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The Most Frequent Complications after Cranio-cerebral Injuries in Children Hospitalized at the Department of Paediatric Surgery

Najczęstsze powikłania po urazach czaszkowo-mózgowych u dzieci hospitalizowanych na oddziale chirurgii dziecięcej

Małgorzata Kołpa¹, Aneta Grochowska¹, Beata Jurkiewicz¹, Renata Wolny²

¹Institute of Health Sciences, State Higher Vocational School in Tarnów, Poland

²Graduate student of Institute of Health Science, State Higher Vocational School in Tarnów, Poland

Abstract

Introduction. Head injuries among children are the most frequent cause of hospitalization. Posttraumatic cranio-cerebral damage in children can lead to the occurrence of partial physical and mental disorders and in some cases prevent proper functioning of the organism.

Aim. The goal of this research was to study the frequency of complication occurrence among children after cranio-cerebral traumas as well as to determine the character they most often take on.

Material and Methods. The study was conducted at Paediatric Surgery Outpatient Clinic at the St. Luke District Hospital in Tarnów. It included 150 children hospitalized at the Department of Paediatric Surgery within the period from July to October 2015 due to sustained cranio-cerebral injuries ranging from minor and moderate to severe.

Results. The most frequent causes of sustained injuries were sport-related ones as well as those resulting from a fall from height. Among the vast majority of the children with an injury (95%) an early posttraumatic complication occurred in the form of concussion. The most often demonstrated early side symptoms of sustained injury included: emesis (80%), poor well-being and headache (69%) as well as drowsiness and changes in behavior (53%). The most frequent late complication was posttraumatic cerebraesthesia characterized by headache, memory disorders and problems with concentration. In the study group of children with an injury, poor well-being and headache were experienced by approximately 50% of the patients one week following the hospital discharge and by approximately 20% one month after the discharge.

Conclusions. The demonstrated early and late side symptoms observed among children with an injury, when properly treated and controlled, with time tend to decrease and thus contribute to comforting statistics of occurrence of a small number of serious complications following minor and moderate to severe cranio-cerebral injuries. (JNNS 2017;6(3):107–113)

Key Words: cranio-cerebral injury, children, medical rescue

Streszczenie

Wstęp. Urazy głowy u dzieci są najczęstszą przyczyną hospitalizacji. Pourazowe uszkodzenia czaszkowo-mózgowe dzieci mogą prowadzić do wystąpienia u nich częściowych zaburzeń fizycznych lub psychicznych a w niektórych przypadkach uniemożliwiać prawidłowe funkcjonowanie organizmu.

Cel. Zbadanie częstości występowania powikłań u dzieci po urazach czaszkowo-mózgowych oraz określenie jaki przybierają one najczęściej charakter.

Materiał i metody. Badania przeprowadzono w Poradni Chirurgii Dziecięcej w Szpitalu Wojewódzkim im. św. Łukasza w Tarnowie. Badaniem objęto 150 dzieci hospitalizowanych na Oddziale Chirurgii Dziecięcej w okresie od lipca do października 2015 r., z powodu doznanych lekkich lub średniociężkich urazów czaszkowo-mózgowych.

Wyniki. Najczęstszą przyczyną doznanych obrażeń były urazy sportowe oraz upadki z wysokości. U zdecydowanej większości dzieci urazowych (95%) wystąpiło wczesne powikłanie po urazie w postaci wstrząśnienia mózgu. Najczęściej występującym wczesnym objawem ubocznym doznanego urazu głowy były wymioty (80%), złe samopoczucie i bóle

głowy (69%) oraz senność i zmiany w zachowaniu (53%). Najczęstszymi późnymi powikłaniami była celebrastemia pourazowa, charakteryzująca się bólami głowy, zaburzeniami pamięci i problemami w koncentracji. W badanej grupie dzieci urazowych złe samopoczucie i bóle głowy tydzień po wypisie ze szpitala odczuwało około 50% pacjentów, a miesiąc po wypisie około 20%.

Wnioski. Występujące wczesne i późne objawy uboczne zaobserwowane u dzieci urazowych, odpowiednio leczone i kontrolowane z czasem mają tendencję do zmniejszania się i dzięki temu przyczyniają się do pocieszającej statystyki występowania małej ilości poważnych powikłań po lekkich i średnich urazach czaszkowo-mózgowych. (PNN 2017;6(3):107–113)

Słowa kluczowe: uraz czaszkowo-mózgowy, dzieci, ratownictwo medyczne

Introduction

The 21st century constitutes the time of technological progress through development of mechanisation of everyday life and means of communication. On the one hand, this brings an improvement of the standard of human life whereas on the other hand this causes that a very young person is exposed to numerous factors that may cause life-threatening injuries of the body. Children and teenagers constitute a special group that is particularly exposed to accidents. In our country it is estimated that approximately 1 million of them sustain various types of injuries every year. The head injury is the most dominant injury of the body. The most frequent head injuries that children are subject to are caused by falls from heights and traffic accidents as well as various cranio-cerebral injuries caused by being hit by a car, battery and other. They are the cause of deaths of larger numbers of children than the total number of all other childhood diseases [1].

