ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN — POLONIA
VOL. LIV, 17 SECTIO D 1999

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Risk factors in patients after severe head injury

Czynniki ryzyka u pacjentów po ciężkich urazach głowy

We attribute great importance to determining the prognosis of severely head-injured patients.

In the surveys of patients presented here, the factors of greater prognostic significance have been studied as a contribution to the common goal of identifying methods for the stratification of cases into homogeneous classes of injury severity. Many clinical factors have been shown to predict the outcome in patients with head injury. Numerous studies have indicated that these important factors are: patients' age, admissions acc. to Glasgow Coma Scale score, motor responses, pupillary responses and the presence of associated injuries, hypotension, hypoxia and certain intracranial hemorrhages.

According to statistical research, central nervous system trauma amounts to 12% of all trauma injuries and in case of multiple trauma this number rises to 60%. On the other hand, the latest progress in medical science allows save life of many people even if they have had severe head injury with very low admission according to Glasgow Coma Scale (GCS).

Unfortunately disability and deaths caused by head injury in most cases are related to young, socially active people and treatment and rehabilitation of trauma victims require high social and economic cost. So then, worldwide intensive research on traumatic brain injury is carried on (1, 8, 11, 14).

Many authors (5, 7, 9, 10) underline that early identification, intensive treatment and monitoring of risk factors can improve outcome and save life of many victims with head trauma. Recently secondary brain injury and injury of other body regions concomitant of head injury are considered main risk factors which adversely affected head injury outcome. A very important risk factor is also time after injury in which proper resuscitation procedure and intensive emergency care are introduced.

The purpose of this study was: to determine the risk factors which adversely affected head injury outcome and which are responsible for high mortality and number of unsatisfactory results in this group of patients.

MATERIAL AND METHODS

Description of material: Traumatology Department of Medical University in Lublin take care about the population of 140 thousand Lublin inhabitants and a few villages situated near Lublin. Head injury, isolated or concomitant injuries of the other part of the body, make quite large number of all traumas. In hospital emergency treated 6,485 patients with head injury (it is 20.4% of all injuries) and 1,266 of them require hospitalisation (it is 16.3% patients treated in Traumatology Department. 274 of the patients had admission according to Glasgow Coma Scale (GCS) lower than 14 and this group of patients were investigated in this study.

Assessment of outcomes: The functional outcomes were estimated on the day of discharge from the hospital according to Glasgow Outcome Scale. This scale consists of five categories: good recovery, moderate disability, severe disability, persistent vegetative state, dead. Disability was defined according to international WHO classification (15). For purposes of statistical analysis, the good and moderate disability categories and severe vegetative and vegetative categories were combined. Severity of injury were estimated according to Injury Severity Score (ISS) (4 to 75 points).

Statistical analysis: Chi–squared tests were performed on variables previously known to affect outcome. Results were considered as statistically significant when probability was lower than 0.05 ($p < 0.05$).

RESULTS

There were determined the following risk factors:

Multiple injuries. The outcome of patients with cranio–cerebral injuries with injuries of other regions of the body was far worse than that of patients with isolated head injury (25.4% v. 10.9%) (Tab. 1).

Tab. 1. Influence of concomitant injuries and loss of consciousness (GCS ≤ 14) on treatment outcome

Head injury with loss of consciousness	992	20	2.0	98.15	< 0.001
Head injury with loss of consciousness	274	47	17.2		
Isolated cranio-cerebral injuries	156	17	10.9	9.98	< 0.01
Cranio-cerebral injuries with concomitant injuries of other body regions	118	30	25.4		

χ^2 – Chi–square test, p – probability

Severity of injury in cases of patients with multiple injury had statistically significant correlation with mortality rate, 51.3% of patients with ISS higher than 50 points died while in the group with ISS 20–50 points the mortality rate was 20.2% and in the group with 4–19 points only 1.9% (Tab. 2).

Tab. 2. Statistical analysis severity of injury according to Injury Severity Score (ISS) and outcome according to Glasgow Outcome Scale (GOS)

ISS / GOS	4 – 19		20 – 50		> – 50		Total	
	n.	%	n.	%	n.	%	n.	%
Good or moderate disability	104	c 96.3	82	b 63.6	7	a 18.9	193	70.4
Severe disability or vegetative	2	a 1.9	21	b 16.3	11	b 29.7	34	12.4
Dead	2	a 1.9	26	b 20.2	19	c 51.3	47	17.2
Total	108	100%	129	100%	37	100%	274	100%
% of studied group	39.4		50.7		13.5		100	

Percentage in GOS groups different with statistic significance ($p < 0.05$), if the upper index is not the same letter

Hypotension and hypoxia. Hypotension (RR < 95 mm Hg and hypoxia $pO_2 < 60$ Hg) irrespective of whether they exist together or individually, are responsible for higher mortality rate in patients with cranio–cerebral injuries compared with patients who have had neither hypovolemia nor hypoxia (Tab. 3).

