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Initial Factors Affecting 6-month Outcome of Patients Undergoing Surgery for Acute Post-traumatic Subdural and Epidural Hematoma

Bartłomiej Kulesza[1], Jakub Litak[1], Marek Mazurek[1], Adam Nogalski[2]

[1] Department of Neurosurgery and Pediatric Neurosurgery, Medical University, Lublin, Poland
[2] Department of Trauma Surgery and Emergency Medicine, Medical University, Lublin, Poland

Corresponding author: Bartłomiej Kulesza, Department of Neurosurgery and Pediatric Neurosurgery, Medical University, Independent Public Clinical Hospital No 4, 8 Jaczewskiego St., 20954 Lublin, Poland; E-mail: kuleszabartek88@gmail.com; Tel: 508387689

Abstract

Introduction: The most frequent consequences of a traumatic brain injury are acute subdural (SDH) and epidural hematoma (EDH), which usually require a surgical treatment. Most of the factors affecting the prognosis have been analyzed on a wide group of traumatic brain injuries. Nonetheless, there are few studies analyzing factors influencing the prognosis regarding patients with EDH and SDH. The aim of the study is to identify factors which have prognostic value in relation to 6-month outcome of patients undergoing surgery for acute hematoma.

Patients and methods: The study included a group of 128 patients with isolated craniocerebral injuries. The patients were divided into two groups, namely a group of 28 patients operated on due to epidural hematoma and a group of 100 patients operated on due to acute subdural hematoma. All patients were operated and treated in the Department of Neurosurgery at the Medical University in Lublin from 1.10.2014 to 31.08.2017. The following factors from the groups were analyzed: demographic data, physiological factors, laboratory factors, computed tomography scan characteristics, and time between the trauma and the surgery. All the factors were correlated with six-month outcome in Glasgow outcome scale.

Results: The univariate analysis has confirmed the influence of many factors affecting the outcomes.

Conclusion: It is interesting that the factors such as GSC score, saturation, respiratory rate, and systolic blood pressure were associated with outcome with highly statistically significant differences in both group. These are factors that, with an appropriate treatment, could be normalized at the place of the accident.

Keywords

traumatic brain injury, epidural hematoma, subdural hematoma, factors, outcome

INTRODUCTION

Traumatic brain injury (TBI) is a real social problem, with an upward trend worldwide. TBI is the leading cause of death and disability, especially among young men. Each year in Europe, 243 per 100,000 individuals suffer from TBI. The most frequent consequences of TBI are extra-axial hemorrhages, i.e. an acute subdural and epidural he-matoma, which usually requires a surgical treatment. It is estimated that intracranial hematomas occur in 25-45% of severe traumatic brain injuries, 3-12% of moderate cases, and 0.2% of mild craniocerebral injuries. Establishing a reliable prognosis after a head injury is difficult as is captured in the Hippocratic aphorism, 'No head injury is too severe to despair of, nor too trivial to ignore'.[1,2] The outcome after this type of injury is difficult to predict, but usually unfa-

vourable. Most of the factors affecting the prognosis have been analyzed on a wide group of traumatic brain injuries. There are only a few studies in terms of the factors influencing the prognosis concerning patients undergoing the surgery due to acute post-traumatic subdural and epidural hematoma. The aim of the study was to identify factors which have the strongest prognostic value in relation to a 6-month outcome of patients undergoing surgery for acute post-traumatic subdural and epidural hematoma.

PATIENTS AND METHODS

The study included a group of 128 patients with isolated craniocerebral injuries. The patients were divided into two groups, namely a group of 28 patients operated on due to epidural hematoma (EDH group) and a group of 100 operated on due to acute subdural hematoma (SDH group). All patients were operated and treated in the Department of Neurosurgery from 1.10.2014 to 31.08.2017. During this period, 146 patients were treated surgically for extra-axial hematoma whereas 18 patients were excluded from the study. Exclusion criteria for the examined group of patients included: lack of complete medical documentation, incomplete laboratory tests, lack of description of the computed tomography of the head, lack of contact with the patient or his family after 6 months and off-the-head injuries detected in the whole-body computed tomography requiring treatment.