Post-traumatic brain injury is one of the causes of acquired neurological and mental disorders in children in Poland. It constitutes an important socio-medical problem as sustained injuries may lead to the permanent physical or mental disability as well as result in losses due to inability to work. The increasing number of injuries in children are the subject of interest of numerous centres in the world, led by the World Health Organization. The significance of the issue is vast, which is unanimously emphasized by the authors dealing with this issue. They indicate that injuries in children constitute a considerable problem of the social health and they are the largest epidemic of the contemporary well-developed societies [2].

The objective of the thesis was to examine the prevalence of complications in children and teenagers hospitalised at the Department of Paediatric Surgery after the cranio-cerebral injuries.

Material and Methods

The method of the analysis of the medical documentation of the patients hospitalized at the

Department of Paediatric Surgery was applied in the thesis. Taking into account the research problem that has been presented below it was necessary to adjust the research tool in the form of the database from the medical documentation of the patients from the Paediatric Surgery Outpatient Clinic where the patients are controlled at least twice after discharge from hospital. The first control appointment is arranged in a week after hospitalization, the second one after a month.

The basic descriptive statistics and statistic tests have been used. The comparison of the values of the qualitative variables in groups was performed using the chi square test (with Yates' correction) and precise Fisher test. The comparison of the values of the quantitative variables in two groups was performed using Student's t-test or the Mann-Whitney test. Comparison of the values of the quantitative variables in three and more groups was performed with the application of analysis of variance or the Kruskal-Wallis test. When this comparison confirmed statistically significant differences, post hoc analysis using the HSD Tukey test or the Mann-Whitney test with the Bonferroni correction was carried out. Correlation between two quantitative variables was analysed using the Pearson or Spearman coefficient. Normal distribution of variables was examined with the application of the Shapiro-Wilk test. In the analysis statistical significance at the level of 0.05 was defined. The analysis was performed in the R programme, version 3.2.3.

The place of the conducted research was Paediatric Surgery Outpatient Clinic at the St. Luke District Hospital in Tarnów. The research was carried out within the period from July 2015 to October 2015 and it included 150 children who were hospitalized after sustained mild or moderately severe cranio-cerebral injury. The consent for conducting the research and analysis of the medical documentation was obtained from the Director of the District Hospital in Tarnów.

Results

In the group of examined children the age of children hospitalised due to injuries ranged from the second month of life to the age of 17. The average age of patients (in years) was 6.64.

Among the examined children the most frequent cause of the head injury was a sport-related injury (31.33%), next a fall at the same level (24.67%), falls from height constituted the same percentage (24.67%), traffic accidents were the least frequent cause (19.33%).

Vomiting (80.00%) and headaches (69.33%) constituted the most dominant side effects after the head injury during hospitalization, excessive drowsiness (53.33%), changes in behaviour (44.67%), memory disorders, time and place of the injury (36.00%) occurred to a lesser extent. In a few cases, there were head wounds (19.33%), pathological discharge from the ear or nose (10.00%) and vision disorders (7.33%). Balance and gait disorders (2.67%), neurological disorders (1.33%) and paresis, numbness and convulsions (0.67%) constituted a small proportion. Percentages do not equal 100% as this was a multiple-choice question.

In the vast majority of the cases (80.00%) there was not a loss of consciousness during the head injury in children and in 30 children (20.00%) there was a short-term loss of consciousness. In the vast majority of cases (98.00%) consciousness was assessed as good, moderate condition was diagnosed in the remaining 2.00% of children. None of the children was in a severe condition.

The vast majority of children after sustained head injuries (88.00%) were subject to immediate hospitalisation and only 12.00% of children were hospitalised after several days following the sustained injury. For diagnostic purposes hospitalised children had an X-ray examination of the skull (73.33%), CT examination of the head (46.67%), transfontanelar ultrasound examination (14.67%) performed.

The most frequent specialist consultation in hospitalised children after the cranio-cerebral injuries was an ophthalmological consultation (70.00%), neurological consultation (13.33%) was conducted to a lesser extent. Laryngological consultation took place in only 8.00% of the traumatic patients of the department of paediatric surgery and only 4.00% of the patients required neurosurgical consultation.

