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CORRELATION BETWEEN PREOPERATIVE GCS SCORE AND POSTOPERATIVE OUTCOME IN TRAUMATIC ACUTE SUBDURAL HAEMATOMA

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ABSTRACT

Background: Acute subdural hematomas (ASDH) are observed in one third of patients with severe traumatic brain injury leading to high mortality. **Objective:** To observe correlation among preoperative and postoperative findings specific to each and every GCS Score**. Methods:** This prospective interventional study was carried out in the Department of Neuro-Surgery, Dhaka Medical College & Hospital, Dhaka during the period between March 2017 and February 2018. A total of 60 patients irrespective of age and sex with Acute Subdural Haematoma were included in this study. After thorough neurological examination and counseling finally preparared for surgical procedures. Before discharge of the patients, the final neurological examinations were performed and all were advised for scheduled follow up. **Results:** The mean age was 41.98±20.24 years and male to female ratio was 2.5:1. Regarding, the preoperative GCS it was observed that 38.3% patients showed GCS on admission 9-12 followed by 36.7% on admission 6-8. About post-operative GCS, almost half (46.7%) patients belonged to post-operative GCS (on 1st POD) 6-8. Mean post-operative GCS (on 1st POD) was 7.30±2.88. The postoperative GCS score were observed as 3-15 among the patients. The functional survival in 53.3% cases and the overall mortality rate was 41.7%. The positive significant correlation was found (r=0.704; p=0.001) between admission GCS Score and GCS Score on 1st POD, 3rd POD, 10th POD and GCS Score on 1 month following surgery.. The overall mortality rate and functional survival were 41.7% and 53.3% respectively. **Conclusion:** Preoperative GCS score and the thickness of the Traumatic Acute Subdural Haematoma are important predictors of mortality. There were statistically positive significant correlation between preoperative GCS Score and postoperative outcome in Traumatic Acute Subdural Haematoma. GCS Score and preoperative CT-Head are important parameters that correlate with the mortality rate.

KEYWORDS: Acute subdural hematomas, traumatic brain injury, motor score, GCS score, decompressive craniectomy, GOS.

INTRODUCTION

Traumatic brain injury is non-degenerative, noncongenital, insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairments of cognitive, physical and psychosocial function with an associated diminished or altered state of consciousness.[1] More than 50% of moderate head injuries and about 99% of severe head injuries lead to substantial degrees of long-term disability.[2] Subdural hematomas (SDHs) are seen in 10-20% of all traumatic brain injury cases and occur in up to 30% of fatal injuries.[3] However, in 20%-30% of cases an arterial source of bleeding can be found.[4] Acute subdural hematoma (ASDH) forms between the dura and arachnoid membranes usually due to tearing of bridging veins or arterial rupture. ASDH are observed in one third of patients with severe traumatic brain injury which carries highest mortality.[5] The mortality rates are seen to be ranging from 40% to 90%.[6] The Glasgow Coma Scale (GCS) is composed of three sub-score "motor

component", "verbal component" and the "eye component". Saha et al.[7] observed the motor component of the GCS score is a powerful predictor of outcome and contains most of the predictive power of the score.

Authors also pointed out the higher accuracy of the motor score compared with the whole GCS score as a predictor of outcome though the last two components are often difficult to evaluate in comatose patients.[7] The decompressive craniectomy is the most useful treatment modalities which can be performed in the worsening and low GCS score patients with dilated pupils and resisting maximal decongestant therapy because of acute subdural hematoma, contusions and acute brain swelling.[8]

The GOS score has also been used to observe following decompressive craniotomy and correlated well with the findings. No recent study is available which shows the direct correlation between specific preoperative GCS Score and its postoperative outcome both in home and in abroad. Therefore, the present study was aimed to observe the correlation of specific preoperative GCS score and postoperative outcome in traumatic acute subdural hematoma to evaluate the current situation in hospital facility in Bangladesh which might determine guidelines for management of such cases.

MATERIALS AND METHODS

This prospective interventional study was done in 60 patients with traumatic brain injury attending in Department of Neuro-Surgery, Dhaka Medical College & Hospital, Dhaka during the period of March 2017 to February 2018. Patients with traumatic brain injury with Acute Subdural Haematoma confirmed by CT-Head irrespective of age and sex were included purposively in this study. Patients who treated conservatively, Traumatic Brain Injury other than Acute Subdural Haematoma, Acute Subdural Haematoma with GCS Score 3 and 4 with Bilaterally Dilated and Fixed Pupils with non-reactive to light, patients' attendants/parents when couldn't communicate properly and patients/attendants when refused to participate in the study were excluded from the study.

