World Neurosurgery: X 21 (2024) 100264

Contents lists available at ScienceDirect

World Neurosurgery: X

journal homepage: www.journals.elsevier.com/world-neurosurgery-x

Clinical characteristics and functional outcome of surgically treated adult head trauma patients with acute subdural hematoma: Ethiopian tertiary hospitals experience

Gemechu Teshita [a], Mulualem Wondafrash [b], Biniam G/Egziabher [b], Biruk Getachew [b], Eyerusalem Bergene [c,*]

[a] Department of Neurosurgery, Minilik Referral Hospital, Addis Ababa, Ethiopia
[b] Department of Neurosurgery, Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia
[c] Department of Neurosurgery, Saint Paul's Millennium Medical College, Addis Ababa, Ethiopia

ARTICLE INFO

Keywords:
Functional outcome
Extended glasgow outcome scale
Acute subdural hematoma

ABSTRACT

Background: Acute subdural hematoma (ASDH) is one of the most common and devastating lesions in traumatic brain injury with a mortality rate upto 60 % especially in low-income countries. The present study aimed to determine the clinical characteristics and functional outcomes and the associated factors of surgically treated head trauma patients with ASDH.

Methods: Between January 2018 and January 2021 we identified 140 head trauma patients with ASDH who underwent surgical evacuation in three tertiary hospitals. Epidemiological data were collected; the six-month functional outcome was studied using an extended Glasgow outcome score (EGOS) and associated factors were also studied. Univariate analysis was performed at first, and variables with a *P*-value of <0.05 were entered into the multivariable logistic regression model.

Results: Male predominance was seen accounting for 87 % and assault was the most common mechanism of injury (35.7 %). Sixty-five (56.5 %) of patients achieved favorable functional recovery (EGOS of 5–8) and 50 (43.5 %) of patients had unfavorable recovery (EGOS of 1–4) after 6 months of follow-up. In multivariate logistic regression models, GCS <5, Pupillary abnormality, hypotension, oxygen saturation <90 at presentation, and hospital-acquired pneumonia were the independent factors associated with unfavorable functional outcomes.

Conclusion: In our setup, most of the patients are male from assault injuries. There is still a high rate of unfavorable outcomes in patients with acute subdural hematoma. GCS <5, pupillary abnormality, hypotension and desaturation at presentation, and postoperative hospital-acquired infection are predictors for unfavorable functional outcomes.

1. Introduction

Acute subdural hematoma is one of the most prevalent traumatic brain injuries in which a blood clot fills up the subdural space.[1–4] It is found in one-third of all severe head injuries, and the fatality rate rises as high as 60 %.[4,5] However, mild to moderate traumatic brain injury accounts for up to 86 % of all ASDH that require hospitalization.[4] Furthermore, mortality rates of ASDH have recently begun to drop roughly to 14 % as a result of advances in neurosurgery and early therapies, however, in low-income countries, the prognosis continues to be poor.[2,6–9]

GCS score, pupillary abnormalities, systemic blood pressure, respiration rate, glycemic status, length of hospital stay, hypoxia, concomitant subarachnoid bleed, and intraventricular hemorrhage are some of the predictors of prognosis.[7] Mortality is influenced by age, mechanism, and severity of the injury, associated craniocerebral injury, prompt surgical evacuation and technique, and postoperative care.[2,6,7,10] Surgery is recommended when there is a loss of consciousness, neurological symptoms, a hematoma thickness of more than 1 cm, or a midline shift of more than 5 mm. Therefore, this study aimed to identify the socio-demographics, clinical presentation, and functional outcome of head trauma patients who were operated on when the acute subdural

* Corresponding author. Addis Ababa, Ethiopia.
E-mail address: eyerusalem.bergene@sphmmc.edu.et (E. Bergene).

https://doi.org/10.1016/j.wnsx.2023.100264
Received 11 July 2023; Received in revised form 29 October 2023; Accepted 28 November 2023
Available online 12 December 2023

hematoma had surgical indication according to the existing literature.