Demographic and clinical information was collected retrospectively of the patients on their admission to the Emergency Department. It included: demographic data, physiological factors, laboratory factors, computed tomography scan characteristics, and the time between trauma and surgery. The records were examined for demographic data, such as gender and age. Physiological factors included initial GCS, pupil reaction to light, saturation, systolic blood pressure (SBP), heart rate (HR) and respiratory rate (RR) (normal or abnormal value). Laboratory factors included the number of white blood cells (WBC), hemoglobin (HGB) value, number of platelets (PLT), glycemia value, sodium concentration, coagulopathy, and alcohol levels. Laboratory factors, similarly to the physiological factors, were analyzed on the basis of two groups: normal values and outstanding ones (**Table 1**). Additionally, the influence of coagulopathy and the state after alcohol intoxication on the prognosis were examined. Coagulopathy was defined as INR > 1.2 or PT > 12.7 s. For the state of intoxication, the alcohol concentration was higher than 0.5‰. Each patient included in the study underwent a computed tomography (CT) of the head as soon as it was possible. The study contained particular characteristics from the CT, such as the present skull fracture, subarachnoid hemorrhage (SAH), intraventricular hemorrhage (IVH), intraparenchymal hemorrhage (IPH), maximum thickness of the hematoma, midline shift (MLS) and obliteration basal cistern. The skull

fracture, SAH, IVH and IPH were analyzed in two categories, either present or absent. The maximum hematoma thickness and MLS were calculated using the Ozirix version 2.5 program based on cross sections from the pre-operative CT scan (**Fig. 1**). Basal cisterns were examined in three categories, namely a normal size, the compressed one, and the absent one. The last factor was the time between the injury and the surgery.

All of the factors were correlated with a six-month outcome (result of treatment). The outcome was assessed 6 months after the injury according to the Glasgow Outcome Scale (GOS). After 6 months, a telephone call was made to the patient's family member or the patient himself in order to obtain necessary information on the current state of health of the patient and based on the conversation, the patient's condition was determined according to the GOS scale. Subsequently, a favourable outcome was assigned to the patients who presented 4 (moderate disability) or 5 (low disability) point on the GOS scale. The remaining patients with scores from 1 to 3 (death, vegetative state, severe disability) according to the GOS scale received an unfavourable outcome.

Statistical analysis

The obtained results of the tests were subjected to the statistical analysis. The $\chi 2$ homogeneity test was performed to detect differences in unrelated qualitative characteristics between groups. The $\chi 2$ independence test was used to investigate the existence of the relationship between the studied features. A significance level of $p < 0.05$ was assumed indicating the existence of statistically significant differences. The database and statistical analysis was performed using STATISTICA 13.0 computer software (StatSoft, Poland).

RESULTS

Characteristics of study groups

The mean age of patients in the SDH group was 57.86±18.26 years and it was statistically significantly higher than the mean age of patients in the EDH group (38.81±13.37 years) (p=0.00001). In both groups, men were hospitalized most often. The patients with SDH (median 6) had statistically significantly less points in the initial GCS scale than patients in ADH group (median 11.5) (p=0.0006). In terms of physiological factors abnormal values were more frequently observed in the SDH group than in the ADH group. Only in the case of saturation this value was statistically significant (p=0.001). Laboratory parameters did not differ significantly between the above mentioned groups. In the case of no patients hemoglobin > 18 mg/dl, sodium > 157 m-Eq/lt and glycaemia < 70 mg/dl were observed. It was demonstrated that the skull fracture was more often associated with the

Table 1. Impact of factors on the 6-month outcome in the EDH group

Group of factors	Factors		Unfavorable N (%)	Favorable N (%)	p-value
Demographic data	Gender	Men	7 (26.92%)	19 (73.08%)	0.18
		Women	2 (100%)	0 (0%)	
Physiological factors	Age	≤ 35 years old	2 (20%)	8 (80%)	0.31
		> 36 years old	7 (38.89%)	11 (61.11%)	
	GCS score	3-8 score GCS	7 (77.78%)	2 (22.22%)	0.0008*
		9-15 score GCS	2 (28.57%)	17 (71.43%)	
	Pupil reaction	Normal	3 (15.79%)	16 (84.21%)	0.02*
		Areactive one or both	6 (66.67%)	3 (33.33%)	
	Saturation	> 96%	4 (17.39%)	19 (82.61%)	0.002*
		≤ 96%	5 (100%)	0 (0%)	
	Systolic blood pressure	90-140 mmHg	2 (11.11%)	16 (88.89%)	0.001*
		< 89 or >141 mmHg	7 (70%)	3 (30%)	
	Heart rate	60-120 pulse	5 (25%)	15 (75%)	0.41
		< 59 or > 121 pulse	4 (50%)	4 (50%)	
	Respiratory rate	10-25 breaths per min	3 (13.64%)	19 (86.36%)	0.0004*
		< 9 or > 26 breaths per min	6 (100%)	0 (0%)	
Laboratory factors	WBC	$4.8\text{-}10.8 \times 10^3/\text{mm}^3$	3 (33.33%)	6 (66.67%)	0.73
		< 4.7 or $>10.9 \times 10^3/\text{mm}^3$	6 (31.58%)	13 (68.42%)	
	HGB	12-18 mg/dl	6 (28.57%)	15 (71.43%)	0.82
		< 11 mg/dl	3 (42.86%)	4 (57.14%)	
	PLT	$130\text{-}400 \times 10^3/\text{mm}^3$	5 (22.73%)	17(77.27%)	0.12
		< 129 or $> 401 \times 10^3/\text{mm}^3$	4 (66.67%)	2 (33.33%)	
	Glycaemia	70-110 mg/dl	0 (0%)	7 (100%)	0.04*
		> 111 mg/dl	9 (42.86%)	12 (57.14%)	
	Na	135-157 mEq/It	7 (28%)	18 (72%)	0.48
		< 134 mEq/It	2 (66.67%)	1 (33.33%)	
	Coagulopathy	INR≤1.2 or PT≤12.7 s	13 (65%)	7 (35%)	0.61
		INR>1.3 or PT>12.8 s	6 (75%)	2(25%)	
	Ethanol	≤ 0.5‰	2 (25%)	6 (75%)	0.6
		> 0.6‰	7 (35%)	13 (65%)	
Computer tomography scan characteristics	Skull fracture	Present	7 (35%)	13 (65%)	0.61
		Absent	2 (25%)	6 (75%)	
	SAH	Present	7 (63.64%)	4 (36.36%)	0.01*
		Absent	2 (11.76%)	15 (88.24%0	
	IPH	Present	6 (37.5%)	10 (62.5%)	0.77
		Absent	3 (25%)	9 (75%)	
	IVH	Present	3 (100%)	0 (0%)	0.04*
		Absent	6 (24%)	19 (76%)	
	Basal cistern	Normal size	0 (0%)	9 (100%)	0.02*
		Compressed and absent	9 (47.37%)	10 (52.63%)	