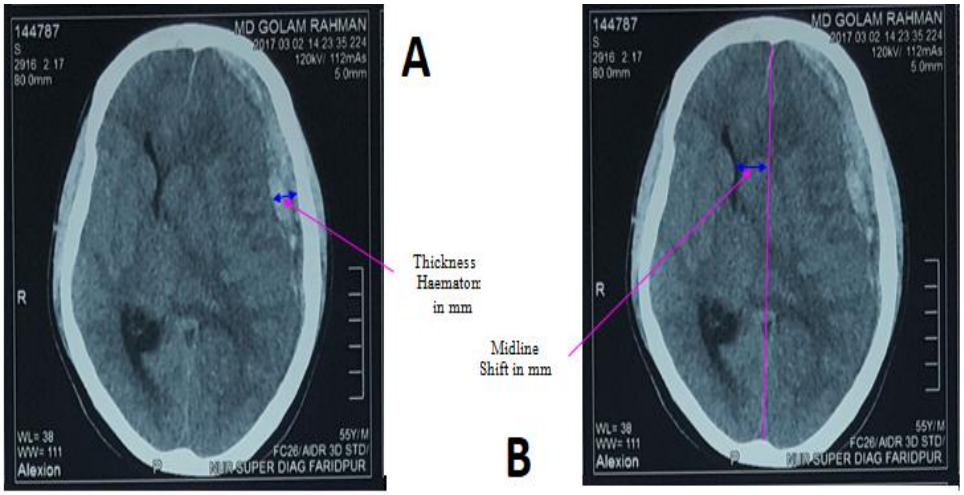
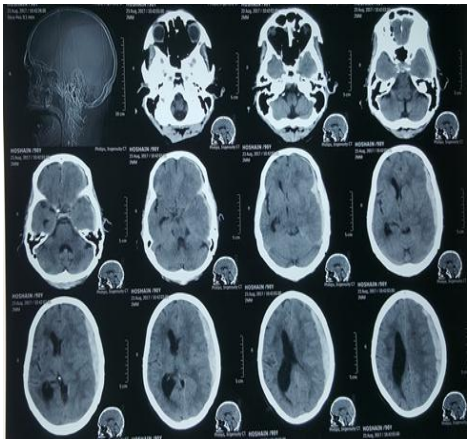
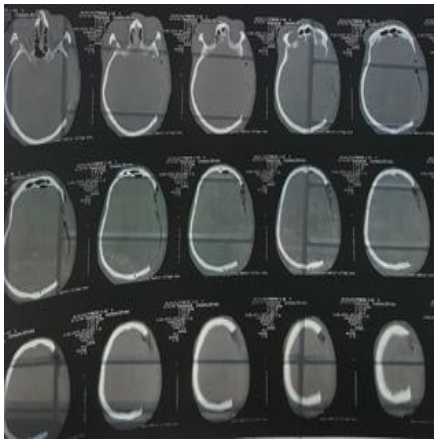


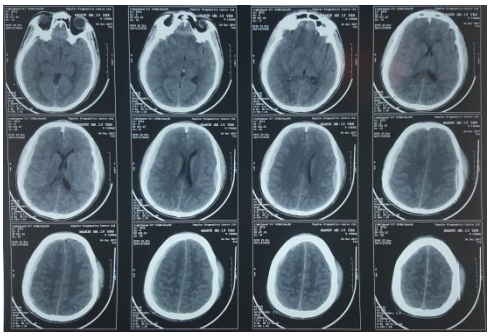
Figure 1: Axial CT scan of head showing ASDH. (A) measurement of thickness of haematoma in mm, (B) Measurement of midline shift.



Pre-operative CT scan.



