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A COMPARATIVE STUDY OF SMS (SIMPLIFIED MOTOR SCORE) VS GCS (GLASGOW COMA SCALE) IN PREDICTING CRITICAL OUTCOMES IN TRAUMATIC BRAIN INJURY

Surgery

Dr. Shailova Ranjan Shukla
Dr. Yogesh Kumar
Dr. Anindya Gupta

ABSTRACT

Background: Traumatic Brain Injury (TBI) poses a significant global health challenge, with young adults particularly at risk. Traditional assessment tools like the Glasgow Coma Scale (GCS) have limitations, prompting the need for simpler, more effective alternatives, especially in resource-limited settings. **Aims & Objectives:** This study aimed to compare the predictive accuracy of the Simplified Motor Score (SMS) with the GCS in determining key clinical outcomes, including the need for intubation, neurosurgical intervention, significant radiological findings, and in-hospital mortality among TBI patients. **Methodology:** An 18-month observational study was conducted at B.R.D Medical College, Gorakhpur, enrolling 178 TBI patients. Demographic data, injury etiology, and scores from both the SMS and GCS were recorded. Statistical analyses, including ROC curve comparisons, were performed to evaluate the predictive efficacy of the SMS and GCS. **Results:** Young adults aged 21-30 years (30.30%) and males (79.8%) were predominantly affected by TBI, with road traffic accidents (74.70%) as the leading cause. The SMS showed high sensitivity (94.5%) and specificity (89.4%) for predicting intubation needs, and effectively predicted in-hospital mortality with 91.2% sensitivity. **Conclusions:** The SMS is a reliable tool for assessing TBI severity, particularly for intubation and mortality prediction, offering a practical alternative to the GCS in emergency and resource-limited settings.

KEYWORDS

Traumatic Brain Injury; Simplified Motor Score; Glasgow Coma Scale; Intubation; Mortality Prediction.

INTRODUCTION

Traumatic Brain Injury (TBI) is a major global health issue, with significant implications for mortality and long-term disability.[1] In India, the increasing incidence of TBI highlights the need for reliable and efficient tools to assess the severity of brain injuries, particularly in resource-constrained settings like tertiary care hospitals in Uttar Pradesh. Traditionally, the Glasgow Coma Scale (GCS) has been the primary tool for evaluating TBI, offering a detailed assessment based on verbal, motor, and eye responses.[2] However, the GCS has certain limitations, especially in situations where patients are intubated or where language barriers exist, potentially affecting the accuracy of the assessment and subsequent management decisions.[3]

The Simplified Motor Score (SMS) presents a viable alternative to the GCS, particularly in emergency settings where rapid evaluation is crucial.[4] By focusing solely on motor responses, the SMS streamlines the assessment process, making it particularly valuable in high-volume and resource-limited environments. The SMS's straightforward scoring—ranging from 0 to 2 points—allows for quick determination of neurological status, which is essential for timely intervention in TBI cases.[4,5] In hospitals like Baba Raghav Das Medical College in Uttar Pradesh, where patient volumes are high and resources are limited, the SMS could serve as a more practical tool for assessing TBI severity.

This observational study is designed to compare the predictive value of the Simplified Motor Score (SMS) with the Glasgow Coma Scale (GCS) in patients with traumatic brain injury at a tertiary care hospital in Uttar Pradesh. The study will examine key outcomes such as mortality, hospital stay duration, and recovery patterns to determine whether the SMS can provide an equivalent or superior assessment compared to the GCS. The results of this study could have significant implications for clinical practice, potentially leading to broader adoption of the SMS in similar healthcare settings across India, ultimately aiming to enhance the management and outcomes of TBI patients in regions with limited medical resources.

