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Original Research Article

Correlation between timing of surgery and post-operative outcome in traumatic acute subdural hematoma

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ABSTRACT

Background: The timing of surgery in acute subdural hematoma affects post-operative outcomes and is a modifiable factor, along with other variables, impacting patient prognosis following surgical intervention.
Methods: A prospective observational study was conducted at department of neurosurgery, Dhaka Medical College Hospital from March 2020 to August 2021. Total 64 patients were included in this study. Data were collected by using preformed data collection sheet. Timing of surgery of all patients documented. Outcome was measured according to the Glasgow outcome scale (GOS) at discharge and at one month following surgery. Statistical analysis was performed by SPSS (version 25). To determine correlation, Spearman's correlation coefficient test was done. Result was considered significant when p value <0.05.
Results: Most of the patients were adult with mean age 48.3±10.6 years. Male were predominant (76%). Majority of cases (67%) were operated within 4-24 hours of injury. Overall mortality was 32.8% and favorable outcome (GOS 4, 5) was 39%. The time from injury to operative evacuation of the acute subdural hematoma in regards of outcome, such as morbidity and mortality, had statistically significant negative correlation. Significant negative correlation was also found between timing of surgery and post-operative Glasgow coma scale.
Conclusions: Significant negative correlation was found in terms of GOS with timing of surgery, which had potential influence on post-operative GCS of patients of ASDH who were operated. It was seemed that early surgery may improve post- operative GCS and GOS.

Keywords: GCS, Neurosurgery, Post-op results, Subdural hematoma, Surgery timing

INTRODUCTION

Traumatic brain injury (TBI) results from external mechanical force and can lead to cognitive, physical, and psychosocial impairments, often accompanied by altered consciousness.[1] The incidence of TBI is on the rise globally, contributing significantly to morbidity, mortality, disability, and socioeconomic burdens. In India alone, an estimated 1.5-2 million individuals sustain injuries annually, resulting in 1 million deaths.[2] In the United States, approximately 1.6 million people suffer head injuries each year.[3] While the majority of head injuries are mild to moderate, they predominantly affect individuals aged 20-40 years, with mean age groups reported at 45.7 and 48.9 years.[4] Falls are a leading cause of head injuries in children, accounting for 25-30% of total cases.[5] Moreover, head injuries exhibit a male predominance, with an incidence ratio of 3:2 favoring males.[6]

Traumatic acute subdural hematoma (TASDH) represents one of the most devastating forms of TBI, carrying a mortality rate ranging from 30% to 70%. TASDH occurs between the dura and arachnoid membranes, typically due to the rupture of bridging veins or arteries.[7] Acute subdural hematomas (ASDH) are present in a third of

patients with severe TBI, posing the highest mortality risk. These hematomas often accumulate around parenchymal lacerations, most commonly in the frontal or temporal lobes, and result from cerebral acceleration-deceleration forces during violent head movements.[8]

Symptoms of TASDH may arise from the compression of the underlying brain, midline displacement, parenchymal brain injury, and cerebral edema.[9] Comatose patients meeting surgical criteria require emergent intervention. Decompressive craniectomy is a treatment option for patients with deteriorating conditions, low Glasgow coma scale (GCS) scores, dilated pupils, and resistance to maximal decongestant therapy due to acute subdural hematoma, contusion, or brain swelling.[10]

The timing of surgery is a critical factor influencing post-operative outcomes in TASDH patients. It is one of the few factors that neurosurgeons can actively modify. Early surgery, typically within 4 hours of injury, has been associated with significantly lower mortality rates compared to delayed surgery, with respective rates of 30% and 90%.[11] Despite the widespread belief in the benefits of emergency surgery, the overall evidence remains inconclusive, and clinical trial data are lacking. Against this backdrop, this study was conducted to explore the correlation between the timing of surgery and outcomes in traumatic acute subdural hematoma cases at the Department of Neurosurgery, Dhaka Medical College Hospital, Dhaka.

Objectives

General objective

To observe correlation between timing of surgery and postoperative outcome in traumatic acute subdural hematoma.

Specific objectives

To observe GCS and radiological parameters of patients by CT scan preoperatively. To assess the timing from injury to initiation of surgery. To observe the GCS score postoperatively on 1st POD, 3rd POD, on discharge and after one month of surgery. To observe radiological parameters of patients postoperatively by CT scan at 3rd POD. To observe the GOS score postoperatively on discharge and after one month of surgery. To assess the correlation between timing of surgery and outcome in terms of GOS and GCS in traumatic acute subdural hematoma.