2. Patients and methods

We retrospectively identified 140 head trauma patients who were surgically treated for an acute subdural hematoma in the Department of Neurosurgery at AaBET Hospital, Minilik II referral hospital, and St Peter's Specialized Hospital, Addis Ababa, Ethiopia between January 2018 and January 202. Of these 115 fulfilled the inclusion criteria and were included in the study. The indications of surgery in our institution were the presence of one or more of the following: hematoma thickness 1 cm and above, midline shift >5, asymmetric or fixed dilated pupils. The surgery of choice for hematoma evacuation was either craniotomy or decompressive craniectomy if there is intraoperative brain swelling. The Diagnosis was confirmed by a CT scan in all patients. The Exclusion criteria included[1] Pediatric patients aged less than 14 years[2]; patients with missing data.

2.1. Patients characteristics

The following clinical data were analyzed: Age, sex, mechanism of injury, presenting GCS, Oxygen saturation, Mean arterial pressure (MAP), pupillary size and reactivity, time from injury to surgery, other comorbidities, and other site injuries. EGOS (Extended Glasgow outcome scale) at 6 months expressed as favorable and unfavorable were studied.

2.2. CT imaging evaluation

All patients had a Head CT at presentation and the following parameters were identified: hematoma side, midline shift, maximum width of the hematoma, and associated other head CT findings.

2.3. Surgical management and follow-up

Patients' surgical data included are as follows: time from injury to surgery; duration of surgery; type of procedure performed whether craniotomy or decompressive craniectomy and post-operative complications.

2.4. Statistical analysis

All analyses were performed using SPSS (version 26.0, IBM Corp.) The statistical significance was defined as a *P*– *P*-value <0.05. All tests were 2-sided. Data were described using means (standard deviations) and numbers of patients (percentages) for continuous and categorical variables, respectively. Categorical variables were compared using the chi-square test, continuous variables were assessed using the student's t-test. Variable with a *P*-value of <0.05 in univariable analysis were entered into a multivariable logistic regression model to identify the factors associated with the outcome of ASDH.

3. Results

A total of 140 procedures for ASDH were done and 115 met the inclusion criteria and were included in the study. The sociodemographic and clinical characteristics are presented in Table 1. There were 100 males (87 %) and 15 females (13 %), and the male/female ratio was 6.7 The mean at diagnosis was 35.9 years (ranging from 15 to 86 years). Assault with a stick and stone was the most common mechanism of injury in 41 (35.7 %) followed by road traffic accidents for 29 (25.2 %). The mean arterial pressure at presentation was below 70 mmhg in 43 patients (37.4 %) and 45 patients (39.1 %) were desaturating with oxygen saturation below 90 %. A majority (75.7 %) of the patients had no associated medical illness identified.

Amongst the patients, 28.7 % arrived at our tertiary center without any prehospital care while the rest received different levels of care. At emergency 35 (30.4 %) patients were intubated and put on mechanical ventilators. The mean duration from the time of injury to the start of surgery was 32.2 h (with a range of 1–210 h) Only 10.4 % of the patients were taken to surgery within 4 h of the injury. The mean duration of surgical procedures was 232.8 min (ranging from 60 to 500 min). Decompressive Craniectomy was done for 48 patients (41.7 %) and craniotomy was done for the remaining 67(58.3 %). Post-operative complications occurred in 59 patients (51.3 %) with hospital-acquired pneumonia and surgical site infections accounting for the majority.

The Glasgow outcome score is presented in Table 2 and Table 3. In-hospital mortality occurred in 20 patients (17.4 %) and another 5 (4.3 %) had mortality within 6 months of discharge. The means GCS at discharge was 13 with a range of 9–15. The average hospital stay was 20.85 days (ranging from 1 to 500 days). The extended Glasgow outcome score was 5 and above (favorable outcome) at 6 months follow-up in 65 patients (56.5 %). From the favorable outcome group, patients with upper and lower good recovery were 36(31.3 %) and 19(16.5 %) respectively.

