Craniocerebral injuries in the practice of emergency medical rescue teams

(Obrażenia czaszkowo – mózgowe w praktyce wyjazdowych Zespołów Ratownictwa Medycznego)

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Abstract – **Introduction**: Head injuries have been experienced by humans from the time immemorial. Craniocerebral injuries appear to be one of the most frequent head injuries. Moreover, they can often pose a threat to a patient's life.

Objectives: The aim of the study was a retrospective analysis of the emergency medical rescue teams' attendance at accidents or other medical emergencies. The criteria included: the sex and age of a patient, the time of day and a season when craniocerebral injuries are most frequent, the cause of injury, the type of service provided (Basic Life Support or Advanced Life Support), the time it took to reach the destination and the method of treating the patient at the scene of the accident.

Materials and methods: The reports on emergency medical service provided in the Otwock district in 2009 were analysed. 502 patients out of 6937 suffered from craniocerebral injuries. The cases of those 502 provided a basis for further analysis.

Results and conclusions: According to the research carried out, men aged between 50 and 59, as well as between 20 and 29 experience craniocerebral injuries most frequently. Summertime (mainly June and August) turned out to be the season of the highest frequency of craniocerebral injuries. The days on which craniocerebral injuries were most common were Sundays, Mondays and Fridays, and the time of day with the highest frequency was late afternoon (5 to 6 p.m.). Almost every other patient was provided with emergency medical service within 6 minutes after the accident. However, in every tenth case, it took no less than 15 minutes for the rescue team to arrive. What is more, every tenth patient who suffered a craniocerebral injury refused to be treated and transported to hospital.

Key words **-** head injuries, epidemiology, pre-hospital emergency care, emergency medical service

Streszczenie – **Wprowadzenie**: Urazy głowy towarzyszyły człowiekowi od zawsze. Urazy czaszkowo – mózgowe są jednymi z najczęściej spotykanych, często też prowadzić mogą do bezpośredniego zagrożenia życia.

Cel pracy: Analiza retrospektywna wyjazdowości Zespołów Ratownictwa Medycznego pod kątem : płci i wiek pacjentów, pory dnia i roku obarczonych największą częstością tego typu urazów, przyczyny urazu , rodzaj zadysponowanego zespołu („S" lub „P"), czasu dotarcia na miejsce zdarzenia oraz dalszego postępowania z pacjentem na miejscu zdarzenia..

Materiał i metoda: Analizie poddano karty wyjazdowe pogotowia ratunkowego zabezpieczającego medycznie powiat otwocki w okresie 1.01-31.12 2009 roku. Spośród 6937 interwencji medycznych jakie wykonano w tym okresie, wyodrębniono grupę 502 chorych, którzy doznali urazu mózgowo-czaszkowego. Grupa ta stała się podstawą dalszej analizy.

Wyniki i wnioski: W wyniku przeprowadzonych badań stwierdzono, że urazy mózgowo-czaszkowe dotyczą głównie mężczyzn w wieku 50-59 lat oraz w wieku 20-29 lat. Częstość urazów czaszkowo-mózgowych znamiennie statystycznie częściej kumuluje się w miesiącach letnich (przede wszystkim w sierpniu i czerwcu), najczęściej dotyczy niedziel, poniedziałków i piątków, głównie występując w godzinach popołudniowych (17-18 godzina).U prawie co 2-giego chorego zespoły ratownictwa medycznego docierały do 6 minut od momentu wypadku, jednak niemal co 10-ty poszkodowany otrzymał pomoc ratowników dopiero po upływie co najmniej 15 minut od chwili wypadku. U co 10-tego chorego, który doznał urazu czaszkowo-mózgowego ratownicy napotykali kategoryczną niechęć do korzystania z ich pomocy i kontynowania dalszego leczenia w szpitalu.

