Chronic Subdural Hematoma (CSDH) Score for Predicting Outcome in Chronic Subdural Hematoma in a Tertiary Care Center

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Abstract

Introduction: Chronic subdural hematoma (cSDH) presents a significant neurosurgical challenge, particularly in elderly patients and those with predisposing factors such as chronic alcohol consumption or coagulopathies. While burr-hole evacuation is the standard surgical technique, alternative approaches exist. The cSDH score, incorporating variables such as age, Glasgow Coma Scale (GCS), hematoma thickness, midline shift, motor function, and orientation, offers a comprehensive assessment tool. This study aims to evaluate the cSDH score's predictive ability for outcomes in chronic SDH patients using the Modified Rankin Scale (mRS) at discharge and after six months.

Materials and Methods: Patients diagnosed with unilateral chronic subdural hematoma at Tribhuvan University Teaching Hospital between December 2019 and April 2021 were included. Data on cSDH score variables were collected at admission, and outcomes were assessed using mRS at discharge and after six months. Analysis included receiver-operating characteristic (ROC) curve to evaluate discrimination ability and analysis of variance to assess predictive variables.

Results: The study comprised 74 patients, with headache being the most common presentation. At discharge, fifty-five patients (74.3%) of patients had favorable outcomes, increasing to fifty-six patients (75.7%) after six months. Analysis indicated associations between preoperative GCS, age, hematoma thickness, midline shift, motor function, orientation, and unfavorable mRS outcomes. ROC analysis demonstrated excellent discrimination ability of the cSDH score, with AUCs of 0.936 at discharge and 0.948 after six months.

Conclusion: The cSDH score proves valuable in predicting outcomes for chronic subdural hematoma patients. However, larger multicenter studies are needed to validate the predictive ability of the score in patients with chronic subdural hematoma.

Introduction

Chronic subdural hematoma (cSDH) is a common neurologic disorder that predominantly affects older people.[1]

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The disorder is characterized by a collection of blood and blood-breakdown products in the intracranial subdural space that liquefies over time.

Historically considered a result of head trauma, recent evidence suggests there are more additional complex processes such as angiogenesis, fibrinolysis and inflammation involved in the pathophysiology of chronic subdural hematoma.

The characteristic membrane surrounding the cSDH has been identified as a source of fluid exudation and hemorrhage. Angiogenic stimuli lead to the creation of fragile blood vessels within membrane walls, while fibrinolytic processes prevent clot formation resulting in continued hemorrhage. An abundance of inflammatory cells and markers have been identified within the membranes and subdural fluid and are likely to contribute to the propagation of an inflammatory response that stimulates ongoing membrane growth and fluid accumulation.

An early theory about the formation of cSDH was of a traumatic injury causing tearing of the bridging veins traversing from the brain to the draining dural-venous sinuses.[2] This, in turn, would result in the accumulation of venous blood within the subdural space over time, but this theory has long been disputed. The inciting event is often minor head trauma, and subsequent inflammation may play a role in the pathogenesis.[3]The incidence of chronic subdural hematoma is increasing owing to the use of anticoagulant and antiplatelet medications. A steady increase in the incidence of cSDH has been observed in developing countries due to the rise in life expectancy. The overall incidence of cSDH is 8.2 to 17.6/100,000/year.[4] Patients with chronic subdural hematoma often present with cognitive impairment, gait disturbance, limb weakness or headache and the diagnosis is made based on cranial imaging. The standard treatment for cSDH is a surgical evacuation, which usually results in improvement of the neurological picture.[5]This condition has been treated by various surgical procedures such as burr holes evacuation, the most popular technique worldwide, twist–drill craniostomy, craniotomy, endoscopic removal, and subdural – peritoneal shunt. The hematoma recurs in 10 to 20% of surgically treated patients and the outcome is variable depending on several factors.[6]

A simple scoring system that accurately predicts the outcome may be valuable. cSDH score is a simple scoring tool to use as an adjunct to clinical judgment that may be effectively used in decision-making and patient counseling. This score was first introduced in 2017 in the UK by Kwon et.al. to predict the outcome in chronic subdural hematoma patients. cSDH score consists of 6 components which include age, GCS, hematoma thickness, midline shift, motor function and orientation. cSDH score of <9 is associated with an unfavorable outcome while the score of ≥ 9 is associated with a favorable outcome.

