Journal of Neuroscience & Clinical Research

Research Article A SCITECHNOL JOURNAL

Predictors of Outcome in Patients with Severe Traumatic Brain Injury

Leonidas Grigorakos[1,2*], Anastasia Alexopoulou[2], Katerina Tzortzopoulou[2], Stamatoula Stratouli[2], Despoina Chroni[2], Eleni Papadaki[2], Ioannis Alamanos[2] and Nikolaos Sakellaridis[3]

Abstract

Background: Severe traumatic brain injury (TBI) is associated with a high mortality and morbidity rate and is one of the leading causes of death in the intensive care units. The aim of this study was to examine predictors of hospital outcome in adult patients admitted to ICU because of severe TBI.

Methods: A retrospective study was carried on patients (n=621) with severe head injury, defined as Glasgow Coma Scale (GCS) ≤ 8 who were admitted to the general ICU over a 15-year period (1999-2013). Most important variables that could be correlated with outcome (demographics, cause of injury, GCS, clinical variables and computed tomography–CT scan) were analysed.

Results: Total mortality rate was 27.38%. Patients older than 75 years had a mortality rate of 57.14%. 70.05% of the patients were male and 61.99% of cases were due to traffic accidents. Coexisting injuries, found in 52.98% of the patients aggravated the prognosis. Shock developed in 17.23% of the patients and hypoxia in 27.38% were especially aggravating factors. Outcome is highly correlated with GCS' values. CT scan findings revealed that patients with acute epidural hematomas recorded a mortality rate of 8% while those with subdural hematomas 43.75%. The six-month overall good outcome, based on Glasgow Outcome Scale (GOS) was 37.03%.

Conclusions: Severe TBI has a high mortality and morbidity in Greek society as it has a high negative impact on young people, especially men. The age of the patient, GCS at admission and the CT scanning are significant predictors of outcome (p ≤ 0.05). A significant proportion of patients (35.59%) were still dependent for care at six-month post-injury assessment

Keywords: Traumatic brain injury; Glasgow Coma Scale; Clinical predictors; CT scan; ICU

Abbreviations: TBI: Traumatic Brain Injury, GCS: Glasgow Coma Scale; CT: Computed Tomography; ICU: Intensive Care Unit; GOS: Glasgow Outcome Scale

Introduction

Severe TBI is a common cause of neurological disability and death. About 1.5 million people die worldwide due to TBI. It is also

one of the leading causes of mortality in the intensive care units and in the emergency departments of major trauma centers [1].

Pre-injury factors -such as age, coexistence of other injuries, a history of previous head injury, alcohol abuse and lower socioeconomic and educational status- have been linked to increased mortality and worse outcome after TBI [2,3].

Most of patients with severe TBI are unconscious, intubated, anaesthetized and sedated. This makes the use of clinical evaluation of severity of intracranial injury like the GCS less reliable [4]. Thus, the use of CT scanning -which may correlate with the intracranial pressure- may be a useful variable to the clinical evaluation which can provide information on prediction and outcome [5].

Data reveal that the risk of TBI is highest in the 15- to 24- year old age group, decreases in the midlife years and then it increases again after 70 years, mostly due to falls. Males are approximately 3 to 4 times as likely as females to sustain a TBI, but this ratio narrows in the elderly [6]. 50% of all fatal and non-fatal brain injuries are transport related (motor vehicles, bicycles, and pedestrian- automobile accidents) whereas the second most frequent cause of TBI is falls [7].

An accurate assessment of prognosis after TBI is very important in making decisions about the use of specific methods of treatment, preventing nosocomial infections, counselling patients and relatives and identifying the specific rehabilitation the patient needs [8,9].

Thus, the purpose of our study was to evaluate the effect of major prognostic factors of hospital outcome in adult patients admitted to the general ICU because of severe TBI.

Methods

We retrospectively analyzed the medical files of patients admitted with severe head injury to our Intensive Care Unit (ICU) during a 15-year period (January 1999- December 2013). We describe 621 patients, over 18 years of age, who on admission and after resuscitation had a GCS ≤ 8. For the prognostic evaluation we took into consideration age, gender distribution, mechanism of injury, alcohol use, GCS on admission, pupil reactivity, presence of extra-cranial associated injuries, laboratory tests and CT scan results.

Outcome assessment for survivors was based only on data from the medical records of patients during their hospitalization, and that obtained within a 6 month-period after discharge.

Unfavorable outcome (death or severe disability) at six months was defined with the GOS. The scale comprises five categories: death, vegetative state, severe disability, moderate disability, and good recovery. Our results are statistically analyzed and discussed.

Follow up and outcome assessment after 6 months was feasible in 577 patients (92.91% of cases) and is presented in Table 1.