Univariate analysis revealed that GCS at presentation, duration of surgery, MAP, and oxygen saturation were significantly related to outcome. A multivariate logistic regression analysis result is shown in Table 4. It showed that GCS <5 (OR,2.26; CI 1.94–27.17; *P*-value <0.003), abnormal pupillary response (OR, 2.44; CI, 1.09–5.42; P-value

Table 1
Sociodemographic and clinical characteristics ($n = 115$).

		Frequency	Percentile
Sex	Male	100	87 %
	Female	15	13 %
Age	14–20	19	16.5 %
	21–40	66	57.4 %
	41–60	24	20.9 %
	61–80	6	5.2 %
Mechanism of injury	RTA	29	25.2 %
	FDI	24	20.9 %
	Assault	41	35.7 %
	PBI	7	6.1 %
	Other causes	14	12.2 %
GCS at presentation	≤8	50	43.5 %
	9–12	40	34.8 %
	≥13	25	21.7 %
Pupillary reaction at presentation	Abnormal response	58	50.4 %
	Normal response	57	49.6 %
Midline shift	<5 mm	24	20.9 %
	>5 mm	90	78.3 %
ASDH thickness	<1 cm	62	53.9 %
	≥1 cm	53	46.1 %
Additional brain CT findings	SAH	27	23.5 %
	Hemorrhagic contusions	59	51.3 %
	DAI	6	5.2 %
	ICH	35	30.4 %
	AEDH	17	14.8 %
Another site Injury	Spine injury	8	7 %
	Chest injury	6	5.2 %
	Long bone Fracture	6	5.2 %
	Abdominopelvic injury	1	0.9 %

Table 2
Glasgow outcome score of the study participants.

GOSE		Frequency	Percent
1	Death	25	21.7 %
2	Persistent vegetation state	10	8.6 %
3	Severe disability lower	4	3.4 %
4	Severe disability upper	11	9.5 %
5	Moderate disability lower	5	4.3 %
6	Moderate disability upper	5	4.3 %
7	Good recovery lower	19	16.5 %
8	Good recovery upper	36	31.3 %

Table 3
Glasgow outcome scale extended and Mortality.

		Frequency	Percentile
GOSE	Favorable	65	56.5 %
	Unfavorable	50	43.5 %
Mortality	Hospital	20	17.5 %
	Within 6 months post-discharge	5	4.3 %

Table 4
Multivariate logistic regression analysis of factors related to the unfavorable outcome.

Factors	Odd ratio	95%CI	P value
GCS <5	2.26	1.94–27.17	0.003
Abnormal pupillary response	2.44	1.09–5.42	0.029
MAP <70	48.75	14.66–162.05	0.01
Oxygen saturation <90	18.5	7.06–48.45	0.001
Post-operative hospital-acquired pneumonia	11.89	4.82–29.34	0.001

= 0.029), MAP <70 mmHg (OR, 48.75; CI, 14.665–162.05; *P*-value = <0.01), oxygen saturation <90 (OR,18.5, CI, 7.06–48.45; P-value = <0.001) and presence of postoperative pneumonia (OR, 11.89; CI, 4.82–29.34; P-value=<0.001) were independent risk factors for unfavorable outcome.

4. Discussion

Despite the significant number of cases, the outcome of surgically treated traumatic brain injury patients with ASDH and factors associated are not studied in our setup. We were relying on the data from other centers in the literature. Therefore, this study aimed to determine clinical characteristics, functional outcomes, and associated factors of surgically treated adult head trauma patients with acute subdural hematoma.

Acute subdural hematoma (ASDH) is one of the common causes of severe traumatic brain injury.[4,11] Its mortality rate can range from 6.8 % to 60 % depending on the advancement of the setup.[7,8,12] The mortality rates are reported to be the highest in the elderly population. In our study, the overall mortality rate was 22 %, the majority of which was in-hospital mortality. Also in the elderly population (age >60) mortality was 50 % compared to 18.5 % in the age group <60. A similar pattern of higher mortality in the elderly was seen in other studies which found that mortality was 35 % in those below 80 years and 53 % for those over 80 years.[13,14] In addition, patients with low GCS were shown to have a higher rate of mortality.[4,10,15,16] In our study 57.1 %[12] of patients with initial GCS 5 and below ended up with hospital mortality similar to a study done by Alagoz et al which found that patients who died were old and had low GCS scores.

