessitates taking decisions based on a diagnostic and therapeutic algorithm, and at the same time reduces the scope of intervention to the area defined as damage control resuscitation and damage control surgery, delaying further management until the patient is transferred to a level 3 treatment facility (Fig. 5) [15].

Organization problems occur when it is necessary to perform triage of some patients and treat others in the Trauma Room simultaneously, which requires organizing several trauma teams. The mean time between casualty arrival and the beginning of surgery is short; in the study group it was 45 minutes. It should be emphasized that in case of emergency thoracotomies performed in the Trauma Room, the time between casualty arrival and surgery did not exceed 10 minutes. Most interventions were due to muscoskeletal injuries (69 procedures). They were mostly gunshot wounds and fragmentation injuries following IED explosions. The procedures were intended to control bleeding, prevent further damage (initial external stabilization of fractures, fasciotomies) and perform the necessary vascular procedures or amputations [6,11,16].

The short time in which casualties were ready for evacuation (180 minutes) should be emphasized. This time was necessary for the trauma team to perform damage control procedures, and to prepare the casualty for air medical evacuation using the MEDEVAC system.

Figure 5. Casualty of IED blast

Rycina 5. Ofiara wybuchu IED

Conclusions

1. Level 2 field hospitals need to be prepared for the fast management of casualties with body injuries resulting from combat trauma. Because many patients may have multi-site injuries, the basis for operation of the hospital is the preparation of a trauma team according to the unified ATLS standards and Emergency War Surgery procedures.
2. The combat trauma profile demonstrates a prevalence of penetrating injuries concomitant with pressure injuries and burns. They significantly differ from injuries found in civilian practice, where blunt injuries dominate.
3. The aim of the trauma team on the battlefield is to diagnose and treat critical trauma, with emphasis on the survival and preventing disability of the casualties. Damage control procedures do not constitute a definitive treatment of body injuries.
4. The procedures for organization of a trauma team and the functioning of a Trauma Room involve a range of solutions which may find practical use in everyday practice of trauma centers in civilian hospitals.

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Assessment of parasitological diagnosis effectiveness in light microscopy illustrated by an example study of Afghan patients

Ocena skuteczności diagnostyki parazytologicznej w mikroskopii świetlnej na przykładzie badań pacjentów afgańskich

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Abstract. The paper evaluates the effectiveness of parasitological diagnosis performed using three methods of light microscopy. Parasitological stool examination was carried out on 201 Afghan patients being treated for internal diseases at Ghazni Provincial Hospital in eastern Afghanistan in March 2012. The diagnostics was performed with a direct smear, decantation in distilled water and Fülleborn's flotation, at the Department of Epidemiology and Tropical Medicine of the Military Institute of Medicine in Gdynia. Infections with intestinal parasites were observed in 85 patients (42.3% of the study group). The most common pathogens detected in this study were *Ascaris lumbricoides*, *Giardia intestinalis* and *Hymenolepis nana*. The most effective method in the diagnostics of helminthiasis (roundworms, flatworms) proved to be Fülleborn's flotation (95.4–95.8% susceptibility), while the highest detection of protozoa was by decantation in distilled water (100% susceptibility). The use of concentration methods (flotation, decantation) in light microscopy significantly increased the detection of intestinal parasites, in comparison with a traditional direct smear for which susceptibility did not exceed 64% for helminths and 74% for protozoa.
Key words: Afghanistan, diagnostic methods, intestinal parasites

Streszczenie. Cel pracy: W pracy dokonano oceny skuteczności diagnostyki parazytologicznej wykonanej trzema metodami badawczymi w mikroskopii świetlnej. Materiał i metody: Badania parazytologiczne kału wykonano u 201 pacjentów narodowości afgańskiej leczonych w Ghazni Provincial Hospital we wschodnim Afganistanie z powodu chorób wewnętrznych w marcu 2012 r. Badania wykonano metodą rozmazu bezpośredniego, dekantacją i flotacją w Zakładzie Epidemiologii i Medycyny Tropikalnej WIM w Gdyni. Wyniki: Zarażenia patogennymi pasożytami jelitowymi wykryto u 85 osób (42,3% grupy badanej). Do najczęściej rozpoznawanych patogenów należały Ascaris lumbricoides, Giardia intestinalis i Hymenolepis nana. Najskuteczniejszą metodą badawczą w diagnostyce robaczyc (obleńce, płazińce) okazała się flotacja (czułość 95,4–95,8%), z kolei najwyższą wykrywalność pierwotniaków wykazano stosując dekantację (czułość 100%). Wnioski: zastosowanie metod zagęszczających (flotacja, dekantacja) w mikroskopii świetlnej w znaczący sposób zwiększa wykrywalność pasożytów jelitowych w porównaniu ze stosowaniem podstawowej metody rozmazu bezpośredniego, dla której czułość w zadaniu badawczym nie przekraczała 64% w przypadku robaków obłych i płaskich oraz 74% dla pierwotniaków.
Słowa kluczowe: Afganistan, metody diagnostyczne, pasożyty jelitowe

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Introduction

Gastrointestinal parasitic diseases are one the most significant health problems in the modern world [1]. Over two billion people are infected with at least one intestinal parasite, whereas five billion people live in regions with constant risk of parasite infection. The risk of becoming infected is especially high in the Third World countries, where low standards of hygiene, poor sanitary habits and lack of medical care, promote spreading of gastrointestinal diseases [2-4]. Spectrum of clinical signs of parasitic infections is very wide, including asymptomatic carriage, chronic diarrhea, abdominal pain, and malnutrition leading to severe anemia. The principle of the diagnostics of intestinal parasitic diseases is light microscopy which can detect different life forms of intestinal parasites (cysts, trophozoites, eggs, larvae) [5]. The detection of intestinal parasites in light microscopy is much dependent on diagnostic methods and the experience of laboratory staff who performs the task. With using only the direct smear method, the probability of receiving a positive result is unlikely or very low. In laboratories which specialize in intestinal parasitology, concentration methods are used frequently to highly increase pathogen detection [6]. Using more than one diagnostic method is understandable while performing screening tests in population with low infection coefficients (very few pathogens detected) as well as amongst population where such infections are frequent (detecting all pathogens in complex infections). An example of a population with high level of parasitic infection are the people of Afghanistan, who live with very poor sanitary habits, also in hard living conditions, with a limited access to medical care. For several years Polish health care has been working for the International Security Assistance Force in the Forward Operating Base in Ghazni and conducts parasitological examination for local people, leading to detection and elimination of gastrointestinal parasitic diseases.

The aim of this study was to evaluate the effectiveness of parasitological diagnostics per formed with three research methods in light microscopy with an example of biological material from Afghan patients.

Material and methods

Study population

A group of 201 patients treated in Ghazni Provincial Hospital because of internal health problems took part in parasitological examination in March 2012. The study group consisted of 164 children aged 1–17, and 37 adults (18–80 years of age). Three stool samples were taken from each patient in 2–3 days intervals. Biological material was stained in 10% formalin or SAF preservative and transported by air from east Afghanistan to Poland, to the Department of Epidemiology and Tropical Medicine of the Military Institute of Medicine in Gdynia, to conduct parasitological examination with three methods of light microscopy (direct smear, decantation, flotation). A total of 1809 stool samples was examined (3 samples × 3 methods for each person taking part in the study).

Parasitological examination

The diagnostics of intestinal parasites was performed by means of three stool testing methods using a light microscopy:

Direct smear in Lugol's solution

Approximately 2 mg of stool is collected with a glass rod and applied onto a slide, a drop of Lugol's solution is added and the material is smeared over a 4 cm^2 surface. Then, a cover slide is placed on top of the preparation and the material is examined microscopically with × 20 magnification objective. The material prepared using such method allows the diagnostician to conduct an initial analysis of non-concentrated material while staining the preparation with Lugol's solution improves the quality of the picture of detected parasites.

Preparation from decantation in distilled water

Approximately 2 ml of stool specimen is mixed thoroughly with a small amount of water in a test tube. Then, water is added to the top of the tube. After 30 minutes the supernatant is decanted and another portion of water is added. This procedure is repeated until clear supernatant is obtained, generally three to four times. The sediment is then placed on a slide and stained with Lugol's solution for microscopic examination (×40 magnification).

Preparation from Fülleborn's flotation

Approximately 2 ml of stool specimen is mixed with saturated NaCl solution in a test tube and next, NaCl solution is added to the top of the tube. A cover slide is placed gently on the top of the tube and in contact with the suspension. After 30 minutes the cover slide is gently removed with tweezers and placed on a slide wet side down. The preparation is ready for microscopic examination (×10 magnification).

Results

The research for evaluation of effectiveness of parasitological diagnostics for intestinal parasites in light microscopy was conducted for 201 patients of Afghan origin. A total of 85 people were approved infected with intestinal parasites (42.3% of the study group), while 27 people were diagnosed of being infected with more than one intestinal parasite. The most common parasites were nematodes (*Ascaris lumbrocoides*, 21% infected patients), protozoa (*Giardia intestinalis*, 17.9%) and cestodes (*Hymenolepis nana*, 8.5%) (Table 1).

Table 1. Pathogenic intestinal parasite infections in Afghan patients (n = 201)
Tabela 1. Zarażenia patogennymi pasożytami jelitowymi u pacjentów afgańskich (n = 201)

Pathogenic intestinal parasite infections		Number of infections	% of infections	% of tested patients (n = 201)
Single parasitic infections	*Ascaris lumbricoides*	43	50.6	21.4
	Enterobius vermicularis	3	3.5	1.5
	Strongyloides stercoralis	2	2.35	1.0
	Hymenolepis nana	17	20.0	8.5
	Hymenolepis diminuta	1	1.2	0.5
	Taenia spp.	4	4.7	2.0
	Dicrocoelium dendriticum	2	2.35	1.0
	Giardia intestinalis	36	42.3	17. 9
	Entamoeba histolytica/dispar	2	2.35	1.0
	Iodamoeba bütschlii	8	9.4	4.0
Multiple parasitic infections	*Al, Hn, Gi*	3	3.5	1.5
	Hn, Gi	4	4.7	2.0
	Al, Gi	3	3.5	1.5
	Al, Hn	2	2.35	1.0
	Ev, Gi	2	2.35	1.0
	Al, Hd	1	1.2	0.5
	Al, Ib	1	1.2	0.5
	Al, T	1	1.2	0.5
	Al, T, Gi	1	1.2	0.5
	Al, Dd, Gi	1	1.2	0.5
	Al, Gi, Ib	1	1.2	0.5
	Al, Ev	1	1.2	0.5
	Al, Ss	1	1.2	0.5
	Gi, Ib	2	2.35	1.0
	Hn, Ib	2	2.35	1.0
	Dd, Ib	1	1.2	0.5

Abbreviations: *Al – Ascaris lumbricoides, Ev – Enterobius vermicularis, Dd – Dicrocoelium dendriticum, Gi – Giardia intestinalis, Hd – Hymenolepis diminuta, Hn – Hymenolepis nana, Ib – Iodamoeba bütschlii, Ss – Strongyloides stercoralis, T – Taenia spp.*

The examination proved that the most efficient method in parasitological diagnostics, especially for nematodes and cestodes, is flotation (95.8% and 95.4% detected parasites). For protozoa, the detection was 100% using decantation. Susceptibility of direct smear was much lower with 62.5% for nematodes, 63.6% for cestodes and 73.9% for protozoa (Table 2).

Conclusions

Concentration methods in light microscopy, especially flotation in helminth diagnostics and decantation in protozoa diagnostics, in comparison to a standard direct smear method, for which the susceptibility in the study did not exceed 64% for nematodes and cestodes and 74% for protozoa, significantly increase detection of intestinal parasites.

Table 2. Detection of intestinal parasites in light microscopy
Tabela 2. Wykrywalność pasożytów jelitowych w mikroskopii świetlnej

Intestinal parasites	n	Diagnostic methods		
		Direct smear (% of detected parasites)	Flotation (% of detected parasites)	Decantation (% of detected parasites)
Nematodes	48	30 (62.5)	46 (95.8)	24 (50.0)
Ascaris lumbricoides	43	28 (65.1)	41 (95.3)	24 (55.8)
Enterobius vermicularis	3	1 (33.3)	3 (100.0)	0 (0.0)
Strongyloides stercoralis	2	1 (50.0)	2 (100.0)	0 (0.0)
Cestodes	22	14 (63.6)	21 (95.4)	5 (22.7)
Hymenolepis nana	17	12 (70.6)	17 (100.0)	3 (17.6)
Hymenolepis diminuta	1	1 (100.0)	0 (0.0)	1 (100.0)
Taenia spp.	4	1 (25.0)	4 (100.0)	1 (25.0)
Trematodes	2	2 (100.0)	2 (100.0)	0 (0.0)
Dicrocoelium dendriticum	2	2 (100.0)	2 (100.0)	0 (0.0)
Protozoa	46	34 (73.9)	3 (6.5)	46 (100.0)
Giardia intestinalis	36	27 (75.0)	2 (5.6)	36 (100.0)
Entamoeba histolytica/dispar	2	2 (100.0)	0 (0.0)	2 (100.0)
Iodamoeba bütschlii	8	5 (62.5)	1 (12.5)	8 (100.0)

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Significance of endosonography application in classification recognition for gastric lesion therapy

Znaczenie endosonografii w rozpoznawaniu kwalifikacji do leczenia patologii w zakresie żołądka

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Abstract. The basic aim of the study was to assess the functionality of endoscopic ultrasonography in the detection of submucous lesions, gastric wall thickening and surface roughness cases**.** The authors analyzed 111 patients (60 male and 51 female) hospitalized in the Gastroenterology Department of the Military Institute of Medicine in Warsaw between 2009 and 2012 due to gastric lesions diagnosed by upper gastrointestinal tract endoscopy. All patients subsequently underwent endosonography. In 72 cases (64.9%) organic lesion in the gastric wall was diagnosed, and in 39 cases (35.1%) normal anatomical structures were found beyond the gastrointestinal tract. On the basis of the advancement of lesions of the gastric wall found by ultrasonography, the patients were qualified to surgical, endoscopic or oncology treatment. In 77 (69%) cases, the lesion was limited to the mucosa and submucosa and therefore only subject to endoscopic treatment/surveillance. In other cases infiltration beyond the muscle membrane (n = 34 and 31%, respectively) was diagnosed and the patients qualified for surgery or oncology treatment. Endoscopic ultrasound plays a key role in the diagnosis of submucosal lesions, allowing proper assessment for appropriate treatment.
Key words: endosonography, gastric lesion treatment, gastroscopy, submucosal lesion/tumor

Streszczenie. Cel pracy: Podstawowym celem pracy było ustalenie przydatności endoskopowej ultrasonografii w wykrywaniu zmian podśluzówkowych oraz pogrubienia i nierównych zarysów ścian żołądka. Materiał i metody: Przeanalizowano 111 pacjentów (60 mężczyzn i 51 kobiet) hospitalizowanych w Klinice Gastroenterologii Wojskowego Instytutu Medycznego w latach 2009–2012 z powodu patologii żołądka stwierdzonej w badaniu gastroskopowym. U wszystkich chorych wykonano na kolejnym etapie badanie endosonograficzne. Wyniki: W 72 przypadkach (64,9%) stwierdzono zmianę organiczną w obrębie ściany żołądka, u 39 (35,1%) pacjentów prawidłowe struktury położone poza przewodem pokarmowym. Na podstawie zaawansowania zmian w obrębie ściany żołądka w EUS zakwalifikowano chorych do jednej z trzech metod terapii: endoskopowej, chirurgicznej lub onkologicznej. W 77 (69%) przypadkach zmiana ograniczona była do błony śluzowej i podśluzowej, a więc podlegała terapii/nadzorowi endoskopowemu. W pozostałych przypadkach rozpoznano naciek przekraczający błonę mięśniową (n = 34; 31%), kwalifikując odpowiednio chorych do leczenia chirurgicznego lub onkologicznego. Wnioski: Badanie endosonograficzne odgrywa kluczową rolę w diagnostyce zmian podśluzówkowych, umożliwiając prawidłową kwalifikację do odpowiedniej metody leczenia.
Słowa kluczowe: endosonografia, gastroskopia, guz/zmiana podśluzówkowa, terapia zmian organicznych żołądka

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Introduction

In recent years we have witnessed achievements in the field of imaging tests used for gastrointestinal tract diagnostics, resulting from improvements in endoscopic equipment and systems which enable imaging.

Classical endoscopes only allow the evaluation of the surface of the gastrointestinal mucosa. Examination of deeper located lesions, particularly those beyond the gastrointestinal wall, is impossible. This contributed to increased interest in ultrasound examination as complementary to classical endoscopy. The significance of endoscopic ultrasound is in the recognition of suitability for the treatment of gastric pathologies. The technique, which combines ultrasound and endoscopic imaging, is known as

endoscopic ultrasonography (EUS). The use of high-frequency (5-20 MHz) transducer provides excellent image quality of the gastrointestinal wall and its adjacent structures. The high sensitivity and specificity of EUS results from both the shorter distance between the head of the device and the organ tested, and the high resolution. It allows one to evaluate individual layers of the gastric wall, as well as the adjacent organs. In endosonography, the ultrasound wave emitted by the head reflects from the surrounding tissue and is received back (also by the head), and processed as in a standard ultrasound examination. As a result, an image of the organs is shown on the screen.

A submucosal lesion/tumor is a term used in endoscopic diagnostics to describe any protrusion into the gastrointestinal lumen covered with normal or pathologically changed mucosa. Gastroscopic examination enables one to detect, apart from the above pathologies, flat lesions with a thickened gastrointestinal wall and rough surface, which are normally difficult to interpret. Such a lesion may be caused by a normal organ or by a pathological structure, directly adjacent to the gastrointestinal wall. Within the stomach, the tumor effect may be caused by enlarged cardiac muscle, left hepatic lobe, protruding pancreatic parenchyma, as well as pancreatic abnormalities. Impressions in the stomach may also result from the gall bladder and the spleen or its vessels.

The following pathologies require endosonographic verification in the stomach:

- submucosal gastric tumor/lesion,
- thickened gastric wall with rough surface,
- ulceration, atypical polypoid lesions, suspected varicose veins,
- impression differentiation from the outside,
- assessment of the depth of infiltration into the wall while assessing suitability for endoscopic or surgical treatment,
- lymph nodes assessment in abdominal lymphadenopathy,
- fluid in the abdominal cavity,
- diagnostic uncertainty in imaging and endoscopic examinations,
- assessment following neoadjuvant therapy.

Aim of the study

The primary aim of the study was to evaluate usefulness of endoscopic ultrasonography in the detection of submucosal lesions and thickened and irregular gastrointestinal walls within the stomach. We will determine the significance of EUS for decisions regarding the assignment of pathological lesions for endoscopic, surgical or oncologic treatment. Moreover, we will attempt to determine the significance of EUS in the verification of pathological lesions compared to histopathological test results. The above aims were implemented on the basis of gastroscopy, computed tomography, endosonography and histopathological test results.