Hematoma thickness	< 30 mm	2 (11.76%)	15 (88.24%)	0.01*
	> 31 mm	7 (63.64%)	4 (36.36%)	
MLS	< 10 mm	5 (22.73%)	17 (77.27%)	0.04*
	> 11 mm	4 (66.67%)	2 (33.33%)	
Time injury – surgery	≤ 4 hours	2 (28.57%)	5 (71.43%)	
	5 – 9 hours	5 (38.465)	8 (61.54%)	0.79
	≥ 10 hours	2 (25%)	6 (75%)	

- normal value of physiological factors and reference values of laboratory factors
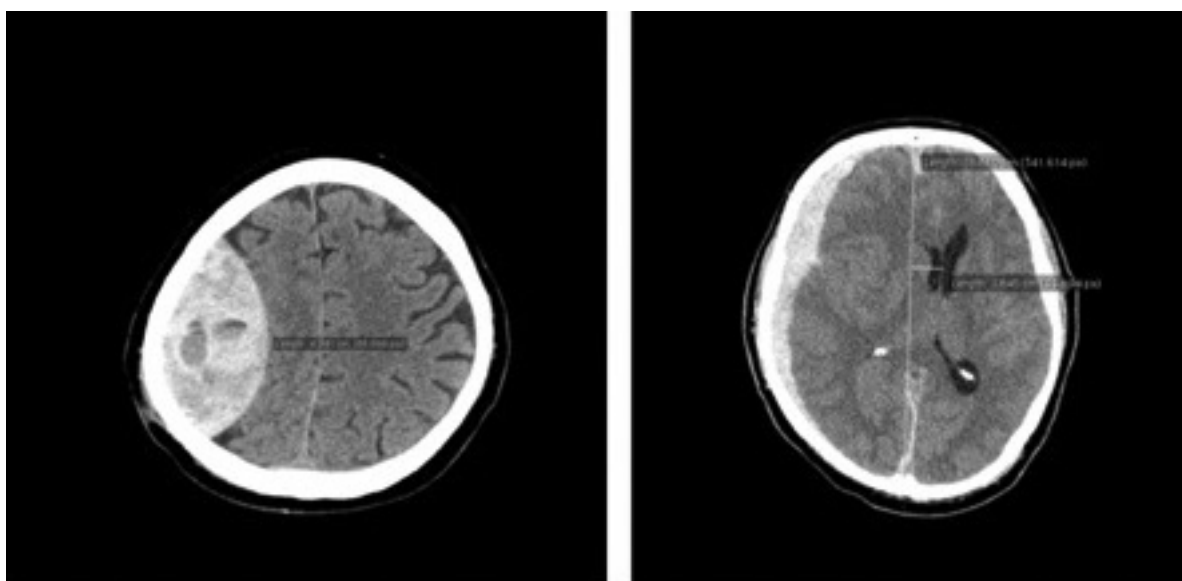 * statistically significant value