Results

During the fifteen years' period, 621 patients over 18-year old (435 male and 186 female) were admitted in our hospital due to severe TBI. A preponderance of injuries occurred among men (70.05%) and among ages 18-30-year old (57.97%).

*Corresponding author: Leonidas Grigorakos MD, PhD, 36 B Figaleias Str, 14564, N. Kifissia, Athens, Greece, Tel: +30.210.3709522; Fax: +30.210.3709520; E-mail: grigorakos@parliament.gr

Table 1: Outcome according to GOS at 6-month post-injury assessment.

	Percentage (%)
Death	27.38
Vegetative state	5.15
Severe disability	7.73
Moderate disability	22.71
Good recovery	37.03

Transportation-related accidents were the leading cause of TBI (61.99%), mostly in the younger ages, followed by injurious falls (23.99%), more pronounced in the elderly population, which represented 24.8% of all patients of our study. Positive alcoholemy was found in 8.05% of the patients resulting mainly in injurious falls. Table 2 shows the distribution of injuries by gender, age and cause as well as the mortality rate in the different categories.

Table 3 presents percentages and mortality rate of patients in relation to their GCS score on admission and after resuscitation. Patients above 75-year old had worse outcome compared with the youngest group of patients (57.14% vs 34.72% mortality rate). GCS level is highly correlated with mortality rate. Patients with GCS of 3-4 had 54.96% mortality, 5-6 at 29.95% and 7-8 with mortality of 11%.

Presence of extracranial injuries is shown in Table 4. Most patients presented injuries in the extremities and the pelvic gridle (34.30%), followed by injuries in the chest area (21.74%), head and face (20.93%). Only 6.76% of the patients recorded abdominal injuries.

CT findings at admission and mortality rates in relation to the type of injury are highlighted in Table 5. They reveal that the highest mortality rate is recorded in the case of patients with subdural hematoma (43.75%), followed by patients with brain contusion (33.87%) (Figures 1 and 2). Intracerebral hematoma, even though it was the most frequent image finding (49.92% of all cases studied), mortality rate was 25.16%.

Coexisting injuries, found in 52.98% of the patients aggravated the prognosis. The mortality of patients with unequal or unreactive pupils was 53.95%. Hypoxia (pO2<60 mmHg) in the first 6 hours after admission was developed in 27.38% of our patients and their mortality rate was 48.96%, while 17.23% developed shock (SBP<90 mmHg) and the mortality rate of that group was 46.73%. Anemia (Hct<30%) was noted in 18.52% of cases with a mortality rate of 35.65%.

The majority of patients (94.04%) were intubated and subjected to mechanical ventilation. 19.00% of the patients needed a placement of an intracranial pressure monitor. Surgical treatment was necessary in 32.04% of the patients.

Outcome according to GOS at six-month post-injury assessment is presented in Table 1 and it reveals that death emerged in 27.38% of cases while good recovery was seen in 37.03% of the patients.

Discussion

TBI remains a leading cause of death and disability worldwide, which can affect the daily life activities and presents high risk of readmission to hospital and/or subsequent death. Thus, studies have been carried out so as to investigate variables, which could predict outcome in TBI (demographics, cause of injury, GCS, clinical variables and CT findings) [10-13].

Sex does not have statistical significance in predicting outcome, although males are more likely to sustain a TBI than females [5,10,11].

Table 2: Characteristics of patients with traumatic brain injury (n = 621) and mortality rates.

Characteristics	Percentage (%)	Mortality rate (%)
Age, years		
18-30	57.97	34.72
30-75	17.23	28.03
>75	24.80	57.14
Sex		
Male	70.05	24.83
Female	29.95	34.95
Cause of head injury		
Road-traffic crash	61.99	28.31
Falls	23.99	22.15
Workplace accidents	7.08	15.91
Physical aggression	6.94	27.91

Table 3: Distributions and mortality rate of patients in relation to GCS in admission (n= 621).

GCS score	Percentage (%)	Mortality rate (%)
3	19.00	58.47
4	19.97	51.61
5	19.00	35.59
6	15.94	23.23
7	15.14	12.77
8	10.95	8.82

Table 4: Percentage of patients with coexistence of extra-cranial injuries.

	Percentage (%)
Extermities/Pelvic girdle	34.30
Chest	21.74
Abdomen/Pelvic contents	6.76
Head/Face	20.93
Spinal cord	8.86
Other body regions	7.41

Table 5: CT findings at admission and mortality rates.

	Percentage (%)	Mortality rate (%)
Epidural hematoma	8.05	8.00
Subdural hematoma	18.04	43.75
Intracerebral hematoma	49.92	25.16
Brain contusion	9.98	33.87
Petechial haemoraghes	9.98	22.58
Normal scan	4.03	8.00

This has been attributed to more men being drivers and being involved in accidents [14]. In our study, the majority of patients were male (70.05%) and only 29.95% were female. The commonest cause of severe TBI was indeed road traffic accidents (61.99%) and injurious falls (23.99%). Other causes (i.e. workplace accidents and physical aggression) accounted for 14.02%. The overall mortality rate in the study is 27.38%. This rate is lower than the one reported by other researchers, usually varying between 32-49% [5,15,16].