Material and Methods

The analysis involved 111 patients (60 males and 51 females) hospitalized at the Gastroenterology Department of the Military Institute of Medicine in Warsaw in the years 2009-2012. The study inclusion criterion was presence of submucosal lesion or thickened gastric wall with rough surface under gastroscopic examination. All the patients were qualified for endoscopic ultrasonography, computed tomography of the abdominal cavity, followed by a decision regarding endoscopic, surgical or oncologic therapy. The study is in compliance with the statutory activity of the Military Institute of Medicine, and has been approved by a Bioethical Committee. All patients provided an informed consent to participate in the study.

Results

Among the 111 patients at the Gastroenterology Department of the Military Institute of Medicine in Warsaw who in the years 2009-2012 underwent endosonographic examination of the stomach, 54% of the study population were males (n = 60%), whereas 46% (n = 51) were females. Average age was 63.4 (± 13.9) years (Tab. 1).

The patients were divided into two groups. The first group comprised patients with thickened gastric wall and surface roughness as observed under gastroscopic examination (n = 24, 21.6%). The second group comprised patients with a submucosal lesion present in the stomach (n = 87; 78.4%).

The next stage involved all patients undergoing endosonographic examination, which revealed an organic lesion within the gastrointestinal wall in 72 cases (64.9%), and in 39 (35.1%) patients

Table 1. Study group patients
Tabela 1. Badana grupa chorych

Study group	Number	Age of the study group (in years)
total number of study subjects	111	22-87 (x̄ 63.4 ± 13.9)
females	51	22-84 (x̄ 63.2 ± 14.9)
males	60	25-87 (x̄ 63.5 ± 13.3)

normal structures were found outside the gastrointestinal tract. Based on advanced lesions in the gastric wall, the patients were assigned to one of

three treatments: endoscopic, surgical or oncologic therapy. Endosonography revealed 77 (69%) lesions limited to the mucosa and submucosa, subsequently subject to endoscopic therapy/surveillance. In other cases, infiltration beyond the muscle membrane was found (n = 34; 31%), which qualified 28 patients (26%) for surgical treatment, and 6 patients (5%) for oncologic treatment due to generalized proliferation process.

After the diagnostic and therapeutic process was completed, the 111 patients with gastric abnormalities were eventually diagnosed with the following: benign lesions 33.3% (n = 37), such as intramural cyst (n = 7), ectopic pancreas (n = 17), lipoma (n = 12), and inflammatory polyp (n = 1). The other lesions, 31.5% (n = 35), were potentially malignant and malignant, such as: GIST (n = 24), cancer (n = 3), lymphoma (n = 3), neuroendocrine tumor (n = 5) and normal structures located outside the gastrointestinal tract (n = 39; 35.1%) (Tab. 2).

Discussion

Due to the greater access to endoscopic examinations, submucosal tumors and flat lesions with thickened gastric wall with rough surface are diagnosed increasingly often. In the retrospective material collected in the years 1976-1984 by Hedenbro, 15,104 endoscopic examinations were analyzed [1]. One submucosal lesion in 300 endoscopic examinations of the upper gastrointestinal tract was found. The lesions were most frequently found in the stomach (68%), then in the esophagus (25%), and the least (7%) in the duodenum [2].

Table 2. The final diagnosis after diagnostic process in patients with submucosal lesions and thickened gastric wall
Tabela 2. Ostateczne rozpoznanie po zakończeniu procesu diagnostycznego u pacjentów ze zmianami podśluzówkowymi oraz pogrubiałą ścianą w zakresie żołądka

normal structures located outside the stomach	39 (35.1%)
intramural cyst	7 (6.3%)
neuroendocrine tumor	5 (4.5%)
lymphoma	3 (2.7%)
ectopic pancreas	17 (15.3%)
lipoma	12 (10.8%)
gastric cancer	3 (2.7%)
GIST	24 (21.6%)
inflammatory polyp	1 (0.9%)

In the material studied, in 39 (35.1%) cases the presence of normal organs located outside the gastrointestinal tract was observed. Suggested inaccuracies in the gastroscopic examination were caused by protruding left hepatic lobe, pancreatic parenchyma, gall bladder and spleen.

In the study population, benign gastric lesions were found in 33.3% of patients, of which the most common was ectopic pancreas (15.3%). Ectopic pancreas is pancreatic tissue present outside the organ itself, usually in the gastric wall. It is a benign developmental anomaly, which consists in the presence of pancreatic tissue at an atypical site, without connection with the normal pancreas [3]. In the stomach, 85–95% of lesions are located in the *antrum*, usually on the side of the major curvature [4]. The occurrence of gastric submucosal lesions is second only to mesenchymal tumors as the most frequent. Ectopic pancreas is usually asymptomatic as it is diagnosed accidentally during endoscopy. However, symptoms such as nausea, abdominal pains, weight loss or even gastrointestinal bleeding were also reported [5]. In an endoscopic examination, ectopic pancreas is present as a small submucosal lesion with a depression or dimpling corresponding to the site where the ducts empty. There are single reports of malignant transformation into adenocarcinoma [6]. If examination of the endoscopic samples confirms that the lesion is an ectopic pancreas, no treatment is required. Under endosonographic examination, pancreatic heterotopy is present as a lesion of the heteroechogenic structure, although hypoechogenic relative to the adjacent tissues [7]. It is located in the second or third layer of the gastrointestinal wall [8]. If the lesion is small, up to a few millimeters in size, its endoscopic presentation is typical, and histopathological analysis does not reveal potentially malignant cells; the treatment consists of endoscopic surveillance and leaving the lesion untreated.

The second most common benign lesion in the study material is lipoma (10.8%), built of mature lipocytes. It is characterized by slow growth and is primarily asymptomatic in its course. The upper section is usually found in the peripyloric region of the stomach. Endoscopically, a lipoma is a yellowish submucosal lesion with a characteristic "pillow" sign. After pressing the lesion with closed biopsy forceps, a depression occurs, which disappears once the pressure is released. Under EUS, it appears as a lesion with a regular outline and intensive, hyperechogenic structure (Fig. 1). It originates in the third layer of the gastrointestinal wall in the EUS image [8, 9]. The image is typical and does not require further diagnostics. If the lipoma diagnosis is unambiguous, the patient does not require any treatment or supervision.

Intramural cysts are rare benign submucosal lesions; in the study material they constituted 6.3% of the cases. Intramural cyst is a developmental abnormality which may occur in any part of the

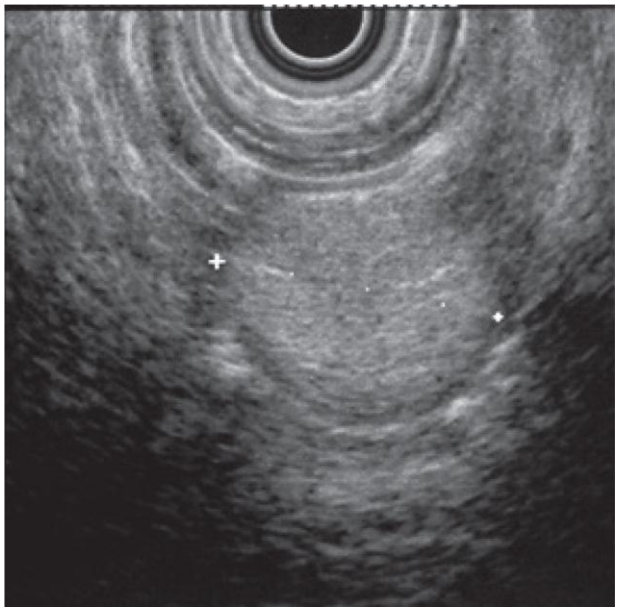

Figure 1. Gastric lipoma in endosonography

Rycina 1. Obraz endosonograficzny tłuszczaka żołądka

gastrointestinal tract. This type of submucosal tumor is usually asymptomatic. Cysts are mostly found incidentally, during endoscopy or imaging tests. Endoscopically, cysts are present as submucosal nodules with smooth walls, covered with normal mucosal membrane [10]. Under echoendoscopic examination, they appear as anechoic, homoechogenic lesions which may present divisions in the lumen and be located in any layer of the gastrointestinal tract, primarily in the second and third layers [9]. Doppler-endowed EUS reveals any absence of flow.

In the study group a single case of inflammatory polyp was found. It is a rare, non-neoplastic tumor originating in the submucosal membrane. Most frequently (50% of cases) located in the stomach, but may also be found in the small intestine, large intestine or, rarely, in the esophagus [11]. Histopathologically, it is a tumor with numerous blood vessels, inflammatory cells and eosinophils. Under endoscopic examination it appears as a submucosal nodule, often with ulceration on top. Usually it does not present any symptoms; however, due to its tendency to ulceration on the surface, bleeding may occur. Under EUS examination they are seen in the deep layers of the mucosa and submucosa, e.g. in the second and third layer of the gastrointestinal wall, without contact with the muscularis propria. They appear as hypoechogenic submucosal tumors. Due to the location and echostructure of the lesion under EUS, differentiation occurs with the mesenchymal tumor, neuroendocrine tumor, or leiomyoma.

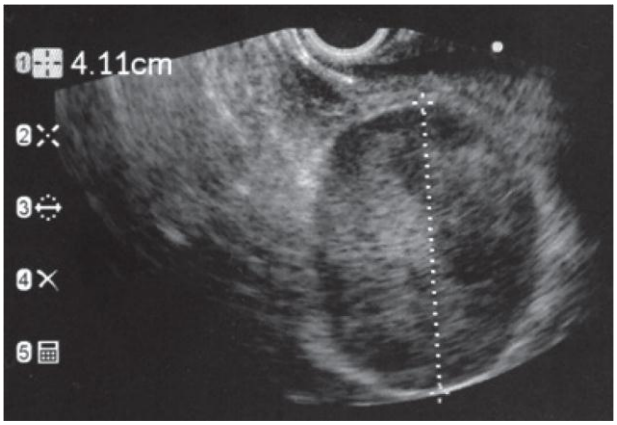

Figure 2. Gastric GIST in endosonography

Rycina 2. Obraz endosonograficzny GIST żołądka

Endoscopic or surgical removal of the lesion is recommended [12].

The most frequently found potentially malignant lesion in the study group was gastrointestinal stromal tumor (GIST), observed in 24 (21.6%) cases. This type of tumor is the most common mesenchymal gastrointestinal tumor. It probably originates from the "pacemaker" Cajal cell precursors. GISTs are primarily located in the gastrointestinal tract (approx. 90%), usually in the stomach (40-70%) and small intestine (20-50%). They constitute a heterogeneous group of lesions, from small, benign, incidentally diagnosed nodules without clinical symptoms to advanced metastatic lesions. Endoscopically, GIST is observed as a submucosal lesion covered with normal mucosal membrane. With large lesions, ulceration may occur on the surface [13]. In echoendoscopy, GIST is a hypoechogenic lesion, usually with a regular outline, well-defined. Most GISTs originate in the fourth layer, in single cases (mostly small lesions) in the second layer of the gastrointestinal tract (Fig. 2). Treatment of GIST is determined by the size and location of the lesion. Endoscopic procedures are used to remove lesions of up to 2 cm in size, located in the submucosal membrane [14, 15].

Of the malignant lesions in the study group, 2.7% were gastric cancers. Although the prevalence and mortality rates due to gastric neoplasms in Poland, as elsewhere in the world, continue to fall, they are still the highest rates in Europe. The development of gastric cancer is determined by environmental factors and specific genetic modifications, relevant for the growth of this neoplasm in younger patients, i.e. those less than 45 years old. The most common gastric neoplasm is adenocarcinoma [16]. Early forms of gastric cancer do not present any clinical symptoms, and are detected mostly incidentally. Gastric cancer diagnosis is based on endoscopic examination of the upper gastrointestinal tract, with specimen collection

for histological tests. Advanced gastric cancer in gastroscopic examination may be typical, i.e. in the form of an exophytic lesion with or without ulceration. There are also cancer forms with thickened and rough walls, as well as small flat lesions, either concave or convex. The intramural form *(linitis plastica)* may pose diagnostic difficulties, and remain unnoticed by the person performing the endoscopic examination. Early gastric cancer diagnosis requires a high quality examination technique, experience on the part of the doctor performing endoscopy, and suitable equipment. In each case endosonography needs to be performed, as it is characterized by higher diagnostic efficacy than other imaging examinations [17]. Echoendoscopic tests show cancer as a hypoechogenic structure with a rough outline, which may be located in any layer of the gastrointestinal tract, i.e. in the mucosa, submucosa, muscularis propria or serosa. Malignant lesions often infiltrate adjacent layers of the wall, and the layers become indistinguishable, or the whole gastrointestinal wall, invading the adjacent organs. Endosonography is crucial in the assessment of regional gastric lymph nodes, including perigastric nodes along the major and minor curvature, the nodes along the left gastric artery, common hepatic artery, splenic artery, coeliac trunk, and hepatoduodenal nodes [18, 19].

Another malignant lesion recognized in the study group was malignant lymphomas, occurring in 2.7% of cases. They are neoplasms of the lymphatic system, varying considerably in their clinical picture, disease dynamics, complication, response to treatment and prognosis. The most frequent form of lymphoma in European adult patients is large B cell lymphoma. Most lymphomas with extranodal manifestation occur in the gastrointestinal tract (4-18%). Over 80% of these are non-granular lymphomas originating from B lymphocytes. In this group the dominant ones are MALT lymphomas (lymphoma of mucosa associated lymphoid tissue) of limited malignancy, and highly malignant, diffuse large B-cell lymphomas (DLBCL). The next most common are mantle cell lymphomas, Burkitt lymphoma, and lymphomas in patients with immunodeficiency. In etiopathogenesis of gastric MALT lymphomas, infection is the key factor [20]. Over 90% of patients with this type of lymphoma are infected with *Helicobacter pylori.* The main diagnostic tool in case of lymphomas of the upper gastrointestinal tract is gastroscopy with specimen collection for histopathological examination. Under endoscopic presentation, lymphomas can take the form of uneven, thickened folds, ulcerations and polypoid lesions. In 80% of cases, histopathological diagnosis of gastric lymphoma may be determined on the basis of endoscopic biopsy. Endoscopic ultrasonography complements endoscopy in the diagnostics of thickened folds or polypoid lesions. It allows one to assess the advancement, i.e. the depth

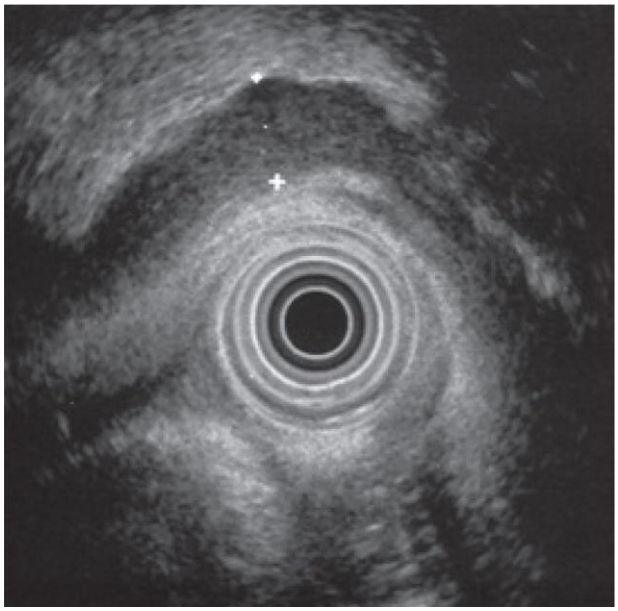

Figure 3. Gastric lymphoma in endosonography

Rycina 3. Chłoniak żołądka w badaniu endosonograficznym

of infiltration and invasion of the regional lymph nodes. Under EUS, lymphoma appears as a hypoechogenic lesion with a rough outline, involving several layers of the gastrointestinal wall, usually the second, third or fourth, and the layers become indistinguishable (Fig. 3) [21].

In this study, neuroendocrine tumors were found in 4.5% of cases. This neoplasm originates in the diffuse endocrine system (DES) dispersed in the gastrointestinal system. Gastric neuroendocrine tumors (NETs) account for approx. 1% of all the gastric neoplasms, and approximately 9% of all such tumors in the gastrointestinal system. Recently, the occurrence of these lesions in the stomach has been increasing, which may be partially due to increased detection as a result of the availability of endoscopic techniques. They rarely reveal an endocrine activity; therefore, typical carcinoid syndrome usually is not observed [22].

In endoscopic examination, neuroendocrine tumor presents as a polypoid lesion or round lesion, covered with a normal mucosal membrane, rarely with mucosal ulceration. Under echoendoscopy, NET presents as a hypoechogenic of isoechogenic lesion with a regular outline [23]. They originate from the second or third layer of the gastrointestinal wall. Under EUS, they typically demonstrate a "salt and pepper" structure [24].

In neuroendocrine tumors of the upper gastrointestinal tract, endoscopic treatment is the first-line therapy. It is indicated in patients with small (up to 10 mm) and few (up to 5) carcinoids. Other cases require surgical treatment.

Conclusions

Endosonographic examination plays a key role in the diagnostics of submucosal lesions in the upper gastrointestinal tract. In 35.1% (n = 39) of cases the presence of normal structures located outside of the gastrointestinal tract was confirmed, which allows one to renounce further diagnostics. In 33.3% (n = 37) of cases benign lesions were found, in which only endoscopic or echoendoscopic surveillance is recommended. The greatest diagnostic difficulty are flat lesions and thickened, rough gastric walls. The above pathologies require endosonographic examinations and extension of the diagnostic procedures by additional imaging tests. Whenever a flat lesion or thickened gastric wall is found, the presence of malignant process should be considered.