Post-operative CT scan



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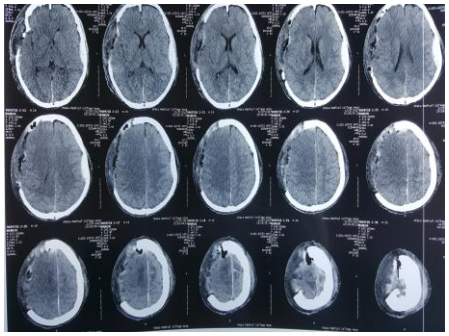
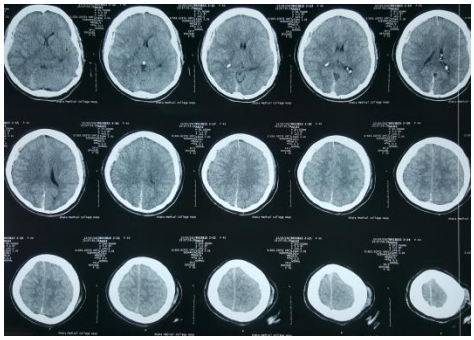


Post-operative CT scan.



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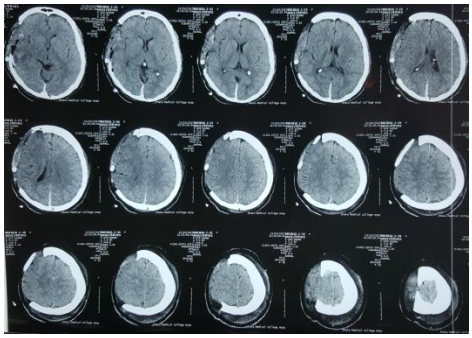

Post-operative CT scan.

Figure 2: Pre-operative and post-operative CT scan.

Study Procedure

The patients who attended with Traumatic Acute Subdural Haematoma written informed consent forms were obtained from all patients or legal guardians in case of unconscious patients. All the patients were evaluated by detailed history and thorough physical including neurological examination as well as primary management was given accordingly. After that CT-Head, counseling and finally preparation for surgical procedure was performed. Blood was arranged for perioperative transfusion. Decompressive Craniectomy was done under GA (when available) and L/A and Deep Sedation when GA were not available.[9] Local anaesthesia was performed by infiltration of 2% Xylocaine with adrenalin along the incision line and predicted drain site. The maximum single dose of Xylocaine with adrenaline, 7 mg/kg or 500 mg total, whichever is the lower was used. Deep sedation was given by I/V Midazolam 0.03 mg/kg and I/V fentanyl 1 microg/kg intermittently in divided doses throughout the surgery. Patients were followed up and data were recorded on 1st, 3rd, 10th POD and 1 month following surgery. Postoperative CT-Head were done on 3rdPOD when possible. GCS Score on admission**,** per-operative findings such as dural laceration, dural tightness, brain pulsation and brain swelling were assessed. The postoperative outcome were evaluated on the basis of the GCS score and GOS Score on- 1st POD, 3rd POD, 10th POD and 1 month following surgery. Before discharge of the patients, the final neurological examinations were performed and all were advised for scheduled follow up. All findings were collected in a pre-designed data collection sheet.

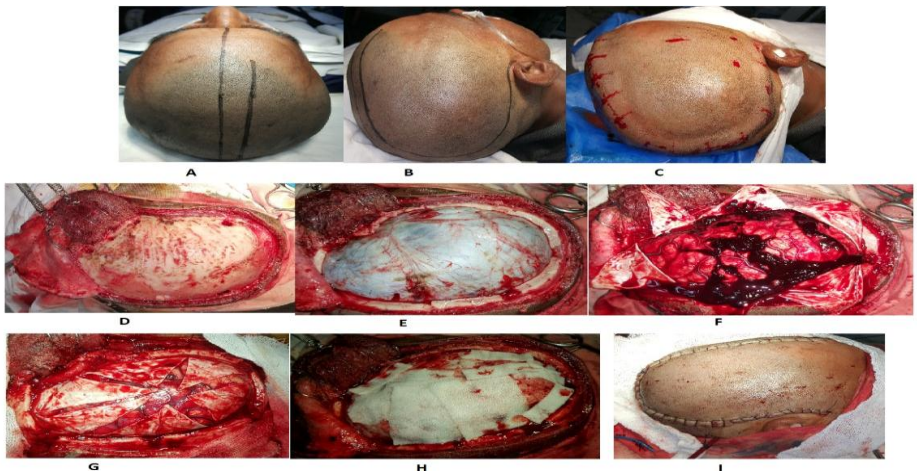

Figure 2: (A) Planning and Marking of predicted scalp Incision (Top view), (B) Planning and Marking of predicted scalp Incision (Right lateral view), (C) Infiltration of planned Incision line and predicted drain site by

