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RESEARCH ARTICLE

The Correlations of Clinical-Neurological Signs with The Different Outcomes of Traumatic Brain Injury and their Prognostic Important

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ABSTRACT
Clinical manifestations were correlated with traumatic brain injury outcomes using electronic computers. Neuroopthalmologic signs, motor and vital disorders had maximal prognostic values. Outcome was highly correlated with consciousness disorders phase scaling and patients' state scores as well as with coma and consciousness disorders length suggesting that these parameters are of major prognostic importance. A close correlation was found between consciousness states, patients' state scores and traumatic brain injury variants, brain lesion forms, vital and somatic disorders indicating their role as determinants of traumatic brain injury outcome.

Keywords: clinical signs, TBI, correlation, prognostic, Moscow Coma Scale.

Background

In order to solve the problem of predicting the outcomes of traumatic brain injury (TBI) unification of a large clinical material and the determination of a set of informative clinical signs has great importance. Informative value of each investigated clinical signs is determined by differences in clinical signs of its mean values and standard deviations for different outcomes, as well as its correlation with the other signs (3, 4, 6, 9, 11, 13). Correlation analysis was calculated using the Microsoft Excel 2019 application.

Materials and methods

In this study, carried out with the use of a statistical computer processing, it has been put the following tasks: 1) to reveal a correlation of individual outcomes of TBI with neurological symptoms and state of consciousness in the affected people in a large number of observations, 2) to determine the relationship between the outcome and severity of the patients' condition, assessed by the use of a scale point assessment of the condition and the state of consciousness according to the Moscow Coma Scale, and various forms of TBI, and 3) to explore and describe the meaning of mean and standard deviation of some clinical signs to predict the outcomes of TBI (1, 2, 5, 7, 8).

Table 1: Moscow Coma Scale

№	Consciousness phase	Neurological sign							
		Opening eyes to sound or pain	Execution of instructions	Answers on questions	Focus on time and place	Bilateral fixed mydriasis	Muscle atony	Code	Middle scores on a Patients' state scores (PSS)
1.	Clear state of consciousness	+	+	+	+	-	-	1	65
2.	Moderate stunning of consciousness	+	+	+	-	-	-	2	60±1
3.	Deep stunning consciousness	+	+	±	-	-	-	3	54±3
4.	Soporotic consciousness (*Vegetative status)	+	-	-	-	-	-	4	46±3
5.	Moderate coma	-	-	-	-	-	-	5	32±5
6.	Deep coma	-	-	-	-	-	+	6	20±7
7.	Terminal coma	-	-	-	-	+	+	7	6±6

*** Periodic restoration of elementary verbal contact**

The study is based on the materials of the unified survey of 320 patients with TBI who were hospitalized and treated at the Clinic of Neurosurgery of Samarkand Medical University, as well as 91 patients who were treated in the Neurosurgery National Centre N.N. Burdenko, Moscow. 331 patients suffered from closed TBI, 42 patients suffered from an open non-penetrating TBI and 38 patients suffered from open penetration TBI. The largest numbers of cases (73,5%) were patients with severe brain contusion.

State of consciousness of the affected patients has been evaluated in dynamics according to the uniform classification of disturbance of consciousness with the use of Moscow coma scale developed by A.R. Shakhnovich and A.M. Mamadaliev (1, 2, 10, 12). The data craniography, echoencephalography, MSCT and MRI have been used to verify the various forms of TBI.

Table 2: Patients' state scores (PSS)

Neurological sign	**Points**
Opening eyes to sound or pain	10
Execution of instructions	8
Answers on questions	8
Focus on time and place	5
Bilateral fixed mydriasis	5
Muscle atony	5
Respiratory failure	4
Corneal reflexes	4
Knee reflexes	4
The reaction of the pupils to the light	3
Cough reflex	3
Symptom of Majandi	3
Spontaneous movements	3
Movements to pain	3
Maximum points	65

Results

Clinical and series instrumental data (in general 70 signs) of these 411 patients at the age from 1 to 87 years old (343 males and 68 female) were used to examine the issues of predicting outcomes and the effectiveness of treatment of TBI in acute period by statistical processing on the computer. Patients were distributed into four groups depending on the outcomes, among which it has been detected the death outcome (DO), rude neurological disorders (RND), mild neurological disorders (MND) and restoration of function to the compensated condition (CC).