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Causes of pain and contusions in amateur long distance runners

Przyczyny dolegliwości bólowych i kontuzji u amatorów uprawiających biegi długodystansowe

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Abstract. The paper concerned both positive and negative results of amateur long distance running. The aim of the work was to evaluate the rate of pain and contusions as well as indicating their sources and possibilities for their prevention in amateur long distance runners. The study involved 100 randomly selected volunteers, aged 25–59 (female = 34, male = 66) involved in amateur long distance running. The author's own questionnaire was used as well as five functional tests to evaluate the motor functions of certain parts of the spine, as well as measurements of body mass, height and the girths of seven body parts. About 92% of the subjects declared pain and 53% serious contusions. The results of the functional tests showed essential motor limitations within the spine and contractions of many muscle groups, while girth measurements showed essential differences between right and left sides of the body. Despite the fact that amateur long distance running enables one to maintain proper body shape and body mass while improving chest mobility resulting in breathing comfort, too much training load and blind following of sports stars may result in pain and contusions. The competence of the professional trainer is to prevent contusions by applying the correct training load, regular stretching, and elimination of muscle misbalance and body asymmetry, with the recommendation of running on soft surfaces using the appropriate shoes.
Key words: contusion prevention, long distance running, pain

Streszczenie. Wstęp: Praca dotyczy pozytywnych i negatywnych skutków uprawiania biegów długodystansowych przez amatorów. Cel pracy: Celem pracy była ocena częstotliwości występowania, wskazanie przyczyn dolegliwości bólowych i kontuzji i możliwości zapobiegania im u amatorów biegających długie dystanse. Materiał i metody: W badaniach wzięło udział 100 dobranych losowo wolontariuszy w wieku 23–59 lat (kobiety n = 34, mężczyźni n = 66), którzy amatorsko uprawiają biegi długodystansowe. Zastosowano ankietę autorską, pięć testów funkcjonalnych w celu oceny ruchomości odcinkowej kręgosłupa oraz pomiary masy, wysokości oraz obwodów siedmiu części ciała. Wyniki: Aż 94% badanych deklaruje dolegliwości bólowe, a 53% odniesienie poważniejszej kontuzji. Wyniki testów funkcjonalnych wskazują na istotne ograniczenia ruchomości kręgosłupa oraz przykurcze wielu grup mięśniowych, a pomiary obwodów na istotne różnice między prawą a lewą stroną ciała. Wnioski: Mimo iż amatorskie uprawianie biegów długodystansowych pozwala zachować prawidłową sylwetkę, masę ciała i dużą ruchomość klatki piersiowej poprawiającą komfort oddychania, to stosowanie zbyt dużych obciążeń treningowych i bezkrytyczne naśladowanie mistrzów, może być istotną przyczyną występowania dolegliwości bólowych i kontuzji. Zapobieganie kontuzjom poprzez stosowanie odpowiednich obciążeń, regularne rozciąganie, likwidowanie dysbalansów mięśniowych i asymetrii ciała, zalecanie biegania po miękkich nawierzchniach i w odpowiednim obuwiu, leżą w kompetencjach dobrze przygotowanego trenera.
Słowa kluczowe: biegi długodystansowe, dolegliwości bólowe, zapobieganie kontuzjom

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Introduction

Athletic competitions involving distances of over 3,000 meters are referred to as long distance running. They constitute a very important element of training and verification in all kinds of armed forces. Recently, the number of people participating in street runs has been increasing considerably, also due to the large numbers of soldiers, often entire squads or platoons, who take part in the runs [1, 2]. Very popular are 5,000 and 10,000 meter events, which almost anyone can manage, as well as half-marathons and marathons, which are more difficult and require better preparation. For long distance runners there are ultramarathons, which can cover various distances, from 43 km to the popular 100 km, or even over 200 km. In Poland, 24-hour and 48-hour timed events have become famous and attract high attendances, and soldiers from special units often participate in them [1, 2]. The increased interest in running among people of various ages (often middle-aged persons and seniors) who find this form of physical activity interesting is of significant importance in maintaining health and well-being, and seems to be highly beneficial. The advantageous effect of this form of physical activity is in the prophylaxis of diseases of affluence (coronary disease, arterial hypertension, obesity, neuroses) [3]. Running is a simple activity which does not require any specialist equipment or resources, and those who practice long distance running regularly often become interested in other disciplines and complete their training with various forms of physical activity [4, 5].

However, running, as all sports, entails a risk of contusion. During a one kilometer run, each leg hits the ground approximately 500 times, with the force exceeding our body weight by three to six times [2]. Many amateurs do not realize that their approach to training is a matter of ambition; they lack proper preparation or basic knowledge about the training methodology. Running, which does not engage equally all body parts, may lead to disproportions in muscle structure and tension, and, consequently, to more or less significant changes in the structure of the feet and of the entire body. Moreover, the sedentary lifestyle of many amateur runners may increase the abnormal position of individual body segments and contribute to impaired muscle balance: contraction of the chest muscles, iliolumbar muscles, rectus femoris muscle, lower leg flexors, as well as weakening of the abdominal and gluteal muscles. Too intense training, which do not follow an individual plan complemented with stretching exercises, may be associated with an increased risk of contusions related to the impaired muscle balance mentioned above [6, 7]. Therefore, long distance running may have both positive and negative results, whose scope and significance is worth analyzing. The analysis of the potential in actions of a well-prepared trainer, which will help to prevent the negative aspects of running, seems to be of particular interest.

Aim of the study

The aim of the study is to assess frequency, to present causes of pain and contusions, as well as the possibilities of avoiding them by long distance amateur runners.

Material and methods

Characteristics of the study group

The study involved 100 volunteers (women = 34, men = 66), randomly selected, aged 23-59 years old (women 23-59 years, men 27-55 years), who are amateur long distance runners. The women were 164 cm ± 10 cm tall, the men were 178 cm ± 11 cm tall. The body weight of the women was 61 kg ± 4 kg, and the body weight of the men was 77 kg ± 6 kg. Average training experience of the subjects was 5 years, average number of training runs: 4 times per week, average distance covered weekly: 49 km. The majority of people (97%) run in shoes with amortization with only 3% uses footwear without amortization, while 88% of people run without special insoles. The most frequently reported other forms of physical activity included: exercising in a gym, swimming, riding a bike. Average number of kilometers run weekly on hard surfaces (asphalt, concrete, concrete pavers) is 22.5 km (48%), and on soft surfaces (forest paths, Tartan, gravel, running simulator) is 24.5 km (52%). The system of competitions in the study group throughout a year (in the distance function) is presented in the Figure. In compliance with the Declaration of Helsinki, the participants were informed about the purpose of the study, methodology of procedures, possibility to withdraw at any time, and they gave their written consent to participate in the tests.

Study methods

A diagnostic survey with the use of original questionnaire was conducted to obtain the following data: calendar age, sex, training experience and information regarding the training load, footwear used, type of biological renewal, as well as pain and contusions. The subjects underwent five function tests to assess spinal sectional mobility (Schober and Otto tests) and muscle tensions in the area of the pelvis and lower limbs (Thomas, Thomayer and Patrick tests) [8, 9].

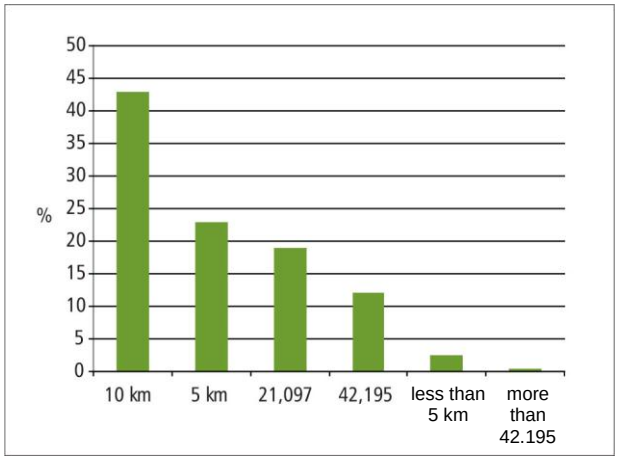

Figure. System of long distance runner competitions throughout a year

Rycina. Struktura startów biegaczy długodystansowych w ciągu roku

The Schober test evaluates the mobility of the lumbar spine. While the subject is in a standing position, the spinous process of the L5 vertebrae should be marked, and another mark should be made 10 cm above, along a vertical line. The subject is asked to bend deeply forward. In this position, the distance between the marks is measured again. Under normal conditions, the distance increases in adults to over 14.5 cm.

The Otto test evaluates the mobility of the thoracic spine. The spinous process of the C7 vertebrae and a point 30 cm below are used as reference points. Following a deep bend forward, under normal conditions the distance increases to 33 cm.

The Thomas test is used to detect contraction of the hip joint flexors, which is one of the most often occurring and affecting spinal curvature disorders to the largest extent. It increases anterior pelvic tilt and lumbar lordosis, as well as causes bending in the knee joints. The subject is put in a supine position, with one leg maximally bent at the hip joint, while the other leg, in case of contraction, is lifted above the supporting surface.

The Thomayer test is used to detect contraction of the hamstring muscles. The subject, in a standing position, bends his/her upper body forward, without bending the knee joints. If contraction occurs, the subject cannot touch the ground with his/her fingers.

The Patrick test allows one to assess contraction of the femoral adductors, as well as blocking of the sacro-iliac joints. The test is performed in a lying position. The test subject bends one leg at the hip joint and knee joint, and places the foot of the bent leg over the knee of the lying leg. Next, the patient extends the bent leg down. Contraction occurs if the subject cannot extend the bent leg to the ground.

To evaluate somatic characteristics, measurements of the weight, height and girths of seven body parts were used (chest, waist, hips, thigh, calf and forearm). The measurements were performed at rest and at maximum tension. Body weight measurements were conducted under fasting conditions, without clothing, at 7:00 a.m. Weight to height ratio was calculated (BMI). Anthropometric measurements were conducted following generally accepted principles [10, 11]. Girth measurements of individual body parts were made with the use of a tape divided in 1-millimeter divisions, and accuracy of 0.1 cm. The chest girth was measured during inspiration and expiration, at the breast level (between the mesosternale and thelion points). The thigh girths (left one and right one) were measured at the widest area of the thigh, below the gluteal fold, with straight shin and equal load on both limbs. The waist girth in men was measured at the navel level (the omphalion point), and in women following the WHO standards (half the distance between the lower edge of the rib cage and the upper edge of the hip bone). The hip girth was measured at the hip level (above the iliocristale points). The arm girth at rest was measured at the half of its length, between the shoulder process (acromion) and the elbow process (olecranion), with the limb straight along the body, and during tension the measurement was made around the widest area of the biceps, with the forearm flexed at the elbow joint. The calf girths (left one and right one) were measured at the widest area of the calf, with straight shin and equal load on both limbs. The right and left forearm girths were measured right below the elbow joint.

The percentage values were calculated, and Student's t-test was used for dependent groups ($p<0.05$). The significance of changes in individual repetitions was determined using the Wilcoxon test, and significance of changes depending on a group was determined by the Mann-Whitney test.

Results

With average training load of 49 km, as many as 95% of the study subjects reported experiencing pain, and 53% reported a serious contusion, although 95% of subjects also declared that they pursue other forms of physical activity apart from running.

Pain symptoms – the questionnaire allowed multiple answers regarding pain symptoms ever experienced by the subjects in relation to running. Most frequently reported were the following: knee pain (55.9%), Achilles tendon pain (35.3%), problems with plantar aponeurosis (35.3%), hip pain and foot corns (32.4%), pain symptoms in the anterior shin (26.5%), calf and lumbar spine pain (23.5%), sacral pain – below the lumbar spine (20.6%), problems with the ankle joint and the hamstring (17.6%), pain in the

anterior and posterior thigh (11.7%), pain in the cervical spine (8.8%), and problems with the quadriceps and pain in the hallux area (5.8%). The only pain symptom not observed in the study subjects was "problem with the thoracic spine". Only 5% of subjects did not report any pain symptoms.

Contusions – questions regarded contusions suffered since the beginning of the training. The following contusion were significantly often reported: knee joint contusion (23%), Achilles tendon contusion (14%), hip contusions (8%), and shin splints (medial tibial stress syndrome) (5%). Contusions of the femoral biceps, groin, sciatica and foot drop were also listed. 44% of the subjects did not suffer any contusions. Regarding biological renewal, a significant number of responses featured sauna (42%), as well as massage (38%). In single responses cryotherapy, procedures performed by osteopathic physicians, Jacuzzi and naps were mentioned. 16% of the subjects did not use any form of biological renewal.

The results of the function tests indicate a significant reduction in spinal mobility and contractions in multiple muscle groups. Distinctive limitation to normal mobility of the thoracic spine was found in 38% of the subjects (Otto test), and of the lumbar spine in 30% of the subjects (Schober test). Distinctive contraction in the hamstring muscles was observed in 12% of the subjects (Thomayer test), femoral adductor muscles contraction in 26%, and a significant difference between the left and right limb was found (Patrick test), bilateral contraction of the iliopsoas was observed in 65%, as well as absence of significant differences between the left side and the right side (Thomas test). Average body weight in men was 77 (± 6) kg, average BMI value was 24, and for women the values were 60 (± 4) kg and BMI of 22. Differences between the chest girth during inspiration and expiration (chest mobility) was significant, an average difference of 8.7 cm in men and 7 cm in women. Hip and waist girths did not deviate significantly from the WHO standards and mean values reported in the literature of the subject for average body height in both women (98 cm in the hips, 73 cm in the waist)and in men (98.7 cm in the hips, 88 cm in the waist) [10,11]. Girth measurements revealed significant differences between the right and left limbs. Regarding the lower limbs, the mean difference between the right and left tight in women was 0.6 cm, 1 cm in men, and the mean difference between the left and right calf in women was 0.5 cm, 0.6 cm in men. Regarding the upper limbs, the mean difference between the right and left arm in women was 0.2 cm, 0.3 cm in men, and the mean difference between the left and right forearm in women was 0.2 cm, 0.5 cm in men.

Discussion

The training load declared by the amateur runners (49 km per week) place them, according to the classification used in the literature, among intensively training runners (over 32 km per week). This may explain the percentage of injuries and pain symptoms, significantly higher (95%) than that reported by other authors (34-65%) [6, 7, 9]. Very often the cause of running-related injuries is training mismanagement: incorrect length (too long) and distance, frequency and intensity, as well as moving too suddenly to the next stages of the training macrocycle [6, 7]. Important elements also include warm-up, cooling down, stretching before and after training, biological renewal, complementation with other forms of activity, e.g. swimming, strength training, or even yoga, which support general fitness, relieving the muscle structures strained by running [5, 12]. However, practicing other forms of physical activity by 95% of the subjects did not protect them against pain symptoms and contusions. Similarly, standard forms of biological renewal (sauna 42%, massage 38%, other 4%), at such high training loads did not provide the desired regenerative effect, and probably should be deemed insufficient. In the literature of the subject also other individual risk factors for injuries are mentioned, such as age, sex, body build, running biomechanics, experience, susceptibility to contusions and former injuries, which often recur and cause new pain symptoms [12-14]. Other factors include the area where the training is conducted, surface, climate, time of day and footwear [6]. Regarding running surface, the study subjects do not indicate distinctive preferences (48% prefer hard surface, 52% prefer soft surface), although in case of contusion-inducing hard surface (asphalt, concrete pavers), using it was declared to be a necessity (participation in competitions, running to reach another type of surface). Selection of proper runner footwear is important, and 97% of subjects declared that they run in shoes with amortization, and change them as often as the manufacturer recommends. Shoes may be adapted to differences in length between the limbs, anatomic variations, functional changes or the foot size. They can also reduce the load in the areas of excessive pressure by changing the configuration of the sole middle layer (which provides amortization) and hardness of the heel. Most footwear manufacturers use three types of classification of runner shoes, which provide movement control to facilitate compensatory pronation control, support for the "normal" foot, and a bedding for a stiff, high-arched foot. If matching proper footwear for a given foot type is impossible, a special insole may be additionally ordered [6]. The number of factors does not allow one to determine precisely the reasons of such a high percentage of amateur runners suffering

from pain symptoms and contusions, apart from the high training load value, which, in our opinion, is the dominant factor. This cause becomes even more plausible considering that runners often adapt training recommended by former professionals, long distance runner champions such as J. Skarżyński, J. Daniels, or P. Greif [6, 7]. The programs are developed for amateurs; however, they are not individually adjusted and recommend covering long distances, as well as many "quality" training sessions, which heavily overload the musculoskeletal system [3, 6, 7]. The results of function tests indicate that the stretching exercises declared by 68% of the study subjects are more often a theoretical than actual element of training. The analysis of training records and the test results indicate increased tension of the pelvic area muscles in runners – gluteus or iliolumbar muscles (Thomas test 65%, Patrick test 26%) – and, additionally, a distinctive asymmetry of this tension, significantly associated with lumbar spine contusions. Only in the hamstring muscles group is the number of indications small, although distinctive (Thomayer test 12%), which may be due to popularity among runners and simplicity of exercises stretching these muscles.

Regarding the frequency of contusions and pain symptoms associated with long distance running, the studied group of amateur runners did not differ significantly from professional runners [13]. Knee joint injuries are the most common (23% of contusions and 63% of pain symptoms), and despite multiple possible causes, they were primarily due to muscular imbalance [6, 7]. Lateral femoral muscles are stronger and often contracted, the lateral head (vastus lateralis) of the femoral quadriceps and the tractus iliotiblialis whose fibers partially wrap the patella as lateral retinaculum, and pull the patella to the side, which results in abnormal load distribution. Patellofemoral joint dysfunction results in the reduction of the surface of adjacency to the femoral condyles by even 50% compared to the normal value. Such situation is often associated with increased pronation of the heel, increased external rotation of the shin, reduced internal rotation of the thigh, uneven load on the limbs, increased anterior pelvic tilt and pelvic rotation. To eliminate the problem, sometimes using special insoles is sufficient, regularly stretching certain muscle groups, particularly the tibial flexors in the knee joint and the rectus femoris of the femoral quadriceps, as well as learning proper tension of the femoral quadriceps or exercising femoral rotators [14]. This activities may be recommended and effectively implemented not only by a physiotherapist, but also by a well-qualified trainer [15].

Significantly frequent were problems with the Achilles tendon (35.3% of pain symptoms and 14% of contusions), as it bears a particular burden during running. The tendon is joined with the calcaneal tuber, thus all deformities of the heel may cause pathology in the Achilles tendon. Valgus heel (excessive pronation) causes absence of synchronization between the calf muscles; excessive tension of the vastus medalis and extension of the lateral head of the gastrocnemius. Similarly, instability of the ankle joint and frequent sprains force additional work of the tendon, and may contribute to microinjuries and inflammations [16]. A well-prepared trainer should be able to implement proper stretching exercises which prevent contraction of the calf muscles and disturbed tension in the myofascial lines, as well as regulate the resting time between training sessions, to enable proper regeneration of the movement apparatus [6, 7]. It is of particular importance when the season changes from winter to summer, and runners rapidly introduce excessive training load [17]. The risk of tendon injuries is significantly increased if we run on a hard surface [16]. All runners who have problems with Achilles tendon reported that they run of a hard surface (asphalt, concrete pavers, concrete). The majority of the subjects (58%) run over half of the weekly distance on a hard surface. One should also add the distance run during competitions covering various distances throughout the year. It may also affect pain symptoms associated with plantar aponeurosis (35.3%), which not only contributes to raising of the longitudinal arch, but also to rear foot supination. Plantar aponeurosis is an element in a chain of movement which transfers the forces generated by the tibial triceps and the Achilles tendon to the toes, where the block shifting the force direction is the calcaneus [17]. Frequently, plantar aponeurosis occurs in patients whose calf muscles are too tense, as well as the hamstring muscles or even the spinal reactors on the same side. In this case, it is the trainer's task to recommend regular stretching of the soleus and gastrocnemius muscles of the calf, the hamstring muscles, and introducing equivalent exercises (e.g. on a rehabilitation cushion). Other factors affecting problems with plantar aponeurosis may include: excessive pronation (the heel tilts inwards), uneven length of the limbs (excessive load on one limb), as well as concave foot (a foot with higher longitudinal arch and shorter distance between the calcaneal tuber and the heads of the metatarsal bones). Among the study subjects reporting this pain symptom, the concave foot or lightly high-arched foot occurred distinctively often (58%), which indicates an increased risk of the problem among long distance runners.