2% Xylocaine with Adrenalin, (D) Dissection of Reversed Question Mark flap and burr holes, (E) Standard Decompressive Hemicraniectomy. Subdural blood is seen, (F) Standard Durotomy in stellate Fashion (Haematoma and underlying brain damage seen), (G) Replacement of Dura mater. Brain got extra space, (H) The exposed brain tissue was covered by the loosely replaced remaining dura and Surgicel or Gel foam, (I) Layered closure of Scalp with a subgaleal drain.

RESULTS

Table 1: Socio-demographic characteristic of the study patients (n=60).

Age (in years)	Number of patients	Percentage
0-10	2	3.3
11-20	9	15.1
21-30	11	18.3
31-40	7	11.7
41-50	11	18.3
51-60	8	13.3
61-70	8	13.3
>70	4	6.7
Mean±SD	41.98±20.24	
Range(min-max)	4.5-85	
Sex		
Male	43	71.7
Female	17	28.3
Weight (kg)		
Mean±SD	59.12±11.4	
Range(min-max)	15-80	

Table 1: Show; the age ranged varied 4.5 to 85 years and almost three fourth (71.7%) patients were male. The mean weight was 59.12±11.4 kg varied from 15 to 80 kg.

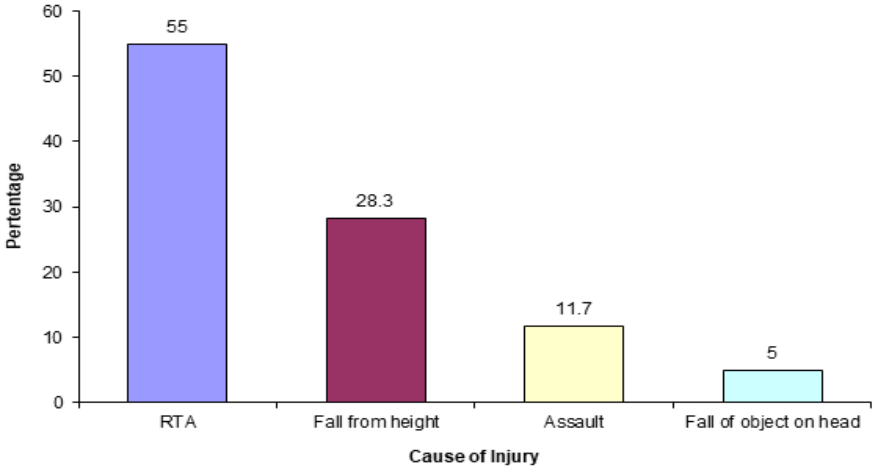

Figure 3: Distribution of the study patients by cause of injury (n=60).

Figure 3: Shows, RTA was more frequent cause of injury (55.0%) and 17(28.3%) fall from height, 7(11.7%) assault and 3(5.0%) fall of object on head.

Table 2: Distribution of the study patients by presenting complaints (n=60).

Complaints	Number of patients	Percentage
Vomiting	50	83.3
Headache	41	68.3
Altered state of consciousness	39	65.0
Convulsion	1	1.7
Vertigo	1	1.7

Table 2 shows, regarding the presenting complains 50(83.3%) patients had vomiting, followed by 41(68.3%) headache and 39(65.0%) with Altered State of Consciousness, 1(1.7%) convulsion and 1(1.7%) vertigo.

Table 3: Distribution of the study patients by examination (n=60).

Physical examination	Number of patients	Percentage
a. Higher Psychic Function		
Normal	5	8.3
Disoriented	17	28.3
Unconscious	38	63.4
b. Speech		
Normal	8	13.3
Dysphasic	13	21.7
Aphasic	39	65.0
c. Memory Impairment	33	55.0
d. Pupillary Changes		
Normal bilaterally	12	20.0
Unilaterally normal reaction to light	16	26.7
Unilaterally Sluggish Reaction to light	31	51.7
Unilaterally Areactive to light	12	20.0
e. Neurological Deficit Hemiplegia/ Hemiparesis	40	66.7
Sensory Impairment	18	30.0
Autonomic Impairment	21	35.0

Table 3 revealed, almost two third (63.4%) patients were unconscious, 39(65.0%) aphasic in speech, 33(55.0%) with memory impairment; 12(20.0%) with bilaterally normal pupils, 16(26.7%) with unilaterally normal pupils, 31(51.7%) with unilateral sluggish reacting pupils and 12(20.0%) with unilaterally are active pupils; 40(66.7%) hemiplegia/hemiparesis, 21 (35.0%) autonomic impairment and 18(30.0%) had sensory Impairment.