In our study, 56.5 % of the patients had a favorable outcome which is significantly better than a study done by Igbokwe et al in Abuja, Nigeria which found that only 26.7 % had functional recovery post-operatively and a study done by Wilberge JE *et al* which found overall mortality rate was 66 % and 19 % had functional recovery.[8,17] Functional recovery is defined by GOS as those patients with a good recovery or disabled yet functionally independent.[17] Our finding was comparable to a study done by Chen et al where 52.8 % of patients achieved functional recovery (GOS of 4 or 5) after 1 year of follow-up.[2] The functional outcome was significantly associated with the GCS 5 and below, MAP at presentation, oxygen saturation, pupillary response, and postoperative complication. This finding was comparable to other studies which found a strong association between outcome and age, GCS at presentation, surgical type, and associated CT scan finding.[7,13,16]

It is reported that age has a direct relationship with the outcome of acute subdural hematoma patients.[7,13,18] However, in our study patients between the age group 20–40 years had more favorable outcomes 44 (66.7 %) compared to patients below 20 years of age 7(36.8 %) and those above 40 years of age 14(46.7 %). Despite this finding, a statistically significant relationship between age and outcome was not found (p = 0.167). We ascribed this to the fact that the majority of our patients were below the age of 40 denuding the statistical significance.

In this study we found a higher number of male patients with a male-to-female ratio of 6.7:1. This correlates to previous studies which show a significantly high number of male patients sustain traumatic ASDH.[4,8] This result explains our social culture that males are more exposed to unskilled high-risk jobs and exposed to the external environment for trauma than females. In this study, the proportion of favorable outcomes in both sexes was nearly even (M: F 57 %: 53.3 %) similar to a study done by Mushkudiani et al no gender differences in outcome were found (OR: 1.01; CI 0.92–1.11).[18]

Traffic accidents and fall accidents were the major mechanisms of trauma in patients with ASDH.[12,19] However, in our study assault by stick and stone, 41(35.7 %) was a major cause of trauma. Those patients who sustained road traffic accident had a higher number of unfavorable outcome compared to other mechanisms but was not statically significant (chi-square p = 0.187). Similar to our finding a study on morbidity and mortality of ASDH was done by Wilberger JE *et al.* The worst outcome was seen in motorcycle accidents with a 71 % mortality rate and no survivors with functional recovery.[17]

In this study, we found that the mean GCS was 9 ± 3 which was better than a study done by Chen et al mean coma scale score of 5.9 ± 1.1.[2] Fifty (43.5 %) of patients were comatose at presentation GCS below 8. It is comparable to the study done by Daniel et al on the survival pattern of ASDH stated that over half of the patients were comatose at presentation (53 %).[20] Higher mean GCS in a favorable group (10 ± 3) than the unfavorable group (8 ± 3) which is statically significant (t-test p < 0.001). In multivariate analysis, we found that patients presenting GCS 5 and below had significant prognostication association on functional outcome. Similar to studies by Kemal et al and Trevisi et al. The most important predictors of outcome were GCS score in ASDH in their study.[3,21] Twelve (57.1 %) of patients with initial GCS 5 and below end up with hospital mortality. Better than to study done by Abdelfatah et al on the prognosis of ASDH in patients with an extension or no motor response to pain motor response found that all patients died within 1 month.[19]

Normal pupillary finding on initial evaluation was significantly higher in favorable outcome group 52(91.2 %) than in unfavorable group 5(18.8 %) (p = 0.000). In multivariate analysis, pupillary light response on initial evaluation had an independent prognostication effect on functional outcome (p = 0.007). Similar to studies that showed fixed pupil patients never had a favorable outcome.[3,6,22,23]

As part of secondary brain injury mean arterial pressure and oxygen saturation at presentation had significant differences between favorable and unfavorable outcome groups. Both had prognostic effects on function outcomes which are supported by other studies that show that unfavorable outcomes increase to 70.6 % in the hypoxic group and 78.8 % in the hypotensive group.[24,25] Additional brain CT finding was found in 88.7 % of the patients with the most common finding being hemorrhagic contusion similar to a study done in Turkey.[6] However, in other studies SAH was the most common finding.[7,19] In addition, hemorrhagic contusion was found significantly higher in unfavorable outcome group 31(52.5 %) (Chi-square p = 0.044).