Significantly high occurrence ratio (32.4%) is also associated with hip pains related to incorrect muscle or tendon movements during frequent flexing and extending of the thigh [6]. Runners usually refer to it as "crunching" in the hips, and the problem may be caused by weakness or contraction of the iliopsoas. Trainers usually recommend strengthening this muscle group and extending the scope of movement,

which also reduces the risk of painful hip bursitis [18]. A pulling pain on the side of the thigh, from the knee to the hip, may indicate excessive tension of the iliotibial band, and its rubbing against the thigh elevation [6]. Sometimes incorrect positioning of the pelvis (its rotation) and asymmetrical contraction of the gluteal muscle increase tension of the fascia, which may even cause pain in the side of the knee. This may occur after the amount of training in mountainous areas has been increased (especially running upward), and as a result of increased training intensification. In such situations it is recommended to stretch regularly the gluteal muscles, tibial flexors in the knee joint, and even to visit a manual therapist who can relax the fascia [18]. *Shin splints* is the term used to describe pain in the anteromedial tibia surface, also referred to as medial tibial stress syndrome or overload of the posteromedial tibial surface, indicated by a significant number of runners (26.5% – pain, 5% – contusions) [19]. As a result of too high training load, inflammation may occur due to excessive pull of the muscles attached to the tibial periosteum. This enthesopathy (change in the attachments due to overload) usually results from incorrect foot biomechanics (excessive pronation or supination), using inadequate footwear or increasing the training volume too rapidly, as well as running on a hard surface (56% of the subjects complained about shin splints runs of hard surfaces), lack of elasticity in the tibial muscles, and reduced range of mobility in the ankle joint and its consequences. To protect their clients from recurring shin splints, trainers should first eliminate biomechanical causes, restore proper mobility of the ankle joint, correct training load, ensure proper elasticity of the tibial muscles (gastrocnemius and soleus) through regular stretching exercises and switching to a surface which provides adequate amortization [19].

A significant proportion of the subjects indicated back pain in the questionnaires (23.5% in the lumbar spine, 20.5% in the sacral spine, 44% in total). Back pain symptoms may have different causes, but the dominant ones among runners are: uneven, rotated position of the pelvis, blocked intervertebral joints in the lumbar and sacro-lumbar section, or contraction of the posterior femoral muscles and anterior iliac muscles [9]. Among those amateur runners who reported back pain symptoms, contraction of the iliopsoas (66%) and blocked intervertebral joints in the lumbar and sacro-lumbar section (40%) occurred. Moreover, active stabilization of the spine is provided by the following muscles: the multifidus, longissimus, iliocostalis, abdominis transversus muscles, as well as the pelvic floor muscles and the diaphragm [14, 15]. When the stabilizing muscles are weakened (runners do not pay sufficient attention to strengthening and stabilizing exercises), there is a high risk of stress transfer to other elements of the kinematic chain, and development of muscular imbalance. Back pain may also be cause by insufficient mobility of the thoracic and lumbar segments. A significant number of subjects reporting pain symptoms in the lumbar and sacro-lumbar spine demonstrated limited spinal mobility (Otto test and Schoberg test).

Calf pain was reported by 23.5% of runners. In case of placing high load on the toes and metatarsus, absence of proper warming-up or initial stretching of the tibial muscles, the soleus may become strained, or even "tennis leg" may occur, which sometimes requires 2-3 weeks of training break [1].

Pain symptoms in the ankle joint and the hamstring muscles were declared by a significant number of subjects (17.6%). Disturbed muscle force balance between femoral extensors and flexors in the hip joint may cause frequent contractions, pulling or even tearing of the femoral biceps, weakening of the muscles during eccentric work [20, 21]. To prevent pain symptoms from the posterior femoral muscles, this group of muscles should be strengthened, so that the balance between the force of the femoral quadriceps and biceps is not disturbed. This goal can be effectively obtained using a body building method of developing strength by building up (increasing) the muscle mass [4, 5, 15]. The trainer may also recommend stretching which may prevent contractions of this group of muscles, and properly modify the training by changing the running area. Body weight is an important element, often indicated as affecting the number of pain symptoms and contusion [8, 15]. The study subjects (men and women) did not differ significantly from the WHO standards regarding average body weight and BMI in adults, therefore, a distinctively high number of contusions and pain symptoms in this case cannot be associated with the body weight.

No significant changes in the hip and waist girths were found with relation to the common body shape standards, which argues for long distance running as a form of physical activity which does not result in deformation of the silhouette. Also, increased mobility of the chest improves respiratory comfort. Regarding lateralization of the body, the thigh and calf girth measurements, as well as the arm and forearm girth measurements indicate significant differences between right and left limbs. It can be assumed that due to distinctively larger girths, the right limbs are significantly stronger, which may contribute to asymmetry-induced pain symptoms and contusions. Elimination of the asymmetry may be undertaken by a trainer familiar with the methods of muscular strength development used in strength sports [4, 5, 15].

Conclusions

1. Long distance running may have both positive and negative effects regarding sectional spinal mobility

and muscle tensions in the pelvic area and in the lower limbs.

2. Amateur long distance running enables one to maintain proper silhouette, body weight and significant chest mobility, contributing to increased respiratory comfort.
3. Important causes of pain symptoms and contusions among long distance runners may include: excessive training load, indiscriminate following of champions, as well as absence of proper warming-up with elements of muscle stretching and ignoring stretching techniques after the training.
4. Contusions may be prevented by applying adequate loads and principles of training methodology, regular stretching, properly selected biological renewal procedures, elimination of muscular imbalance and body asymmetry, recommending running on soft surfaces and in proper footwear. All these actions are within the scope of competence of a well-prepared trainer.

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Foot structure in amateur long distance runners

Budowa stóp u amatorów uprawiających biegi długodystansowe

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Abstract. The paper concerned relations between long distance running and foot structure**.** The aim of study was to evaluate the foot structure of long distance runners, paying particular attention to the correctness of the arches. The study involved 134 (44 female, 90 male) randomly selected volunteers, aged 24–59 (female 24–59, male 27–58) involved in amateur long distance running. Plantocontourography was used to evaluate foot condition. The results were analyzed according to Clark`s and Weisflog's method, which evaluates longitudinal and transverse arches, and compared to model types of foot according to Bunak. A significant number of the subjects had the correct "W" Weislog`s index and were not inclined to flattened transverse arches. Compared to the population mean, long distance runners significantly more often have feet with correct or higher arches. Long distance running causes deformation of neither the lower longitudinal arches nor transverse arches. A significantly higher prevalence of correct and high arches occured in the long distance runners in comparison with the population mean, demonstrating that this type of activity can prevent lowering of the foot arches.
Key words: feet structure, foot arches, long distance running

Streszczenie. Wstęp: Praca dotyczy relacji między uprawianiem biegów długodystansowych a budową stóp. Cel pracy: Celem pracy jest ocena budowy stóp biegaczy długodystansowych w aspekcie prawidłowości ich wysklepienia. Materiał i metody: W badaniach wzięły udział 134 osoby (kobiety n = 44, mężczyźni n = 90) – dobrani losowo wolontariusze w wieku 24–59 lat (kobiety 24–59 lat, mężczyźni 27–58 lat), którzy amatorsko uprawiają biegi długodystansowe. Do oceny stanu stóp badanych biegaczy wykorzystano metodę plantokonturografii. Wyniki opracowano według sposobów Clarke'a i Wejsfloga oceniających wysklepienie podłużne i poprzeczne stopy oraz porównano z wzorcowymi typami stóp według Bunaka. Wyniki: Znamienna liczba badanych posiada prawidłowy wskaźnik „W" Wejsfloga i nie wykazuje tendencji do spłaszczenia łuku poprzecznego stopy. W stosunku do średniej populacyjnej, u biegaczy występują istotnie częściej stopy o prawidłowym i podwyższonym wysklepieniu. Wnioski: Biegi długodystansowe nie powodują obniżenia wysklepienia podłużnego stóp oraz nie powodują zniekształcenia poprzecznego łuku stopy. Występowanie wśród biegaczy długodystansowych typów stopy prawidłowej i o podwyższonym łuku znamiennie częściej od średniej populacyjnej wskazuje, iż ten rodzaj aktywności może zapobiegać obniżaniu się łuków stopy.
Słowa kluczowe: biegi długodystansowe, budowa stopy, łuki stopy

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Introduction

The foot is the medium through which the body comes into contact with the ground, for which reason it plays a vital role in the process of human locomotion [1,2]. The appropriate structure and agility of the foot significantly affect both the motor skills, which are essential in our daily lives, and the way we practice most sports [3,4]. The structure of the feet is dependent on their morphology and, in particular, on appropriate formation of the longitudinal and transverse arches. The foot plays the role of shock absorber to safeguard the internal organs and the nervous system against micro-damage sustained during movement [5,6]. The arching of the foot is genetically predetermined, but can also be conditioned environmentally [5]. The most important factors which can be both beneficial and destructive for the foot are body weight, the nature of the ground surface with which the foot comes into contact, as well as the footwear type and the workout intensity [4,6]. During training for long-distance running the feet are subjected to regularly applied pressure, which may result in an overload leading to the formation of

numerous micro-damages [7]. Many sportsmen lack the opportunity to run on natural ground surfaces and most of the distance that they cover is on concrete, asphalt or paving bricks. The same applies to soldiers, who in addition need to be prepared to run in the most extreme of conditions using footwear which falls short of the physiological requirements of the foot. Additionally, for most competitions the courses are either in their entirety or partially run on hard surfaces (asphalt or concrete) [6]. Abnormalities in the foot structure may lead to injuries of other body parts, hinder runners from training or taking part in competitions, and until recently were a reason for candidates to be deemed unfit for military service. Numerous scientific reports confirm that long-distance running may have both positive and negative impacts, but their extent and significance are not unanimously interpreted [8,9]. It appears valid to verify whether amateur long-distance running causes adverse changes in the osseous and ligamentous system within the foot and contributes to its degeneration, or whether it should be recommended as a means of ensuring its correct development.

Aim of the study

The aim of the study was the assessment of the foot structure in long-distance runners in terms of correct arching of the foot.

Material and methods

Characteristics of the study group

The study comprised 134 randomly selected, volunteer amateur long-distance runners (women n = 44, men n = 90), aged 24-59 (women 24-59, men 27-58 years of age), who expressed their approval in writing before participating in the study. Body height of the women was: 162 cm ±8 cm, and men: 176 cm ±10 cm. Body weight of the women was: 63 kg ±5 kg, and men: 78 kg ±7 kg. The average training experience was 5 years, the group's average number of training sessions amounted to 4 times a week, and the average distance covered weekly was 47 km. A total of 99% used shock absorbing footwear, with only 1% choosing shoes without it; 80% used footwear without special shoe insoles. Other forms of physical activity that the participants listed were gym and stretching exercises, cycling, swimming and yoga (Surya Namaskara). The average distance covered on hard surfaces (asphalt, concrete, paving bricks) amounted to 21 km (47%), and on soft surfaces (forest paths, tartan tracks, gravel roads, treadmills) to 25 km (53%).

Pursuant to the guidelines of the Declaration of Helsinki the participants were informed of the purpose of the study, methodology of proceedings, possibility to withdraw from the study at any stage of its performance, and expressed their consent for participation in the study in writing.

Test Procedures

A questionnaire survey method was used to obtain personal information such as age, sex, training experience, as well as the information regarding training intensity, footwear and biological regeneration.

The condition of the feet in the runners was assessed by means of the **plantocontourography** method. The method consists in an analysis based on numbers and graphics, made with the use of specially prepared footprints. It constitutes a valuable auxiliary examination and a method of graphic documentation, which enables a more accurate interpretation of the chain of morphological changes to the sole of the foot, not only in a qualitative but also in a quantitative manner. It also enables documenting and interpreting of the entire array of foot deformations [2,10].

In order to obtain a copy of the print, the participants dipped their feet in paint and set them on A4-sized white pieces of paper placed next to each other. Each of the participants were put through two tests, with and without load respectively. The first print was taken from a sitting and the second from a standing position [3,2,11]. The obtained footprints were prepared by Clarke's and Weissflog's methods, which enabled an assessment of the longitudinal and transverse arching of the foot [2]. Clarke's angle was measured with an accuracy of 1º and defined by drawing a line (BC) which connected point B, created where the forefoot adjoins with the internal tangent (b), and point C, which was determined by moving a gauge along the surface of the tarsus towards the metatarsus, until it touched the internal tarsal sinus. The BC line along with the internal tangent (b) together form Clarke's angle (fig. 1). The norms for Clarke's angle are distributed respectively as follows: normal foot 42– 54º, foot with a high arch >55º, foot with a fallen arch 31–41º, flat foot <30º.

The Weissflog index 'W' was measured with the accuracy of 0.5 cm and calculated according to the equation W = S/P, where S is the length of the foot and P its width. The ideal value of the Weissflog index for a foot in terms of transverse arching is 3. The finding of such a value, however, is rare. The 'W' index usually ranges between 2 and 3. Values nearer 2 are indicative of transverse platypodia, whereas values nearing 3 are indicative of correct transverse arching of the foot [10,11].

The footprints have also been compared with model foot types according to Bunak on a scale from 1 (a foot with excessive arching) to 10 (a flat foot) (fig. 2).

In order to assess the significance of differences between models, nomograms and the

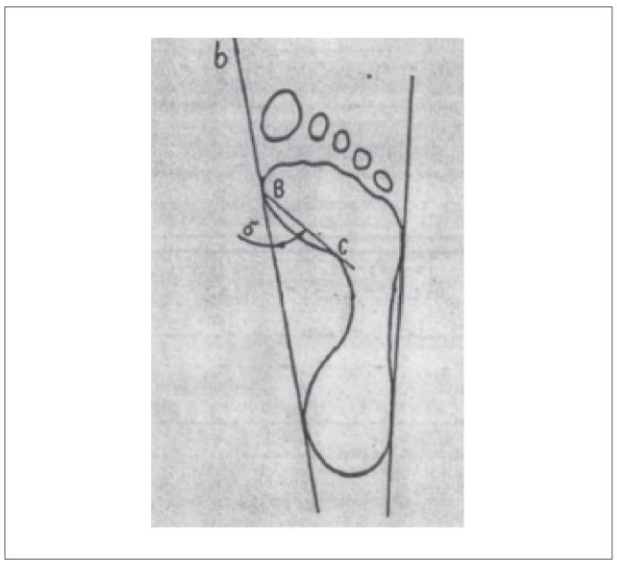


Figure 1. Clarke's angle defining method [9]

Rycina 1. Sposób wyznaczania kąta Clarke'a [9]

Figure 2. Footprints according to Bunak [10]

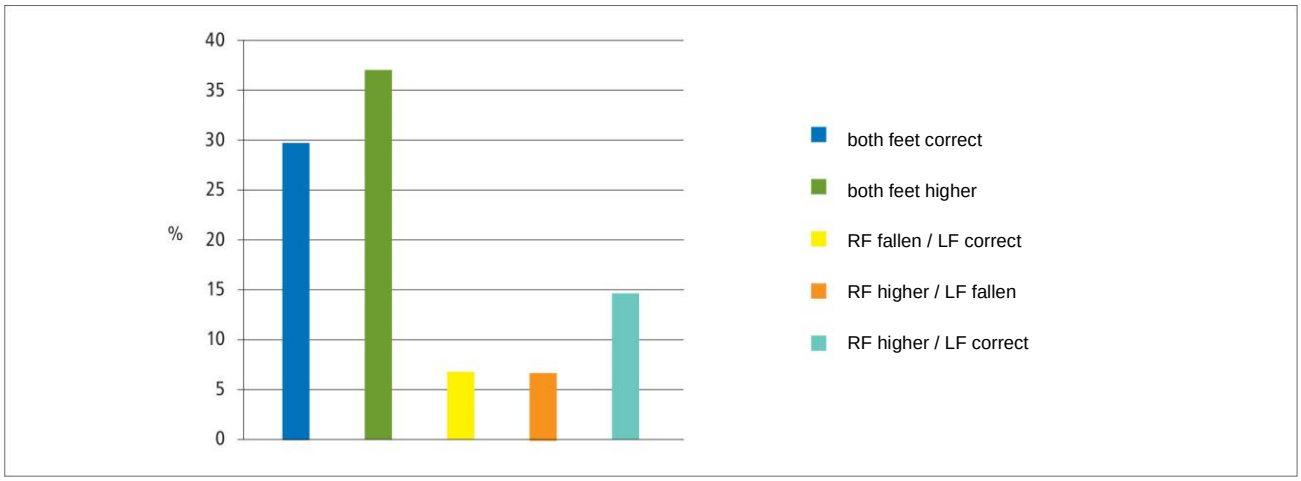
Rycina 2. Odbitki stóp według Bunaka [10]

plantocontourography results, a Student's *t*-test ($p < 0.05$) was used.

Results

After Clarke's angle has been defined, the participants' feet were categorized as either feet with correct arching, or feet with a higher arching (fig 3–6). Differences in the arching angle between the left and right feet, both with and without load, proved to be negligible. A flat foot did not occur among the women and the frequency of a fallen arch occurrence was statistically negligible. When no load was applied to the left or right foot of a woman, the arching was either correct or the longitudinal arch was higher. No significant changes were recorded when load was applied.