METHODS

Study design

This study employed a prospective observational design to investigate the correlation between the timing of surgery and post-operative outcomes in traumatic acute subdural hematoma (TASDH) patients. The research was conducted at the department of neurosurgery, Dhaka Medical College Hospital, Dhaka, Bangladesh, over the period from March 2020 to August 2021. A total of 64 patients, irrespective of age and gender, diagnosed with traumatic acute subdural hematoma (ASDH) confirmed by CT-head were included in the study. Patients who were managed conservatively or had traumatic brain injuries other than ASDH were excluded. Informed consent was obtained from all participants or their legal guardians.

Inclusion criteria

All patients of all age with both gender with traumatic acute subdural hematoma. ASDH treated surgically. ASDH patient with GCS 4-15.

Exclusion criteria

ASDH patient treated conservatively. Spontaneous ASDH without history of trauma. ASDH with EDH, penetrating injury, intra-parenchymal hematoma volume more than 30 ml and associated torso trauma. Nonspecific time of injury. Patient with GCS 3 with bilaterally dilated and non-reacting pupilsRefused to be a part of the study.

Data collection

A preformed data collection sheet was used to gather information from the study participants. Data included patient demographics, timing of surgery, clinical presentation, Glasgow coma scale (GCS) scores on admission, pupillary status, CT findings, type of surgery performed, complications, and outcomes at discharge and one month following surgery.

Surgical procedures

The surgical interventions included decompressive craniectomy, with or without duraplasty, aimed at managing increased intracranial pressure. The specific procedure was determined based on intraoperative findings such as brain swelling and pulsations.

Outcome measures

Outcomes were assessed using the Glasgow outcome scale (GOS) at discharge and after one month. GOS scores were used to categorize patients into favorable (GOS 4, 5) and unfavorable (GOS 1-3) outcomes.

Data analysis

Statistical analysis was performed using SPSS version 25.0 for Windows. Categorical variables were presented as frequencies and proportions. Group comparisons were made using the chi-square (χ^2) test. Correlation between variables was assessed using the Spearman correlation

coefficient, and scatter plots were generated for bivariate correlation analysis. Statistical significance was set at $p<0.05$.

Ethical approval

This study received ethical approval from the Institutional Review Board (IRB) of Dhaka Medical College and Hospital, Dhaka, Bangladesh. The IRB reviewed and approved the research protocol, ensuring that it adhered to ethical guidelines and principles for conducting research involving human participants. Informed consent was obtained from all study participants or their legal guardians, and their rights and confidentiality were strictly protected throughout the study. The research was conducted in accordance with the ethical standards and regulations governing human research subjects.

RESULTS

This prospective observational study was conducted to find out correlation between timing of surgery and post-operative outcome in traumatic acute subdural hematoma of the patients attending in department of neurosurgery in Dhaka Medical College Hospital (DMCH). Total sample size was 64. All of them were underwent surgical intervention. Out of 64, 21 patients were expired unfortunately within one month of surgery. Remaining 43 patients were followed up.

Table 1: Age and gender distribution of the study population (n=64).

Category	Sub-category	Frequency	Percentage
Age	11-20	3	5
	21-30	12	19
	31-40	11	17
	41-50	14	22
	51-60	12	19
	61-70	11	17
	>70	1	1
Mean±SD	48.3±10.6 years		
Range	15-87 years		
Gender	Male	49	76
	Female	15	24

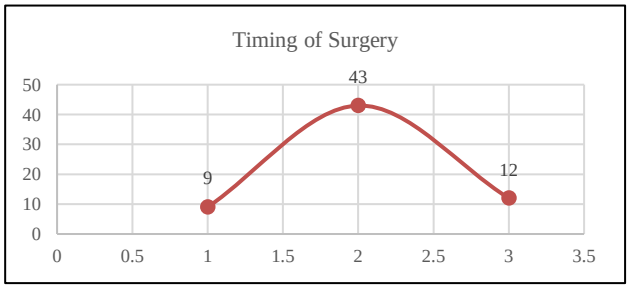

Figure 1: Distribution of the study population according to timing of surgery (n=64).

Table 1 shows that most of the study population 14 (22%) were in the age group of 41-50 years. Most were male 49 (76%) with male: female =3:1.

Figure 1 shows distribution of the study population according to timing of surgery. Here, majority of cases 43 (67%) were operated within 12-24 hours of injury. Twelve (19%) cases were operated more than 24 hours of injury and 9 (14%) cases within 4 hours of injury.