The study of correlations of different features that define the state of consciousness, and two quantitative scales that characterize the state of consciousness and severity of the patients' condition, as well as the correlation of these factors with the outcomes of TBI have been given us the possibility to obtain data to assess the prognostic significance of clinical signs.

The most interesting in terms of predicting outcomes in TBI is the study of correlation dependence between neurological symptoms and sign of "outcome". The correlation coefficient (r) of any neurological signs with the outcome actually specifies its information and prognostic significance in determining the outcome of TBI: the higher the correlation coefficient, the higher this value.

Table 3: Correlation of neurological signs with TBI outcome

Neurological sign	**Correlation coefficient *(r)***
Opening eyes to sound or pain	+0,41
Execution of instructions	+0,3
Answers on questions	+0,31
Focus on time and place	+0,14
Bilateral fixed mydriasis	+0,24
Muscle atony	+0,32
Respiratory failure	+0,32
Corneal reflexes	+0,36
Knee reflexes	+0,28
The reaction of the pupils to the light	+0,45
Cough reflex	+0,32
Symptom of Majandi	+0,12
Spontaneous movements	+0,33
Movements to pain	+0,35
Epileptic seizures	-0,26
Anisocoria	-0,33
Speech Disorders	-0,24
Hemiparesis	-0,31

It was established a high predictive value of neuroophthalmological signs (reaction of pupils to light, eye opening for sound or pain, corneal reflex safety, anisocoria, bilateral mydriasis), as evidenced by the relatively high correlation with their outcome.

The next most important thing for predicting the outcomes by the group of symptoms were disorders in the motor spheres: movement in response to pain stimulation, spontaneous movements, muscle atonia and hemiparesis (r≈0,35-0,31).

The Influence of the vital disorders on the outcome of TBI at victims in this table is characterized by a significant correlation with the outcome of trauma symptoms such as breathing problems and cough reflex (r=+0,32). The absence of cases with low (r <0,1) correlation with neurological symptoms with outcome of TBI confirms the prognostic value of all the above signs, carefully selected on the basis of the study of literature and clinical experience of leading medical and research institutions, as well as the study of being kept informed of 50 neurological signs with the use mathematical methods.

Table 4: Correlation of phases of impaired consciousness and PSS in patients with TBI outcome within 5 days after injury

Signs	**Day after TBI**	**Correlation coefficient *(r)***
Phases of impaired consciousness	1st	-0,46
	2nd	-0,62
	3rd	-0,68
	4th	-0,66
	5th	-0,63
PSS	1st	+0,53
	2nd	+0,65
	3rd	+0,67
	4th	+0,65
	5th	+0,62
Coma duration	-	-0,40
Duration of impaired consciousness	-	-0,31

During the analyzes the correlation of states of consciousness and PSS with the outcome of TBI (table 4) it has been revealed a significantly higher correlations (r≈0,46-0,68), than during study of relationships outcomes with individual neurological symptoms during the 5 days of the investigation. The maximum correlation is marked on the 3-4th day after the trauma, which indicates about the critical value of these days for fatal or favorable outcome.

The high correlation of using scales of states of consciousness and PSS with the outcome of TBI is an important fact testifying about the prevailed importance them in order to predict the outcomes of TBI among all investigated clinical signs (separate neurological signs, the type and severity of TBI, vital disorders, etc.).

There are some reports on the impact of the outcome of TBI duration of comatose condition, which is a highly informative indicator of the severity of brain damage. We have assessed in detail not only the duration of the comatose condition, but also the duration of impaired consciousness in accordance with the classification of states of consciousness. The duration of coma – is the whole period of the patient in a comatose state, regardless of its degree (moderate, deep, prohibitive) after admission to hospital. The duration of impaired consciousness is not only the duration of comatose condition, but also the entire period of impaired consciousness, including coma, stupor, deep and moderate stunning. The duration of coma and duration impaired consciousness estimated in the dynamics with the use of a scale states of consciousness have significant correlations with the outcome (r = -0,40 and -0,31) and, therefore, significantly affect the TBI outcome.