Radiological signs of high intracranial pressure are the next important risk factor in the studied group. Patients with radiological signs of high intracranial pressure visible in initial CT scans have significantly ($p < 0.05$) higher mortality and higher number of worse results (52.0% v. 8.9% deaths and 28.0% v. 8.9% severe disability or persistent vegetative state) than patients without such intracranial pathology (Tab. 4, Fig. 1).

DISCUSSION

The secondary brain injury seems to have a very important influence on outcome after cranio–cerebral injuries (4, 13). In contrast to primary brain injury, which is out of medical control because they come to exist in place of accidents, the secondary brain injury starts later and proper treatment and prevention make possible to improve the outcome and sometimes save someone's life. The main important factors responsible for secondary brain injury are hypotension and hypoxia. According to large samples studies (13) these factors were confirmed as an independent prognostic factors connected with almost two times higher mortality in contrast to patients groups who have no hypotension or hypoxia. So that many authors pointed out the importance of early intubation and oxygen supply in unconscious patients not only as a treatment method, which is obvious, but also as prevention in patients who have no clinical signs of hypoxia (1, 2, 3).

Tab. 3. Influence of hypotension (BP < 95 mm Hg) and hypoxia (p O_2 < 60 mm Hg) on treatment outcome according to Glasgow Outcome Scale (GOS)

Patients group	Group A		Group B		Group C		Group D	
Outcome in GOS	n.	%	n.	%	n.	%	n.	%
Good or moderate disability	22	b 53.7	6	b 46.1	4	a 12.5	161	c 85.6
Severe disability or vegetative	9	b 22.0	3	b 23.1	12	b 37.5	10	a 5.3
Dead	10	b 24.4	4	bc 30.8	16	c 50.0	17	a 9.0
Total	41	100	13	100	32	100	188	100
% of 274	15	–	4.7	–	11.7	–	68.6	–

Percentage in GOS groups are different with statistic significance ($p < 0.05$), if the upper index is not the same letter

Group A – only RR < 60 mm Hg (p O_2 normal). Group B – only pO2 < 95 mm Hg (RR normal). Group C – RR < 60 mm Hg and p O2 < 95 mm Hg. Group D – neither RR < 60 mm Hg not p O_2 < 95 mm Hg.

The role of injuries of other regions of the body concomitant of head injury is very important treatment process and has a great influence on final treatment outcomes (4, 6, 8, 10, 12). The reason of these facts is that patients with multiple injuries are much more exposed to secondary brain injury than patients with isolated head injury. The authors confirmed that the higher severity of injury is, the worse outcome and the highest mortality rate are noticed in the studied group.

Many authors (8, 11) underline that radiological signs of high intracranial pressure visible in initial CT have negative influence on treatment results of patients allter head injury. Brain oedema with totally compressed brain ventricules and/or midline shift displacement more than 5 mm, intracranial hematomas with midline shift displacement more than 5 mm, multiple area of brain contusion, or brain steam contusion are the group of intracranial pathology which could predict unfavourable treatment results.

CONCLUSIONS

The main risk factors responsible for high mortality and increase in the number of unsatisfactory outcomes are: multiple injuries concomitant with head injury (ISS > 50 points), hypotension and/or hypoxia in the first few hours after trauma, radiological signs of high intracranial pressure visible in the initial CT scans.

Tab. 4. Influence of intracranial pathology visible in initial CT on outcome according to Glasgow Outcome Scale (GOS)

Intracranial pathology Outcome in GOS		Group A	Group B	Group C	Total
Good or moderate disability	n.	37	24	5	66
	%	82.2 c	57.1 b	20.0 a	58.9
Severe disability or vegetative	n.	4	4	7	15
	%	8.9 a	9.5 a	28.0 b	13.4
Dead	n.	4	14	13	31
	%	8.9 a	33 b	52.0 b	27.7
Total	n.	45	42	25	112[x]
	%	100	100	100	100

Percentage in GOS groups are different with statistic significance ($p < 0.05$), if the upper index is not the same letter.

