Section: Neurosurgery

Original Research Article

ANALYSIS OF CLINICAL FACTORS INFLUENCING PROGNOSIS IN PATIENTS WITH TRAUMATIC BRAIN INJURY AND CONCURRENT EXTRACRANIAL TRAUMA: AN INSTITUTIONAL BASED STUDY

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Abstract

Background: Traumatic brain injury (TBI) is recognized as a significant contributor to mortality and long-term disability. Serious extracranial injury (SEI) frequently coexists in patients with TBI who experience high-impact trauma. Hence, the present study was conducted to analyze clinical factors influencing prognosis in patients with traumatic brain injury and concurrent extracranial trauma. **Materials and Methods:** The diagnosis was established through a comprehensive assessment that included a history of injury, clinical symptoms, and radiological evaluations. The study's inclusion criteria specified that participants must have experienced a traumatic brain injury, with a head abbreviated injury scale (AIS) score of 3 or higher. A total of 120 patients were enrolled. Collected data encompassed various factors such as age, gender, mechanism of injury, the duration from injury to hospital admission, blood pressure, heart rate, pupil size, pupillary reflex, admission Glasgow Coma Scale (GCS) score, head AIS score, injury location, and the necessity for tracheal intubation or tracheotomy, as well as any complications encountered during hospitalization. All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software. **Result:** A total of 120 patients were evaluated. Favorable outcome was seen in 75 percent of the patients. Significant results were obtained while comparing pupil size among patients with favorable and unfavorable outcome. Higher incidence of craniotomy was seen among patients with unfavorable outcome. Other factors associated with unfavorable outcome included Low platelet count, Anemia, High sodium concentration, High blood creatinine, Low potassium concentration and High AIS score. **Conclusion:** Pupil size, GCS score, Low platelet count, Anemia, High sodium concentration, High serum creatinine, Low potassium concentration and High AIS score were found to be significant predictor of outcome.

INTRODUCTION

High-impact trauma often results in injuries affecting multiple regions and organs of the body. Traumatic brain injury (TBI) is recognized as a significant contributor to mortality and long-term disability. Approximately one-third to one-half of TBI cases are accompanied by severe extracranial injuries (SEI) involving the chest, abdomen, and limbs.[1,2] Numerous studies have indicated that the presence of SEI alongside head injuries correlates with elevated mortality rates. However, the effect of extracranial injuries on TBI outcomes remains a subject of debate.[3] In individuals suffering from brain injuries, the presence of additional extracranial injuries can lead to reduced cerebral blood flow and/or coagulopathy resulting from substantial hemorrhage, which may exacerbate secondary brain damage.[4,5] Serious extracranial injury (SEI) frequently coexists in patients with traumatic brain injury (TBI) who experience high-impact trauma, with reported prevalence rates varying between 23% and 41% across different populations and definitions of SEI. In the case of children with severe TBI (sTBI), the incidence of SEI has been observed to range from 46% to 63%. While numerous studies have indicated that SEI adversely affects the outcomes of TBI patients, most of these investigations have

encompassed a broad age spectrum of TBI patients, resulting in an inconclusive consensus regarding the impact of SEI on patient outcomes.[2-6] McMahon CG, in a previous work, tested the hypothesis that moderate traumatic brain injury is an independent predictor of outcome in patients with multisystem trauma. They carried out an analysis of the UK Trauma Audit and Research Network Database. Moderate traumatic brain injury was defined as an Abbreviated Injury Scale score of 3. The study population included 2,717 patients with multisystem injuries, 378 patients had a moderate brain injury with peripheral injury, and 2,339 patients had extracranial injury alone. Mortality rates for both groups were compared at increasing injury severity. Moderate brain injury alone was associated with a mortality rate of 4.2%. However, when combined with extracranial injury, the risk of death was double that attributable to extracranial injury alone.[7] Hence, the present study was conducted to analyze clinical factors influencing prognosis in patients with traumatic brain injury and concurrent extracranial trauma.