The occurrence of a foot with a correct or higher arch was significant among the men. A flat foot affected 3 % of the men, both with and without load; however, after the load had been applied, the flat feet "became higher" and met the criteria of feet with a fallen arch (6%). A foot with a fallen arch had a significantly higher frequency of occurrence among



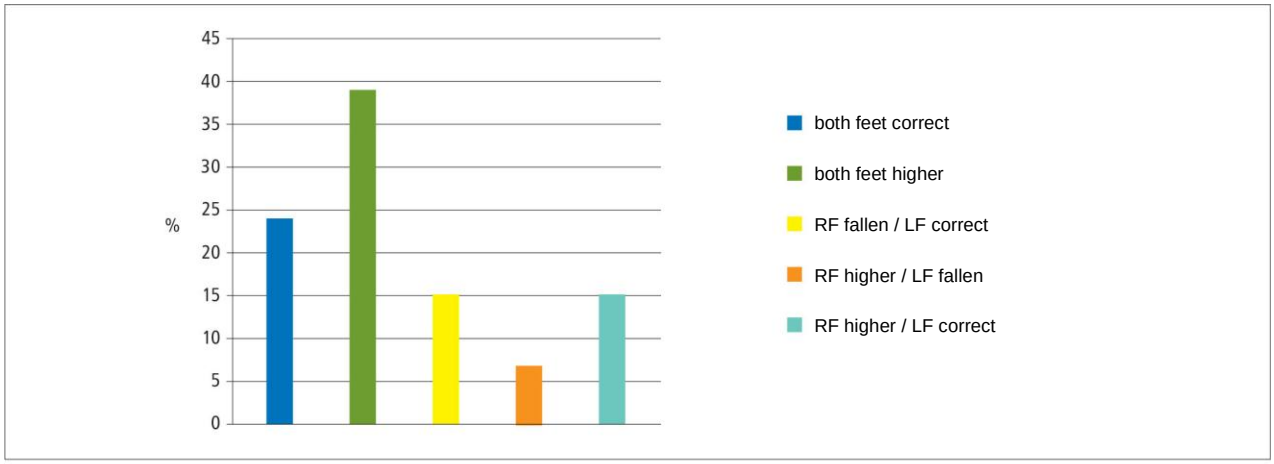


Figure 4. Female foot arches with load

Rycina 4. Wysklepienie stóp kobiet w warunkach dociążenia

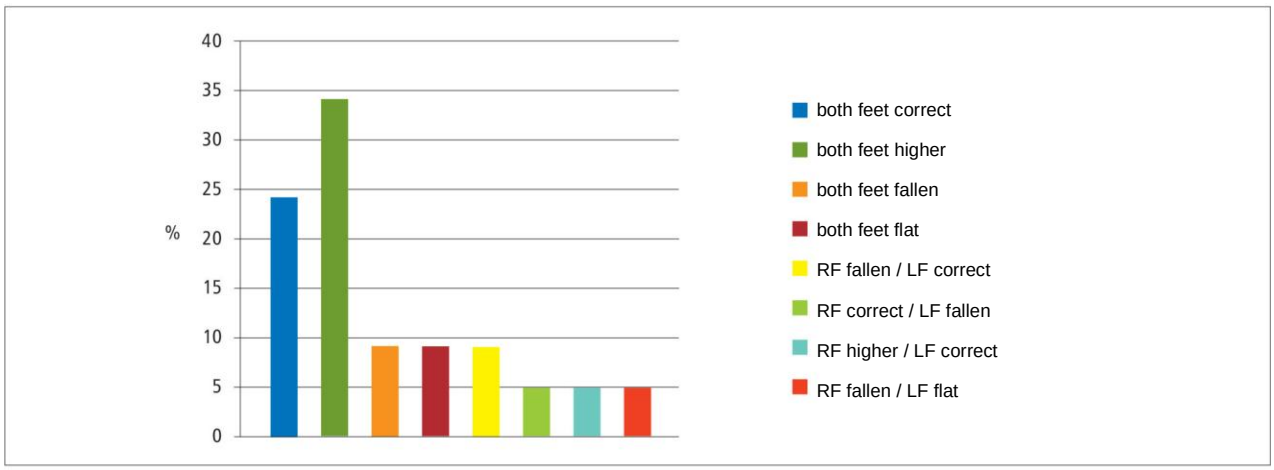


Figure 5. Male foot arches without load

Rycina 5. Wysklepienie stóp mężczyzn w warunkach odciążenia

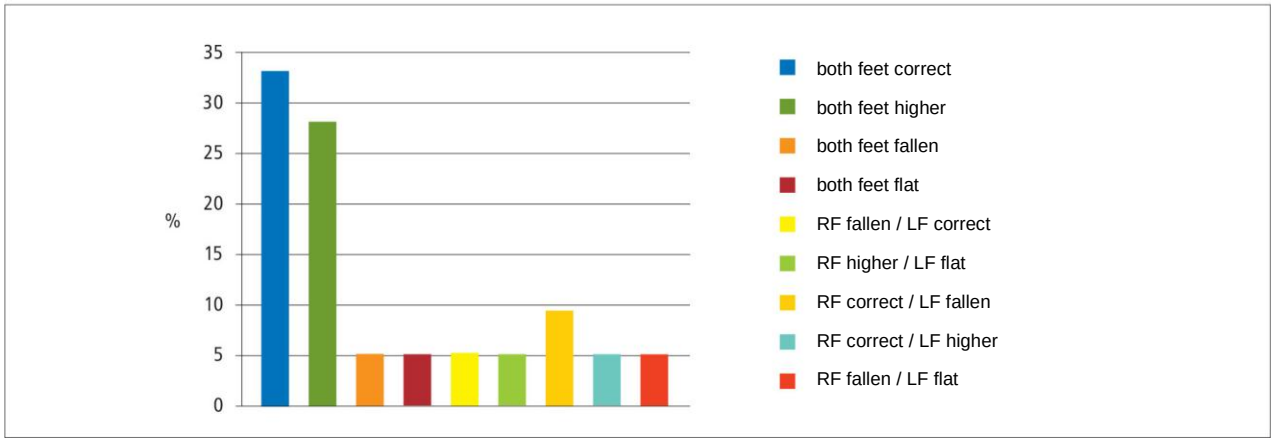


Figure 6. Male foot arches with load

Rycina 6. Wysklepienie stóp mężczyzn w warunkach dociążenia

the men than the women, and the longitudinal arch under load was not significantly lowered either in the right or the left foot. In relation to the population mean, both in men and women, with and without load, the differences in the frequency of correct and higher arch types are significantly in favor of the participants.

When compared to the footprints according to Bunak, types 4 and 2 were prevalent among the women, and type 4 among the men (feet with correct and higher arch). Significant differences (within correct types) between the prints of the left and the right foot occurred in 54% of the women and 43% of the men.

The Weissflog 'W' index, which is used for determining the tendency for transverse platypodia was less than 2.5 in 17% of the women and 19% of the men. The lowest value of the index was 2.2 in the men and 2.3 in the women, which indicated no transverse platypodia in runners of either sex. The differences in index values between the left and the right foot were negligible. The body weight of the women was 63 kg ±5 kg with a BMI of 23, and the men was 78 kg ±7 kg, with an average BMI of 23 as well.

Discussion

The value of the Weissflog 'W' index is correct for the vast majority of the participants, which means there is no indication of a tendency for a flattened transverse foot arch, regardless of the considerable load applied to the forefoot during long-distance running sessions. Having studied weightlifters, track and field athletes and a control group, Kurnikiewicz-Witczak and Furman noted the proportion of feet featuring a fallen arch to be the highest in the control group. The results were justified by the selection and the functional adaptation of the foot to the demands of sports. The greatest proportion of feet having correct and higher arches was found among weightlifters, followed by track and field athletes [12]. Apparently, as the physical training intensifies, all the elements in the foot become strengthened due to the higher intensity of physiological stimuli. An increased foot capacity is conducive even to very high-intensity training sessions [13,14]. However, it is imperative that runners are provided with appropriate training conditions, biological regeneration and proper footwear [12]. During frequent training sessions, the muscles that take part in maintaining the correct arching of the foot are understood to be subjected to intense load, and so they adapt accordingly [6]. Hence there were no cases of flat or low-arched feet in the studied group, but significantly frequent instances of high arched feet. Moreover, in relation to the population mean, both in men and women, with and without load, significant differences occurred in the condition of feet in the case of correct and higher arch types. It would appear to be an additional argument in favor of regarding long-distance running as a precautionary measure against the lowering of foot arches. Body weight is frequently indicated as a significant factor affecting irregularities in the arching of the foot [14,15]. The participants in the study (both men and women) did not fall short of the BMI norms defined by WHO regarding average body weight for adults, therefore no possible changes in the arching of the foot could be linked to improper value of body mass.

Conclusions

1. No lowering of the longitudinal arch of the foot, nor deformations of the transverse arch of the foot were observed among the amateur long-distance runners.
2. A more frequent occurrence of correct and higher foot arch types among long-distance runners than in the general population may indicate that this type of activity prevents the lowering of the foot arches.

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Royal Air Force aeromedical evacuation in Western Europe campaign, 1944–1945

Medyczna ewakuacja lotnicza Królewskich Sił Powietrznych w kampanii w Europie Zachodniej 1944–1945

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Abstract. Large scale aeromedical evacuation was one of the greatest achievement of allied combat medicine during World War II. Although the idea of transporting combat casualties by aircraft was not new, the Western Allies created a significant system of unprecedented magnitude. This system was at its most efficient during the Western Europe campaign, which began on 6 June 1944 with the Allied landing in Normandy. British Transport Command and American IX Troop Carrier Command were mainly responsible for the air medical evacuation of the Allied soldiers from the forward areas to hospitals in Great Britain. In this article, the authors focused on the activities of the Royal Air Force, presenting the organization of air evacuation, discussing the contemporary clinical management standards and those of patient care during the flights, as well as presenting statistical data concerning RAF air evacuation in Western Europe in the years 1944–1945.
Key words: aeromedical evacuation, Royal Air Force, World War II

Streszczenie. Wprowadzenie masowej ewakuacji lotniczej było jednym z największych osiągnięć alianckiej medycyny wojskowej w okresie II wojny światowej. Choć idea transportu rannych i chorych za pomocą samolotu nie była już wtedy nowa, zachodni alianci stworzyli doskonały system o niespotykanej dotychczas skali. Był on najbardziej wydajny podczas rozpoczętej 6 czerwca 1944 r. lądowaniem w Normandii kampanii w Europie Zachodniej. Lotnicza ewakuacja alianckich żołnierzy ze strefy przyfrontowej do znajdujących się na terenie Wielkiej Brytanii szpitali spoczywała głównie na barkach brytyjskiego Transport Command oraz amerykańskiego IX Troop Carrier Command. W poniższym artykule autorzy skupili się na działaniach Królewskich Sił Powietrznych, przedstawiając organizację ewakuacji lotniczej, omawiając ówczesne standardy postępowania klinicznego i opieki nad pacjentem podczas lotu oraz prezentując dane statystyczne dotyczące ewakuacji lotniczej prowadzonej przez RAF na froncie w Europie Zachodniej w latach 1944–1945.
Słowa kluczowe: ewakuacja lotnicza, II wojna światowa, Królewskie Siły Powietrzne

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Introduction

It was a grey morning, at 05:00 hours on 13 June 1944. Three Douglas Dakota Mk. III aircraft belonging to one of the divisions of the RAF Transport Command took off from a runway in southern England and headed to the coast of France. On board of each of them was a female nurse from the Women's Auxiliary Air Force (WAAF). Roughly at 07:00 hours the planes landed at an airfield prepared by the bulldozers of the Royal Engineers. The roar of artillery could be heard in the distance and smoke from numerous fires billowed on the horizon. Only a few days before, the area had been occupied by Germans. Those who were only slightly wounded were carried on board the first of the Dakotas. They were able to board the aircraft themselves and managed to travel in a seated position. Corporal Lydia Alford looked after them while they were on board. The plane took off as planned. The other two aircraft were to take the more heavily wounded. However, the loading of the stretchers was delayed and the line of

clouds became dangerously low. The wind picked up too. Eventually, the flight was cancelled. Edna Birkbeck and Myra Roberts had to remain near the front lines. The two nurses in RAF field uniforms and Red Cross armbands in a male-dominated milieu quickly attracted the attention of war reporters. The news of "the first women on Normandy soil" spread rapidly through the British media, most notably the BBC. In the meantime, the plane with the wounded soldiers and their guardian, Corporal Alford, was approaching the coast of England. They were the first combat casualties on the Western European front[1] to be transported by air with the aid of the RAF. It was then, on the seventh day following the launch of Operation Overlord and D-Day, that the most complex medical emergency evacuation ever commenced [1].

The following article presents an outline of the RAF activities during military operations in Europe that began on 6 June 1944.

Road to Normandy

When the allied forces landed in Normandy, the idea of aeromedical evacuation of combat casualties was not new. The idea of transporting patients by aircraft is thought to have originated as early as in 1910 [2]. However, it was not until a few years later, during World War I, that the first successful attempts to assign aircraft to this role took place. The first evacuation of the wounded was effected by the British in 1920; the "Z" Force sent against the Dervish rebellion led by Mohammed Abdullah Hassan had a DH 9 aircraft available, which was modified to carry one stretcher [3]. An operation on a large scale occurred with the use of British air forces in 1923, when a British regiment operating in Kurdistan was decimated by dysentery. 198 patients were then transported from the base in Rowanduz in present-day Iraq to Kirkuk and further on to Baghdad. Had it not been for aviation, the fate of many of them would have been sealed [3]. The Near East became a training ground for the RAF to develop the technique of aeromedical evacuation. Vast desert spaces, large distances between garrisons, poor road infrastructure and shortage of hospitals were conditions meaning aerial transportation was the last resort for the wounded and the sick.

In the interwar period the British were able to modify a number of planes to transport patients: the Vickers Vimy bomber from the First World War period, and the subsequent Vickers Vernon and Vickers Victoria transport planes, or the rounded Vickers Valentia introduced in the mid-1930s. The beautiful DH 86 and DH 89 of the de Havilland and the Airspeed Oxford, released shortly before the war broke out, were also fit for stretcher transport [4].

The system of aeromedical evacuation discussed in the following chapters was developed by the British during the period of warfare in North Africa in 1941-1943. At the beginning of the desert operations the Commonwealth armies experienced major difficulties with aeromedical evacuation. The situation was remedied by the appearance of the Australian No. 1 Air Ambulance Unit, which used DH 86 aircraft. The aircraft carried both Royal Australian Air Force markings and Red Cross markings on the fuselage. Although ambulance aircraft of the South African Air Force were also used, it was soon realized that the units destined for aeromedical evacuation of combat casualties were not sufficient for the purpose. There were too many wounded to carry and the distances were far too large for the aircraft to cover. Evacuation was then added to the task of transport divisions, using the Bristol Bombay and Lockheed Hudson. When heading for the front, these aircraft would carry supplies, munitions and medicines. On their way back they would carry the wounded. Evacuation was greatly facilitated by this strategy, but it also entailed new organizational improvements. In the system in its present form the aircraft could not wait on the ground for the wounded to arrive at the airfield. The wounded had to be ready for the aircraft. In order to make this possible, the hospital infrastructure was developed around the airfields. The RAF had its own Mobile Field Hospitals, which formed holding units to prepare the injured for evacuation. The field hospitals soon extended to centers of aerial evacuation with transfusion units and a blood bank. However, as RAF hospitals became engaged in work at these airfields, a problem occurred. The injured were most commonly picked up from those airfields nearest the front, where the combat divisions also operated. In the case of an attack, the hospitals might be within bombing reach of a hostile air force. However, they could not take refuge under Red Cross flags. Large white sheets would certainly have attracted the attention of enemy reconnaissance aircraft pilots and provoked attacks on the neighboring facilities. The transport planes which took part in aeromedical transport also carried munitions and supplies. For this reason they could not bear Red Cross marks either [5,6]. Over time it transpired that this commonly respected sign of "immunity" did not protect aircraft that carried the injured – in Africa, one of the Australian DH 89s was brought down by aircraft of the Luftwaffe [5].

[1] The Western European Front is considered to include all the military operations of the allied forces commencing with the landings in Normandy on the 6 June 1944. Although military operations by the allied forces had started earlier in Italy, in 1943, they are regarded to be part of the Mediterranean Front.

Near the front

The Polish translation of the "Royal Army Medical Corps Training Pamphlet No.2" of 1943 states: *The air force bears the responsibility of providing all necessary medical treatment to all the injured and the sick from the moment of their arrival at the airfield until they are discharged at the point of their destination. The military authorities are thus obliged to ensure that the injured be delivered to the appropriate airfield in due time and in compliance with the directives on aeromedical evacuation. However, as a rule, the air forces appoint a medical unit deployed at the airport for the purpose of accommodating the wounded and the sick that have been sent until the arrival of the aircraft to carry them to the base. In certain cases, airborne medical service units may be replaced by military medical service units* [7]. It was according to this general principle that aeromedical evacuation was organized in the British Army during the Western European campaign (fig. 1). Although the smooth operation of the aeromedical evacuation system was ensured by both the ground forces and the Royal Air Force, it was the medical services of the latter that had to bear the brunt of the operations.

After having been provisionally treated in field conditions at the unit level (brigade or division), the injured were taken to Casualty Clearing Stations (CCS). Those injured who required immediate surgical operation were first directed to a forward surgical team. The 200-bed CCSs were often clustered together. Along with field surgical units, transfusion

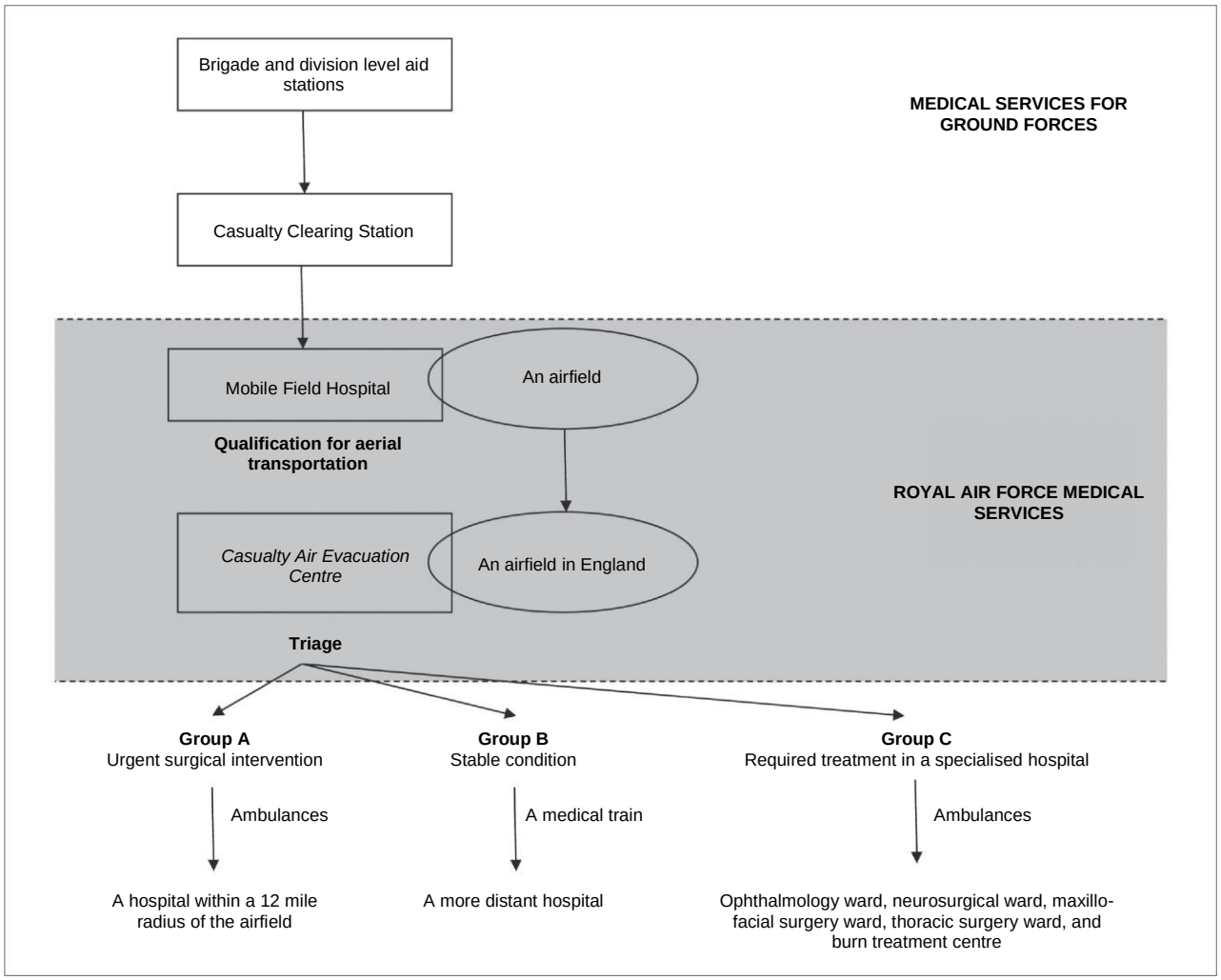


Figure 1. Simplified diagram of RAF aeromedical evacuation in Western Europe 1944–1945 (own work)

Rycina 1. Uproszczony schemat medycznej ewakuacji lotniczej stosowany w Armii Brytyjskiej podczas działań w Europie Zachodniej 1944–1945 (oprac. własne)

units and major military hospitals they comprised hospital centers to the rear of the front. The first center of this kind during the Western campaign was located near Bayeux in Normandy. However, the possibilities for treatment, even in a large hospital center, were restricted. Some of the patients were in need of specialist neurological, thoracic or maxillo-facial surgery. Such surgery could not always be performed in the centers. The hospitals were constantly at full readiness to admit another batch of wounded combatants. However, the number of patients who were treatable at a particular time was restricted to the number of beds and staff. The injured and the sick could only be temporarily provided with medical care in the field hospitals. They were then in need of evacuation. By principle, the slightly injured could stay in the field hospitals longer. Those patients with little chance of recovering within a month had to be sent to the rear positions. This time was reduced to two weeks during the Normandy campaign [9].