Table 2: Association of GCS during admission with GOS after 1 month (n=64).

GCS during admission	GOS after 1 month		P value
	Unfavorable	Favorable	
4-8	33 (51%)	5 (9%)	<0.001
9-13	6 (9%)	18 (28%)	
14-15	0	2 (3%)	
Total	39 (61%)	25 (39%)	

Table 2 shows association of GCS during admission with GOS after 1 month. After 1 month, 43 patients were followed up. Twenty-five (39%) patients were in favorable condition according to Glasgow outcome scale (GOS). Majority of the patients with 4 to 8 GCS scale were in unfavorable condition and patient with 9 to 13 GCS were in favorable condition. All patients with 14 to 15 GCS were in favorable condition after 1 month. To find the association, chi-square test was done and it was significant ($p<0.001$).

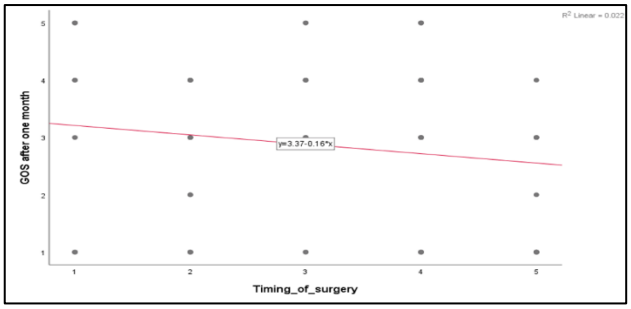

Figure 2: Scatter plot for correlation between timing of surgery with Glasgow outcome scale (GOS) after 1 month (n=64).

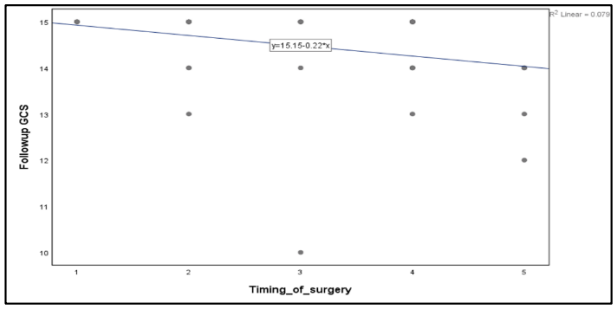

Figure 2: Scatter plot for correlation between timing of surgery with Glasgow coma scale (GCS) after 1 month (n=43).

Table 3: Correlation between other variables with Glasgow outcome scale (GOS) after 1 month (n=64).

Variables		GOS after 1 month					Spearman's correlation coefficient	P value
		GOS 1	GOS 2	GOS 3	GOS 4	GOS 5		
Age	11-20	1	0	1	1	0	-0.250	0.046
	21-30	3	0	2	6	1		
	31-40	2	0	3	3	3		
	41-50	5	2	1	4	2		
	51-60	4	1	3	2	2		
	61-70	6	0	4	1	0		
	>70	0	0	1	0	0		
GCS on admission	4-8	20	2	9	6	1	0.715	<0.001
	9-13	1	1	4	11	7		
	14-15	0	0	2	0	0		
Type of surgery	DC with duroplasty	1	1	4	2	1	-0.178	0.159
	DC without duroplasty	20	3	9	14	5		
	Craniotomy	0	0	1	1	2		

Table 3 shows correlation between other variables with Glasgow outcome scale (GOS) after 1 month of the study population including the expired (GOS 1). Age of the patient showed statistically significant negative correlation whereas GCS on admission showed significant positive correlation. Type of surgery showed no correlation.

DISCUSSION

This study focused on traumatic acute subdural hematoma (TASDH), which is the most prevalent type of traumatic intracranial hematoma and accounts for 24% of severe head injury cases, carrying the highest mortality rate.[12] TASDH typically occurs between the dura and arachnoid membranes due to severe traumatic brain injury, often involving underlying brain injury. A significant portion of the mortality associated with TASDH is attributed to the underlying brain injury rather than the hematoma itself. Mortality rates are traditionally considered higher in aged patients (60%), reaching 90-100% in patients taking anticoagulants.[13]

The primary objective of this prospective study was to investigate the correlation between the timing of surgery and post-operative outcomes in traumatic acute subdural hematoma cases. The study included 64 patients of various ages and genders with confirmed traumatic acute subdural hematoma who were admitted to the Department of Neurosurgery at Dhaka Medical College Hospital between March 2020 and August 2021. Patients with ASDH were confirmed through CT scans, and those managed conservatively or with traumatic brain injuries other than ASDH were excluded. Patients who couldn't effectively communicate or refused to participate were also excluded.