MATERIALS & METHODS

The present study was conducted over a period of 18 months in the Department of General Surgery at B.R.D Medical College, Gorakhpur, following the approval from the Institutional Ethics Committee. All patients presenting to the emergency department with traumatic brain injury (TBI) were considered for inclusion, provided they met the inclusion criteria, which required them to be adolescents or adults aged over 10 years and to have presented within 24 hours of sustaining the injury. Patients with severe spinal cord injuries, those intubated prior to arrival, and those with pre-existing neurological disorders or a history of neurosurgical intervention were excluded from the study.

This observational longitudinal study's sample size was calculated using a prevalence estimate of 12% based on a previous study, resulting in a required sample size of 162 patients. To account for potential non-response, the sample size was adjusted to 178 patients. A consecutive sampling method was employed to enroll patients until the desired sample size was achieved.

Upon presentation to the emergency department, patients' demographic information, including age, gender, and place of residence, was recorded. The cause of injury was documented, and each patient was assessed using both the SMS and the individual components of the GCS. Key study outcomes, such as the need for intubation, neurosurgical intervention, significant radiological findings, and in-hospital mortality, were tracked and analyzed. Neurosurgical interventions included procedures such as craniotomy, craniectomy, and evacuation of brain hematomas, as deemed necessary by a neurosurgeon. The primary imaging modality used in the study was non-contrast computed tomography (NCCT) of the head.

Data management and analysis were performed using SPSS software (version 26). Categorical variables were expressed as numbers and percentages, while quantitative data were presented as means ± standard deviations or medians with interquartile ranges. Statistical tests, including the Student's t-test for quantitative data and Fisher's exact test or Chi-square test for categorical data, were applied to compare variables. A p-value of less than 0.05 was considered statistically significant. Additionally, receiver operating characteristic (ROC) curves were generated to compare the predictive abilities of the SMS, GCS, and their components against the key clinical outcomes.

RESULTS

Table 1: Age and Gender Distribution of Study Population

CHARACTERISTICS	Frequency (N)	% of Total
AGE GROUP (YEARS)		
10-20	25	14.00%
21-30	54	30.30%
31-40	38	21.30%
41-50	18	10.10%
51-60	17	9.60%
61-70	19	10.70%
71-80	4	2.20%
81-90	3	1.70%
Total	**178**	**100%**
GENDER		
Male	142	79.8%

Female	36	20.2%
Total	**178**	**100%**

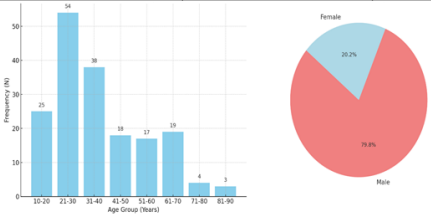

Figure 1: Age and Gender Distribution of Study Population

Table 2: Radiological Findings and Etiology of Injury in Study Subjects

RADIOLOGICAL FINDING	FREQUENCY (N)	% OF TOTAL	ETIOLOGY OF INJURY	FREQUENCY (N)	% OF TOTAL
Frontal Contusion	10	5.62%	**RTA**	133	74.70%
EDH	18	10.11%	**Violence**	19	10.70%
Pneumo	9	5.06%	**FFH**	19	10.70%
SAH	9	5.06%	**Train**	1	0.60%
Depressed Fracture	9	5.06%	**Unknown**	3	1.70%
SAH, IPH	1	0.56%	**Machine**	2	1.10%
IPH Contusion	16	8.99%	**Blunt Trauma**	1	0.60%
Contusion	51	28.65%	**Total**	**178**	**100%**
A. on C. SDH	1	0.56%			
Fracture Contusion	1	0.56%			
Fracture	2	1.12%			
IPH Fract.	1	0.56%			
Dep. Frac. Cont.	1	0.56%			
Dep. Fract. Cont. Shift	1	0.56%			
Cont. SAH IPH	1	0.56%			
IVH IPH Cont.	2	1.12%			
SDH	6	3.37%			
Fract. Skull Cont. Pneumo	1	0.56%			
Acute SDH	2	1.12%			
SAH Cont.	1	0.56%			
IVH	1	0.56%			
Cont. Fract.	1	0.56%			
Frac. Cont. Extrusion	1	0.56%			
Normal CT Scan	33	18.54%			
Total	**178**	**100%**			