Figure 1. Epidural hematoma with maximum thickness of 43 mm and subdural hematoma with midline shift of 16 mm.
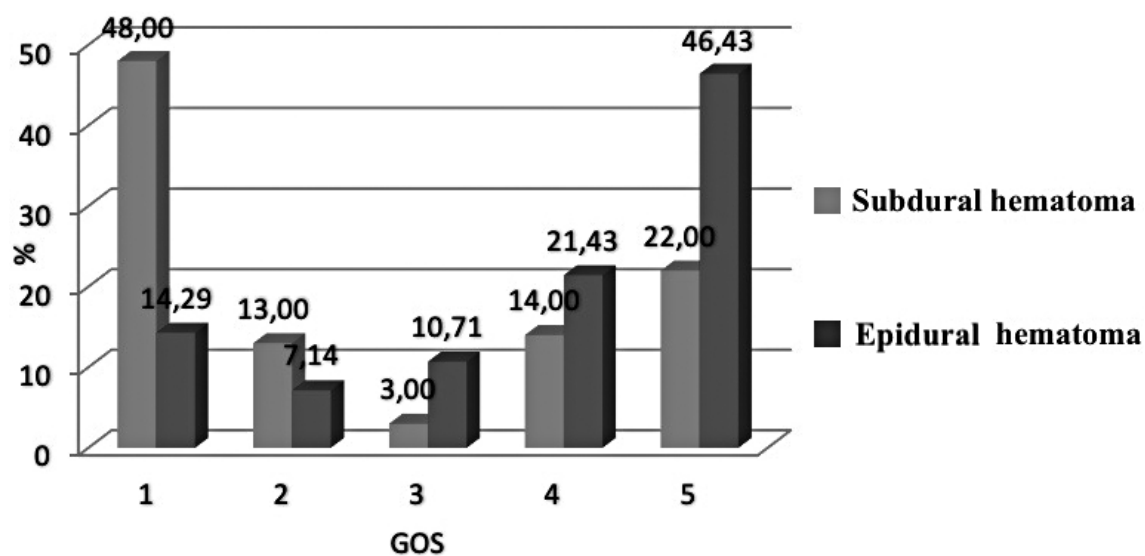

Figure 2. Percentage of patients in groups depending on the GOS scale.

patients in EDH group (71.43%) rather than in SDH group (30.00%) (p=0.00007). It was shown that the basal cistern was more often compressed in EDH group (53.57%) than in SDH patients (43.00%) (p = 0.03). The thickness of the hematoma was significantly greater in EDH group (median 26.50 mm) than in SDH group (median 17.00mm) (p=0.00004). Other factors from the computer tomography scan characteristics and the time between injury and the surgery did not differ significantly between the two groups.

Six-month outcome

In the EDH group the patients were more likely to have a favourable outcome (67.86%) than those in the SDH group (36.00%). The differences found were statistically significant (p=0.003) (**Fig. 2**).

Impact of factors on the 6-month outcome in EDH I SDH group (Tables 1, 2)

Demographic data

In the EDH group an unfavourable outcome (100%) was more frequent in women than in men (26.92%) (p=0.18). The 35-year-old patients had more frequently a favourable outcome than the elderly patients (80% vs. 61.11%) (p=0.31). In the SDH group, no significant differences between the gender and 6-month outcome were found (p=0.78). The patients older than 60 years had a significantly worse outcome than the younger ones (p=0.01).

Physiological factors

In the EDH group, the patients after a severe head injury (3-8 GCS) had a remarkably worse outcome (77.78%) than after a moderate (9-12 GCS) or a mild (13–15 GCS) head injury (28.57%) (p=0.0008). The patients with a non-reactive one or both pupils had a significantly worse outcome than the patients with a reactive pupil (66.67% vs. 15.79%) (p=0.02). The patients with an abnormal value of saturation, systolic blood pressure, and respiratory rate definitely more often had an unfavourable outcome after 6 months unlike the patients with normal values (p=0.002, p=0.001, and p=0.0004, respectively). Similarly, the patients with an abnormal pulse rate demonstrated a worse outcome than the ones with a normal heart rate. The difference here failed to reach statistical significance (p=0.41).

In the SDH group, the patients after a severe head injury had a significantly worse outcome (91.67%) than after a moderate or a mild head injury (44%). The patients with the saturation below or equal to 96% were more likely to have an unfavourable outcome (90.57%) compared with the patients with normal saturation (34.04%). For the patients with abnormal SBP, unfavourable outcome (80.70%) was more common than for the patients with a normal blood pressure (41.86%). All patients with abnormal respiratory rate had an unfavourable outcome (100%) compared to those with a normal respiratory rate (37.93%). All the above differences in the SDH group were highly statistically significant (p≤0.00006). The patients with non-reactivity of both or one pupil had a remarkably worse outcome than in the group with a normal pupillary reaction to light (p=0.04). Similarly, the patients with an abnormal HR had a worse outcome than those with normal heart rate, but the difference barely missed statistical significance (p=0.77).