MATERIALS AND METHODS

The diagnosis was established through a comprehensive assessment that included a history of injury, clinical symptoms, and radiological evaluations. The study's inclusion criteria specified that participants must have experienced a traumatic brain injury, with a head abbreviated injury scale (AIS) score of 3 or higher. A total of 120 patients were enrolled. Collected data encompassed various factors such as age, gender, mechanism of injury, the duration from injury to hospital admission, blood pressure, heart rate, pupil size, pupillary reflex, admission Glasgow Coma Scale (GCS) score, head AIS score, injury location, and the necessity for tracheal intubation or tracheotomy, as well as any complications encountered during hospitalization. Follow-up evaluations were conducted to determine the Glasgow Outcome Scale-extended (GOSE) score one-month post-discharge. The diagnosis of traumatic brain injury (TBI) was confirmed through head computed tomography (CT) scans performed upon admission, which identified acute brain injuries. The AIS was categorized as follows: minor (1 point), moderate (2 points), severe but not life-threatening (3 points), severe and life-threatening (4 points), critical (5 points), and lethal (6 points). Consequently, an AIS score of 3 or higher was classified as indicative of severe TBI. All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software.

RESULTS

A total of 120 patients were evaluated. Favorable outcome was seen in 75 percent of the patients. Among patients with favorable outcome, dimeter of both pupils was less than 4 mm in 95.56 percent of the patients while among patients with unfavorable outcome, dimeter of both pupils was less than 4 mm in 76.67 percent of the patients while among patients. Significant results were obtained while comparing pupil size among patients with favorable and unfavorable outcome. Non-significant results were obtained while comparing the abdominal organ involvement among patients with favorable and unfavorable outcome. Higher incidence of craniotomy was seen among patients with unfavorable outcome. Other factors associated with unfavorable outcomes included Low platelet count, Anemia, High sodium concentration, High serum creatinine, Low potassium concentration and High AIS score.

Table 1: Distribution of patients according to outcome.

Outcome	Number	Percentage
Favorable outcome	90	75
Unfavorable outcome	30	25
Total	120	100

Table 2: Comparison of clinical variables

Clinical variables		Favorable outcome	Unfavorable outcome	p-value
Mean age (years)		51.3	49.5	0.12
Males (%)		77.77	73.33	0.81
Pupil size	Diameter of both pupils ≥ 4mm (%)	1.11	10	0.00*
	Diameter of one pupil ≥ 4mm (%)	3.33	13.33	
	Diameter of both pupils < 4mm (%)	95.56	76.67	
GCS Score ≤ 8		10	53.33	0.00*

*: Significant

Table 3: Involvement of abdominal organs

Abdominal organs	Favorable outcome	Unfavorable outcome	p-value
Involved	35.56	36.67	0.565
No-involved	64.44	63.33	
Total	100	100	

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Table 4: Distribution of patients according to hemorrhage and craniotomy

Variable	Favorable outcome	Unfavorable outcome	p-value
Subarachnoid hemorrhage	61.11	66.67	0.68
Cerebral hemorrhage	46.67	53.33	0.77
Craniotomy	11.11	36.67	0.00*

*: Significant

Table 5: Variables associated with unfavorable outcome

Variable	r-value	p-value
High WBC Count	0.25	0.56
High neutrophil levels	0.43	0.37
Low lymphocyte count	0.22	0.58
Low platelet count	1.82	0.00*
Anemia	2.68	0.00*
High sodium concentration	1.79	0.00*
High blood creatinine	2.17	0.00*
Low potassium concentration	1.62	0.00*
High AIS score	3.28	0.00*

*: Significant

DISCUSSION

Traumatic brain injury (TBI) represents a significant public health concern, with an incidence rate of 200 cases per 100,000 individuals. This condition is associated with considerable mortality and morbidity, leading to a substantial loss of productive years for those affected. Upon admission, patients with TBI frequently present with extracranial injuries, including respiratory, cardiac, renal, and hepatic complications, particularly in the context of polytrauma or as a result of systemic issues that may arise during their stay in the intensive care unit (ICU). Recent findings from the Collaborative European Neurotrauma Effectiveness Research in Traumatic Brain Injury (CENTER-TBI) study, a comprehensive European multicenter observational cohort investigation, revealed that significant extracranial injuries, defined by an abbreviated injury score (AIS) of 3 or higher, were observed in 55% of TBI patients admitted to the ICU and in 28% of those admitted to general wards. Despite their prevalence, the impact of these injuries on patient outcomes is often overlooked, as clinicians tend to concentrate primarily on intracranial injuries while neglecting the broader systemic implications of TBI.[6-10] Hence, the present study was conducted to analyze clinical factors influencing prognosis in patients with traumatic brain injury and concurrent extracranial trauma.