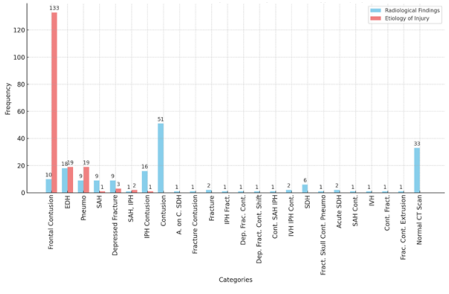

Figure 2: Radiological Findings and Etiology of Injury in Study Subjects

Table 3: Distribution of Glasgow Coma Score and Simplified Motor Score in Study Subjects

SCORE TYPE	SCORE	FREQUENCY (N)	% OF TOTAL	SCORE TYPE	SCORE	FREQUENCY (N)	% OF TOTAL
Glasgow Coma Score	3	7	3.91%	**Simplified Motor Score**	0	48	26.96%
	4	23	12.84%		1	58	32.60%
	5	3	1.67%		2	72	40.40%
	6	9	5.02%				
	7	7	3.91%				
	8	8	4.46%				
	9	13	7.26%				
	10	12	6.70%				
	11	5	2.79%				
	12	15	9.94%				
	13	10	5.58%				
	14	4	2.23%				
	15	63	36.44%				

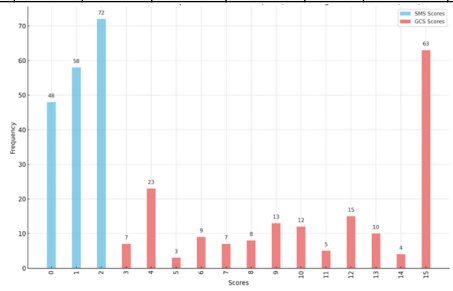

Figure 3: Distribution of Glasgow Coma Score and Simplified Motor Score in Study Subjects

Table 4: Effectiveness of the Motor Score, GCS Score, and Simplified Motor Score (SMS) in predicting clinical outcomes

OUTCOME	SCALE	CUT POINT	SENSITIVITY (%)	SPECIFICITY (%)	PPV (%)	NPV (%)	YOUDEN'S INDEX
Need for Intubation	GCS Score	7	95.12	90.38	95.9	88.68	0.900
	SMS	4	94.5	89.4	93.6	86.42	0.966
Need for Neurosurgical Intervention	GCS Score	8	72.6	40.62	84.8	24.53	0.900
	SMS	3	70.6	38.6	82.6	22.2	0.966
Significant Radiological Findings	GCS Score	7	90.62	13.01	18.59	86.36	0.903
	SMS	4	88.6	12.6	17.2	84.2	0.951
In-Hospital Mortality	GCS Score	7	93.66	83.33	96.38	73.53	0.911
	SMS	5	91.2	81.6	94.2	71.4	0.971

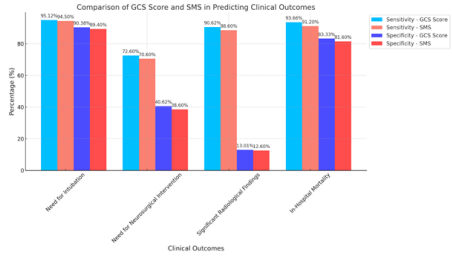

Figure 4: Effectiveness of the Motor Score, GCS Score, and Simplified Motor Score (SMS) in predicting clinical outcomes

DISCUSSION

Our study revealed that the largest proportion of traumatic brain injury (TBI) cases occurred in the 21-30 year age group, representing 30.30% of the total population. This finding is consistent with existing literature, which highlights the heightened vulnerability of younger adults to TBIs due to factors such as risk-taking behaviors and increased exposure to high-risk activities like driving. **Anderson et al.**[6] particularly noted that this age group is often overrepresented in TBI cases. The significant male predominance in our study (79.8%) also aligns with global trends, where males are generally at higher risk for TBIs due to factors such as occupational hazards and engagement in physical activities that carry a higher risk of head injury. **Gardner et al.**[7] also supported this observation, pointing to the behavioral and social factors contributing to this gender disparity.