The vast majority of the traumatic children suffered from concussion (95.33%) and in 2.67% of the patients the presence of pericerebral hematoma was confirmed whereas in about 1.33% of the patients there appeared subgaleal hematoma and in 0.67% there was subarachnoid hematoma. In the examined group of children there did not occur hematoma and subdural hematoma (Table 1).

In the group study group of children there were not fractures within the scope of bone structures of the skull (79.33%), in 8.00% of the children there was an injury of the facial skeleton, in 4.67% of the children there was a fracture of the temporal bone, in 4.67% of the children there was a fracture of the frontal bone and in the remaining 2.67% there was a fracture of the occipital bone.

During the first control appointment at the paediatric surgery outpatient clinic after a week from following discharge from hospital, in 46.67% of the children the following were reported: malaise and headaches, and in 1.33% there were positive neurological signs (focal and meningeal) (Table 2).

During the second control post-hospital appointment arranged after a month following completed hospitalisation, the side effect after the injury in the form of malaise and headaches was reported by 18.67% of the examined patients (Table 3).

Table 1. Type of intra-cranial lesions

Type of intra-cranial lesions	N	%
Concussion	143	95.33
Subdural hematoma	0	0.00
Extradural hematoma	0	0.00
Subarachnoid hematoma	1	0.67
Subgaleal hematoma	2	1.33
Pericerebral hematoma	4	2.67

Table 2. The first post-hospital appointment — a week after discharge from department

Signs during the first post-hospital appointment	N	%
Positive neurological meningeal signs	2	1.33
Positive neurological focal signs	2	1.33
Pathological reaction of pupils	0	0.00
Malaise, headaches	70	46.67

Table 3. The second post-hospital appointment — a month after discharge from department

Signs during the second post-hospital appointment	N	%
Positive neurological meningeal signs	1	0.67
Positive neurological focal signs	1	0.67
Pathological reaction of pupils	0	0.00
Malaise, headaches	28	18.67

The influence of socio-demographic factors, such as: age, gender and place of residence on the occurrence of the post-traumatic lesions in children hospitalised due to cranio-cerebral injuries was subject to analysis. In the study group of children at the age of up to 2, to a small extent — in 7.41% — there were injuries within the bone structures, in the group of children at the age ranging from 3 to 10 there were injuries of bone structures in 18.37% and the highest percentage (38.30%) was observed in the group of children at the age of over 10. The statistical analysis has confirmed that age influences prevalence of complications within the scope of bone

structures ($p=0.001$). It has turned out that frequency of this type of injuries increases with age.

The injury within the scope of bone structures occurred in 14.93% of girls and 25.30% of boys. Gender of the child does predispose to the occurrence of complications after the an injury in the form of cranial fractures ($p>0.05$).

Among the children coming from the city, 18.37% of them sustained the injury within the bone structures and in 81.63% there were not any cranial injuries. Among the children living in the country, 21.78% sustained the injuries of bone structures and in 78.22% there were not any cranial injuries. Statistically, the place of residence did not have a considerable influence on the occurrence of the injury within the scope of bone structures of the cranium ($p>0.05$). The cause of injury had a significant impact on occurrence of fractures within bone structures ($p=0.009$). Injuries of bone structures of the head occurred in 41.38% of the children during the traffic accident, in a lesser extent — in 21.28% of the children — after sustained sports injuries and in 21.28% of the children the sustained injury was a result of the fall at the same level whereas the smallest percentage of children (8.11%) sustained the injury resulting from a fall from height.

The statistical analysis has confirmed that the cause of injury did not have a significant effect in the type of intra-cerebral lesions ($p=0.874$).

It has been proved that disorders of memory, time and place as well as head wounds occurred in patients with injuries of bone structures of the cranium more frequently whereas excessive drowsiness in patients without this type of injuries (Table 4).

The statistical analysis has confirmed that the type of intracranial lesions is not significantly related to the occurrence of the side effects ($p<0.05$).

State of consciousness of the patient (up the third year of life) significantly depended on the occurrence of an injury within bone structures of the cranium ($p=0.021$). Children who sustained this type of injury were — at the same time — in worse health condition (they obtained fewer points scored on the Raimondi scale).

Dependence of occurrence of the injury within bone structures and the state of consciousness of the older patient (above the third year of life) according to the Glasgow Coma Scale was subject to the analysis. It has been confirmed that the patient's condition is significantly related to the injury within the bone structures ($p<0.001$). In the event of diagnosing this type of injury, the patient's condition was worse (fewer points on the Glasgow Coma Scale).