A total of 120 patients were evaluated. Favorable outcome was seen in 75 percent of the patients. Among patients with favorable outcome, the diameter of both pupils was less than 4 mm in 95.56 percent of the patients while among patients with unfavorable outcome, dimeter of both pupils was less than 4 mm in 76.67 percent of the patients while among patients. In a previous study conducted by Baum J et al, authors evaluate patients treated for traumatic brain injuries (TBI) determined how multiple organ trauma (MOT) and lung injuries sustained at the time of initial injury affect outcome. There were 409 patients reviewed. The majority of patients were male (73%), average age was 46 years (range, 16-94 years), average Glasgow Coma Scale (GCS) score was 7, and 71% had a severe TBI (GCS ≤8). Thirty percent of patients had poor outcome (Glasgow Outcome Scale = 1-2) Regression analysis indicated age, initial GCS, Injury Severity Score}, and head AIS ≥5 were significant independent predictors of poor outcome. Sex, MOT, lung injury, and lung injury severity were not significant predictors of outcome. Age, GCS, Injury Severity Score, and critical head injuries (AIS ≥5) were significant tools in predicting outcome in this patient cohort.[11]

In the present study, significant results were obtained while comparing pupil size among patients with favorable and unfavorable outcome. Non-significant results were obtained while comparing the abdominal organ involvement among patients with favorable and unfavorable outcome. Higher incidence of craniotomy was seen among patients with unfavorable outcome. Brennan PM, et al determined what information would be gained by combining these indicators into a single index and to explore the merits of different ways of achieving this. Separately, the GCS score and pupil response were each related to outcome. Adding information about the pupil response to the GCS score increased the information yield. The performance of the simple GCS-P was similar to the performance of more complex methods of evaluating traumatic brain damage. The relationship between decrease in the GCS-P and deteriorating outcomes were seen across the complete range of possible scores. The additional 2 lowest points offered by the GCS-Pupils scale (GCS-P 1 and 2) extended the information about injury severity from a mortality rate of 51% and an unfavorable outcome rate of 70% at GCS score 3 to a mortality rate of 74% and an unfavorable outcome rate of 90% at GCS-P 1. The paradoxical finding that GCS score 4 was associated with a worse outcome than GCS score 3 was not seen when using the GCS-P. A simple arithmetic combination of the GCS score and pupillary response, the GCS-P, extends the

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information provided about patient outcome to an extent comparable to that obtained using more complex methods.[12]

In the present study, other factors associated with unfavorable outcome included Low platelet count, Anemia, High sodium concentration, High serum creatinine, Low potassium concentration and High AIS score. Watanabe T et al assessed 485 patients with the blunt head injury with head abbreviated injury scale (AIS) ≧ 3. SEI was defined as AIS ≧ 3 injuries in the face, chest, abdomen, and pelvis/extremities. Vital signs and coagulation parameter values were also extracted from the database. Total patients were dichotomized into isolated TBI (n = 343) and TBI associated with SEI (n = 142). The differences in severity and outcome between these two groups were analyzed. To assess the relation between outcome and any variables showing significant differences in univariate analysis, we included the parameters in univariable and multivariable logistic regression analyses. Mortality was 17.8% in the isolated TBI group and 21.8% in TBI with SEI group (P = 0.38), but the Glasgow Outcome Scale (GOS) in the TBI with SEI group was unfavorable compared to the isolated TBI group (P = 0.002). Patients with SBP ≦ 90 mmHg were frequent in the TBI with SEI group. Adjusting for age, GCS, and length of hospital stay, SEI was a strong prognostic factor for mortality with adjusted ORs of 2.30.[13]

CONCLUSION

Traumatic brain injury (TBI) represents the primary contributor to mortality, prolonged disability, and cognitive deficits, particularly among the youth globally. The prognosis for individuals suffering from traumatic brain injury remains uncertain. Pupil size, GCS score, Low platelet count, Anemia, High sodium concentration, High serum creatinine, Low potassium concentration and High AIS score were found to be significant predictors of outcome.

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