Słowa kluczowe - urazy głowy, epidemiologia, opieka przedszpitalna, zespoły ratownictwa medycznego

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A. The idea and the planning of the study
B. Gathering and listing data
C. The data analysis and interpretation
D. Writing the article
E. Critical review of the article
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I. INTRODUCTION

Craniocerebral injuries are life-threatening conditions characterized by high percentage of disability and high mortality rate as compared to other multiple organ traumas [1,2]. It is estimated that they are the most frequent cause of deaths of injured people as well as the most common cause of acquired neurological diseases [1,3]. Statistics around the world have it that, among the cases of people suffering from multiple physical traumas, the central nervous system is damaged in as many as 40% of them. The traumatic deaths resulting from them amount to 25% of all deaths caused by transportation accidents [2,4]. Moreover, it has to be stressed that the frequency of traumas penetrating the brain or the spinal cord is observed to be currently on the increase.

Craniocerebral injuries are caused by the impact of a short mechanical trauma on the cranium. Bidziński defines craniocerebral injuries as the outcome of the traumas suffered in that area, whose strength surpasses the compensational abilities of the organism [5].

An average barotrauma may cause either sharp force or blunt force injury, as a result of which open and closed craniocerebral wounds may be inflicted. Another classification (the so-called OCM classification) differentiates between open injury (with damage to dura mater) and closed injury (with no damage to dura mater observed).

Frequent difficulties in diagnostics and treatment of craniocerebral injuries stem from the overlap of symptoms, which is related to the risk of overlooking a trauma and a threat to a patient's safety. A significant problem for emergency medical rescue teams is the frequently encountered drunken state of the craniocerebrally injured, which limits the possibility of precise neurological assessment (as it is then difficult to recognise the level of the patient's consciousness). Another impediment is the fact that severe and dangerous brain traumas are not always accompanied by adequate external injuries on the head, which could indicate how serious the condition is [5].

The process of treating multiple physical traumas should commence at the site of the accident, therefore medical emergency staff should be familiar with the issues related to craniocerebral injuries. One also has to remember that, as Brain Trauma Foundation advises, each craniocerebral injury should be considered as one coexisting with a cervical spine trauma, which is related to the fact that rescue procedures should include stabilizing the cervical section of the spine.

The ability to assess an injury on the basis of post-traumatic symptoms is directly related to the emergency procedure and further diagnostic and therapeutic procedures. At the accident site, the following should be carried out: a quick traumatic assessment, proper clearance of the airways, ventilation, prevention from hypotension, preparation for quick transportation to hospital. Meanwhile, the basic vital functions should be constantly monitored. It is extremely important to record all the parameters monitored accurately and regularly in order to make explicit the evaluation of the organism response to the injuries suffered.

The currently growing relevance of craniocerebral injury-related issues in the everyday practice of emergency medical rescue teams has lead the authors to conduct an analysis of their own material. The studied cases were analysed with reference to the sex and age of the patient, time of day and season characterised by the most frequent craniocerebral injuries, the causes of the injuries, the type of service provided (Basic Life Support or Advanced Life Support), the time it took to reach the destination and the method of treating the patient at the scene of the accident.

II. MATERIALS AND METHODS

This paper is a retrospective analysis of the craniocerebral injuries in the medical documentation of emergency medical rescue teams working in the Otwock district in the period of 1st January to 31st December 2009.

The factors analysed were: the sex and age of the patient, time of day and season characterised by the most frequent craniocerebral injuries, the causes of the injuries, the type of service provided (Basic Life Support or Advanced Life Support), the time it took to reach the destination and the method of treating the patient at the scene of the accident.

The statistical analysis was conducted using Statistica 10 software, the Student's t-test, the Wilcoxon rank sum test, the chi-squared test, chi-squared test for cross tabulation and the Cramér's V intercorrelation coefficient. All the tests were carried out on a significance level of α=0,05.

II. Results

In the period of the study (1st January to 31st December 2009), emergency medical rescue teams providing their services in the Otwock district were required to intervene 6937 times overall. Out of those, 502 cases of craniocerebral injuries that were in accordance with the criteria were selected for the study.