Table 5: Duration of coma and impaired consciousness (in days) in patients with TBI with different outcomes (M±m)

Sign	**DO**	**RND**	**MND**	**CC**
Coma duration	4,7±4,0	4,6±4,3	1,1±1,4	0,4±0,5
Duration of impaired consciousness	15,0±15,3	26,7±26,6	5,4±5,0	3,6±3,7

These clinical factors were investigated in order to clarify their values to predict both the DO and the degree of recovery functions in patients with different categories of a favorable outcome (CC, MND and RND). As you see from Table 5 the average duration of coma at DO and RND is the same and equal to 5 days, while in patients with restoration of functions to the CC and the MND it ranges from a few hours to 1 day.

The study of coma duration in acute TBI is prognostic important in determining the character of the outcomes. If the duration of coma is more than 5 days, it increases the likelihood of DO and RND.

Table 6: Mean age at different TBI outcomes (M ± m)

Outcomes	Number of patients	Age, years
DO	129	37,4±19,3
RND	71	31,6±17,5
MND	103	27,4±17,0
CC	108	23,7±17,6

The various outcomes of TBI significantly depend on the duration of comatose condition and impaired consciousness: the more their duration, the worse the outcome, and, conversely, if the duration of coma is less than 1 day, and the duration of impaired consciousness is 3-5 days, it increases the likelihood of recovery from CC and MND. An exception is the duration of impaired consciousness at RND, where it is more than in the DO.

Prognosis of TBI significantly becomes worse with increasing age. In this investigation we restrict ourselves by the analysis of the average values of age during the various outcomes of TBI. As it can be seen from Table 6, in the group of patients with DO the average age was respectively for 10-14 years longer than in patients with MND and recovery functions to the CC. The average value of age at the DO and outcomes with RND differs less – about 6 years, but this difference is significant.

As it is known, along with the state of consciousness and neurological symptoms the great importance for the outcome of has the type of TBI and form of brain damage, focal neurological and vital disorders. The analysis of their correlations with the state of consciousness and PSS in the different days of the acute period of TBI show the close relationship between the state of consciousness, and the severity of the condition and forms of brain damage (r = 0,44-0,51), intracranial hematomas (r = 0,31-0,36). In addition, it has been observed the correlations of the values for 5 days with the following features: body temperature (r = 0,33-0,40), with a frequency of breathing and self-managed or moderated breathing (r = 0,21-0,34), with convulsions of the hemispheric or stem origin (r = 0,26-0,34), with anisocoria (r = 0,26-0,3) and with an offset of M-echoes (r = 0,26-0,38).

Based on the dynamics of change in correlations with the state of consciousness and PSS in different days after the trauma can be stated as follows: the maximum correlations with the frequency of breathing spontaneously breathing or IVL and body temperature observed in the first days after the trauma, then to the 5th day they are decreased, in contrast, the occurrence of pneumonia has a maximum correlation to the 5th day, as soon as the correlation between the state of consciousness, pneumonia and PSS for all 5 days is quite high (r=0,21-0,50).

Conclusion

1. The analysis of the correlations of the separated neurological symptoms with the outcome of TBI demonstrates their high predictive value, moreover the neuroophthalmological symptoms have a leading role (especially the opening of the eyes for the sound or pain, reaction of pupils to light, the preservation of corneal reflexes, bilateral fixed mydriasis), then disorders in the movement sphere (movement or reaction to pain and muscle atonia) and vital disorders.
2. The high correlation the scales of states of consciousness and PSS in patients with the outcome of TBI which we used demonstrate about the high importance of them for predicting the outcome of TBI than all investigated clinical signs.
3. The duration of coma and duration of the impaired consciousness have significant correlations with the outcome of TBI and, therefore, significantly affect to the outcome of TBI: the more their duration, the worse the outcome, and vice versa.
4. It has been determined the close connection between the state of consciousness, PSS and types of brain damage, vital and somatic disorders. This shows not only the interdependence of these signs, but also its essential importance for the outcome of TBI.

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