Decompressive craniectomy was done in 48(41.7 %) of patients in our study. The unfavorable outcome group accounts for 62.5 % of decompressive craniectomy which is statically significant (chi-square p < 0.001). It can relate to brain swelling which determines the replacement of bone flap intraoperatively. In univariate analysis, decompressive craniectomy significantly prognosticates unfavorable outcome COR 3.917(1.788–8.582) (p < 0.001). This was not repeated in multivariate analysis. Similar to the study done by Chen et al types of operation were not significantly associated with functional outcomes.[2]

Patients undergoing decompressive craniectomy account for 80 % of hospital mortality. Similarly, a study done by Monsivais et al found that those who underwent craniectomy were 5.7 times more likely to die than compared to those with craniotomy.[13] In addition, of those who underwent decompressive craniectomy 33 % of them ended up dead and 29.1 % of them had a vegetative state, and severe disability at upper and lower levels. This was in contrast to the trial of decompressive craniectomy for traumatic intracranial hypertension which stated that decompressive craniectomy in patients with TBI and refractory ICP resulted in lower mortality and higher rates of vegetative state.[26]

The mean time from injury to surgery was 32.2 ± 33.87 h. Lower than the study done by Igbokwe et al in Nigeria whose average total delay was 49.8 ± 75.3 h.[8] But significantly higher than a study done by Chen et al which mean TIS was 162.5 ± 45.6 min.[2] The poor referral system in the country is one of the reasons for delayed presentation since 71.2 % of the study population was given some kind of treatment from other centers and then was referred to our centers. Significant differences were not found between the functional outcome group in terms of mean TIS (t-test, $p = 0.611$). In contrast, a study done by Chen et al stated that mean TIS in functional and poor recovery groups significantly differs ($p = 0.002$).[2] The absence of association between TIS and functional outcome can be because most of our patients had delayed presentation. Twelve (10.4 %) of patients had TIS below 4 h. Compare this to the study done by Abdulfetah et al and Alagoz et al where all patients arrived at the hospital before 2 h and the median time was 2 h respectively.[4,19]

Postoperative complications occurred in 51.3 % of the patients and 69.5 % of these patients are from the unfavorable outcome group. It was high compared to a study done by Laeke et al in which postoperative complications occurred in 17 % of patients.[9] The high level of post-operative complication can be due to late presentation with low GCS in most of our patients. From postoperative complication, HAP 32 (27.8 %) and Electrolyte disturbance 31(27 %) was the most common ones. Similar to a study done by Chen et al pneumonia account for 28(40 %) of postoperative complication.[2,27] In multivariate analysis, HAP had significant prognostication on functional outcomes. Patients with HAP were 11 times at risk of unfavorable outcomes ($p = 0.009$*). Similar to the study done by Kesinger et al, hospital-acquired pneumonia is an independent predictor of poor outcomes in TBI. HAP was independently associated with low GOSE scores at follow-up 1 year: AOR 6.39; 95 % [CI].[27]

5. Conclusion

This study emphasized that traumatic ASDH is a fatal condition. In this study, more young patients were involved with ASDH with a mean age of the study population of 35.6 years and more male patients with M: F 6.7:1. Assault with stick and stone accounts for a majority of mechanism. Most patients were comatose (GCS≤8) at presentation. Mortality and function outcome was comparable to most studies done in different areas. Initial GCS below 5, pupillary finding, MAP, oxygen saturation, and development of HAP are independent predictors for functional outcome in traumatic acute subdural hematoma. We found that those patients with GCS 5 and below and those with decompressive craniectomies had higher mortality. Age, gender, midline shift, the thickness of ASDH, mechanism of injury, TIS, type of surgery, hemorrhagic contusion, and mean duration of surgery had no significant association with functional outcomes.