Table 1. Chronic Subdural Hematoma Score

I Scoring System – Minimum score of 3 (worst prognosis), maximum score of 13 (best prognosis)

Age (years)	>75 60-75 <60	1 point 2 points 3 points
GCS	<8 8-13 >13	O point 1 point 2 points
Hematoma Thickness (mm)	>30 10-30 <30	0 points 1 point 2 points
Midline shift (mm)	>20 10-20 <10	0 point 1 point 2 points
Motor function	Deficit Normal	1 point 2 points
Orientation	Deficit Normal	1 point 2 points

MATERIALS AND METHODS

This is a prospective observational study conducted at the Department of Neurosurgery, Tribhuvan University Teaching Hospital, Kathmandu, Nepal from December 15, 2019 to April 15, 2021. All operated patients with the diagnosis of unilateral chronic subdural and unilateral subacute subdural hematoma were eligible to participate in the study. Patients with acute subdural, bilateral subacute or chronic subdural, patients requiring craniotomy and patients managed conservatively were excluded from the study. Ethical approval was taken from the Institutional Review Board of the Institute of Medicine before the commencement of the study. Treatment of cSDH was standardized and included the evacuation of the hematoma via a burr hole with the patient under general anesthesia. Subgaleal drain catheters were inserted for 24 hours. Details of the patients' hospital course and follow-up were gathered. All consecutive patients were routinely followed-up in the neurosurgery OPD at 6 months. For the patients who could not make the follow-up at six months, a phone call was made to inquire about the postoperative outcome. Thus, no patients with cSDH were lost to follow-up.

The sample size was calculated with the formula; n = z2 p(1-p)/ e2; where n is sample size; z is the Z statistic for level of confidence; p is the proportion of population with good outcome; e is the level of precision (margin of error); Z= 1.96 for a confidence level (α) of 95%; p = population proportion (72.3%) =0.723; e= allowable margin of error = 5%=0.05; n= sample size=307.74≈ 308

Adjustment for final population: n'=n/ (1+n/N) =308/ (1+308/85) = 67; Expecting drop-out 10% of 67 (i.e. ≈ 7); Adjusted sample size = 74

Management Protocol of Patients

As per the study protocol, eligible patients were those who met inclusion criteria. Clinical history was taken and relevant physical examinations along with necessary investigations were done. Patients were optimized for surgery. Informed consent was obtained from the legal guardian. Each component of cSDH score was recorded during admission in a pro forma. Patients were managed as per standard TUTH protocol and then discharged once they met the discharge criteria. All the patients were followed up regularly for 6 months and the Modified Rankin Scale (mRS) score was recorded, analyzed and correlated with cSDH score.

The mRS score is listed in Table 2.

Table 2: Modified Rankin Scale (mRS)

0	No symptoms
1	No significant disability. Able to carry out all usual activities, despite some symptoms.
2	Slight disability. Able to look after own affairs without assistance, despite some symptoms.
3	Moderate disability. Requires some help, but able to walk unassisted.
4	Moderate severe disability. Unable to attend to own bodily needs without assistance, and unable to walk unassisted.
5	Severe disability. Requires constant nursing care and attention, bedridden, incontinent.
6	Dead