Table 4: Distribution of the study patients by Investigation (CT - Head) (n=60).

CT- Head Findings	Number of patients	Percentage
a. Site of the Hematoma		
Right fronto- temporal	25	41.6
Left fronto- temporal	13	21.7
Right temporo- parietal	5	8.3
Left temporo- parietal	4	6.7
Both side of head	13	21.7
b. Thickness of Hematoma		
<10 mm	23	38.3
10-25 mm	37	61.7
c. Ventricular Effacement	**46**	**76.7**
d. Condition of Basal Cisterns		
Normal	23	38.3
Compressed	34	56.7
Absent	3	5
e. Midline Shift (mm)		
<5	8	13.3
5-10	32	53.4
>10	20	33.3

Table 4 show, regarding the CT head findings it was observed that more than one third (41.6%) patients had right fronto-temporal haematoma. Thirty seven (61.7%) belonged to thickness of hematoma 10-25 mm, 46(76.7%) had ventricular effacement, 34(56.7%) had compressed basal cisterns and 32(53.4%) had midline shift of 5-10 mm.

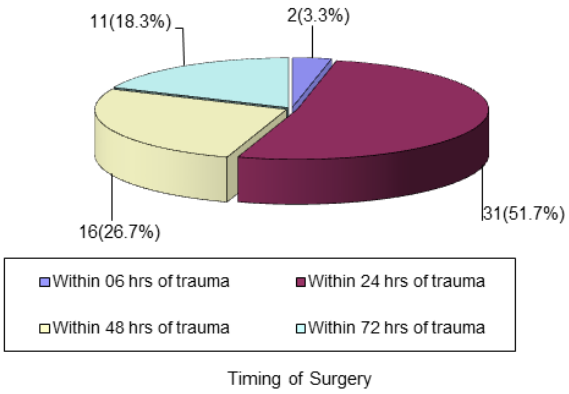

Figure 4: Distribution of the study patients by timing of surgery (n=60).

Figure 4: Shows, More than half (51.7%) patients had surgery within 24 hrs of trauma, followed by 16(26.7%) within 48 hrs of trauma, 11(18.3%) within 72 hrs of trauma and 2(3.3%) had surgery within 06 hrs of trauma.

Table 5 shows, most (96.7%) patients had dural tightness, followed by 43(71.7%) brain pulsation, 40(66.7%) had brain swelling and 4(6.7%) had dural laceration.

Table 5: Distribution of the study patients by peroperative findings (n=60).

Operative note	Number of patients	Percentage
Dural Laceration	4	6.7
Dural Tightness	58	96.7
Brain Pulsation	43	71.7
Brain Swelling	40	66.7

Table 6: Distribution of the study patients by preoperative and postoperative GCS Score (n=60).

GCS Score	Preoperative		On 1st POD		On 3rd POD		On 10th POD		One month of Surgery	
	n	%	n	%	n	%	n	%	n	%
3-5	5	8.3	18	30.0	16	26.7	15	25.0	5	8.3
6-8	22	36.7	28	46.7	15	25.0	4	6.7	0	0.0
9-12	23	38.3	10	16.7	20	33.3	11	18.3	2	3.3
13-15	10	16.7	4	6.7	7	11.7	23	38.3	33	55.0

Table 6 explains, there were positive significant correlation found between on admission GCS Score with GCS Score on 1st POD (r=0.704; *p=0.001*), and on 3rd POD (r=0.608; *p=0.001*). There were not significant positive correlation between GCS Score on admission and GOS Score on 1st POD , but significant positive correlation with GOS Score on 3rd POD (r=0.441; *p=0.001*) (Figure 3).

