THE PLANET

Original Article

Assessment of Early Outcomes Following Decompressive Craniectomy with Hematoma Evacuation for Spontaneous Supratentorial Deep-Seated Intracerebral Hemorrhage

Atiqure Rahman Rimel[1*]

ARTICLE INFO

Received: 11 October 2026
Accepted: 20 October 2026
Published Online: 03 November 2026

DOI: 10.5281/zenodo.23911514

Volume: 10, Number: 3, Page: 1032-1036

e-ISSN: 2789-5912
ISSN: 2617-0817

*Corresponding author

ABSTRACT

Background: Spontaneous deep-seated supratentorial intracerebral hemorrhage (ICH) is associated with high mortality and substantial neurological disability. The role of surgical treatment, particularly decompressive craniectomy combined with hematoma evacuation, remains uncertain because of the risk of additional injury to deep eloquent structures and limited evidence regarding its clinical and radiological benefits. This study aim was to assess the early clinical and radiological outcomes of decompressive craniectomy with hematoma evacuation in patients with spontaneous supratentorial deep-seated intracerebral hemorrhage. **Methods & Materials:** This prospective study included 18 patients with spontaneous supratentorial deep-seated ICH treated at Dhaka Medical College Hospital from October 2022 to March 2024. Patients met predefined clinical and radiological criteria and underwent decompressive craniectomy with hematoma evacuation. Pre- and postoperative GCS, midline shift, and 30-day functional outcomes were assessed using the Glasgow Outcome Scale. Data were analyzed using SPSS 27.0. **Results:** The mean age was 55.39 ± 11.55 years, with 77.8% male patients. Hypertension and diabetes were present in 94.4% and 66.7%, respectively. Mean hematoma volume was 59.88 ± 20.21 mL and preoperative GCS was 8.61 ± 1.78. Postoperatively, GCS improved to 9.22 ± 2.77, while midline shift decreased from 10.12 to 5.70 mm. Functional survival occurred in 50.0% of patients, while mortality was 44.4%. **Conclusion:** Decompressive craniectomy with hematoma evacuation was followed by improvement in neurological status and substantial reduction in midline shift in this cohort. Functional survival was observed in half of the patients, while mortality remained considerable. These findings suggest that this surgical approach may be a feasible option for carefully selected patients with severe deep-seated ICH.

Keywords: *Intracerebral hemorrhage; Decompressive craniectomy; Hematoma evacuation; Deep-seated hemorrhage; Midline shift; Glasgow Coma Scale; Functional outcome; Mortality.*

1. *Neurosurgeon, Department of Neurosurgery, National Institute of Neurosciences & Hospital, Dhaka, Bangladesh (ORCID: 0009-0007-0612-1996)*

INTRODUCTION

Spontaneous intracerebral hemorrhage (ICH) is a major form of stroke associated with high mortality and substantial long-term neurological disability. Supratentorial deep-seated hemorrhages, particularly those involving the basal ganglia and thalamus, are especially challenging because of their proximity to critical neural structures and the potential for significant mass effect and secondary brain injury. Hematoma volume, location, intraventricular extension, and initial neurological status are important determinants of outcome. [1] Management of spontaneous ICH includes rapid neurological stabilization, blood pressure control, correction of coagulopathy, intracranial pressure management, and prevention of secondary brain injury. The role of open surgical evacuation, however, remains controversial. The International Surgical Trial in Intracerebral Haemorrhage (STICH) did not demonstrate an overall functional benefit of early hematoma evacuation compared with initial conservative treatment in patients with spontaneous supratentorial ICH. [2] Similarly, the STICH II trial, conducted in selected patients with superficial lobar hemorrhage without intraventricular hemorrhage, did not demonstrate a significant overall improvement in functional outcome with early surgery. [3] The difficulty is greater in deep-seated ICH because direct access to the hematoma may cause additional injury to surrounding functional brain tissue. Minimally invasive approaches have therefore been investigated to reduce hematoma burden while limiting surgical trauma. The MISTIE III trial demonstrated that minimally invasive catheter-based evacuation was safe but did not significantly improve the primary functional outcome in the overall study population, although greater hematoma reduction was associated with better outcomes. [4] Current guidelines consequently recommend individualized consideration of surgical intervention according to hematoma characteristics, neurological status, mass effect, and the potential risks and benefits of treatment. [5] Decompressive craniectomy represents another potential strategy for patients with severe ICH and substantial mass effect or intracranial hypertension. However, evidence regarding its effectiveness, particularly for deep-seated hemorrhage, remains limited. The recent SWITCH trial specifically evaluated decompressive craniectomy in patients with severe deep supratentorial ICH and did not establish a clear functional benefit, highlighting the continuing uncertainty surrounding decompressive surgery in this population. [6] Importantly, this evidence concerns decompressive craniectomy without planned hematoma evacuation and therefore does not directly address outcomes following combined decompression and hematoma evacuation. Deep-seated ICH may differ substantially from superficial lobar hemorrhage in its clinical course and response to surgical treatment. Earlier surgical studies have suggested that carefully selected patients with large deep hemorrhages may experience improved functional survival after evacuation, although benefits appear to depend on factors such as neurological status, hematoma volume, and location. [7] More recent evidence from minimally invasive evacuation studies has also reinforced the importance of achieving substantial hematoma reduction when surgical treatment is undertaken. [8] Despite advances in ICH management, evidence regarding the early clinical and radiological effects of decompressive craniectomy combined with hematoma evacuation for spontaneous supratentorial deep-seated ICH remains limited. Therefore, evaluating postoperative neurological recovery,

BDJOURNALS.ORG Copyright © 2026 The Planet. Published by Sher-E-Bangla Medical College, Barishal, Bangladesh. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

reduction in hematoma-related mass effect, and early radiological changes may provide clinically relevant information regarding this surgical approach. The present study was undertaken to assess the early clinical and radiological outcomes of decompressive craniectomy with hematoma evacuation for spontaneous supratentorial deep-seated intracerebral hemorrhage.