Data Management and Statistical Analysis

Collected data were analyzed with the SPSS software package (IBM SPSS Statistics 21.0). Means and standard errors were used to describe continuous variables and percentages were used to describe dichotomous variables for baseline demographics. Descriptive statistics were expressed as means, median and percentages and visualized in tables, graphs and charts .The primary endpoint was a dichotomized score on mRS at discharge and after 6 months of follow-up. Favorable outcomes had a score of 0-1 and unfavorable outcomes had a score of 2-6. Means and ranges were compared between favorable and unfavorable groups for associations between mRS and continuous variables. One-way analysis of variance was performed separately at discharge and after six months to determine possible predictors for unfavorable outcomes. Sensitivity and specificity were calculated for the diagnostic accuracy of cSDH score and plotted in the ROC and the AUC was calculated to determine the discrimination ability of the score for outcome at discharge and after six months. p-value <0.05 was considered statistically significant.

RESULTS

During the 16 months study period, 74 patients with chronic subdural hematoma were enrolled in this study. Out of which, 58 cases were male (78.4%) and 16 were female (21.6%) with the male to female ratio of 3.625:1. The age of the study population ranged from 17 to 91 years. The nineteen year-old male had a history of falling from a height two weeks before the presentation. The average age was 57.62 ± 15.82 years. In regards to age distribution, the highest number of patients (41, 55.4 %) was in the age group<60; and 23 patients (31.1 %) belonged to the age group of 60 to 75 years. The majority of patients presented with a GCS score >13 (71.6%). Only one patient had GCS<8. In the majority of the cases, hematoma thickness was 10-20mm. Forty patients (54.1%) presented with motor deficits. The majority of the patients (59.5%) were oriented. Majority of the patients presented with cSDH score of ≥ 9 (Table 3).

Table 3. Distribution of cSDH variables (n = 74)

Variables	Patient Number (n)	Percentage (%)
Age		
>75	10	13.5
60-75	23	31.1
<60	41	55.4
GCS		
<8	1	1.4
8-13	20	27.0
>13	53	71.6
Hematoma thickness		
>30 MM	13	17.6
10-30 MM	54	73.0
<10 MM	7	9.5
Midline shift		
>20 MM	14	18.9
10-20 MM	33	44.6
<10 MM	27	36.5
Motor		
DEFICIT	40	54.1
NORMAL	34	45.9
Orientation		
DEFICIT	30	40.5
NORMAL	44	59.5
cSDH score		
<9	26	35.1
≥9	48	64.9

The most common presentation was headache (64.9%) followed by weakness and altered sensorium. Duration of hospital stay ranged from 2 to 31 days with a mean duration of 5.9 days. Patients with the unfavorable outcome at discharge and after six months had a longer duration of hospital stay compared to those who had a favorable outcome. (Figure 1 and 2).