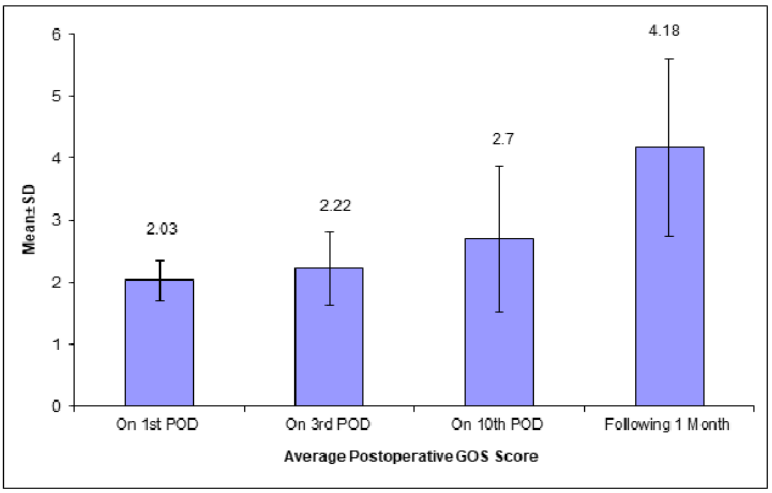

Figure 3: Bar diagram showing Average Postoperative GOS Score of the study patients.

Table 7: Distribution of the study patients by postoperative complications (n=60).

Post-operative complications	Number of patients	Percentage
Aspiration Pneumonia	38	63.3
Septicemia	12	20.0
Electrolyte Imbalance	7	11.7
Wound Infection	2	3.3
CSF Leakage	2	3.3
Pressure Sore	2	3.3
Seizure	1	1.7

Table 7 shows, about the post-operative complications, it was observed that almost two third (63.3%) patients had aspiration pneumonia, followed by 12(20.0%) septicemia, 7(11.7%) electrolyte imbalance, 2(3.3%) wound infection, CSF leakage and pressure sore equally and 1(1.7%) had seizure.

Table 8: Admission GCS Score and Postoperative Functional Outcome (n=60).

Admission GCS	No of Patients	Mortality		Functional survival after 1 Month (GOS 4&5)	
		Number of patients	Percentage	Number of patients	Percentage
3	0	0	0.00	0	0.00
4	0	0	0.00	0	0.00
5	5	5	100.0	0	0.0
6	5	3	60.0	2	40.0
7	7	2	28.6	5	71.4
8	10	4	40.0	6	60.0
9	7	5	71.4	2	28.6
10	5	2	40.0	3	60.0
11	1	0	0.0	1	100.0
12	9	2	22.2	7	77.8
13	4	1	25.0	3	75.0
14	4	1	25.0	3	75.0
15	3	0	0.0	3	100.0

Table 8 shows, maximum functional survival observed in admission GCS Score 11 (100%) followed by GCS Score 12 (77.78%) followed by GCS Score 14 & 15 (66.67%) followed by GCS Score 10 (60%). Overall mortality rate is 41.7% (25/60). Functional Survival in 53.3% cases (32/60).

Table 9 revealed, maximum (21.67%) mortality were within 10th POD followed by 8.33% on 3rd POD and by 1 month following surgery followed by 3.3% within 1st POD. Nearly two third 37(61.6%) patients had 1-10 days hospital stay. The mean duration of hospital stay was 10.7±6.1 days with ranged from 1 to 30 days.

Table 9: Mortality during perioperative periods (n=60).

Postoperative Days	No of patients	Mortality Percentage
Within 1st POD	2	3.33
Within 3rd POD	5	8.33
Within 10th POD	13	21.67
1 month Following Surgery	5	8.33

Table 10: Distribution of the study patients by Outcome according to final GOS (n=60).

Postoperative GOS Score after 1 month	Frequency	%	Outcome
Death	25	41.7	Unfavorable 47.7%
Persistent vegetative state	2	3.3	
Severe disability	1	1.7	
Moderate disability	5	8.3	Favorable 53.3%
Good recovery	27	45.0	

Table 10 shows, favorable outcome according to final GOS seen in maximum patients (53.3%) and un favorable in 47.7% patients.

DISCUSSION

The Glasgow Coma Score (GCS) is used to evaluate patient's status in early onset of injury, preoperatively and postoperative outcome. The decompressive craniectomy is one of the most useful treatment

modality,[10] which can be performed in the worsening and low GCS score patients.