In the group of 502 patients, men were significantly more numerous. A total number of 329 medical interventions in the cases of male patients was recorded (66%). Women required emergency medical service 173 times, which amounts to 34% of all interventions needed because of craniocerebral injuries. The analysis showed that male sex is significantly related to the type of the injury (p<0,001; fig.1).

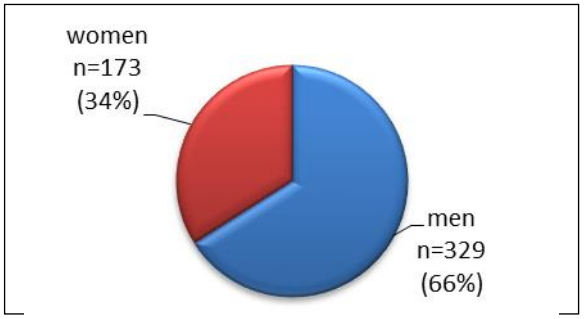

Figure injury

The age of the patients suffering from craniocerebral injuries varied between 3 months and 99 years of age. The mean value for all patients was 45,73±23,93 years of age. The mean age of women (51) was significantly higher than that of men (43). People aged between 50 and 59 as well as 20 and 29 formed the largest age groups, with 79 and 78 cases, respectively (it amounted to 16% of all in each case). It was followed by the group of 30-39 years of age (n=68, 14% of all) and 40-49 (n=65, 13% of all). The least numerous group was that over 90 (n=12, 2% of all). The analysis has indicated that the difference in the patients' ages was statistically significant (p<0,05; fig. 2 and 3).

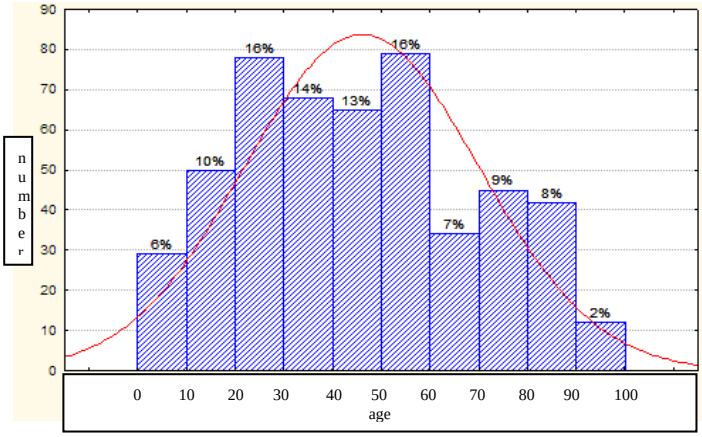

Figure 2. The age of the patients who suffered a craniocerebral injury

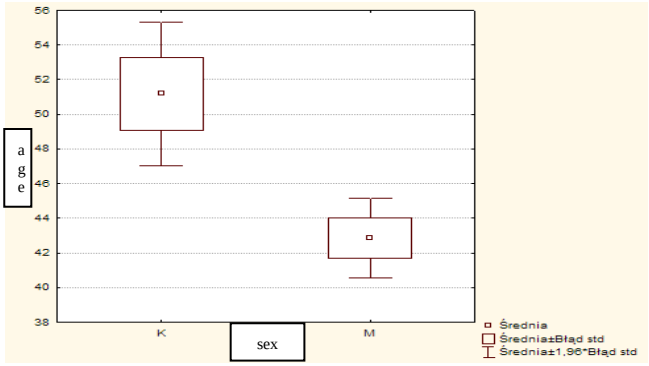

Figure 3. Average age of men and women in the studied material

The following part of the research was focused on the frequency of interventions with reference to the time of day (24 hours).