[x] 112 of 274 patients had computed tomography made in the first 24 hours after injury. Group A – no visible pathology, – brain oedema without midline shift displacement, no compression in brain ventricules – no intracranial hematomas, – no brain contusions. Group B – brain oedema, brain ventricles compressed but visible and/or midline shift displacement 0–5 mm, intracranial hematomas and/or midline shift displacement 0–5 mm, single areas of brain contusions. Group C – brain oedema with totaly compressed brain ventricules and/or midline shift displacement more than 5 mm, – intracranial hematomas with midline shift displacement more than 5 mm, multiple area of brain contusion, or brain steam contusion.

Intensive resuscitation and proper diagnostic methods of patients with cranio–cerebral injuries can prevent secondary brain injury and improve the outcome.

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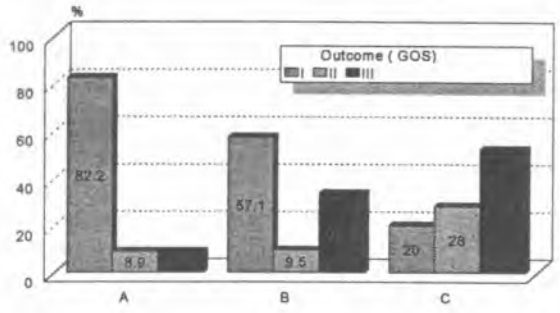

Fig. 1. Radiological signs of high intracranial pressure visible in initial CT and treatment outcome

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Otrz.: 1999.07.28

STRESZCZENIE

Urazy czaszkowe–mózgowe stanowią bardzo istotny problem medyczny i diagnostyczny, a wyniki uzyskiwane przy leczeniu pacjentów są wciąż niezadowalające. Celem pracy była ocena wyników leczenia chorych, którzy doznali ciężkich obrażeń czaszkowo–mózgowych oraz określenie czynników niekorzystnie wpływających na wyniki leczenia. Analizowano wyniki leczenia 274 chorych z ciężkimi obrażeniami czaszkowo–mózgowymi, u których stan neurologiczny oceniany przy przyjęciu do Izby Przyjęć był mniejszy lub równy 14 pkt. wg Skali Glasgow, leczonych w Klinice Chirurgii Urazowej AM w Lublinie w latach 1991–1997. Oceniano retrospektywnie diagnostykę i proces leczenia chorych. Pierwsza tomografia komputerowa głowy wykonywana była w ciągu kilku godzin od urazu. Funkcjonalna ocena wyników leczenia wykonywana była na podstawie Skali Oceny Wyników Leczenia Glasgow (Glasgow Outcome Scale). Uzyskane wyniki poddawano analizie statystycznej. W badanej grupie chorych odsetek zgonów wyniósł 17,2%. Chorzy, u których oprócz obrażeń czaszkowo–mózgowych stwierdzono również inne obrażenia ciała, mieli statystycznie istotnie ($p < 0,05$) większy odsetek zgonów niż w grupie chorych z izolowanymi obrażeniami głowy (31,6 v. 10,9). W grupie chorych, u których udokumentowano epizody spadków ciśnienia tętniczego (RR < < 95 mm Hg) lub spadki prężności tlenu we krwi tętniczej ($p\ O_2 < 60$ mm Hg), stwierdzono statystycznie istotnie ($p < 0,05$) większy odsetek zgonów i niekorzystnych wyników leczenia niż w grupie chorych, u których nie było tych epizodów (34% v. 9% zgonów oraz 25% v. 5,3 % stanów wegetatywnych lub ciężkiego kalectwa). W grupie chorych, u których we wstępnych badaniach tomografii komputerowej wykazano radiologiczne cechy wzrostu ciśnienia śródczaszkowego, stwierdzono statystycznie istotnie ($p < 0,05$) większy odsetek zgonów i niekorzystnych wyników leczenia niż w grupie chorych, u których nie było cech wzrostu ciśnienia śródczaszkowego (52,0 % v. 8,9 % zgonów oraz 28,0 % v. 8,8 % stanów wegetatywnych lub ciężkiego kalectwa). Uzyskane wyniki badań wykazały, że obrażenia innych okolic ciała towarzyszące urazom głowy, hypotensja lub hipoksja oraz radiologiczne cechy wzrostu ciśnienia śródczaszkowego są czynnikami niekorzystnie wpływającymi na wyniki leczenia chorych z obrażeniami czaszkowo–mózgowymi, oraz że agresywne postępowanie resuscytacyjne i właściwa diagnostyka tych chorych po urazie mogą poprawić wyniki leczenia w tej grupie chorych.