It has been stated that the patient's condition (children up to the third year of life) (according to the Raimondi scale) did not significantly depend on the cause of injury ($p=0.838$). Similarly, the relationship between the condition of older patients (above the third year of life) according to the Glasgow Coma Scale and the cause of sustained injury ($p=0.076$).

While examining the relationship in the patients with the injuries within the bone structures and without the injury and pathological signs appearing during the first control appointment it was stated that the patients with injuries within the bone structures and patients without such injuries differed with prevalence of positive neurological meningeal signs ($p=0.042$) as well as malaise and headaches ($p=0.004$): they occurred in patients with injuries more frequently.

The analysis of the same relationship during the second control appointment confirmed that patients with the injuries within the bone structures and patients without such injuries differed with prevalence of malaise and headaches ($p<0.001$): they occurred in patients with the injuries more frequently.

The relationship between the occurrence of neurological side effects during the second control appointment and post-traumatic lesions, e.g. concussion and others were subject to the research. Patients with concussion and patients with other lesions differed with prevalence of these signs; positive neurological focal lesions occurred in patients with other lesions more frequently ($p<0.047$). Positive neurological meningeal signs as well as malaise, headaches were not related to concussion and other lesions ($p>0.05$).

Table 4. Injury within bone structures vs. side effects

Side effects	Injuries		Lack		p**
	N	%*	N	%*	
Vomiting	26	83.87	94	78.99	0.724
Headaches	24	77.42	80	67.23	0.38
Vision disorders	5	16.13	6	5.04	0.051 F
Neurological disorders	0	0.00	2	1.68	1 F
Balance and gait disorders	0	0.00	4	3.36	0.581 F
Changes in behaviour	9	29.03	58	48.74	0.078
Disorders of memory, time and place	17	54.84	37	31.09	0.025
Convulsions	0	0.00	1	0.84	1 F
Excessive drowsiness	10	32.26	70	58.82	0.015
Head wound	14	45.16	15	12.61	<0.001
Discharge from nose/ear	5	16.13	10	8.40	0.197 F
Paresis, numbness of limbs	0	0.00	1	0.84	1 F

* Percentages do not equal 100% as this was a multiple-choice question, ** Chi-square test, F precise Fisher test (low expected results in the table)

Discussion

Disease at an early age is an inevitable and basically normal phenomenon constituting an inseparable element of childhood [3,4]. Injuries the results of which constitute the main cause of life-and-health threatening conditions are the most dangerous among diseases characteristic for childhood [5,6]. The injuries of the motor organ and cranio-cerebral injuries are the most dominant among injuries [5]. According to the World Health Organization, head injuries constitute 50–80% of all injuries. In Poland this percentage is noted at the level of 30–40% [7,8]. “A traumatic child” is every fourth patient hospitalised at the department of paediatric surgery. Almost 25% of these cases are life-threatening conditions or conditions causing permanent health impairment [9].

In this research it has been proved that among traumatic children hospitalised at the department of paediatric surgery boys prevailed (approximately 55%). Similarly, in the research conducted by Janczewska et al. [10] as well as Kalińska-Lipert et al. [1], boys constituted the majority of patients. The study carried out at Hospital Emergency Department in Radom by Szarpak confirms that among the patients with cranio-cerebral injuries, boys prevailed over girls (67% vs. 33%) [11]. Most probably, this results from higher physical activity of boys and their higher temper.

While analyzing the number of the head injuries occurring depending on the place of residence, predominance of the injuries sustained by children in the country than in the city (67% vs. 33%) was confirmed. Similar results were obtained by Piłśniak and Ślusarz [12]. Reverse results were obtained by Janczewska et al. who — while analyzing the medical documentation from the period between 2011 and 2012 — proved that among the patients of the Hospital Emergency Department of the University Children’s Clinical Hospital in Białystok children from urban areas dominated (about 73.0%) [10]. Also, Szarpak stated that children and teenagers living in the cities (63%) sustained injuries more frequently than children living in the country (37%) [11].

The analysis of the own research has confirmed that the most frequent cause of sustained injuries among examined children was a sports injury (31%), afterwards a fall at the same level and falls from the height (25% each, respectively), to a lesser extent traffic accidents (19%). The research conducted by Radlica et al. proves that the most frequent cause of injuries was a fall from height (27.0%), fall from the same level (24.4%) and hitting an object (21.6%) [13]. Results of the research carried out by Kalińska-Lipert et al. confirm that cranio-cerebral injuries were most frequently the result of a fall

from height (28.8%), being knocked down by a vehicle (24.9%) and fall at the same level (17.2%) [1].