Laboratory factors

Statistical analysis in the EDH and SDH groups did not show a significant relationship between the number of WBC, the value of HGB, the sodium level, the presence of coagulopathy, and 6-month outcomes. An abnormal number of PLT was associated with poorer outcomes in the EDH group and better outcomes in the SDH group. Both differences weren't statistically significant (p=0.12 and p=0.27). In the EDH group anyone with normoglycemia had an unfavourable outcome compared with the patients with hyperglycemia (42.86%), similarly in the SDH group (18.18% vs. 76.92%). Both differences were statistically significant (p=0.04 and p<0.00001). In both groups the state after the alcohol intoxication was associated with an unfavourable outcome. Only in the SDH group the difference was statistically significant (p=0.03).

Computer Tomography scans characteristics

The patients with skull fracture in both groups had more often an unfavourable outcome than the patients without the fracture. Only in the SDH group the difference was statistically significant (p=0.03). The patients with the presence of traumatic SAH in both groups had more often an unfavourable outcome than the patients without SAH. Both differences were statistically significant (p=0.01). In the case of the presence of IPH, only in the SDH group it was associated with poorer outcomes (p=0.02). In the EDH group, all patients with a present IVH had more significantly often a poor outcome (100.00%) compared with the patients with no ventricular bleeding (24.00%), (p=0.04). In the SDH group IVH correlated with poorer outcomes too (p=0.02). In the EDH group no patient with basal cistern of a normal size (0%) had an unfavourable outcome in contrast with the patients with compressed or absent basal cisterns (47.37%), (p=0.02). In the SDH group the condition of basal cisterns correlated with poorer 6-moths outcomes too (p=0.08). Only in the EDH group the difference was statistically significant. In both groups, a greater maximum thickness of hematoma and MLS was statistically associated with unfavourable 6-moth outcomes. EDH group: p=0.01 and 0.04, SDH group: p=0.02 and 0.007.

Table 2. Impact of factors on the 6-month outcome in the SDH group

Group of factors	Factors		Unfavorable N (%)	Favorable N (%)	*p* value
Demographic data	Gender	Men	55 (63.95%)	31 (35.05%)	0.78
		Women	9 (64.29%)	5(35.71%)	
Physiological factors	Age	≤ 60 years old	28 (53.85%)	24 (46.15%)	0.01*
		> 61 years old	32 (72.73%)	12 (27.27%)	
	GCS score	3-8 score GCS	55 (91.67%)	5 (8.33%)	<0.00001*
		9-15 score GCS	9 (22.5%)	31 (77.5%)	
	Pupil reaction	Normal	24 (53.33%)	21 (46.67%)	0.04*
		Areactive one or both	40 (72.73%)	15 (27.27%)	
	Saturation	> 96%	16 (34.04%)	31 (65.96%)	<0.00001*
		≤ 96%	48 (90.57%)	5 (9.43%)	
	Systolic blood pressure	90-140 mmHg	18 (41.86%)	25 (58.14%)	0.00006*
		< 89 or >141 mmHg	46 (80.7%)	11 (19.3%)	
	Heart rate	60-120 pulse	50 (63.29%)	29 (36.71%)	0.77
		< 59 or > 121 pulse	14 (66.67%)	7 (33.33%)	
	Respiratory rate	10-25 breaths per minute	22 (37.93%)	36 (62.07%)	<0.00001*
		< 9 or >26 breaths per minute	42 (100%)	0 (0%)	
Laboratory factors	WBC	4.8-10.8×10^3 /mm^3	29 (60.42%)	19 (39.58%)	0.47
		< 4.7 or >10.9×10^3/mm^3	35 (67.31%)	17 (32.69%)	
	HGB	12-18 mg/dl	49 (62.03%)	30 (37.97%)	0.42
		< 11 mg/dl	15 (71.43%)	6 (28.57%)	
	PLT	130-400×10^3/mm^3	46 (67.65%)	22 (32.35%)	0.27
		< 129 or >401×10^3 /mm^3	18 (56.25%)	14 (43.75%)	
	Glycaemia	70-110 mg/dl	4 (18.18%)	18 (81.82%)	<0.00001*
		> 111mg/dl	60 (76.92%)	18 (23.08%)	
	Na	135-157 mEq/It	58 (65.17%)	31 (34.83%)	0.49
		< 134 mEq/It	6 (54.55%)	5 (45.45%)	
	Coagulopathy	INR<1.2 or PT<12.7 s	28 (40.58%)	41 (59.42%)	0.15
		INR>1.3 or PT>12.8 s	8 (25.81%)	23 (74.19%)	
	Ethanol	≤ 0.5‰	15 (48.39%)	16 (51.61%)	0.03*
		> 0.6‰	49 (71.01%)	20 (28.99%)	
Computer tomography scan characteristics	Skull fracture	Present	24 (80%)	6 (20%)	0.03*
		Absent	40 (57.14%)	30 (42.86%)	
	SAH	Present	36 (76.6%)	11 (23.4%)	0.01*
		Absent	28 (52.83%)	25 (47.17%)	
	IPH	Present	29 (78.38%)	8 (21.62%)	0.02*
		Absent	35 (55.56%)	28 (44.44%)	
	IVH	Present	15 (88.24%)	2 (11.76%)	0.02*
		Absent	49 (59.04%)	34 (40. 96%)	