The study revealed that the majority of patients (22%) fell within the age group of 41-50 years, with a mean age of 48.3 years. Notably, a significant proportion of the patients were young, likely due to their frequent outdoor activities and travel, which increased the risk of accidents. This age distribution aligns closely with previous studies.[14,15]

Gender distribution showed a male predominance (76%) with a male-to-female ratio of 3:1, consistent with the findings of other studies.[16-18] Common clinical presentations included impaired consciousness (84%), vomiting (80%), hemiparesis (26%), headache (16%), and convulsions (9%). Upon admission, 60% of patients had a GCS score between 4-8, similar to previous reports.[19]

Regarding pupillary status, 60% of subjects had bilaterally normal-sized and reactive pupils, while 40% had pupillary abnormalities, a finding in line with another study.[20] CT scan findings upon admission indicated a predominance of right-sided lesions, with 37% of patients having only ASDH and 63% having associated lesions like subarachnoid hemorrhage (SAH) and contusion. This aligns with previous studies that reported 65% of patients having associated lesions.[21]

The timing of surgery was notably delayed in this study, with 67% of cases undergoing surgery within 4-24 hours of injury, attributed to the need for transport from primary centers to tertiary hospitals. The most common surgical procedure performed was decompressive craniectomy without duraplasty (80%) to alleviate intracranial pressure. The study reported a 30.8% mortality rate up to the point of discharge, consistent with another study (31%).[22]

At discharge, no patients exhibited a favorable Glasgow outcome scale (GOS) score (4 or 5), but after one month of follow-up, 39% showed favorable GOS scores, which aligned closely with previous findings (45.9%).[23]

Analysis of GCS scores pre- and post-operatively indicated improvements, with most patients displaying GCS scores of 9-13 on the 3rd postoperative day and upon discharge, and GCS scores of 14-15 after one month.[24,25]

The study found a significant correlation between GCS on admission and GOS after one month, indicating that patients with higher preoperative GCS scores had better outcomes. Pupillary reactions also showed a significant association with outcomes. In contrast, there was no significant relationship between different types of lesions and GOS after one month, but a significant relationship was observed between the timing of surgery and GOS after one month, consistent with previous findings.

The overall mortality rate was 32.8%, with a favorable outcome observed in 39% of patients after one month following surgery for ASDH. The study highlighted a weak statistically negative correlation between the timing of surgery and post-operative GOS and a significant moderate negative correlation between the timing of surgery and GCS, suggesting that earlier surgery was associated with better post-operative outcomes.

There are some limitations also. The study population was selected from one selected hospital in Dhaka city, so the results of the study may not reflect the exact picture of the country. Due to time and resource limitations, larger sample size could not be taken. Follow up after discharge was short. Neuro-ICU facilities were not possible for all the patients when required. Post-operative ICP monitoring were not possible for all patients. There was difficulty in study and follow-up due to COVID-19 pandemic.

CONCLUSION

Traumatic acute subdural hematoma is a fatal condition despite all developments in neurosurgical interventions. Adult male peoples were most frequently affected. Majority of the patients were in comatose condition who needed surgical intervention. Decompressive craniectomy without duroplasty was the most common surgery where majority done within 04-24 hours of injury. About one third patients died during admission period in hospital. After one month of surgery thirty nine percent patients had favorable outcome. GCS on admission, pupillary abnormality and timing of surgery had significant association with Glasgow outcome scale. Regarding correlation, age and timing of surgery showed weak negative correlation with GOS that was statistically significant. Timing of surgery had also significant negative correlation with GCS which indicates that early surgical intervention may improve postoperative GCS and GOS. From this study it can be concluded that there is a significant negative correlation present between timing of surgery and post-operative outcome in traumatic acute subdural hematoma in Dhaka Medical College Hospital.

Recommendations

Follow up should be done for at least 6 months to 1 year with a bigger sample size. Neuro-ICU support should be maintained when required during the postoperative period for proper care and monitoring of the critically ill patients. Post-operative ICP monitoring should be available. Emergency management in all level of hospital should be upgraded and occupied with modern and faster technique for early and appropriate management for emergency cases like ASDH. Surgery should be done as early as possible when indicated to improve favorable survival.

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