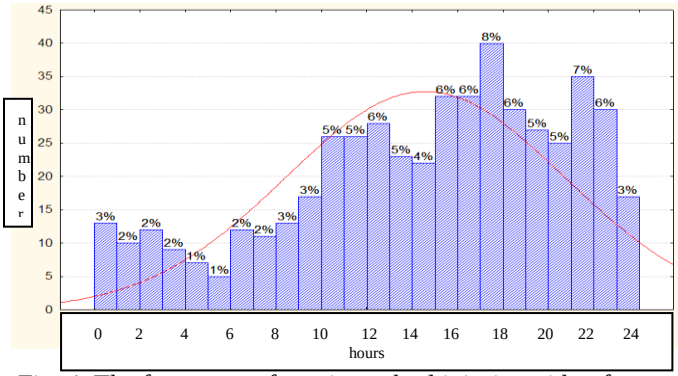

Fig. 4. The frequency of craniocerebral injuries with reference to the hours during the day

In the studied material, the peak of the intervention frequency was at 5 p.m. (n=40, 8% of all). The fewest cases were recorded between 4.00 and 4.59 a.m. (n=5, 1% of all). What is more, a further analysis based on the division into four separate groups: 0:00-5:59 a.m., 6:00-11:59 a.m., 12:00-5:59 p.m. and 6:00-11:59 p.m. showed that interventions were most frequent in the afternoon, between 12:00 and 5:59 p.m. (n=177, 35% of all). The chi-squared test indicated that there is a statistically significant difference it the intervention frequency between various times of day and night (p<0,01).

Furthermore, the frequency with reference to the time of the week was studies as well.

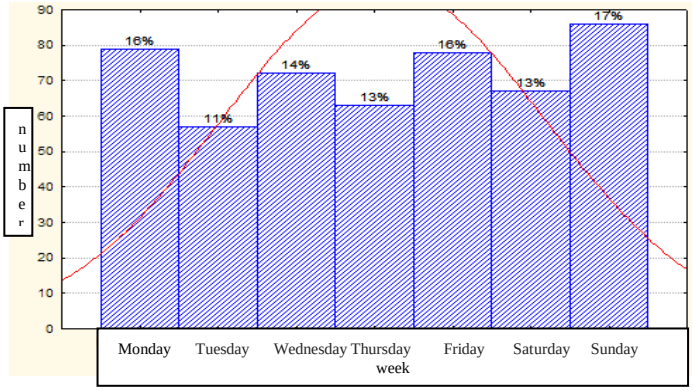

Figure 5. The frequency of craniocerebral injuries with reference to the day of the week

It was observed that craniocerebral injuries were most frequent on Sundays (n=86, 17% of all), Mondays (n=79, 16%) and Fridays (n=78, 16%). The fewest interventions were carried out on Tuesdays (n=57, 11% of all). There is a statistically significant correlation between the craniocerebral injury frequency and the day of the week (p<0,01).

What is more, the distribution of intervention frequency was also measured in relation to the time of the year (12 months).

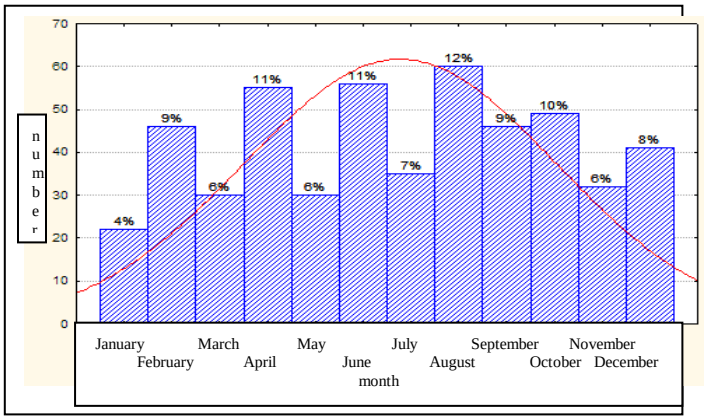

Figure 6. The frequency of craniocerebral injuries with reference to a month

Statistically significant differences between the frequencies of craniocerebral injuries in each month were observed (p<0,01). The most craniocerebral traumas were recorded in August (n=60, 12% of all), June (n=56, 11% of all) and April (n=55, 11% of all), while the fewest interventions were required in January (n=22, 4% of all).