The GCS score was described in 1974 by Teasdale and Jennett and was introduced to assess the degree of unconsciousness in patients with traumatic brain injury [17,18]. Evidence shows that GCS is a strong predictor of outcome in TBI [1,11]. It may however be affected by sedation, paralysis or intoxication with alcohol and affected by presence of facial swelling [5,19]. In our study, classification of head injuries according to admission GCS score and pupil reaction showed, as expected, that the mortality rate of the patients was higher for GCS
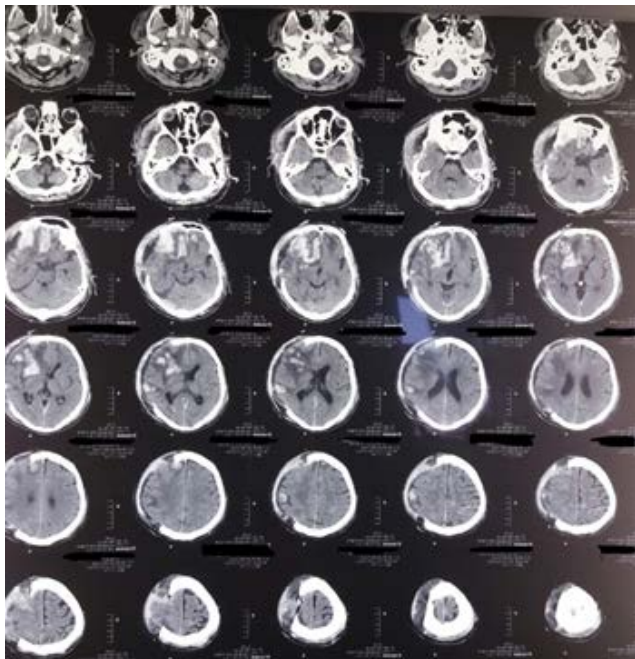
Figure 1: CT scan image of 43-year old male after a motor vehicle accident showing subdural hematoma, brain contusion and frontal bone fracture.
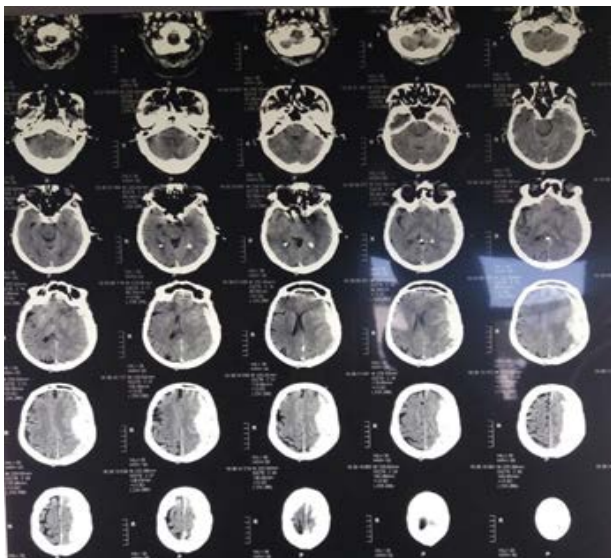

Figure 2: CT scan image of 82-year old female after injurious fall showing subdural hematoma, under anticoagulant therapy.

score lower than 6 and slightly elevated in the patients that were admitted with anisocoria or unreactive pupils.

Beside these important variables, CT scan plays a crucial role in early assessment of patients with TBI. Especially in resource poor settings, where intracranial pressure monitoring is not readily available, CT findings may be used as an important variable in predicting TBI outcome [12]. In our case, we report the highest mortality rate in patients presenting with findings of subdural hematomas, while the most frequent image finding was intracerebral hematomas.

Conclusion

Severe TBI has a high mortality and morbidity in Greek society. It has a high impact on young people, especially men. The age of the patient, GCS at admission and the CT scanning are significant predictors of outcome ($p \leq 0.05$). A significant proportion of patients (35.6%) were still dependent for care at six-month post-injury assessment.

To conclude, we recommend that: a) For the best management and outcome in the case of patients with severe TBI, prediction factors should be assessed in combination; b) CT scan findings should be used together with the clinical findings (i.e. GCS, pupillary findings) when prognosticating patients with severe TBI; c) Repeat CT scans should be done in patients who are intubated and are worsening clinically; d) Head trauma should highly be prevented in order to reduce incidence of TBI related mortality. Thus, traffic rules should be frequently taught and responsible drinking advocated; e) Awareness of the impact of head trauma should be raised through information campaigns; f) Future studies showing impact of longer term outcome of severe TBI patients at one year after injury should be conducted.