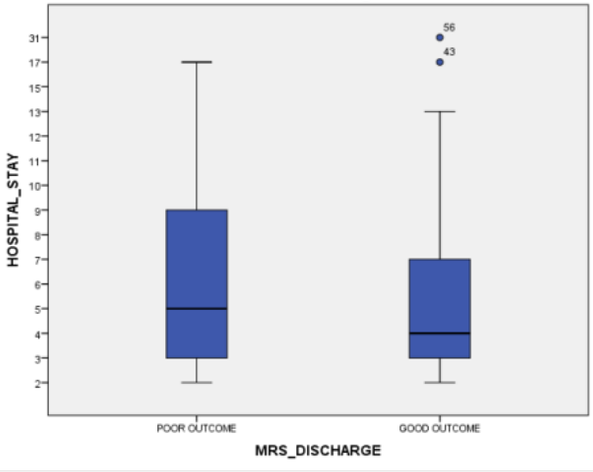

Figure 1. Box diagram showing duration of hospital stay and mRS at discharge

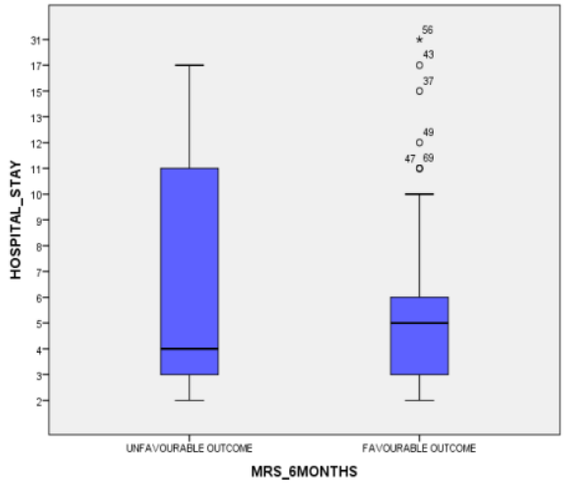

Figure 2. Box diagram showing duration of hospital stay and mRS at six months

The outcome was dichotomized into favorable and unfavorable. At discharge fifty-five patients (74.3%) had favorable outcomes while nineteen patients (25.7%) had unfavorable outcomes. At six months, fifty-six patients (75.7%) had favorable outcomes whereas eighteen patients (24.3%) had unfavorable outcomes. (Figure 3)

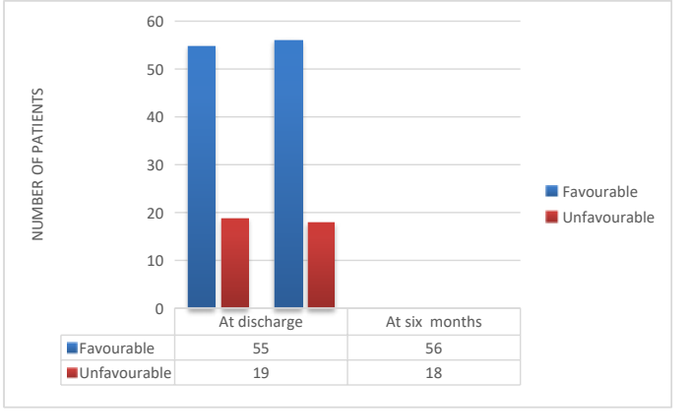

Figure 3.Bar diagram showing outcome at discharge and after six months

As for survival and mortality at discharge, seventy-two patients (97.3 %) survived and two patients (2.7%) died. At six months, seventy patients (94.6%) patients survived with mortality in four patients (5.4%). Out of four, two patients died during the hospital stay. One had aspiration pneumonia and another patient had pneumonia with CKD stage V. Out of the remaining two, one was diagnosed with carcinoma stomach after 3 months and another patient had pneumonia after six months. (Table 4)

Table 4.Outcome at discharge and six months (n = 74)

	Favorable (mRS :0-1) n(%)	Unfavorable (mRS: 2-6)	
		mRS (2-5) n(%)	mRS: 6 (death) n(%)
mRS at discharge	55(74.3)	17(23)	2(2.7)
mRS at 6 months	56(75.7)	14(18.9)	4(5.4)

cSDH score was <9 in twenty-six (35.1%) patients and ≥9 in forty-eight (64.9%) patients. (Table 5)

Table 5. cSDH score and outcomes(n = 74)

		MRS_DISCHARGE		MRS_6MONTHS	
		UNFAVORABLE OUTCOME	FAVORABLE OUTCOME	UNFAVORABLE OUTCOME	FAVORABLE OUTCOME
		n(%)	n(%)	n(%)	n(%)
cSDH score	<9	18(69.2)	8(30.8)	14(53.8)	12(46.2)
	>=9	4(8.3)	44(91.7)	1(2.1)	47(97.9)

Analysis of variance (one-way ANOVA) showed that age, GCS, hematoma thickness, midline shift, motor power, orientation and overall cSDH score were associated with the unfavorable outcomes at discharge and six months. (Table 6 and 7)

