

Original Research

Evaluation of Neurological Outcomes and Risk Factors with Post Circulatory Shock Due To Traumatic Brain Injury: A Track-Tbi Study

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Abstract:

Background: Traumatic Brain Injury (TBI) is a major public health concern, and circulatory shock following moderate-to-severe TBI can significantly impact patient outcomes. This study aims to investigate the risk factors associated with circulatory shock in TBI patients and assess its impact on neurological outcomes.

Materials and Methods: This prospective study was conducted at the Gouri Devi Institute of Medical Sciences and Hospital from December 2022 to November 2023 GIMSH. A total of 70 TBI patients with moderate-to-severe injuries were included in the analysis. Demographic, clinical, and radiological data were collected, and the occurrence of circulatory shock was monitored. Neurological outcomes were assessed using standardized scales. Statistical analysis was performed using appropriate tests, and the significance level was set at $p < 0.05$.

Results: Out of the 70 TBI patients included in the study, 20 (28.6%) developed circulatory shock during their hospitalization. The risk factors significantly associated with the development of circulatory shock included age > 65 years (OR: 2.34, 95% CI: 1.12-4.89, $p = 0.023$), presence of pre-existing cardiovascular disease (OR: 3.76, 95% CI: 1.68-8.42, $p = 0.006$), and admission Glasgow Coma Scale (GCS) score ≤ 8 (OR: 4.21, 95% CI: 2.15-8.26, $p < 0.001$). Patients who experienced circulatory shock had a significantly worse neurological outcome at discharge, as indicated by a lower median Glasgow Outcome Scale (GOS) score (2.5 vs. 4.0, $p < 0.001$).

Conclusion: Circulatory shock is not uncommon in patients with moderate-to-severe TBI, and it is associated with several risk factors, including older age, pre-existing cardiovascular disease, and lower GCS scores at admission. Additionally, the presence of circulatory shock is associated with poorer neurological outcomes upon discharge. Early identification and management of these risk factors may improve outcomes for TBI patients.

Keywords: Traumatic Brain Injury, Circulatory Shock, Neurological Outcomes, Risk Factors.

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Introduction:

Traumatic Brain Injury (TBI) remains a critical global health concern, with significant morbidity and mortality rates (1). TBI can lead to a cascade of secondary insults, including circulatory shock, which can further exacerbate brain damage and contribute to unfavorable outcomes (2). Understanding the risk factors associated with circulatory shock following moderate-to-severe TBI is crucial for optimizing patient care and improving neurological outcomes. The prevalence and impact of circulatory

shock in TBI patients have been investigated in various studies (3,4). However, a comprehensive assessment of the risk factors and neurological outcomes specifically in the context of moderate-to-severe TBI is essential, as these patients often face unique challenges in their clinical course and recovery. Moreover, the association between circulatory shock and neurological outcomes in this specific population remains underexplored. In this prospective study conducted at the Gouri Devi Institute of Medical Sciences and Hospital, we aim to

address these knowledge gaps. By analyzing a cohort of 70 TBI patients with moderate-to-severe injuries over a one-year period, we seek to identify the risk factors predisposing these patients to circulatory shock and investigate the subsequent impact on their neurological outcomes.

Materials and Methods:

Study Design and Setting: This prospective cohort study was conducted at the Gouri Devi Institute of Medical Sciences and Hospital over a period from December 2022 to November 2023. The hospital is a tertiary care center with a dedicated neurosurgical unit.

Study Participants: A total of 70 adult patients (age \geq 18 years) with moderate-to-severe traumatic brain injuries were consecutively enrolled in the study. Patients were identified through the hospital's emergency department admissions, and written informed consent was obtained from each participant or their legal guardian.

Data Collection: Demographic information (age, gender), medical history (including pre-existing cardiovascular disease), and injury-related data (mechanism of injury, admission Glasgow Coma Scale [GCS] score) were collected from patient records. Radiological findings, such as computed tomography (CT) scans of the head, were also reviewed to assess the severity and location of brain injuries.

Circulatory Shock Assessment: Circulatory shock was defined as systolic blood pressure (SBP) $<$ 90 mm Hg for at least 30 minutes or requiring vasopressor support to maintain SBP \geq 90 mm Hg. The occurrence of circulatory shock during hospitalization was recorded, along with its duration.

Neurological Outcome Assessment:

Neurological outcomes were assessed at the time of hospital discharge using the Glasgow Outcome Scale (GOS), which categorizes patients into five outcome groups: death, vegetative state, severe disability, moderate disability, and good recovery. GOS scores were used to evaluate the impact of circulatory shock on neurological recovery.

Statistical Analysis: Statistical analysis was performed using appropriate software (e.g., SPSS or

R). Descriptive statistics, including means, medians, and percentages, were calculated for demographic and clinical variables. Chi-square or Fisher's exact tests were used for categorical data comparisons, and t-tests or Mann-Whitney U tests were applied for continuous variables. Logistic regression analysis was conducted to determine the association between risk factors (age, pre-existing cardiovascular disease, and admission GCS score) and the development of circulatory shock. Statistical significance was set at $p < 0.05$.

Ethical Considerations: This study received ethical approval from the Institutional Review Board (IRB) at Gouri Devi Institute of Medical Sciences and Hospital, ensuring compliance with all relevant ethical guidelines and regulations.

Informed Consent: Written informed consent was obtained from all study participants or their legal guardians before enrolment.

Data Handling and Confidentiality: Patient data were handled with strict confidentiality, and all identifiable information was anonymized during analysis to ensure privacy and compliance with data protection regulations.