Ethics statement

The ethics committee of St Paul's Hospital Millennium Medical College approved this study.

CRediT authorship contribution statement

Gemechu Teshita: Writing - original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Mulualem Wondafrash:** Validation, Supervision. **Biniam G/Egziabher:** Writing - review & editing, Writing - original draft, Supervision, Resources. **Biruk Getachew:** Validation, Supervision, Methodology. **Eyerusalem Bergene:** Writing - review & editing, Writing - original draft, Software, Resources, Investigation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgment

This study was supported by funding from St Paul's Hospital Millennium Medical College research projects.

References

1. Twamley EW, Jak AJ, Delis DC, Bondi MW, Lohr JB. Cognitive Symptom Management and Rehabilitation Therapy (CogSMART) for veterans with traumatic brain injury: pilot randomized controlled trial. *J Rehabil Res Dev*. 2014;51(1).
2. Chen SH, Sun JM, Fang WK. The impact of time from injury to surgery in functional recovery of traumatic acute subdural hematoma. *BMC Neurol*. 2020;20(1):1–6.
3. Trevisi G, Sturiale CL, Scerrati A, et al. Acute subdural hematoma in the elderly: outcome analysis in a retrospective multicentric series of 213 patients. *Neurosurg Focus*. 2020;49(4):E21.
4. Alagoz F, Yildirim A, Sahinoglu M, et al. Traumatic acute subdural hematomas: analysis of outcomes and predictive factors at a single center. *Turkish Neurosurgery*. 2017;27(2).
5. Hatashita S, Koga N, Hosaka Y, Takagi S. Acute subdural hematoma: severity of injury, surgical intervention, and mortality. *Neurol Med -Chir*. 1993;33(1):13–18.
6. Koç RK, Akdemir H, Öktem IS, Meral M, Menkü A. Acute subdural hematoma: outcome and outcome prediction. *Neurosurg Rev*. 1997;20:239–244.
7. Hiraizumi S, Shiomi N, Echigo T, et al. Factors associated with poor outcomes in patients with mild or moderate acute subdural hematomas. *Neurol Med -Chir*. 2020;60(8):402–410.
8. Igbokwe KK, Ayogu OM, Onobun DE, et al. The outcomes of traumatic acute subdural hematoma in a tertiary center in Abuja, Nigeria. *Cureus*. 2021;13(11).
9. Laeke T, Tirsit A, Kassahun A, et al. Prospective study of surgery for traumatic brain injury in Addis Ababa, Ethiopia: surgical procedures, complications, and postoperative outcomes. *World neurosurgery*. 2021;150:e316–e323.
10. Atalay T, Ak H, Gülsen I, Karacabey S. Risk factors associated with mortality and survival of acute subdural hematoma: a retrospective study. *J Res Med Sci: Off J Isfahan Univ Medi Sci*. 2019;24.
11. Lee JJ, Segar DJ, Morrison JF, Mangham WM, Lee S, Asaad WF. Subdural hematoma as a major determinant of short-term outcomes in traumatic brain injury. *J Neurosurg*. 2017;128(1):236–249.
12. Ryan CG, Thompson RE, Temkin NR, Crane PK, Ellenbogen RG, Elmore JG. Acute traumatic subdural hematoma: current mortality and functional outcomes in adult patients at a Level I trauma center. *J Trauma Acute Care Surg*. 2012;73(5):1348.
13. Monsivais D, Choi HA, Kitagawa R, Franch M, Cai C. A retrospective analysis of surgical outcomes for acute subdural hematoma in an elderly cohort. *Interdisciplinary Neurosurgery*. 2018;14:130–134.
14. Taussky P, Hidalgo ET, Landolt H, Fandino J. Age and salvageability: analysis of outcome of patients older than 65 years undergoing craniotomy for acute traumatic subdural hematoma. *World Neurosurgery*. 2012;78(3–4):306–311.
15. Kulesza B, Litak J, Mazurek M, Nogalski A. Initial factors affecting 6-month outcome of patients undergoing surgery for acute post-traumatic subdural and epidural hematoma. *Folia Med*. 2020;62:94.
16. Ssebakumba MK, Lule H, Olweny F, Mabweijano J, Kiryabwire J. Thirty-day clinical outcome of traumatic brain injury patients with acute extradural and subdural hematoma: a cohort study at Mulago National Referral Hospital, Uganda. *Egyptian journal of neurosurgery*. 2020;35:1–2.
17. Wilberger JE, Harris M, Diamond DL. Acute subdural hematoma: morbidity, mortality, and operative timing. *J Neurosurg*. 1991;74(2):212–218.
18. Mushkudiani NA, Engel DC, Steyerberg EW, et al. Prognostic value of demographic characteristics in traumatic brain injury: results from the IMPACT study. *J Neurotrauma*. 2007;24(2):259–269.
19. AbdelFatah MA. Prognosis of acute subdural hematoma greater than 10 mm in thickness in head injury patients with an extension or no motor response to pain after resuscitation. *Egyptian J Neurosurgery*. 2019;34(1):1–5.
20. Fountain DM, Kolias AG, Lecky FE, et al. Survival trends after surgery for acute subdural hematoma in adults over a 20-year period. *Ann Surg*. 2017;265(3):590.