The effects of an injury can be visible directly after the injury, they may reveal after several days, months and even years. In the examined children after the cranio-cerebral injuries, fractures within bone structures of the cranium (79%) were not confirmed in general.

The vast majority of traumatic children hospitalised at the Department of Paediatric Surgery (95%) were diagnosed with concussion and in 2.5% the presence of a subdural hematoma was confirmed whereas in approximately 1.3% there appeared a subgaleal hematoma. The research conducted by Kalińska-Lipert et al. cerebral edema which was isolated or accompanied other forms of injuries of this part of the body affected 15.3% of the patients. Fracture of the cranial bones was confirmed in 3.4% and intra-cranial hematomas were confirmed in 6.1% of the patients [1].

While analyzing the problem of injuries in children taking into account the social aspect, particular attention must be paid to growing awareness of parents regarding the necessity of examining the child after the injury by proper healthcare facilities. Own research has proved that the vast majority of children after head injuries (88%) were subject to immediate hospitalisation. While analyzing the own research within the scope of imaging diagnostics, X-ray examination of the cranium dominated (about 73%), to a lesser extent — CT examination of the head (about 47%) and transfontanelar ultrasound examination was performed in about 15% of hospitalised children. The research conducted by Dzienis-Koronkiewicz et al. confirms that CT examination of the head has become an actual ‘golden standard’ also performed to monitor uncertain cases and assess the effects of surgical treatment [14].

The fact of unpredictability of possible complications and late consequences of the injuries is alarming. The analysis of own research in traumatic children has proved that among the side effects after the head injury during hospitalization the following dominated: vomiting (80%) and headaches (69%), to a lesser extent — excessive drowsiness following the injury (53%). The research carried out by Rożek et al. confirms that the examined patients most frequently complained of headaches (49%), dizziness (27%) and the feeling of fatigue (31%) in relation to the ailments related to the injury [15].

The information gathered during the first control appointment at the Paediatric Surgery Outpatient Clinic after the week following discharge from hospital was subject to analysis malaise and headaches were confirmed in about 47% of the children. During the second control post-hospital appointment arranged in a month after completed hospitalisation the same signs were reported by about 18% of examined patients. The research conducted by Rożek et al. present the health condition

of the patients after 12 weeks following the injury. It shows that mood disorders, hyperactivity and nervousness were present in 4% of the patients, the same percentage reported disorders of the short-term memory and attention problems [15].

The conducted analysis of the reviewed material and data available from literature confirms that injuries sustained by children constitute an important medical, social and economic problem. Increased mechanization of daily life as well as considerable mobility and activity of children influence an increase in frequency of injuries [16]. Many children who sustained injuries have become disabled until the end of their lives, which significantly makes their functioning in the social life difficult. An economic aspect of injuries is related to the costs of treatment and rehabilitation of their victims. These are expenses that could be avoided in most cases by implementing proper preventive programs aimed at avoiding the occurrence of injuries among children [17].

Conclusions

Prevalence of injuries within the scope of bone structures of the cranium increases with age of the children. Gender and place of residence do not have an influence on the presence of post-traumatic lesions.

The condition of the patients is not related to the cause of sustained injury.

Injuries of bone structures of the cranium influence health condition of children and side effects of the injury, such as: memory disorders, time and place as well as head wounds.

The occurrence of malaise and headaches during the control appointments was related with the sustained injury of the cranial structures.

The present early and late side effects observed in traumatic children which are properly treated and controlled have a tendency to decrease with time and therefore they contribute to the comforting statistics of occurrence of a small number of complications after the mild and moderate cranio-cerebral injuries.

Implications for Nursing Practice

Cranio-cerebral injuries constitute severe systemic diseases which requires complex treatment. Only professional procedures performed by highly-qualified staff give chances to save lives of young patients and regain their health. While taking care of a child after the cranio-cerebral injury, persistence in the proper nursing, respecting children's rights, providing emotional support to families and their guardians is the most important thing. This requires appropriate attitude,

involvement and occupational effort from nurses without whom it is difficult to implement the objectives of nursing care. It is very important to broaden prophylaxis of complications of the injuries by training parents and teachers within the scope of skills regarding recognition of alarming side effects after cranio-cerebral injuries.

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Corresponding Author:

Aneta Grochowska
Institute of Health Sciences
State Higher Vocational School in Tarnów
ul. Mickiewicza 8, 33-100 Tarnów, Poland
e-mail: apea1@op.pl

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Author Contributions: Małgorzata Kołpa^{A, C, D, G, H}, Aneta Grochowska^{B-F}, Beata Jurkiewicz^{C, D, F}, Renata Wolny^{B, C, F}
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