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Basal cistern	Normal size and compressed	35 (58. 33%)	25 (41.67%)		0.08
	Absent	29 (72.5%)	11 (27.5%)		
Hematoma thickness	< 20 mm	43 (57.33%)	32 (42.67%)		0.02*
	> 21 mm	21 (84%)	4 (16%)		
MLS	≤ 20 mm	50 (58.14%)	36 (41.86%)		0.007*
	> 21 mm	14 (100%)	0 (0%)		
Time injury – surgery	≤ 4 hours	12 (63.16%)	7 (36.84%)		
	5 – 9 hours	40 (64.52%)	22 (35.48%)		0.99
	≥ 10 hours	12 (63.16%)	7 (36.845)		

* statistically significant value

Time between injury and surgery

In the EDH and SDH groups the statistical analysis did not reveal a significant relationship between the time to surgery and the 6-month outcome.

DISCUSSION

Demographic data

Age is one of the strongest determinants of mortality and outcome in TBI. The increasing age was associated with the worse outcome.[1,3] Other authors report that this relation was apparent not only after the age of 60[4], but also especially above 40[5]. The age is the most powerful independent prognostic factor[6] and the increasing age is associated with worse 6-month outcomes, creating approximately linear function.[7] The authors studying the patients with ADH and SDH also demonstrated that the increasing age was associated with a worse outcome.[8-10] In our study the patients with ADH younger than 35 years demonstrated a better outcome than older patients, however, the difference was not statistically significant (p=0.31). This is due to a small number of patients in the EDH group (28 patients) and there was only one person over 60 years in the group. In the SDH group the age over 60 years was associated with a worse 6-month outcome than in the case of younger patients (p=0.01).

There is strong evidence that gender does not affect the prognosis in TBI.[6,7,11] In our studies in the EDH group, women had more frequently an unfavourable outcome than men, but the difference failed to achieve statistical significance (p=0.18), which resulted from the fact that in this group the women were much older than men (49.5±13.44 vs. 38±3.27). Leitgeb et al. observed a similar relationship, where the difference of age women : men – 52±24 : 43±20.[12] In the SDH group, no significant differences between the gender and 6-month outcome were found (p=0.78). It was

also observed by the authors studying the patients operated on due to SDH.[13]

Physiological factors

The Glasgow Coma Scale (GCS) is used not only to assess the patient's state of consciousness after a head injury, but it also has a strong prognostic value.[1] The age followed by the GCS motor score and the pupil response are most powerful independent prognostic factor.[6] In addition, GCS like age creates a linear function.[5,6] The authors investigating the patients operated on due to extra-axial hematoma also found an important impact of GCS and the pupil response on the outcome.[8,14,15] Our study confirmed this result in both groups.

Dysautonomia or autonomic dysfunction is a condition in which the autonomic nervous system does not work properly. TBI causes dysautonomia manifested by episodes of fluctuations in blood pressure, heart rate, respiratory rate and others.[1] Hypotension and hypoxia following TBI are recognized as a significant secondary insult associated with a poor outcome.[16] Petroni et al. found a very strong relationship between hypotension and outcome. Hypotension (SBP<90 mmHg) was associated with 90% mortality and 96% unfavourable 6-month outcome.[17] On the other hand, there is a characteristic U-shaped relationship between SBP and TBI outcome. The values of SBP higher than 135 or even 150 or lower than 90 mmHg were associated with poorer outcomes.[6,4] It is also worth mentioning that hypoxia and oxygen saturation lower than 90% were associated with a poor outcome.[4] Kalayci et al. studied the patients undergoing decompressive craniectomy for SDH. The authors of the study found that saturation less than or equal to 96% was significantly associated with unfavourable 6-month outcome (p=0.002).[18] Both the increase and the decrease in RR and HR beyond a normal range is associated with a poor outcome in TBI.[4] In our study, all physiological factors associated with 6-months outcome were statistically significant, only in case of heart rate the differences couldn't achieve statistical significance. Additionally, in case of ini-

tial GCS score, saturation and RR were highly statistically significant (*p*<0.00006) in the SDH group.