An additional analysis that took into account the craniocerebral injury frequency with reference to the season showed, that the interventions were needed mostly in the summer, (n=151, 30% of all). A statistically significant correlation between craniocerebral injury frequency and the season was established (p<0,01).

Additionally, the circumstances in which the craniocerebral injuries were inflicted were studied.

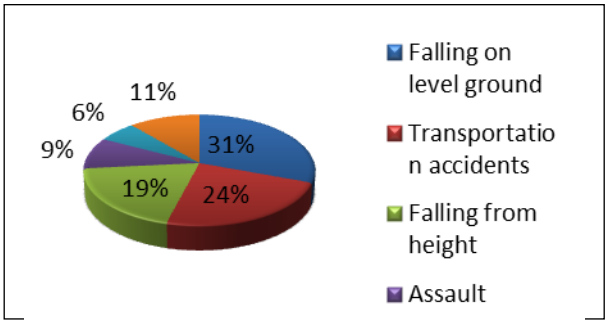

Figure 7. The circumstances of craniocerebral injuries

The research indicated that the greatest number of craniocerebral traumas were caused by falling on level ground (n=155, 30% of all). It was followed in terms of frequency by accidents in transportation (n=115, 23% of all). 97 suffered craniocerebral injuries as a result of falling from a height, which amounted to 19% of all medical interventions required because of craniocerebral injuries. This cause was followed by assaults (n=46, 9% of all). 30 people (6% of all) suffered craniocerebral injuries because of being hit by an object. 59 injuries were caused by other kinds of circumstances (11%) (p<0,01).

Also the type of service provided in the studied cases was analysed. It was observed that Basic Life Support was significantly (p<0,01) more frequent (n=355, 71% of all) than Advanced Life Support (n=147, 29% of all interventions).

Furthermore, the average time needed for the emergency team to reach the destination was studied.

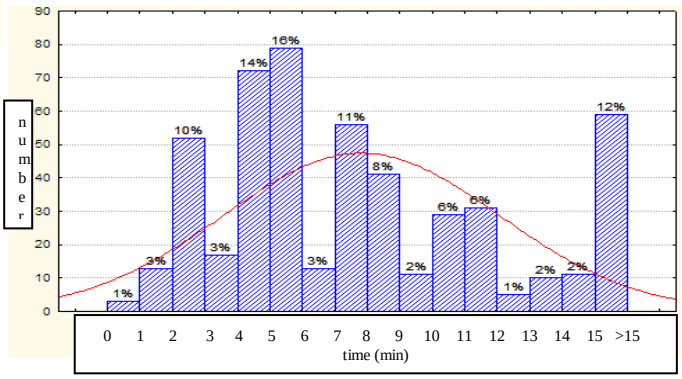

Figure 8. The time it took emergency medical rescue teams to arrive at the accident site

The longest time period needed to arrive at the accident site was 73 minutes. The most frequent one was 6 minutes (n=79, 16% of all). In 12% of the cases, more than 15 minutes (n=59) was needed (p<0,01).

11% of all medical interventions required in the cases of craniocerebral injuries ended with the patient remaining in the

place to which emergency medical service was called. In 446 cases (89%), the patient was transported to hospital; 62 patients were taken to hospitals outside the Otwock district ($p<0,01$).

III. DISCUSSION

The number of cases of craniocerebral injuries in Western Europe and the USA has been decreasing for two decades. It is the effect of preventive programmes implemented in those countries, whose objective is to limit the number of transportation accidents and the number of injuries themselves. Unfortunately, the situation is different in Poland. Among all the patients treated for injuries, head traumas are on the increase. The main causes of those injuries remain unchanged. However, it is emphasised that injuries are more and more often caused by transportation accidents and violence [1,6].