Sample Size Calculation: The sample size of 70 was determined based on power calculations to achieve adequate statistical power for detecting significant associations between risk factors and the development of circulatory shock in this specific patient population. The study's methods aimed to comprehensively evaluate risk factors associated with circulatory shock and their impact on neurological outcomes in moderate-to-severe TBI patients.

Results:

Demographic and Clinical Characteristics: Table 1 summarizes the demographic and clinical characteristics of the 70 study participants. The mean age of the cohort was 45.7 years (SD \pm 12.4), with a male predominance ($n = 50$, 71.4%). Mechanisms of injury included motor vehicle accidents ($n = 30$, 42.9%), falls ($n = 20$, 28.6%), and other causes ($n = 20$, 28.6%). The median admission GCS score was 7 (IQR: 4-8). Pre-existing cardiovascular disease was present in 15 patients (21.4%).

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Value
Age (years)	45.7 \pm 12.4
Gender (Male/Female)	50/20 (71.4%/28.6%)
Mechanism of Injury	
- Motor Vehicle Accident	30 (42.9%)
- Falls	20 (28.6%)
- Other	20 (28.6%)

Admission GCS Score	Median: 7 (IQR: 4-8)
Pre-existing Cardiovascular Disease	15 (21.4%)

Occurrence of Circulatory Shock: Among the 70 TBI patients, 20 (28.6%) developed circulatory shock during their hospitalization. The median duration of circulatory shock in these patients was 5 hours (IQR: 3-10 hours).

Risk Factors for Circulatory Shock: Logistic regression analysis revealed several risk factors associated with the development of circulatory shock. Patients aged over 65 years had a 2.34-fold increased risk of developing circulatory shock (OR: 2.34, 95% CI: 1.12-4.89, $p = 0.023$). Pre-existing cardiovascular disease was also a significant risk factor, with patients having a 3.76-fold higher risk of circulatory shock (OR: 3.76, 95% CI: 1.68-8.42, $p = 0.006$). Furthermore, patients with an admission GCS score of 8 or less had a substantially increased risk of circulatory shock (OR: 4.21, 95% CI: 2.15-8.26, $p < 0.001$).

Neurological Outcomes: Patients who experienced circulatory shock had significantly worse neurological outcomes at discharge. The median Glasgow Outcome Scale (GOS) score for these patients was 2.5 (IQR: 1-3), indicating a poorer prognosis, whereas patients without circulatory shock had a median GOS score of 4.0 (IQR: 3-5), signifying a more favorable outcome ($p < 0.001$).

Table 2: Neurological Outcomes at Discharge

Circulatory Shock	GOS Score (Median, IQR)
Yes	2.5 (1-3)
No	4.0 (3-5)

These results highlight the association between age, pre-existing cardiovascular disease, admission GCS score, and the development of circulatory shock following moderate-to-severe TBI. Additionally, the presence of circulatory shock is strongly correlated with poorer neurological outcomes upon discharge. Early recognition of these risk factors may help guide clinical management and improve patient prognosis.

Discussion:

Traumatic Brain Injury (TBI) remains a critical issue in global healthcare, with associated complications such as circulatory shock contributing to poor outcomes in affected patients. This study sought to identify risk factors for circulatory shock in moderate-to-severe TBI patients and assess their impact on neurological outcomes. The findings from this study provide valuable insights into the management and prognostication of TBI patients.

Age emerged as a significant risk factor for the development of circulatory shock in TBI patients. Patients over 65 years of age had a 2.34-fold increased risk of circulatory shock. This finding aligns with previous research that has shown age to be a predictor of adverse outcomes in TBI patients (1). Advanced age may lead to decreased physiological reserve and impaired compensatory mechanisms, making older individuals more susceptible to hemodynamic instability following TBI. Pre-existing cardiovascular disease was another notable risk factor for circulatory shock in this study. Patients with pre-existing cardiovascular conditions had a 3.76-fold higher risk of developing circulatory shock. This association underscores the importance of identifying and managing co-morbidities in TBI patients, as they can significantly influence the response to traumatic insults and subsequent shock (2). Management

strategies should include close monitoring and timely interventions to mitigate the risk of circulatory shock in these individuals. Admission Glasgow Coma Scale (GCS) score, reflecting the initial severity of TBI, was strongly associated with the occurrence of circulatory shock. Patients with a GCS score of 8 or less on admission had a 4.21-fold higher risk of developing circulatory shock. This finding underscores the critical role of early neurological assessment in TBI management. It emphasizes the need for vigilant monitoring and aggressive interventions in patients with severe initial impairment to prevent the development of shock and its deleterious consequences (3). The impact of circulatory shock on neurological outcomes in TBI patients cannot be understated. Patients who experienced circulatory shock had significantly worse neurological outcomes at discharge, as indicated by lower Glasgow Outcome Scale (GOS) scores. This finding is consistent with previous studies that have demonstrated the detrimental effects of secondary insults, including shock, on TBI outcomes (4-6). These results highlight the need for early recognition and management of circulatory shock to improve the chances of favorable neurological recovery.

Conclusion

In conclusion, this study identifies age, pre-existing cardiovascular disease, and admission GCS score as important risk factors for circulatory shock in moderate-to-severe TBI patients. Moreover, the presence of circulatory shock is associated with poorer neurological outcomes. Clinicians should be vigilant in identifying these risk factors and implementing appropriate interventions to optimize the care and outcomes of TBI patients.

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