Table 6. Analysis of variance of cSDH variables and mRS at discharge

Variables		Sum of Squares	df	Mean Square	F	p-value
AGE	Between Groups	3.430	1	3.430	7.140	.009
	Within Groups	34.584	72	.480		
	Total	38.014	73			
GCS	Between Groups	2.857	1	2.857	14.085	.000
	Within Groups	14.603	72	.203		
	Total	17.459	73			
HEMATOMA_THICKNESS	Between Groups	1.408	1	1.408	5.600	.021
	Within Groups	18.105	72	.251		
	Total	19.514	73			
MIDLINE_SHIFT	Between Groups	4.923	1	4.923	10.489	.002
	Within Groups	33.793	72	.469		
	Total	38.716	73			
MOTOR	Between Groups	2.325	1	2.325	10.427	.002
	Within Groups	16.054	72	.223		
	Total	18.378	73			
ORIENTATION	Between Groups	4.875	1	4.875	27.079	.000
	Within Groups	12.963	72	.180		
	Total	17.838	73			
CSDH_	Between Groups	7.548	1	7.548	58.332	.000
	Within Groups	9.317	72	.129		
	Total	16.865	73			

Table 7. Analysis of variance of cSDH variables and mRS at six months

Variables		Sum of Squares	df	Mean	F	p-value
AGE	Between Groups	2.254	1	2.254	4.537	.037
	Within Groups	35.760	72	.497		
	Total	38.014	73			
GCS	Between Groups	1.586	1	1.586	7.196	.009
	Within Groups	15.873	72	.220		
	Total	17.459	73			
HEMATOMA_THICKNESS	Between Groups	2.254	1	2.254	9.401	.003
	Within Groups	17.260	72	.240		
	Total	19.514	73			
MIDLINE_SHIFT	Between Groups	4.891	1	4.891	10.410	.002
	Within Groups	33.825	72	.470		
	Total	38.716	73			
MOTOR	Between Groups	2.039	1	2.039	8.985	.004
	Within Groups	16.339	72	.227		
	Total	18.378	73			

ORIEN-TATION	Between Groups	3.298	1	3.298	16.332	.000
	Within Groups	14.540	72	.202		
	Total	17.838	73			
CSDH_						
	Between Groups	5.526	1	5.526	35.085	.000
	Within Groups	11.339	72	.157		
	Total	16.865	73			

Receiver operating characteristic curves were constructed to predict favorable versus unfavorable outcomes with the sensitivity analysis showing excellent discrimination at six months (area under the curve 0.948, 95% confidence interval) (Figure 4)