The material studied here was to a large extent consistent with the results obtained by other authors. In our studied group, men were dominant 66% of all patients. The dominance of men, ranging from 62 to 79% of the craniocerebrally injured, has also been observed by other authors (Paiva – 62% [7], Mortensen – 63% [4], Kleiven – 67,7% [8], Gassner – 68% [9], Jackiewicz 68,5% [3], Cadotte – 69,6% [2], Hussaini – 79% [10]). In the study of Gandhi the dominance of men over women is even more visible as it amounts to the ratio of 6,6:1[11].

The authors of this study found out that the men who suffered head injuries were significantly younger than the women (the mean age of men was 43, while that of women was 51).

This type of trauma was especially frequent in two age groups, i.e. that of 50-59 years of age as well as 20-29 years of age. The patients in each of those groups amounted to 16% of all studied cases. The lowest number of head injuries pertained to those over 90 years old (2%), which most probably stems from the fact that people over 90 are not too numerous in the Polish population. The results of our study suggest that there is a tendency to get head injuries at younger age, which overlaps with the findings of Paiva [7]. Nevertheless, some observations are inconsistent with that – for example the study by Chiu [12]. This author claims that craniocerebral injuries are predominantly a problem of the elderly. Such discrepancies may stem from the specificity of each patient material.

The literature on this subject relatively rarely analyses the frequency of head injuries in relation to different months and seasons. Our observations indicate that head injuries are most common in the months of August and June. Injuries were significantly more frequent in summer months than in winter. Similar findings were described, among others, by Duusa, who showed that there was the increase in the frequency of head injuries in spring and summer [13]. The authors' own study shows that the days of the week that are most likely to bring craniocerebral injuries are Sundays, Mondays and Fridays. The frequency of craniocerebral injuries on these days is comparable.

As the authors of the current study managed to establish, the highest frequency of head injuries falls on afternoon hours (5-6 p.m.), which may be a result of increased activity in the population (coming back from work etc.).

In the patient material studied here, the most frequent cause of the head injuries was falling from heights (50% of all causes). Accidents in transportation accounted for every fourth injury, while violence was the cause of almost every tenth trauma. These results are in accordance with the data presented by other authors. Two instances of those include Ingebrigtsen's (falling from height - 62%, accidents in transportation - 21%, violence - 7%)[14] and Agrawal's studies (falling from height - 65%, accidents in transportation - 25,6%, violence - 9,4%) [15]. Nevertheless, other data may also be encountered – for instance in Cadotte's study accidents in transportation are a dominant cause (60,3%)[2].

The effectiveness of first aid in the cases of personal injuries is dependent, of course, on the severity and seriousness of those injuries, but also on the time after the accident in which the injured can be reached by an ambulance. Our study indicates that emergency service was provided quite timely. Almost every other craniocerebrally injured patient was reached within 6 after the accident. However, the upsetting fact is that almost every tenth patient had to wait at least 15 minutes after the accident. It is virtually natural that the vast majority of craniocerebrally injured patients studied here were taken to hospital to be treated. Nevertheless, it is puzzling that every tenth injured person chose to remain at the accident site – in each of those cases, rescue workers were handed a written refusal to be treated or taken to hospital.

The study results presented here indicate that the Medical Rescue Act was by no means a panacea for all rescue services. Alongside numerous benefits, such as the design of standard procedures for rescue workers in emergency or Minister of Health regulation on hospital emergency wards, there is still a space that needs to be filled with fully developed standards and procedures.

IV. CONCLUSIONS

1. Craniocerebral injuries are inflicted predominantly on men aged between 50 and 59 as well as 20 to 29.
2. The frequency of craniocerebral injuries is increased in a statistically significant manner in summer (mainly in

August and June), on Sundays, Mondays and Friday and in the afternoon (5 to 6 p.m.).

3. Almost every other patient was provided with emergency medical service within 6 minutes after the accident. However, in every tenth case, it took no less than 15 minutes since the accident for the rescue team to arrive.
4. Every tenth patient who suffered a craniocerebral injury strongly refused to be treated and transported to hospital.

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