Regarding the age incidence Prahaladu et al.[11] study observed nearly two third (63.0%) of patients suffering from ASDH age belonged to 20-40 years. In another study Alagoz et al.[12] found the mean age of 46.8±21.3 years with ranged from 4 and 93 years old, which are comparable with the current study.

In this study, it was observed that traumatic acute subdural haematoma was more common in male subject, which is in agreement with Prahaladu et al.[11] and Alagoz et al.[12]

Prahaladu et al.[11] and Kodliwadmath et al.[13] were found the most common mode of injury was RTA. However, Ahn et al.[14] reported that slip or fall was the most common cause of trauma.

Alemdar et al.[15] reported that headache and confusion appear to be the most common presenting features, occurring in as many as 90% and 56% of cases respectively. Other common symptoms include weakness, seizures, and incontinence. In another study, Ahn et al.[14] reported that the most common symptom was headache.

Prahaladu et al.[11] reported that the prognosis is worse in patients with pupillary abnormalities. They found 10% mortality in patients with normal size reacting pupil, 24% with unilateral dilated pupils and 100% with dilated fixed pupils. Kristianson and Tandon,[16] found 100% mortality when pupils are dilated and fixed, 19% when they are unequal and 14.0% when pupils are normal.[16]

Leitgeb et al.[17] stated that the mortality rate was found to be 47% and additional trauma and mortality were found to be increased as the GCS score was lowered. Kilincaslan et al.[18] reported that the GCS score was strongly correlated to mortality. Shen et al.[13] found that the mortality rate was higher in patients with a lower GCS score. Ahn et al.[14] observed that the level of consciousness on admission was GCS 13 to 15 in 25 patients.

Ahn et al.[14] showed the GCS on admission was 13 to 15 in more than a half of the cases and the patients with GCS <8, pupillary inequality, volume of hematoma >30ml, with a mortality of 40%. The overall mortality according to Prahaladu et al.[11] was 22.67% and most of the mentioned studies are comparable with our study.

There was statistically significant positive correlation between admission GCS Score with GCS Score on 1st, 3rd, 10th POD and following 1 month following surgery. There was also statistically significant positive correlation between admission GCS Score and GOS Score during subsequent postoperative follow-up in this present study. Similarly, Kodliwadmath et al.[20] reported that there was statistically significant positive correlation between GCS Score recorded on admission with GOS Score recorded on day 7 and GOS Score recorded on day 28. The positive correlation was also seen between GCS recorded at 6 hours with GOS Score recorded on day 7 and GOS Score recorded on day 28.

The maximum mortality with admission GCS Score 5 (100%) followed by GCS score 9(71.4%) observed in this study. Maximum functional survival observed in admission GCS Score 11(100%) and 15(100.0%) followed by GCS Score 12 (77.78%). The overall Functional Survival in 53.3% cases (32/60) and good recovery in 27(45%) patients and mortality rate is 41.7% (25/60). Almost similar research findings were observed by Emami et al.[21]

CONCLUSION

This study showed a significant positive correlation between admission GCS score; and GCS Score recorded on 1st, 3rd and 10th POD and following 1 month of surgery. Traumatic acute subdural haematoma is a fatal condition despite all improvement in neurosurgical interventions. GCS Score and preoperative CT-Head are important parameters that correlate with the mortality rate.

REFERENCES

1. Dawodu ST. Traumatic brain injury (TBI)-definition, epidemiology, pathophysiology. Medscape Reference: Drugs, Diseases and Procedures, 2011.
2. Tallon JM, Ackroyd-Stolarz S, Karim SA, Clarke DB. The epidemiology of surgically treated acute subdural and epidural hematomas in patients with head injuries: a population-based study. Canadian journal of surgery, 2008; 51(5): 339.
3. Heegaard WG, Biros MH. Head injury. In: Marx JA, Hockberger RS, Walls RM, et al, eds. *Rosen's Emergency Medicine: Concepts and Clinical Practice*. 8th ed. Philadelphia, PA: Elsevier Saunders; chap, 2014; 41.
4. Victor M, Ropper AHA, Raymond D, Allan HR. Adams and Victor's principles of neurology, 2001.
5. Kwon YS, Yang KH, Lee YH. Craniotomy or decompressive craniectomy for acute subdural hematomas: surgical selection and clinical outcome. Korean journal of neurotrauma, 2016; 12(1): 22-7.
6. Greenberg MS. Handbook of neurosurgery: Eighth edition: New York: Thieme, 2016; 1(1): 897-9.
7. Saha AK, Khan AH, Islam KM, Hossain M, Sarker AC, Khair A, Burua KK. A study of Correlation Between motor Component of GCS score on Admission and Glasgow Outcome scale Score at Discharge in head injured Patients who underwent Surgical intervention. Bangladesh Medical Journal, 2011; 40(2): 41-6.
8. Munch E, Horn P, Schürer L, Piepgras A, Paul T, Schmiedek P. Management of severe traumatic brain