Motorcades of ambulances carried the injured from the field hospitals to the vicinity of airfields where the RAF Mobile Field Hospitals (MFH) were deployed. The first unit of this kind ever to be deployed on the continent was the 50th RAF MFH under the command of Wing Commander L.L. Ingram. His forward surgical team arrived in Normandy during the afternoon of D-Day [10,11]. Each MFH was prepared to simultaneously care for 70 patients who were waiting to be transported back to Great Britain. The arrival of aircraft could be delayed, so the hospital had to be prepared for diagnosis and treatment. This is the reason why, apart from the emergency room and the bed unit, they also had an x-ray unit and an operating theatre with a surgical team. The MFH also included a dental team with a mobile dental surgery installed on a truck [11].

The aircraft

In June 1941 the aeromedical evacuation unit began operational flights within the structures of No. 24 Squadron, RAF. It operated from Hendon airfield, which nowadays is situated in the outskirts of London. In the beginning it employed 7 aircraft, including the de Havilland DH 89. Each one of them had RAF as well as Red Cross markings. They were true flying ambulances. Each could carry four patients positioned horizontally. On board was additional oxygen and lighting, while the doctor and the nurse had a set of basic medical instruments [4,12]. The experience of warfare in Africa proved that, financially and logistically, it was impossible to provide an effective system of aeromedical evacuation based only on specialized units of this type. Therefore it was the Douglas Dakota aircraft of the Transport Command squadrons that had to bear the brunt of aeromedical transport in Western Europe.

The twin engine C 47 Skytrain was a military version of the DC-3, suitable for cargo and passenger flights and which entered production in 1935. It was manufactured by the Douglas Aircraft Company, based in America. The British named it the Douglas Dakota. Subsequent British versions were known as Dakota Mk.I-Mk. IV. The first aircraft of this type joined RAF service in 1940. They were ideal for transportation and airdrop operations. The spacious fuselage could hold 28 paratroopers or 3.5 tons of cargo, accessible through a wide cargo door [13].

The RAF used the Dakotas for aeromedical transport of the injured for the first time in warfare in North Africa during late 1942 / early 1943, superseding the obsolete Bristol Bombay aircraft. However, a problem was encountered at a very early stage. Namely, the stretcher racks that were mounted inside the planes were suitable only for American stretchers. These in turn were not suitable for the mountings installed in British ambulances. The matter was resolved by two doctors, Group Captain C.J.S. O'Malley of the RAF and a USAAF surgical consultant, Major Randolph Lovelace, who was a representative of the Office of the Air Surgeon General. Both agreed that a pair of stretchers needed to be sent to the USA to act as a model for the next stretcher racks. The problem was resolved, and during the invasion of Sicily in July 1943 the RAF Dakotas successfully evacuated patients to hospitals in Africa [14].

During the invasions on the continent, the Dakotas used to evacuate combat casualties did not have Red Cross markings. They were not allowed to. Officially, their main task was to transport supplies and paratroopers as well as towing military gliders. Their fuselage and wings had black and white stripes, which were used for quick identification of most aircraft that took part in Operation Overlord. However, when the allied forces almost entirely dominated the skies, it brought with it no threat whatsoever for the injured. The ubiquitous Spitfire, Mustang and Thunderbolt fighters provided the required security.

A Dakota could carry 18 stretchers or 25-35 seated injured soldiers on board [15].

Airborne personnel

Each Dakota had a crew of four: pilot, co-pilot, navigator and radio operator. On the other hand, the injured were looked after by a WAAF nurse or an RAF medic, otherwise known as *nursing orderlies* (fig. 2). Contrary to the *fight nurses* of the American Army Nurse Corps who flew on USAAF aircraft, the WAAF nurses were not qualified nurses [16]. They merely underwent a short training on how to care and provide for the injured, which included the basics of aeromedicine, issues concerning care for the injured, as well as wound dressing and injection techniques

[15,16]. As a matter of fact, the RAF had within its structures a nursing service, the Princess Mary's Royal Air Force Service (PMR AFN); however, its staff served mainly in hospitals [17].

While in flight the nurses wore battleship-grey uniforms (*battledress),* the likes of which were worn by all members of the Royal Air Force. A pinned caduceus on the collar was a symbol of the RAF medical service. On colder days a fur lined leather jacket, known as an Irvin flying jacket, was indispensable, together with high boots. Like the rest of the crew they had to wear life vests ("Mae Wests"), complete with a parachute harness. [17].

Clinical aspects of aeromedical evacuation

The wide scale use of aircraft to evacuate the injured had two basic advantages. Firstly, they enable the field hospitals to be "drained" of patients to make room to admit new patients. Secondly, they gave hope to those of the injured who required urgent treatment in specialist centers.

However, the possibility of treatment on an aircraft was limited. Twenty patients were transported with only one nurse or medic to take care of them, on an aircraft that was not really suitable for transporting the injured. The key decision for the doctor before each flight was to clearly define which of the patients were fit for travel and which should remain behind. It was beyond any doubt that those patients who were clinically unstable, especially those in shock, were not suitable for evacuation. Before diagnostic tests and a possible surgical procedure at the CCS level, those patients with chest or abdominal cavity injuries could not be evacuated either. The soonest possible date for aerial transport for these was 5 days after the procedure. Patients with gas gangrene were not evacuated before a surgical procedure either. Nor were patients in need of immediate surgery within the abdominal cavity - for appendicitis, gastrointestinal perforation, etc. Another contraindication for aeromedical transportation was meningitis. Victims of gas attack had to be thoroughly decontaminated before they were allowed on board. Fortunately, the latter case never took place during the Second World War. Patients with lung and heart diseases were also vulnerable to high altitudes. According to Squadron Leader J. Thompson, they should not be transported at an altitude higher than 1000 feet (300m). In emergencies, an oxygen supply needed to be considered. Patients with pleural empyema after drainage, as well as patients with tuberculosis (with no anemia or hemoptysis) were fit for aeromedical transport at an altitude of no higher than 5000 feet [16]. So which patients could be evacuated by air? Wounds within the cranium and the facial skeleton had priority over others, as they were difficult to treat in field conditions. Patients with burns had to be evacuated within 48 hours, unless they were in shock. Penetrating injuries to the eyeball were also among the priorities. Patients with injuries to extremities, broken pelvis or backbone, or infectious diarrhea could be transported by air without restraint [15, 16].

For most of the injured, aeromedical evacuation by RAF aircraft was their first ever contact with aviation. For many of them it was a cause of additional stress. Thus, creating a friendly atmosphere by the medical crew was crucial. However, comfort was a rare commodity in the austere interior of a Dakota. The only thing that could be done was to feed those patients who were able to take solid food, and keep them warm. It was also important to ensure that patients could do seemingly mundane things, like urinating. Before take-off, dressings had to be seen to and oxygen masks put on those patients who required them (fig. 3).

Figure 2. WAAF nursing orderly P. Braudburn is completing medical documentation of the wounded British airborne soldier onboard of an aircraft belonging to one of the Transport Command squadrons, on the way back to England. Please notice stretchers racks installed inside the transport compartment [author's collection]
Rycina 2. Sanitariuszka WAAF P. Braudburn wypełnia dokumentację medyczną rannego brytyjskiego spadochroniarza na pokładzie samolotu należącego do jednego z dywizjonów Transport Command w drodze powrotnej do Anglii. Warto zwrócić uwagę na stelaże na nosze zainstalowane w kabinie transportowej (kolekcja autorów)

Casualty Air Evacuation Centers

The Casualty Air Evacuation Centers were located near airfields in England, and it was to these that the patients were taken after landing. The role of CAEC was not reduced to being stations accepting the injured. Patients could be diagnosed and, if the need arose, also treated.

Having landed, the aircraft were positioned on the flight line. The injured were carried to the ambulances which approached the aircraft. Subsequently, a

motorcade of Austin K2s, the basic military ambulances used by the British Army, slowly approached the evacuation center situated a few hundred meters from the airfield at a speed of 5 mph. In the emergency department, stretcher-bearers, medics and, most importantly, a doctor, were ready to admit the new patients. It was at this stage when another triage was performed. The injured were divided into three groups. Patients with severe conditions in need of an emergency surgical procedure (up to 6 hours) were qualified as category 'A'. They had priority over other categories. They were transported by road to hospitals within a 12 miles radius of the airfield. Patients whose condition unlikely to deteriorate within 20 hours were qualified as category 'B'. These were most frequently transported by hospital trains to medical centers further away. Patients who required treatment in specialized surgical centers were qualified as category 'C'. The patients in this group usually had severe burns, which qualified them for burn treatment centers, or injuries to the eyeball, facial skeleton, cranium or the chest. They were transported by ambulance to specialist hospitals within 30 miles [15, 18].

The treatment started by field doctors continued at CAEC - the patients were administered medicines, including penicillin, they had blood transfusions or traction applied to broken extremities. If the condition of any patient required urgent intervention, they were immediately taken to the operating theatre to be operated on by RAF surgeons. All the medicines that were administered and all the surgical procedures performed were recorded in an evacuation card that had accompanied the patient from the very first medical encounter at the field hospital until the hospital in the British Isles (fig. 4).

Apart from the operating theatre the center had a bed unit, a cast room and an x-ray lab [18]. The team was composed of doctors, a specialist surgeon, PMRAFNS nurses, medics, drivers, administrative personnel and cooks [15].

Patients who were expecting transport further across the country were served hot meals and beverages. They were also supplied with newspapers, magazines, toiletries and even playing cards. They had access to the radio. All this was down to the organizations that operated alongside the RAF evacuation centers: the RAF Comforts Committee and the Red Cross [18].

The CAEC was regulated by the rhythm of day and night. Evacuation flights only took place in broad daylight. The nights were usually reserved as preparation time for new admissions. A sunny morning was a harbinger of a hard and strenuous day. The aircraft arrived in waves. The magnitude of the work that the evacuation center personnel had to perform is indicated in the figures. One of them admitted and transferred 500 patients in one session

Figure 3. Capabilities of treatment onboard the RAF transport aircrafts were very limited. In fact, nursing orderlies had only medical bags with dressings, tablets against air sickness and thermoses with food. Patients could also get a morphine injection. The photo shows elements of the original RAF medical service equipment and uniforms: medical bag, Shell Dressing, morphine syringe boxes, general service cap with the RAF badge (worn only by male personnel) and Red Cross armband [author's collection]

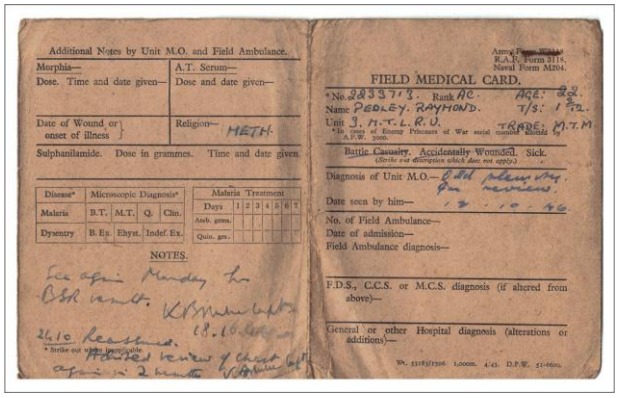
Rycina 3. Możliwości terapeutyczne na pokładzie maszyn transportowych był y bardzo ograniczone. Sanitariuszka miała do dyspozycji w gruncie rzeczy jedynie torbę z opatrunkami, tabletki na chorobę powietrzną oraz termosy z jedzeniem. Pacjenci mogli dostać także zastrzyk morfiny. Fotografia przedstawia elementy oryginalnego wyposażenia medycznego i umundurowania wykorzystywanego przez personel medyczny RAF: torbę na opatrunki, opatrunek 'Shell Dressing', pudełeczka na ampułkostrzykawki z morfiną, furażerkę z odznaką RAF (noszona była przez personel męski) oraz opaskę Czerwonego Krzyża [kolekcja autorów]

in a mere four hours. In that time 1825 meals were served by the kitchen [18]!

Poles on board

In late July and early August 1944 the 1st Polish Armoured Division arrived in Normandy. In the early morning of 8 August the army commanded by General Stanisław Maczek advanced through the devastated city of Caen only to engage the enemy a few hours later as part of Operation Totalize, the opening of the division's nine-month military campaign. In September the 1st Independent Parachute Brigade under the command of General Sosabowski entered combat and took part in the bloody Operation Market Garden.

As part of the British and Canadian tactical formation, the Polish troops suffered heavy losses as far as casualties and the wounded were concerned. However, the Polish Armed Forces in the West were not in the position to transport the injured by air on their own. As a result, injured Polish soldiers were evacuated in aircraft of the allied forces. Major Stefan Kazimierczak, Deputy Commander of the Podhale Rifles Battalion of the 1st Armoured Division, was among those so transported. Kazimierczak was


Additional Notes by Unit M.O. and Field Ambulance.

Morphia— A.T. Serum—
Dose. Time and date given— Dose and date given—

Date of Wound or onset of illness — Religion— METH.

Sulphanilamide. Dose in grammes. Time and date given.

Disease*	Microscopic Diagnosis*			Malaria Treatment						
				Days	1	2	3	4	5	6
Malaria	B.T.	M.T.	Q.	Clin.						
Dysentery	B. Ex.	Ehrst.	Indef. Ex.	Quin. gm.						

NOTES.

FIELD MEDICAL CARD.

No. 2833713. Rank AC. AGE: 22.
Name PEGLEY. RAYMOND. T/S: 1.12.
Unit J. M.T.L.R.U. TRADE: M.T.M.

Battle Casualty. Accidentally Wounded. Sick.

Diagnosis of Unit M.O.— Gall bladder.

Date seen by him— 13.10.44

No. of Field Ambulance—
Date of admission—
Field Ambulance diagnosis—

F.D.S., C.C.S. or M.C.S. diagnosis (if altered from above)—

General or other Hospital diagnosis (alterations or additions)—

Figure 4. Evacuation card (RAF Form 3118) accompanied the wounded soldier during his route from a regimental aid post to a general hospital in Great Britain. It was a record of all medicines administered to the patient and intervention procedures [author's collection]

Rycina 4. Karta ewakuacyjna (RAF Form 3118) towarzyszyła rannemu podczas całej drogi od batalionowego punktu opatrunkowego aż do szpitala na terenie Wielkiej Brytanii. Odnotowywano w niej wszystkie wykonane procedury zabiegowe oraz leki podane pacjentowi (zbiory autorów)

wounded during the St. Sylvain offensive in Normandy, after which he was taken to a hospital near Bayeux. Some years after the war he wrote down what he remembered, which included an account of his stay in hospital: *A few hours after the operation the doctor told me to consider the possible amputation of my left hand as the carpus was severely shattered and there was a danger of infection. I replied on the spot that amputation was out of the question. I knew that my body was regenerating exceptionally rapidly and I trusted that with the help of penicillin I would be able to keep the hand. However, the doctor did not know that. As a consequence of my decision, the day after the operation I was taken together with the others and transported in a medical Dakota to the British Isles. There was no room or time for the field hospital to follow the development of my condition. There only life-saving procedures could be carried out, whereas prolonged treatment had to take place in Britain. At 7.15 p.m. the heavy Dakota took off from the Banville airfield. At 7.33 the plane crossed the coast of France and then landed in Swindon, near London, at 8.50. Aircraft with combat casualties continued to arrive until midnight. The injured were directed to respective medical trains according to their category, and later sent to hospitals across the country. I was sent to the west. In the afternoon, together with a second lieutenant of the Polish Army, Jacek Stwora of the 24th Uhlans Regiment, we were transported to a hospital with the Welsh name of 'Llandough Hospital' in the fishing town of Penarth, situated in the outskirts of Cardiff, the capital of Wales [19].* It was in a RAF Dakota that another person was transported to the British Isles - a doctor of the 1st Independent Parachute Brigade, wounded at Arnhem, Lieutenant Stanisław Leszczyński: *The following day all the patients* (in the British 3rd CCS in Nijmegen) *were asked individually if they would give their consent to being evacuated to England. Volunteers were few and far between, but the decision was not forced on anybody. Although evacuation was regarded to be yet another risk to be taken, I gave my consent. We were driven in an ambulance to Eindhoven and put on an old plane that had been adapted for the purposes of medical transport. Stretchers were placed on three levels. From my stretcher I had a view out of a window. We flew low over the Netherlands to Brussels. (…) We landed at Brussels airport in late afternoon (it was the end of September) Triage again (segregation of the injured - auth.). (…) I stayed in Brussels for only one night, as I was qualified to continue aeromedical evacuation to England. The flight did not take long. Some time in the morning we landed at an airfield near Wolverhampton. It was a sunny day. Stretchers with the injured were lined up on the ground. A doctor in an airman's uniform – with the insignia of a Polish major – examined the patients and urgently ordered penicillin injections. I recognized him. It was Major Knappe – a doctor and a pilot [20].*

Looking ahead, the Polish doctors closely observed how aeromedical evacuation was developing in the allied armies. A Polish delegation was present in Philadelphia at a conference organized by the American Association of Military Surgeons called 'The Symposium on War Medicine' in October 1943. The busy conference agenda included a paper presented by Col. Paul W. Holbrook regarding this very issue [21]. The issue of aeromedical evacuation was also tackled during the Scientific Conference of Polish Military Doctors held in London on 11-12 December 1944. On the second day of the meeting an interesting lectures were presented by Mjr Emil Niedźwirski MD, whom Doctor Leszczyński mentioned in his memoire, and Mjr Pil Stefan Knappe MD. Doctor Niedźwirski focused on the organizational issues connected with evacuation in the American Army, whereas Major Knappe tackled the issues of transport by the RAF [15,22].