21. Koç RK, Akdemir H, Öktem IS, Meral M, Menkü A. Acute subdural hematoma: outcome and outcome prediction. *Neurosurg Rev*. 1997;20:239–244.
22. Kim KH. Predictors for functional recovery and mortality of surgically treated traumatic acute subdural hematomas in 256 patients. *J Korean Neurosurgical Societ*. 2009;45(3):143.
23. Leitgeb J, Mauritz W, Brazinova A, et al. Outcome after severe brain trauma due to acute subdural hematoma. *J Neurosurg*. 2012;117(2):324–333.
24. Volpi PC, Robba C, Rota M, Vargiolu A, Citerio G. Trajectories of early secondary insults correlate to outcomes of traumatic brain injury: results from a large, single centre, observational study. *BMC Emerg Med*. 2018;18(1):1–9.
25. Becker DP, Miller JD, Ward JD, Greenberg RP, Young HF, Sakalas R. The outcome from severe head injury with early diagnosis and intensive management. *J Neurosurg*. 1977;47(4):491–502.
26. Hutchinson PJ, Kolias AG, Timofeev IS, et al. Trial of decompressive craniectomy for traumatic intracranial hypertension. *N Engl J Med*. 2016;375(12):1119–1130.
27. Kesinger MR, Kumar RG, Wagner AK, et al. Hospital acquired pneumonia is an independent predictor of poor global outcome in severe traumatic brain injury up to 5 Years after discharge: HAP predicts poor outcomes 5 years post TBI. *J Trauma Acute Care Surg*. 2015;78(2):396.

Abbreviations

AaBET: Addis Ababa Burn Emergency and Trauma
AAU: Addis Ababa University
ASDH: Acute Subdural Hematoma
CT Scan: Computerized Tomographic Scan
DVT: Deep venous Thrombosis
FDI: falling down injury
GCS: Glasgow coma scale
GOSE: Extended Glasgow Outcome scale
Gov't: Government
HAP: Hospital acquired pneumonia
ICP: Intracranial pressure
ICU: Intensive Care Unit
ISS: Injury Severity Scores
MAP: Mean arterial pressure
NSRC: Neurosurgical referral clinic
OPD: Out Patient Department
PBI: Penetrating brain injury
Postop: post operative
RBS: Random blood sugar
RTA: Road traffic accident
SAH: Subarachnoid Hemorrhage
SD: Standard deviation
SP: spinous process
SPHMMC: St Paul Hospital Millennium Medical College
TBI: Traumatic Brain injury
TIS: Time from injury to surgery
TP: transverse process