Laboratory factors

Laboratory parameters routinely recorded on admission following TBI had a predictive value. Hyperglycemia is a cause of secondary damage for the patients after TBI, and it is associated with a poorer outcome.[19] Stress hyperglycemia is a common finding after the injury.[20] In the study of Van Beek et al. 82% of the patients had increased glucose levels whereas in our study 77% patients had hyperglycemia. Hyperglycemia in our study was associated with poorer outcome in both groups. Coagulopathy, especially prothrombin time and platelets, are major determinants of disability and death among the patients with traumatic intracranial hemorrhage.[19,21] Stated coagulopathy in ED was associated with the outcome.[19,22] Fujii et al., studying operated patients due to intracranial hematomas, found that lower values of INR and PTT outcomes were remarkably better than the higher values.[23] Glucose and prothrombin time demonstrated a linear relationship with the outcome (increasing values associated with poorer outcome).[19] Both hypo- and hypernatremia are associated with a poorer outcome, but hyponatremia is a relatively infrequent occurrence on admission following TBI. Sodium revealed a U-shaped relationship with outcome, but hyponatremia is more strongly related to a poorer outcome.[1,19,24] Hemoglobin, platelets showed an inverse linear relationship to the outcome (low values associated with a poorer outcome). Van Beek et al. observed high hemoglobin values very rarely.[19] In our study, no patients had hemoglobin > 18 mg/dl. Leukocytosis was associated with a poor outcome after TBI.[25] In our study, the statistical analysis did not show a significant relationship between coagulopathy, sodium level, hemoglobin concentration, and WBC value and outcome. Alcohol use was found to be an important risk factor for TBI, with the prevalence of alcohol intoxication between 20–55% at the time of injury.[26,27] In our study 31.25% patients were under the influence of alcohol. Alcohol intoxication was associated with a poorer outcome after a severe TBI.[27] On the other hand, alcohol is associated with a decreased mortality[28], and the relationship between alcohol and the outcome after TBI remains uncertain.[26] The present study showed that patients with alcohol intoxication had a worse outcome than the others, in the SDH group (*p*=0.03).

Computer Tomography (CT) scans characteristics

Computerized tomography (CT) scanning provides an objective assessment of a structural damage to the brain and is associated with the outcome following traumatic brain injury.[1] Strong evidence was found for the midline shift[6,29,30] and a greater of the midline shift associated with a poorer outcome[29]. The authors studying patients with EDH and SDH found a poorer outcome associated with a greater midline shift and the thickness of hematoma.[14,15,31] Our analysis confirms these relationships. Similarly, the greater the thickness of hematoma is, the worse the prognosis in the EDH and SDH groups is. Overall frequency of the skull fracture in EDH is 68–78%. Khaled et al. associated EDH with the skull fracture in the case of 74.09% patients.[32] In our study, 71.43% of the patients had a skull fracture in EDH group. The skull fracture cannot reliably predict the outcome, but its presence is a manifest indication that the injury was caused by a greater force.[33] The skull fracture among TBI patients is associated with an increased risk of neurosurgically relevant intracranial lesions[34] and unfavourable outcomes[35]. On the other hand, a certain amount of energy is absorbed when the skull is broken and, consequently, the brain is not exposed to the full brunt of the impact.[36] Our analysis in SDH group shows that skull fractures are associated with a poorer 6-month outcome (*p*=0.03). The presence of a traumatic subarachnoid hemorrhage predicts poor outcomes.[12,29,35,37] Our study confirms this relationship in EDH and SDH group (*p*=0.01). Our study shows that the presence of intraventricular and intraparenchymal hemorrhage is associated with poor outcomes, respectively in EDH group (*p*=0.77) and (*p*=0.04) in SDH group in both cases (*p*=0.02). This finding has also been noticed by other authors.[10,12] Obliteration of the basal cistern was associated with a poorer outcome after 6 months.[5,6] It has been also confirmed by our research in EDH group (*p*=0.02).

Time between injury and surgery

Matsushima et al. showed that in-hospital mortality was significantly lower in the group of patients operated on up to 200 minutes after arrival at the emergency department (*p*=0.03).[38] They came to similar conclusions.[14,39] Khaled et al., investigating patients with EDH, stated that the time between a trauma and a surgery is the most important prognostic factor, and shortening this time to a minimum can reduce mortality to zero.[11] Seelig et al. based on patients undergoing surgery for SDH found that surgery reduces mortality from 90% to 30% within 4 hours.[40] On the other hand, there are a few studies that didn't associate a shorter period of time between the injury and the surgery and the outcome.[12,41,42] Our study didn't show differences between time to surgery and outcome. Despite this, it is reasonable to perform a surgery as soon as it is possible.

CONCLUSION

We were unable to find a study which would collectively analyze all the factors which we examined in one work regarding the patients operated on due to epi- and subdural hematomas. Our study demonstrates that the factors affecting the 6-month prognosis in both groups were age,

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initial GCS score, pupil reaction to light, saturation, SBP, RR, glycemia, presence of skull fracture, traumatic SAH, IVH, IPH, status of basal cistern, MLS, and thickness of hematoma. It is interesting that the factors such as initial GSC score, saturation, respiratory rate and systolic blood pressure were associated with outcome with highly statistically significant differences in both group ($p \leq 0.002$). In addition to the GCS scale, these are factors that, with an appropriate treatment, could be normalized at the place of the accident, which may result in improved patient outcomes. These results require confirmation in other studies on a larger group of patients because the present study has a significant limitation. The number of patients was small, especially the ones operated due to epidural hematomas.