Grand scheme of the aeromedical evacuation

6 June 1944 went down in history as 'D-Day' – the day that opened up a second front in Europe. Only a few days later the first injured soldiers from Normandy began to be transported to hospitals across Great Britain – by air. The number of soldiers being evacuated grew day by day. Never before had aircraft been used in this role on such a scale. By the end of

November 1944 the RAF had transported 47 thousand combat casualties to hospitals in Britain [18]. The Dakota aircraft with the characteristic markings of the Royal Air Force on the fuselage did not transport only British soldiers. More often than not the injured soldiers were American, Canadian or Polish.

This system based on transport aircraft proved to be very efficient and enabled the evacuation of a large number of injured soldiers in a short period of time. The monthly statistics indicated that two thirds of the patients sent to the CAEC had been injured two to five days previously. A sixth of the wounded soldiers were sent to Britain within 24 hours of being wounded [18]. This was incredibly quick! Besides, the wounded were a priority. It was "because of the wounded" that soldiers of the 1st Independent Parachute Brigade returning to England after Operation Market Garden were temporarily delayed at the airport near Brussels. An entry in the report of the 3rd Parachute Battalion for 8 October 1944 said: *08:00 hours, the entire brigade is setting off in a motorcade to an airfield near Brussels. (…) 16:00 hours: flight cancelled due to a lack of aircraft. Owing to bad weather conditions an insufficient number of Dakotas had arrived.* The wounded had priority, therefore 60 Dakota aircraft took wounded soldiers [23]. Eventually, the brigade returned to their base by sea, embarking from the port of Ostend.

The RAF system of aeromedical evacuation developed in Africa proved itself in Europe. Here, two other factors were conducive to its development: the almost absolute domination of the allied forces in the air and the geographical circumstances. The British 21st Army Group was a tactical formation of the British Army that operated in Western Europe and advanced across northern France, Belgium and the Netherlands. The only obstacle that separated the area of war operations from the British Isles was the English Channel and the North Sea. The Dakotas easily managed the 300-400 kilometer distance between Caen, Brussels or Nijmegen and airfields in the south of England.

The end of the war did not put an end to the evacuations, it merely opened a new chapter in their history. The medical services of the allied forces now faced the problem of thousands of released prisoners of war as well as prisoners of labor and concentration camps, who were in need of medical assistance. Having just been released from camps, the exhausted British soldiers had to be quickly and efficiently moved back to Britain. The RAF doctors, medics and nurses as well as the crew of the transport aircraft were facing an entirely new task… [24]

Summary

During the Second World War, the technical capacity of the allied forces was insufficient to conduct mass evacuations of the wounded from the front line. It only became a reality with the introduction of helicopters during the Korean War. However, during the Second World War the allied forces developed a method of aerial transportation of the wounded from field hospitals to those hospitals offering a higher level of care.

The allies decided to place an emphasis on mass evacuation in given circumstances. The experiences of 1942–1945 contributed to the development of what today is known as strategic aeromedical evacuation, or STRATEVAC in NATO terminology. It is worth noting that nowadays the transport of the wounded over larger distances is effected with transport aircraft which, apart from evacuation, are involved in landing and supplying operations. The simple stretcher racks that were installed in the Dakota aircraft have evolved into technically advanced racks equipped with respirators, patient monitors, intensive care units mounted on rails inside Hercules and Globemaster aircraft, as well as the Casa C-295 used by the Polish Air Force. The WAAF nurses have been replaced by highly qualified medical personnel serving in aeromedical evacuation units.

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The Military Hospital building in Łódź at 113 Żeromskiego Street – an example of the changing face of a military hospital in an urban space

Zmieniające się oblicze szpitala wojskowego w przestrzeni miejskiej na przykładzie gmachu Szpitala Wojskowego w Łodzi przy ul. Żeromskiego 113

Magdalena Bednarkiewicz

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Abstract. The conditions of military health care in Łódź were very difficult from the nineteenth century until 1934. The military hospital was situated in wooden barracks and two single-story brick pavilions dating back to 1896. Such adapted buildings did not often meet the necessary sanitary conditions regarding stationary as well as out-patient health care for the soldiers of the Łódź garrison. In 1920, an intensive search for a new building site began. After a few years, the authorities of the city of Łódź suggested 113 Pańska Street (currently 113 Żeromskiego Street) – a plot of land of about 7.9 morga (approx. 11 acres) for the construction of the new hospital. The building was designed for the army by the architect Stanisław Odyniec-Dobrowolski. The hospital was ready for use by 18 September 1937. The six-story building constructed in Żeromskiego Street consisted of the main hospital space, a residential area for medical personnel and nuns, a chapel and a mortuary. The huge, over 200 meter long front elevation of the building was monumental in character, becoming one of the largest and most significant architectural elements of Żeromskiego Street. The architectural design of the Military Hospital in Łódź was modern, progressive and modernistic. The building complied with the latest medical achievements, it concentrated all of medical personnel in one place and allowed the closure of impractical branches of the previous hospital, spread throughout the city.
Key words: hospital construction project, interwar 20 years, military hospital, modernistic architecture, Stanisław Odyniec-Dobrowolski

Streszczenie. Warunki lecznictwa wojskowego w Łodzi od XIX w. do 1934 r. były bardzo trudne. Siedziba szpitala wojskowego zajmowała drewniane baraki i dwa pawilony, parterowe, murowane z 1896 r. Adaptowane obiekty dla szpitala często nie spełniały warunków sanitarnych dla stacjonarnej i ambulatoryjnej opieki zdrowotnej żołnierzy łódzkiego garnizonu. Od 1920 r. rozpoczęto intensywne poszukiwania terenu pod budowę szpitala. Trwające kilka lat poszukiwanie odpowiednich gruntów doprowadziło do wskazania przez ówczesne władze Łodzi parceli przy ul. Pańskiej 113 (obecnie ul. Żeromskiego 113), gdzie pod budowę nowego gmachu przeznaczono 7,9 morgi. Projekt dla wojska wykonał architekt Stanisław Odyniec-Dobrowolski z zespołem. Szpital uruchomiono 18 IX 1937 r. Pięciopiętrowy budynek powstał wzdłuż ulicy Żeromskiego i obok właściwego szpitala, składał się z części mieszkalnej dla personelu lekarskiego i sióstr, a także budynku z kaplicą przedpogrzebową z prosektorium. Potężna dwustumetrowej długości elewacja szpitala o monumentalnym charakterze, zabudowała duży fragment pierzei ulicy Żeromskiego. Konkurs wygrał projekt postępowy i awangardowy, promujący modernistyczną architekturę. Wzniesiona budowla, była nowoczesna i uwzględniała postępy w medycynie, a z chwilą uruchomienia w jednym miejscu skupiono cały personel medyczny, jednocześnie zamknięto niefunkcjonalne filie szpitala rozmieszczone w kilku miejscach Łodzi.
Słowa kluczowe: dwudziestolecie międzywojenne, modernistyczna architektura, projekt budowlany szpitala, Stanisław Odyniec-Dobrowolski, szpital wojskowy

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Conditions were difficult for military hospital treatment in Łódź from the 19th century until 1934. The center of the military hospital was housed in barracks built for a former Russian Red Cross hospital in 1896 at 113 Pańska St. (present-day 113 Żeromskiego St.). This wooded area covering several hectares was located between Żeromskiego St., Łąkowa St. and Kopernika St. (former Milsza St.) up to the Ks. J. Poniatowski Park. Remaining after the Russian Red Cross were two one-story pavilions made of stone, one of which housed a chapel, as well as five wooden barracks with beds for patients and storage for farm equipment. This 100-bed hospital treated wounded soldiers returning from wars and also provided medical assistance to the citizens of Łódź, especially workers from lesser factories [1]. Difficulties in supplying beds for patients, especially during the wars of 1914 and 1920, forced the hospital authorities to open a subsidiary unit in which to accommodate patients:

- the Russian Grammar School building in Sienkiewicza St., where they arranged for one thousand beds for the sick with infectious diseases;
- the German Grammar School building in Kościuszki Ave. where a ward with six hundred beds was provided;
- a building in Łomżyńska St. with two hundred and thirty beds for STD patients;
- the leased Shiebler's factory building at 75 Przędzalniana St. [2].

Since the hospital was scattered all around Łódź, with rooms falling short of the required standard and a chronic shortage of beds, a decision was taken to build a new multi-specialty hospital which would combine inpatient and outpatient treatment for soldiers of the Łódź garrison and workers of lesser factories. The idea to build such a hospital had already germinated among the doctors and community workers of Łódź in 1893. Construction plans were drawn up and the investment was to be financed by factory owners. However, the investment had not been carried through, leaving military medical hardships unresolved for more than ten years [3].

For this reason the military medical services were forced to continue running the hospital in the old buildings of the Russian Red Cross at 113 Żeromskiego St. after Poland had regained independence in 1918. They additionally adapted premises for medical purposes in the buildings of the so-called auxiliary hospital (44 Pogonowskiego St.), in the building of the Russian Grammar School (Sienkiewicza St.), in the German Grammar School (at the intersection of Kościuszki Ave. and Zamenchofa St.) and in St. Anna's factory hospital (at the intersection of Przędzalniana St. and Milionowa St.). The number of beds in all these establishments amounted to three thousand and ten. Additionally, after 1920, the Red Cross hospital provided a new military medicine ward with one hundred and sixty beds [2].

The staff of the military medicine hospital had been trained by the Medical Department of the University of Warsaw, and from 1918 the core staff was comprised of civilian doctors who had been conscripted into the army, as well as well experienced doctors obtained from invading armies [4].

The final decisions as to whether to build the military hospital date back to 1920. The efforts to find an appropriate venue for the future building are well documented in papers signed by the military authorities and city officials. At a meeting of 4 May 1920, where both parties were represented by: Eng. Szenfeld – the city's Chief Engineer, Eng. Stebelski, architects: Goldberg and Lisowski, as well as Mr. Kuckiewicz – chief of Military Engineering, Eng. Sunderland, and Col. Arot – head of medical department of D.O.G. Łódź, four sites were put forward:

- premises extending from the tracks of Fabryczna railway station up to Rokicińska St., between Sienkiewicza St. and Skwerowa St., with a total area of 25-30 morga (35-42 acres),
- premises owned by Polesie Widzewskie, with a total area of 15-20 morga (21-28 acres),
- a square at the junction of Dzielna St and Dąbrowskiego Square, with mortgage no 1437 T,
- premises extending from the southern side of the Konstantynowska St. to Retkińska St. (during the concept phase), with an area of 20–30 morga (28–42 acres) [5].

However, none of the above suggestions were approved. The municipal authorities were intent on preserving green areas for establishing a people's park, as the norms for green areas were set at 19.5 m^2 – 21.5m^2 per person, and pre-war Łódź had only 6.85 m^2 per capita. However, the land needed for developing a hospital amounted to about 98 morga (132.5 acres). The size of the plot was determined by the layout design, which was made for a pavilion system surrounded by green areas. According to the spatial development plan at the time, the undeveloped land at city's disposal amounted to 7.56% of the total area. However, these plots were needed for the development of schools, housing, city hospitals and asylums. Therefore, in a letter of 17 July 1920, the municipal officials recommended other plots for the purpose. These were:

- grounds of the Widzewska Manufaktura joint stock company situated between Kunicera St., Dzielna St., 3 Maja St. and the railway track.
- grounds of the K. Schiebler joint stock company between Fabryczna St., Gołębia St., Emilli St., and the factory of Widzewska Manufaktura [5].

The military authorities were adamant that the most suitable plot was located in Polesie Konstantynowskie, with sandy and gravel soil, a low underground water level of 15m, smooth topography and partial forestation. Additionally, the plot was tucked away from major factories, which ensured unpolluted air. Hence the military authorities did not find it troublesome to delimit an area of 40 morga (56 acres) between Krzemienicka St., Unii Ave. and Karolewska St. for the construction of the hospital [5].

However, these conditions were unacceptable for the authorities of Łódź at that time and other units under the authority of the City Hall, as they purported to have earmarked this significantly green area for a people's park, and expected the military authorities to limit the hospital acreage to 21 morga (30 acres). The attempts to define an outline for a1000 bed hospital had to continue in spite of the objections raised by the officials. The norms that were assumed provided 150m^2 per bed, which eventually meant the necessity to obtain 27 morga (37.5 acres) of land for the construction [5].

During the negotiations, the military authorities argued that a plot of 550m x 150m would comply with all their medical requirements, although this was not acceptable for the officials. Instead, they suggested a plot of 380m x 150m [5].

The dispute continued until 8 May 1925, when another offer was presented to the army. This was 131.6 acres of land forming part of Marysin Grange, to be purchased from Mr. G.O. Gehlig. However, a compromise in this case was not reached. Eventually, the city magistrate designated a plot at 113 Pańska St. (present day 113 Żeromskiego St.) where the building of the hospital was to be built on an area of 7.9 morga (11.25 acres). This decision brought to an end a long lasting dispute over the location of the hospital [5].

Prior to the gradual demolition works of the old development in 1935 to make room for the new building, an architectural competition was held by the Polish Architects Association [1].

Stanisław Odyniec Dobrowolski, an architect, with his team (Julian Lisiecki and Janusz Krauss) won the competition for a draft design of a regional military hospital in Łódź in 1935, having beaten 22 other designs (fig. 1). Among the awarded designs were: second prize for the team of architects comprising: Jadwiga Dobrzyńska, Zygmunt Łoboda; third prize for Gustaw Trzciński and fourth prize for Władysław Borawski; Jerzy Gelbard and M Szabuniewicz with their team [6].

A momentous, four-story building with a volume of 70 000 m^3 was erected on Żeromskiego St. on its western side. Having been completed and fitted with state-of-the-art medical equipment, the hospital was ceremoniously opened on Saturday, 18 September 1937. The Garrison Hospital of the IV Corps District,

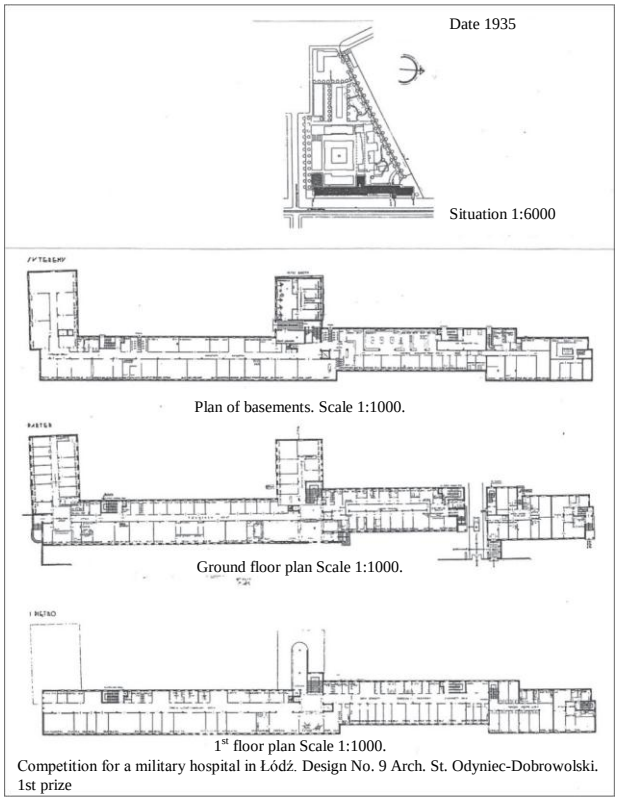

Figure 1. Plans of WAM hospital

Rycina 1. Plany szpitala WAM

Source: Architektura i Budownictwo, 1935: 20 [Architecture and Engineering]

which was given reference number 1, although referred to as the central hospital, and received the patronage of Gen. Brig. Felicjan Sławoj-Składkowski MD [6]. The hospital premises, apart from the building proper, comprised living quarters for the medical staff and nurses, as well as a building positioned on the Łąkowa St. side where a funeral chapel and a dissection room were located [7].

The wards designated for the hospital included: internal (80 beds), surgical (100 beds), gynecology and obstetrics (50 beds), ophthalmic (50 beds), neurological (35 beds), psychiatric (24 beds), laryngological (50 beds), dermatological and venereological (100 beds) and infectious diseases (20 beds) [8]. In the same building were a pharmacy, a laboratory (bacteriological, analytical, and x-ray) as well as a multi-specialty clinic, which included dental services [8]. On the ground floor were a reception unit, an x-ray ward, and a bacteriology ward. On the other floors were an internal diseases ward, a neurological ward, a female health ward, as well as a surgical ward with theatres. In the basement, which was partly a low ground floor, there was a kitchen that was well integrated with the ward kitchens. Another part of the

Figure 2. The elevation seen from Żeromskiego Street, state as of 2013

Rycina 2. Elewacja od strony ul. Żeromskiego stan z 2013 r.
Source: the author's own collection

Figure 3. The elevation seen from Łąkowa Street, state as of 2013

Rycina 3. Elewacja od strony ul. Łąkowej stan z 2013 r.
Source: the author's own collection

long basement housed a laundry room and a disinfector. Everything was connected by lifts and corresponding rooms in wards. In the hospital were three operational stairwells. One main stairwell and two lateral ward stairwells, each accompanied by one passenger lift and one lift for bed-ridden patients. In a separate wing were lying-in rooms which also played the role of common rooms [9].

Rooms with four and eight beds on the western side were separated by a corridor from the rooms for medical staff and the auxiliary personnel on the eastern side. Special wards were provided with isolation rooms with two beds. The building, which was built in less than two years, is a fine example of innovative hospital architecture from the interwar period [8].

The building was accessed by two entrances: a working entrance and an entrance for patients situated next to the guardhouse. The entrance to the hospital building was situated on the eastern side, not the southern, as was the usual practice of the time. The facade, made of sandstone, was 200m long and extended from north to south, and halfway along its length was an offset as well as a lowering of the northern side of the building. From the south, the main body of the building gained a short wing which was positioned slantwise towards the main part of the building. From the courtyard, in a perpendicular short wing, a stairwell was located. In this way the architect managed to avoid the monotony of a long elevation. The advantage of the new hospital was a tram connection with the city center and the Łódź Kaliska railway station. Until the 1960s there was an operational tram track leading to the hospital premises [8]. After the new establishment opened, the hospital branches scattered around the entire city were liquidated. The decision led to the concentration pf the entire medical personnel in one place and automatically closing of impractical branches of the military hospital [10]. The basement plan of the new military hospital building was in the shape of the letter 'E' and its measurements were 164m x 37m. The usable area of the building was 31.962 m^2 and the cubage was 70 000 m^3 [7]. The hospital was erected on a trapezoid-shaped plot. The building was made of cement-based bricks and partially by framing. When constructing the hospital, high quality terrasite plasterwork and ceramic cladding tiles were applied. In the interiors there were colored wall-tiles, terracotta, rubber flooring and marble [8]. The color coordination of woodwork and walls was highly innovative. The division into colors: pink, green, blue and yellow enabled easy orientation in the interiors of the respective floors and wards [9].