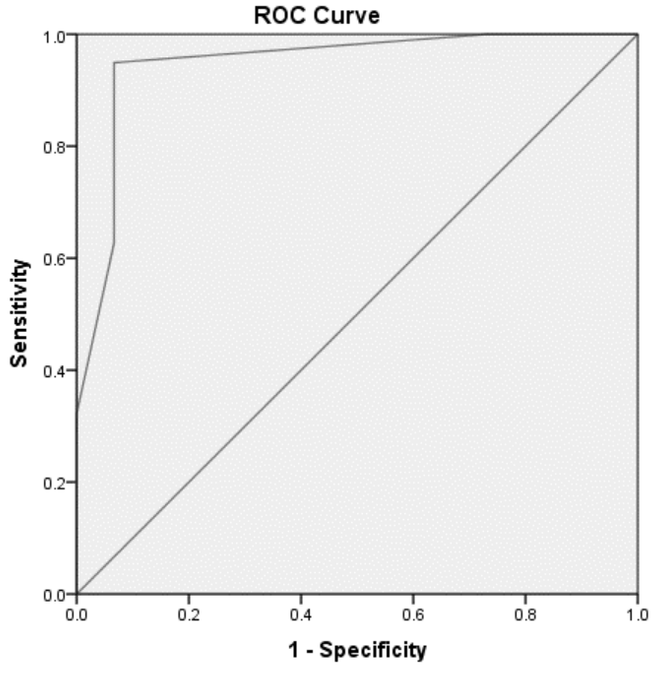

Figure 4. Receiver operating characteristic curve at six months

DISCUSSION

In 1857, Virchow detailed the pathophysiology of chronic subdural hematoma, naming it pachymeningitis haemorrhagica interna.[7] cSDH occurs in the dural border cell layer, located between the duramater and the arachnoid.[8] The dissection of these cell layers creates a subdural cavity.[9] Elderly and alcoholic patients with extensive brain atrophy are vulnerable to developing cSDH.10 Traversing veins are stretched by the shrinking brain until only a minor additional force is sufficient to cause the rupture of the bridging veins and create the hematoma. This is followed by fibrin deposition, organization, enzymatic fibrinolysis, and liquefaction of the clot.10An inflammatory reaction occurs, and neomembranes (inner visceral and outer parietal membranes) are formed with the growth of neocapillaries. cSDH tends to gradually enlarge because of the repeated micro-hemorrhages.[10,8,11]
cSDH scoring system was developed for prognosticating patient outcomes before cSDH surgery. Multiple variables predicting the outcome in chronic subdural hematoma based on previous literature were taken into consideration and analyses were done. A prediction rule for diagnosing poor postoperative prognosis with unfavorable mRS was developed with the obtained results. A scoring system was designed using the final fitted multivariate model with each variable assigned a score. To assess the scoring methodology an area under the curve (AUC) sensitivity analysis for model discrimination was used. Age, GCS, hematoma thickness, midline shift, motor function and orientation were found statistically significant and were incorporated into the scoring system. Thus, the scoring system was developed. It was then used to prognosticate the outcome after surgery in patients with chronic subdural hematoma.

In our study, among 74 patients, 58 cases were male (78.4%) with the male to female ratio of 3.625:1 showing male preponderance which was similar in the studies done by Neto et al. and Sous et al.[12,7] This emphasizes that the incidence of chronic subdural hematoma is more in the male population. One rationale for male dominance could be that men generally have greater exposure to injuries.[13]

The history of trauma was seen in 55.4 % of patients. This is comparable to many studies that show an average of 56 to 77% of cSDH patients with a history of a fall.13-15 Chronic anticoagulation and antiplatelet therapies also increase risks for cSDH.

The most common presentation was headache (64.9%) followed by weakness and altered sensorium in our study which was similar to the study by Mori et al.[14] These findings are in line with previous studies from Nigeria and Ghana.[12, 16]
Patients were managed with burr-hole with closed-system drainage. The mortality rate varies in a recent series from 0 to 13%. [13, 17] and in our series, the mortality rate was 5.4%.
A GCS of equal or greater than 13 is associated with a significant improvement in prognosis. Presenting with a GCS of 13 or greater is associated with an improved outcome and has been replicated in other studies. Similarly, poor GCS is closely related to an unfavorable surgical outcome.
Our results demonstrate preoperative age, GCS, hematoma thickness, midline shift, motor function and orientation are predictors for outcome after surgery for cSDH at discharge and after six months similar to the study by Kwon et al "Predicting Prognosis of Patients with Chronic Subdural Hematoma: A New Scoring System".[18] Similarly, cSDH score of more than 9 was associated with the favorable outcome in our study. For our cohort of patients who underwent unilateral burr hole evacuation for cSDH, the recurrence rate was zero until six months of follow-up. Within our entire cohort of individuals with cSDH, there were an additional 18 patients who were admitted for bilateral cSDH (24.3%). They were excluded from the study.

CONCLUSION

Chronic subdural hematoma is common neurosurgical pathology. cSDH score is a useful clinical tool that can predict outcomes in unilateral chronic subdural hematoma patients after surgical evacuation. So, this tool can be used while counseling the patients and in decision making. However, further multicenter studies involving a larger sample size will better clarify the predictive ability of the score.

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