CONFLICT OF INTEREST

There is no conflict of interest to disclose.

ETHICAL CONSIDERATIONS

The study got the approval of the Bioethics Committee of the Medical University of Lublin (No KE-0254/313/2016). This type of study does not require obtainment of informed consent.

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Начальные факторы, влияющие на шестимесячный исход у пациентов, перенесших операцию по поводу острой посттравматической субдуральной и эпидуральной гематомы

Бартоломей Кулеша[1], Якуб Литак[1], Марек Мазурек[1], Адам Ногалски[2]

[1] *Кафедра нейрохирургии и педиатрической нейрохирургии, Медицинский университет, Люблин, Польша*

[2] *Кафедра травматической хирургии и неотложной медицины, Медицинский университет, Люблин, Польша*

Адрес для корреспонденции: Бартоломей Кулеша, Кафедра нейрохирургии и педиатрической нейрохирургии, Медицинский университет, Независимая общественная клиническая больница No 4, ул. „Яшевского" № 8, 20954 Люблин, Польша; E-mail: kuleszabartek88@gmail.com; Тел: 508387689

Абстракт

Введение: Наиболее частыми последствиями черепно-мозговой травмы являются острая субдуральная (СДГ) и эпидуральная гематома (ЭДГ), которые обычно требуют хирургического лечения. Большинство факторов, влияющих на прогноз, были

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проанализированы в большой группе травматических поражений головного мозга. Тем не менее, есть несколько исследований, анализирующих факторы, которые влияют на прогноз пациентов с диабетом и ЭДГ. Целью данного исследования было выявить факторы, которые имеют прогностическую ценность в отношении шестимесячного исхода у пациентов, перенёсших хирургическое лечение острой гематомы.

Пациенты и методы: В исследование приняла участие группа из 128 пациентов с изолированными черепно-мозговыми травмами. Пациенты были разделены на две группы: 28 пациентов, оперированных с эпидуральной гематомой, и группа из 100 пациентов, оперированных с острой субдуральной гематомой. Все пациенты были прооперированы и проходили лечение на кафедре нейрохирургии в Люблинском медицинском университете с 1 октября 2014 года по 31 августа 2017 года. Были проанализированы следующие групповые факторы: демография, физиологические факторы, характеристики компьютерной томографии и время между травмой и операцией. Все факторы были сопоставлены с шестимесячным исходом по шкале Глазго.

Результаты: Унивариантный анализ подтвердил влияние многих факторов, влияющих на результат.

Выводы: Интересно, что такие факторы, как результат по шкале комы Глазго, насыщение, частота дыхания и систолическое артериальное давление, были связаны с результатом с высокими статистически значимыми различиями в обеих группах. Это факторы, которые при соответствующем лечении могут быть нормализованы ещё на месте происшествия.

Увод: Най-често срещаните последствия от травматично мозъчно увреждане са острият субдурален (СДХ) и епидурален хематом (ЕДХ), които обикновени изискват хирургично лечение. Повечето фактори, засягащи прогнозата, са били анализирани в голяма група от травматични мозъчни увреждания. Въпреки това, има няколко проучвания, анализиращи факторите, които влияят на прогнозата на пациенти със СДХ и ЕДХ. Целта на това проучване беше да се идентифицират факторите, които имат прогностична стойност по отношение на шестмесечен изход при пациенти, подложени на операция за остър хематом.

Пациенти и методи: Проучването включва група от 128 пациенти с изолирани краниоцеребрални наранявания. Пациентите бяха разделени в две групи, а именно – 28 пациенти, оперирани от епидурален хематом, и група от 100 пациенти, оперирани от остър субдурален хематом. Всички пациенти бяха оперирани и лекувани в Катедрата по неврохирургия в Медицински университет в Люблин от 1.10.2014 до 31.08.2017. Следните фактори от групите бяха анализирани: демографски данни, физиологични фактори, характеристки на компютърна томография и времето между травмата и операцията. Всички фактори бяха корелирани със шестмесечния изход по скалата на Гласгоу.

Резултати: Унивариантният анализ потвърди влиянието на много фактори, засягащи изхода.

Изводи: Интересно е, че факторите като Резултат по Гласгоу кома скалата, сатурация, дихателна честота и систолично кръвно налягане бяха асоциирани с изход с високи статистически значими разлики и в двете групи. Това са фактори, които с подходящо лечение, могат да се нормализират още на мястото на инцидента.