The building was designed to consist of six modules, each based on a rectangular plan of various sizes. All the adjoined rectangles penetrated through one another forming the hospital plan (fig. 2).

The two-and-a-half-bayed interior had a corridor which divided the bays. The room interiors lacked decor, but they were of varying sizes and were built on a rectangular plan. Each module had its own stairwell situated on the side of the courtyard. The exterior walls were smoothly plastered and had rectangular window openings. The entire building had a flat roof and a basement running along the entire plan. The height of respective buildings differed and amounted to between three and five stories. On one of the roofs, on the south-western side, there was a terrace for the patients of the hospital (fig. 3) [8].

The building of the hospital was fitted with electrical, water, sewerage and central heating installations. A massive, 200-metre long monumental facade of the military hospital lined the frontage of

Żeromskiego St. A well-chosen steel detail fitted on the front gate was a distinct marker of the designer's fine taste [8]. However, the detail did not sustain the wear and tear of post-war renovations and was removed at some point. A grating with stylish eagles and two Aesculapius snakes placed on the sides was removed from the guardhouse gate. The motifs, which were inspired by the "De Stijl" group, were integrated into a geometrical composition, which was later replaced by a simple glazed door made of aluminum in the 1970s. [7].

What was so exceptional about this design? Basements with a centrally located kitchen from which meals were transported to the ward kitchens situated on the floors, by special lifts designed for food transportation. A similar solution was applied to the central laundry, central air-conditioning for the hospital, which had its own emergency generator. Lying-in rooms were located in a separate wing on the southern side.

In the corridors, just above the patient rooms, a light signaling system was installed and the respective floors were painted in different colors (following the French example): pink, green, blue and yellow for easier orientation for the patients and their families. For every pair of patient rooms there was a common leisure room with comfortable chairs and flowers. A brick construction with elements of framing was intended to resist the impact of missiles, whereas the roof was to resist an explosion of an aerial bomb [11].

The decor that the building gained at the opening was in accord with the principles of functionality. Only the hall decor looked presentable with claddings made of marble and alabaster plates, and a bust of Józef Piłsudski in one of the niches [12]. The specification guidelines of the competition required splitting the investment into stages for realization in later years. Such an opportunity arrived in 1953, when the northern wing was created.

When in the 1970s the intersection between Mickiewicza Ave. and Żeromskiego St. was rebuilt and converted into a multi-level junction, the patients' calm treatment was disturbed, local traffic increased, and the original location near the Józef Poniatowski Park, near the green areas needed so badly by recuperating patients, was no longer relevant.

The hospital's architecture is not only the building itself, but also the space where the building and its surroundings are located. The three elements have long been the building blocks of this part of Łódź. After regaining independence in 1918, the authorities of Łódź had a very busy agenda which included building schools, improving standards of living and work, as well as building health care facilities. With so many challenges to tackle, the implementation of the military hospital project came to completion as a result of a nationwide architectural competition of the Polish Association of Architects. The competition committee chose a progressive and avant-garde design with modernist architecture. The competition program contributed to the enhancement of the competitors' knowledge and their practical abilities. The modern structure, which also allowed for all the progress in medical science, has not sustained any significant damage and has undergone numerous reconstruction works. The renovations taking place after 1945 were in compliance with new sanitary and construction regulations. The hospital building, which is still available for common public use, has been entered in the provincial register of Łódź monuments under no: A/108 on 20 January 1971, on account of its architecture and the medical function in its interior. An age old principle, that a military hospital plays an exceptional role in the treatment of citizens, has not lost its significance, as the hospital has improved the treatment conditions of many generations of inhabitants of Łódź and other, more distant towns.

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Dum vivimus, vivamum – 4th Scientific Conference in Memory of Brigadier General Wojciech Lubiński, MD, PhD

Dum vivimus, vivamum – IV Konferencja naukowa im. gen. Bryg. dr. hab. n. med. Wojciecha Lubińskiego

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On 11 April 2014, the anniversary of the presidential plane crash near Smoleńsk, the fourth scientific conference was held in the auditorium of the Military Institute of Medicine in Warsaw, dedicated to the memory of the late Brig. Gen. Wojciech Lubiński MD, PhD. The organizers of the conference were the Military Institute of Medicine, the Warsaw-Otwock branch of the Polish Respiratory Society and the Polish Federation of Asthma, Allergy and COPD Patients Organizations.

The conference was devoted to the impact of environmental pollution on cardiovascular and pulmonary diseases, as well as to functional tests of the respiratory and cardiovascular systems. The conference was held under the honorary auspices of the Secretary of State and the Head of National Security Office, Gen. Prof. Stanisław Koziej PhD. In his address to the conference participants he emphasized the importance of citizens' health, conditioned by a clean environment, for national security.

This year's conference has also been held under the auspices of the Polish Federation of Engineering Association, Polish Society of Allergology, Polish Federation of Engineering Associations and the Section of Non-invasive Electrocardiology and Telemedicine of the Polish Cardiac Society. The ceremonial inauguration was performed by Paulina Miśkiewicz PhD, director of the Warsaw branch of WHO. On behalf of WHO she expressed her gratitude for tackling the issue of environmental pollution, as it is one of WHO's main orientations. Scientific research on the impact of environmental pollution on public health will certainly prompt the governing authorities to take necessary measures to thwart this dangerous phenomenon.

The first sitting was devoted to pathophysiology of the circulatory and cardiopulmonary systems. It was inaugurated by a lecture delivered by Prof. Henryk Mazurek of the Institute of Tuberculosis and Lung Diseases in Rabka on the role of forced oscillations in the functional diagnosis of the respiratory system. The method was invented in 1956 by du Bois, a military doctor, during the two years he spent on an aircraft carrier. The essence of the examination is to measure impedance, which is the ratio of forced pressure to the flow induced by that force, when the pressure and the flow are measured at the same point at the mouth. Unlike in spirometry, it does not require active cooperation on the part of the patient as the measurements are taken while the patient breathes calmly. The procedure is thus common among children and elderly people, as well as patients with contraindications to spirometry (e.g. hemoptysis, after a myocardial infarction, stroke, or threat of aneurysm rupture). Although it has been long known, it was not until the last decade that this method of diagnosing an airway obstruction gained interest as being more objective than spirometry. It enables an early identification of functional disorders in the respiratory system in smokers, as well as an identification of functional disorders in interstitial lung diseases and heart failure. Although it is an easy and quick method, its restrictions include difficulties in defining referential values, variable measurements, as well a wide span of normal values.

The next lecture was delivered by Prof. Mieczysław Pokorski of the Polish Academy of Science, an authority in the influence of hypoxia on the respiratory system. He collaborates with leading research institutions in Japan, Israel, Russia, Italy and the USA. He presented the role of the intercarotid body in breath control. This minuscule organ (approx. 1 mm in diameter) is unique as it has the highest blood flow of all organs. It analyses the levels of oxygen and carbon dioxide saturation, as well as the

Figure 1. Colonel Wojciech Lubiński, MD, PhD during a meeting at the Military Institute of Medicine
Rycina 1. Płk dr med. Wojciech Lubiński na spotkaniu w Dyrekcji Wojskowego Instytutu Medycznego (zdjęcie archiwalne)

pH in peripheral blood and sends signals to the respiratory center to stimulate or slow down breathing. Most people respond to hypoxia by hyperventilation, yet 10-20% of people do not react to hypoxia at all, or respond with paradoxical hypoventilation. Administration of increased oxygen concentrations initially causes temporary hypoventilation; however, a short while later ventilation intensifies. There is no threat of hypoxia in healthy people resulting from breathing an air mixture with increased oxygen pressure. However, a particular caution is needed with COPD patients who may experience an increased retention of carbon dioxide when the supply of oxygen has been increased. It is interesting how diabetes influences respiratory control. In this group of patients a weakened reaction to hypoxia has been proven. It is suspected that increased release of a hypoxia-inducible factor affects angiogenesis in the intercarotid body. At the end of his lecture, Prof. M Pokorski demonstrated the results of his recent research conducted in Tokyo which have rebutted the existing hypotheses on a unified reaction of the intercarotid body for hypoxia through TRPA 1 receptors *(transient receptor potential cation channel, subfamily A, member 1).* The reaction of the intercarotid body after the TRPA1 has been blocked proves that the process is dependent on many factors and is more complex than originally expected.

During the next speech Prof. Grzegorz Gierlak of the Military Institute of Medicine, and Teodor Buchner PhD of Warsaw University of Technology presented the issue of respiratory variation of sinus rhythm as viewed by a cardiologist and a physicist. It was no coincidence that this issue was tackled by a medical doctor and a physicist, and it became the topic of a very interesting doctoral dissertation at Massachusetts Institute of Technology. It serves to prove that two seemingly diverse disciplines such as physics and medicine need to cooperate very closely. The speeches focused on the mechanisms of central and peripheral integrity of autonomic reflexes, including the respiratory 'gating' of the sinus rhythm of the heart which controls the function of the cardiopulmonary system. The lecture demonstrated convincingly the nature of the mutual relations within the cardiopulmonary system, and proved that the need for pulmonologists and cardiologists to collaborate is strong.

The topic of the lecture given by Katarzyna Piotrowicz MD of the Military Institute of Medicine was the role of obstructive sleep apnea in cardiovascular sleep assessment. First of all, it was pointed out that cardiologists should thoroughly examine the condition of the respiratory system, as both systems are directly related to each other. Obstructive sleep apnea is one of the main causes of sleep-resistant hypertension, which is difficult to treat. The number of acute coronary syndromes and, especially, sudden cardiac deaths in such patients rises considerably. This can be attributed to dangerous heart rhythm disorders, which are typical of hypoxia. Polysomnography tests prove that apnea, hypoxia and heart rhythm disorders are interrelated. The observed noradregenic stimulation affects the circulatory system of these patients significantly. Besides, patients with obstructive sleep apnea frequently suffer from diabetes and metabolic syndrome, which constitute a separate group of risk factors for coronary heart disease and myocardial infarction. Lastly, Katarzyna Hałas of the Military Institute of Medicine discussed interesting cases of patients where the impact of obstructive sleep apnea on the circulatory system has been confirmed.

The first session ended with a lecture delivered by Prof. Władysław Pierzchała, head of the Polish Respiratory Society and a former vice-chancellor of the Medical University of Silesia. At the beginning of his speech Prof. Pierzchała expressed his respect towards the Military Institute of Medicine and Wojciech Lubiński PhD, whose postdoctoral dissertation he reviewed. He gave a lecture on the importance of function tests in operational risk assessment. The removal of lung tumors from healthy tissue saves the lives of lung cancer patients. Indications for surgery are very strong, but it is important to re-establish the functions of the respiratory system after the surgery. To this end it is essential to thoroughly evaluate the patient's condition prior to surgery. Prof. Pierzchała has outlined an algorithm for pre-operational procedures for such patients. Firstly, measurements should be performed of the expiratory volume over 1 second (FEV1) and the diffusing capacity of the lungs for carbon monoxide (DLco). If the results are above 80% of the normal value then surgery is admissible,

whereas a value below 35% means surgery is impossible. With the results within the 35-80% range, it is recommended that more detailed tests are performed. It is particularly useful to perform a cardiopulmonary exercise stress test for oxygen consumption, which should single out those patients who are fit for surgery. It is also helpful to perform a 6 minute walk test, which defines the functional reserves in lung cancer patients with a coexisting COPD. Prof. Pierzchała dedicated his lecture to the memory of Wojciech Lubiński PhD, who attached great importance to an accurate evaluation of the functional condition of the respiratory system.

During an interlude between sessions, a brief press conference was held to discuss air pollution as one of the greatest threats to the environment in the 21st century. Both doctors and engineers emphasized the seriousness of the threat posed by increasing environmental pollution. In recent decades the incidence of respiratory diseases, allergies, cancer and obstructive disorders has been on the rise, which is attributable to a deterioration of the environment around us. This issue was discussed in detail during the second session. The first appearance was made by Prof. Leon Gradoń of the Warsaw University of Technology, who outlined the significance of nanostructured drug particles in inhalation therapy. Professor Gradoń is a world renowned scientist who was entrusted by American industry with the task of minimizing the harmful effects of combusted diesel particles in jet engines. Nanostructured particles that penetrate into vesicular spaces, and further into the circulatory system, may have harmful local and systemic effects. Simultaneously, an appropriate construction of particles in the form of medicines could be used in the treatment of many diseases. Prof. Gradoń demonstrated his own experiments in creating tiny, light and porous structures which could become carriers of such medicines as insulin, antibiotics and bronchodilators. Unfortunately, the procedure of patenting these inventions requires tremendous amounts of resources on the part of the industry, whereas in Poland there are not enough suitable partners who would readily cooperate within the scope of implementing such innovative technologies.

Artur Badyda PhD of Warsaw Technical University gave an engaging lecture on air pollution. With a reference to the latest WHO reports, he discussed the share of respective forms of pollution in different regions of the world, with a particular emphasis on Poland and the European Union. Pollution is mostly generated as a by-product of energy production, industry, transportation and municipal waste. In recent years the role of industry in the European Union has decreased in favor of transportation. The main pollution factors are nitrogen oxide, sulfur dioxide, coal dust, carbon monoxide and dioxide, ozone, volatile organic compounds, and fine dust particles

Figure 2. During 4th Scientific Conference in Memory of Brig. Gen. Wojciech Lubiński, MD, PhD

Rycina 2. W trakcie obrad IV konferencji naukowej im. gen. bryg. dr. hab. Med. Wojciecha Lubińskiego

(PM 10 and PM 2.5). The latter are particularly hazardous in Poland. 6 out of the 10 most polluted EU cities in that respect are in Poland, whereas the remaining 4 are in Bulgaria. The sources of pollution in Poland are, above all, coal-based power industry, raw materials, shortage of installations that purify waste gases, the rapid growth of transportation together with municipal waste. These forms of pollution have been proven to correlate with various diseases. Artur Badyda presented the results of some of his research carried out in cooperation with the Military Institute of Medicine, proving that disorders in respiratory functions of the inhabitants of Warsaw and Silesia were dependent on air pollution levels. The disorders were observed in non-smokers. They were particularly explicit when compared with the respiratory functions of the inhabitants of cleaner Podlasie and Augustów. The following lecture was a continuation of the topic and concerned the harmful effects of air pollution on obstructive diseases in the respiratory system. The lecture was delivered by Piotr Dąbrowiecki PhD of the Military Institute of Medicine, the head of the Polish Federation of Asthma, Allergy and COPD Patients Organizations. The epidemic of asthma and allergies observed in recent decades is inextricably connected with growing environmental pollution. It is no coincidence that as much as 50% of the children in Kraków, the most polluted city in Poland and the third most polluted in the European Union, suffer from asthma and allergy. It was not long ago when an alarming 10 % of the children were announced to be asthmatic. Air pollution in the workplace and place of residence is, after smoking, the second most important cause of chronic obstructive pulmonary disorder, which is becoming the third most important cause of all deaths. Not only does air pollution contribute to the development of asthma and COPD, but it is also one of the chief

causes of their exacerbation, and in consequence, a reason for hospitalization and a cause of death. Spirometric tests performed since 2006 in the Military Institute of Medicine on urban and rural inhabitants have proved the more beneficial lifestyle of the latter. A rapid growth in the number of motor vehicles in cities brings about an increase in pollution, which in turn correlates with a deterioration of respiratory functions, as measured by lowered FEV_1 and Tiffeneau indices. Adam Stańczyk PhD of the Military Institute of Medicine demonstrated how air pollution affects the diseases of the cardiovascular system. Contrary to common belief, air pollution is more dangerous to the cardiovascular than the respiratory system. The frequency of myocardial infarction occurrences and hospitalization due to heart failure in people exposed to polluted air has been proved to be statistically higher. Apparently, the main mechanism that damages the structures of the circulatory system is general inflammation, which leads to increased clotting, impairment of blood vessel functions and intensification of atherosclerotic processes. Eventually, patients experience an intensification of arrhythmia, destabilization of atherosclerotic plaques, which lead to myocardial infarctions and strokes. Additionally, it is of significance how the balance of the autonomic nervous system is compromised through the interaction of dust with neurotransmitters and their influence on disturbing the balance between the functioning of nervous, cardiovascular and respiratory systems. Andrzej Chciałowski, the assistant professor of the Military Institute of Medicine, discussed bronchial inflammation in COPD patients. This was a presentation of W. Lubiński's research results, resumed and concluded by Assoc. Prof. Chciałowski and Iza Toczyńska MD after his death. The test consisted in examining histopathological cuts collected during bronchoscopy from COPD patients, and later comparing them with the results of a long-term inhalation therapy with bronchodilators and glycocorticosteroids. The positive impact of long-term local steroid therapy has been proved even in moderate stages, although earlier indications as to inhalation therapy with glycocorticosteroids is anticipated to have application only in severe cases.

As the discussion continued, a question about the shape of future conferences was raised. The maintenance of the medical-technical platform, which was so dear to Assoc. Prof. Wojciech Lubiński, was strongly advocated. It has been concluded that the topic of pollution is an excellent example of an interdisciplinary issue which may be of great interest to various scientific circles. It has been postulated that non-governmental organizations could take part in the conference on a much wider scale, and that local governments (those responsible for the local environment) be informed about the conclusions of scientific research. This year's conference has been at an exceptionally high level and aroused a lot of general interest.

Acknowledgement

We would like to extend our acknowledgements to Beata Lubińska for providing the photographs attached to the text.

To whom it may concern,

I would like to recommend a new research and education initiative by the Military Institute of Medicine, namely a conference entitled 'Damage Control Surgery – from Battlefield to Trauma Centre', which is to be held on 21-22 November 2014 in the Ossa Hotel near Rawa Mazowiecka, Poland.

The conference is consistent with the agenda of the 50th anniversary of the Central Clinical Hospital of the Ministry of Defence. The treatment of trauma patients has always been among the priorities of our day-to-day medical, research and educational activities.

The purpose of the 'Damage Control Surgery - from Battlefield to Trauma Centre' conference is a multifaceted exchange of experiences between those responsible for the provision of health care systems for trauma patients, including our notable guests from abroad.

Brig. Gen. Grzegorz Gielerak, MD, PhD

Chairman of the Military Institute of Medicine

CONFERENCE TOPICS

1) damage control in treating injuries of body regions and the following systems:
   - cerebrocranial
   - spinal
   - thoracic and abdominal
   - pelvic
   - vascular
   - multi-location and multi-organ
   - motor organs
2) procedures with burns
3) hemorrhagic shock and advances in clinical transfusiology
4) anesthesia and intensive care in severe bodily injuries
5) experience and advances in military medicine
6) cumulative trauma disorder, diagnostic and therapeutic algorithms, registering trauma patients
7) prehospital emergency measures in bodily injuries
8) organization of treatment systems for trauma patients – Polish and international experience
9) emergency nursing in trauma patient care

CONFERENCE WEBSITE
www.damagecontrol.wim.mil.pl
- registration
- information

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