injury by decompressive craniectomy. Neurosurgery, 2000; 47(2): 315-23.
9. Lacombe GF, Leake JL, Clokie CM, Haas DA. Comparison of remifentanil with fentanyl for deep sedation in oral surgery. Journal of oral and maxillofacial surgery, 2006 Feb 1; 64(2): 215-22.
10. IMRAN A. The Craniectomy Procedure Decreased Mortality Rate In Traumatic Acute Subdural Hematoma (TASDH). Abstrak, 2010.
11. Prahaladu P, Satyavara Prasad K, Rajasekhar B, Satyanarayana Reddy K. Clinical Study of Acute Subdural Haematoma—A Level I Trauma Care Centre Experience. International Journal of Research in Medical Sciences, 2017; 5: 857-62.
12. Alagoz F, Yildirim AE, Sahinoglu M, Korkmaz M, Secer M, Celik H, Yel C, Guvenc Y, Uckun OM, Narin F, Daglioglu E. Traumatic acute subdural hematomas: analysis of outcomes and predictive factors at a single center. Turk Neurosurg, 2017; 27(2): 187-91.
13. Kodliwadmath HB, Koppad SN, Desai M, Badiger SP. Correlation of Glasgow outcome score to Glasgow coma score assessed at admission. International Surgery Journal, 2016; 3(4): 1959-63.
14. Ahn JM, Lee KS, Shim JH, Oh JS, Shim JJ, Yoon SM. Clinical Features of Interhemispheric Subdural Hematomas. Korean journal of neurotrauma, 2017; 13(2): 103-7.
15. Alemdar M, Selekler HM, Efendi H. A non–traumatic interhemispheric subdural haematoma: presented with headache as the sole complaint. The journal of headache and pain, 2005 Feb; 6(1): 48.
16. Kristianson K, Tandon PN. Diagnosis and treatment of severe oedema, 2001.
17. Leitgeb J, Mauritz W, Brazinova A, Janciak I, Majdan M, Wilbacher I, Rusnak M. Outcome after severe brain trauma due to acute subdural hematoma. Journal of neurosurgery, 2012; 117(2): 324-33.
18. Kılınçaslan M, Kaptan H, İlhan M, Kasımcan Ö, Çakıroğlu K, Kılıç C. Prognostic factors and their effects on mortality in traumatic acute subdural haematoma. Journal of Nervous System Surgery, 1(4): 214-9.
19. Shen J, Pan JW, Fan ZX, Zhou YQ, Chen Z, Zhan RY. Surgery for contralateral acute epidural hematoma following acute subdural hematoma evacuation: five new cases and a short literature review. Acta neurochirurgica. 2013; 155(2): 335-41.
20. Kodliwadmath HB, Koppad SN, Desai M, Badiger SP. Correlation of Glasgow outcome score to Glasgow coma score assessed at admission. International Surgery Journal, 2016; 3(4): 1959-63.
21. Emami P, Czorlich P, Fritzsche FS, Westphal M, Rueger JM, Lefering R, Hoffmann M. Impact of Glasgow Coma Scale score and pupil parameters on mortality rate and outcome in pediatric and adult severe traumatic brain injury: a retrospective, multicenter cohort study. Journal of neurosurgery, 2017; 126(3): 760-7.
22. Saha SK, Sayed MA, Islam J, Alam S, Asadullah AT, Ahmad MU, Khan SI. Comparative Analysis of the Surgical Outcome of Traumatic Acute Subdural Haematoma with Associated and not Associated Underlying Brain Injury.