Radiological examination in our study identified contusions as the most common finding, accounting for 28.65% of cases, followed by epidural hematomas (EDH) at 10.11%. These results are in line with **Blennow et al.**[8], who discussed how contusions and hematomas are prevalent in TBI cases and are often indicative of severe brain trauma. The etiology of injuries in our population was predominantly due to

road traffic accidents (RTAs), which were responsible for 74.70% of the TBIs. This high incidence of RTAs reflects global epidemiological patterns, particularly in emerging economies where rapid urbanization and increased vehicle use contribute to higher rates of traffic-related injuries. **Faul et al.**[9] highlight the significant public health challenge posed by RTAs, particularly in regions experiencing rapid motorization.

The distribution of scores in our study indicates that a substantial portion of patients had relatively high Simplified Motor Scores (SMS), with 40.4% scoring a 2 and 32.6% scoring a 1. This suggests that while many patients experienced moderate to mild motor impairments, there was still a notable presence of more severe cases. **Blennow et al.**[8] discussed how the severity of brain injuries, as reflected in motor scores, directly impacts patient outcomes and rehabilitation strategies. The Glasgow Coma Score (GCS) distribution further supported these findings, with the majority of patients scoring at the higher end, indicating less severe impairment overall. This distribution is critical for understanding the prognosis and tailoring treatment protocols to the severity of each case.

Our study evaluated the effectiveness of various scoring systems in predicting critical clinical outcomes. The Simplified Motor Score (SMS) demonstrated high sensitivity (94.5%) and specificity (89.4%) for predicting the need for intubation, making it a reliable tool in acute trauma settings. **Dewan et al.**[10] emphasize the utility of such trauma scores in facilitating rapid and accurate decision-making in emergency contexts. However, SMS showed moderate effectiveness in predicting the need for neurosurgical interventions, with a sensitivity of 70.6% and specificity of 38.6%, indicating a potential for overprediction. This finding aligns with the broader discussion by **Faul et al.**[9] on the variability of trauma scores in different clinical situations. When predicting significant radiological findings, SMS had a high sensitivity (88.6%) but low specificity (12.6%), which could lead to unnecessary interventions due to false positives, as noted by **Blennow et al.**[8] Finally, SMS was highly effective in predicting in-hospital mortality, with a sensitivity of 91.2% and specificity of 81.6%, underscoring its value in assessing the severity of brain injuries and guiding treatment decisions, as supported by **Maas et al.**[11] **and Anderson et al**.[6] These results reflect the strengths and limitations of SMS in different clinical scenarios, providing valuable insights into its application in trauma care.

CONCLUSION

The study revealed a demographic concentration of traumatic brain injury (TBI) cases among young adults aged 21-30 years, with a significant male predominance (79.8%), primarily due to road traffic accidents (74.70%). Radiologically, contusions were the most frequent finding (28.65%), emphasizing the need for detailed imaging in TBI management. The Simplified Motor Score (SMS) demonstrated robust predictive capabilities, particularly in intubation needs with high sensitivity (94.5%) and specificity (89.4%), aligning closely with the Glasgow Coma Score (GCS). However, the SMS showed moderate effectiveness in predicting neurosurgical interventions and significant radiological findings, with a tendency towards overprediction due to lower specificity in certain outcomes. Despite these limitations, the SMS was effective in predicting in-hospital mortality, underscoring its utility as a valuable tool in clinical and emergency settings for assessing TBI severity and guiding treatment decisions.

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