Informed Consent

Written informed consent was obtained from the patients/patients' families for publication of this research article and any accompanying images.

References

1. Perel P, Arango M, Clayton T, Edwards P, Komolafe E, et al. (2008) Predicting outcome after traumatic brain injury: practical prognostic models based on large cohort of international patients. BMJ 336: 425.

2. Brazinova A, Rehorcikova V, Taylor MS, Buckova V, Majdan M, et al. (2016) Epidemiology of Traumatic Brain Injury in Europe: A Living Systematic Review. Journal of Neurotrauma.

3. Baguley IJ, Nott MT, Howle AA, Simpson GK, Browne S, et al. (2012) Late mortality after severe traumatic brain injury in New South Wales: a multicentre study. Med J Aust 196: 40-45.

4. Teasdale G, Maas A, Lecky F, Manley G, Stocchetti N, et al. (2015) The Glasgow Coma Scale at 40 years: standing the test of time. The Lancet Neurology 13: 844-854.

5. Kolias AG, Guilfoyle MR, Helmy A, Allanson J, Hutchinson PJ (2013) Traumatic brain injury in adults. Pract Neurol 13: 228-235.

6. Coronado VG, Xu L, Basavaraju S, McGuire L, Wald MM, et al. (2011) Surveillance for Traumatic Brain Injury-Related Deaths - United States, 1997-2007. MMWR Surveill Summ 60: 1-32.

7. Feigin VL, Theadom A, Barker-Collo S, Starkey N, McPherson K, et al. (2013) Incidence of traumatic brain injury in New Zealand: a population-based study. The Lancet Neurology 12: 53-64.

8. Hukkelhoven CW, Steyerberg EW, Rampen AJ, Farace E, Habbema JD, et al. (2013) Patient age and outcome following severe traumatic brain injury: an analysis of 5600 patients. J Neurosurg 99: 666-673.

9. Blot S, Koulenti D (2016) Factors Influencing Outcomes in Intensive Care Unit Patients with Nosocomial Infections. Arch Iran Med. 19: 677-678.

10. MRC CRASH Trial Collaborators (2008) Predicting outcome after traumatic brain injury: practical prognostic models based on large cohort of international patients. BMJ 336: 425- 429.

11. Husson EC, Ribbers GM, Willemse-van Son AH, Verhagen AP, Stam HJ, et al. (2010) Prognosis of six-month functioning after moderate to severe traumatic brain injury: a systematic review of prospective cohort studies. J Rehabil Med 42: 425-436.

12. Mata-Mbemba D, Mugikura S, Nakagawa A, Murata T, Ishii K, et al. (2014) Early CT findings to predict early death in patients with traumatic brain injury: Marshall and Rotterdam CT scoring systems compared in the major academic tertiary care hospital in northeastern Japan. Acad Radiol 21: 605-611.

13. Chesnut RM, Ghajar J, Maas AR (2000) Guidelines for the Management and prognosis of severe traumatic brain injury part II: Early indicators of prognosis in severe traumatic brain injury. J Neurotrauma 17: 556-627.

14. European Road Safety Obsevatory (2008) SafetyNet Annual Statistical Report.

15. Andriessen TM, Horn J, Franschman G, van der Naalt J, Haitsma I, et al. (2011) Epidemiology, severity classification, and outcome of moderate and severe traumatic brain injury: A Prospective Multicenter Study. J Neurotrauma 28: 2019-2031.

16. Kamal VK, Agrawal D, Pandey RM (2016) Epidemiology, clinical characteristics and outcomes of traumatic brain injury: Evidences from integrated level 1 trauma center in India. J Neurosci Rural Pract 7: 515-525.

17. Rizoli S, Petersen A, Bulger E, Coimbra R, Kerby JD, et al. (2016) Early prediction of outcome after severe traumatic brain injury: a simple and practical model. BMC Emerg Med 16: 32.

18. Middleton PM (2012) Practical use of the Glasgow Coma Scale; a comprehensive narrative review of GCS methodology. Australas Emerg Nurs J 15: 170-183.

19. Munakomi S, Bhattarai B, Srinivas B, Cherian I (2016) Role of computed tomography scores and findings to predict early death in patients with traumatic brain injury: A reappraisal in a major tertiary care hospital in Nepal. Surg Neurol Int 7: 23.

Author Affiliations

[1]*School of Nursing, National and Kapodistrian University of Athens, Athens, Greece*
[2]*Intensive Care at Trauma, Hospital of Athens, KAT, Kifissia, Athens, Greece*
[3]*Neurosurgery Department, Tzaneio General Hospital of Pireus, Greece*