METHODS & MATERIALS

This prospective interventional observational study was conducted in the Department of Neurosurgery, Dhaka Medical College Hospital, Dhaka, Bangladesh, from October 2022 to March 2024. A total of 18 patients aged ≥30 years with spontaneous supratentorial deep-seated intracerebral hemorrhage (ICH) involving the ganglionic-thalamic region were enrolled by purposive sampling. Diagnosis was established clinically and confirmed by non-contrast computed tomography (CT) of the head within 72 hours of symptom onset. Patients with a Glasgow Coma Scale (GCS) score ≥5, hematoma volume ≥30 mL, and midline shift (MLS) ≥5 mm was included. Patients with lobar ICH, traumatic hemorrhage, hemorrhage secondary to structural lesions such as aneurysm, arteriovenous malformation, or brain tumor, bilaterally fixed and dilated pupils, or refusal to provide informed consent were excluded. All patients underwent decompressive craniectomy with hematoma evacuation, consisting of frontotemporoparietal decompressive craniectomy, durotomy, expansile duroplasty, and hematoma evacuation through a transcortical approach via a non-eloquent cortical area. Demographic, clinical, radiological, operative, and postoperative data were collected using a pretested semi-structured data collection form. Hematoma volume was calculated using the ABC/2 method [$\pi/6$ (A×B×C)], and MLS was measured on CT using the formula MLS = BPD/2 − SP. Postoperative non-contrast CT was performed on the third postoperative day to assess residual hematoma and changes in MLS. Clinical outcomes were evaluated within 30 days of surgery using the Glasgow Outcome Scale (GOS), with scores 1–2 categorized as poor outcome and scores 3–5 as functional survival. The primary outcomes were postoperative GCS, reduction in MLS, and 30-day mortality, while secondary outcomes included postoperative radiological findings and length of hospital stay. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Continuous variables were expressed as mean ± standard deviation (SD), and preoperative and postoperative measurements were compared using the paired-samples t-test. Categorical variables were presented as frequencies and percentages. Ethical approval was obtained from the Ethical Review Committee of Dhaka Medical College, Dhaka, Bangladesh, and written informed consent was obtained from all participants or their legal guardians before enrollment. The study was conducted in accordance with the principles of the Declaration of Helsinki 1964.

RESULTS

Table I shows the demographic characteristics of the study subjects. The mean age was 55.39 ± 11.55 years, with the largest proportions aged 41–50 years and 51–60 years**,** each comprising 6 (33.3%) patients, followed by >60 years, 5 (27.8%)**,** and 30–40 years, 1 (5.6%)**.** Male patients predominated, accounting for 14 (77.8%) of the study population, while females comprised 4 (22.2%)**.**

Table I
Demographic characteristics of the study subjects (*n* = 18).

Demographic variables	n (%)
Age (years)	
30–40	1 (5.6)
41–50	6 (33.3)
51–60	6 (33.3)
>60	5 (27.8)
Mean ± SD	55.39 ± 11.55
Sex	
Male	14 (77.8)
Female	4 (22.2)

Figure 1 describes the distribution of comorbidities among the study subjects. Hypertension was the most common comorbidity, present in 17 (94.4%) patients, followed by diabetes mellitus in 12 (66.7%), ischemic heart disease in 4 (22.2%), and chronic kidney disease in 1 (5.6%) patient.

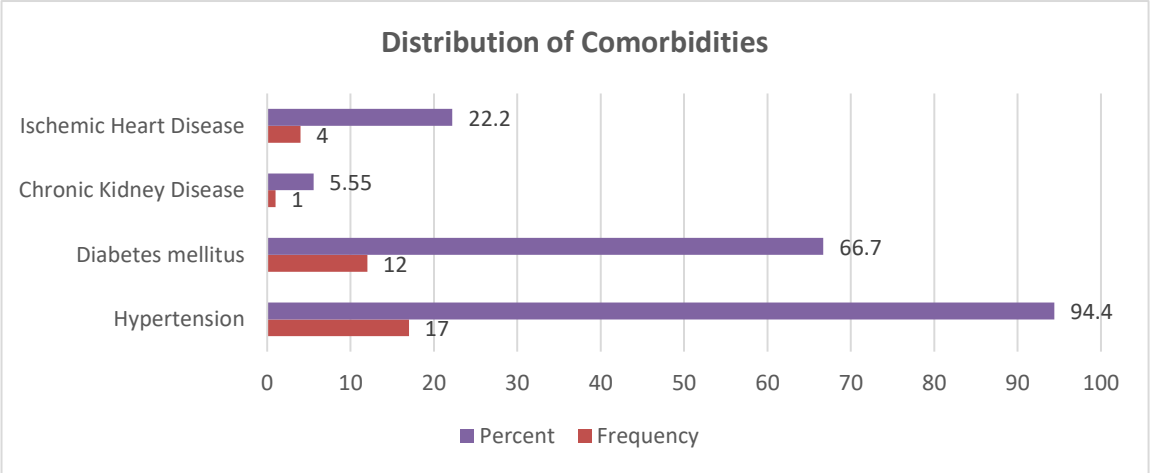


Figure 1 Distribution of comorbidities among the study subjects (*n*=18).

Table II performs the clinical and radiological characteristics of the study subjects. Right-sided hematoma was more common, occurring in 11 (61.1%) patients, while 7 (38.9%) had left-sided hematoma. Intraventricular hemorrhage was present in 9 (50.0%) patients. The mean ICH volume was 59.88 ± 20.21 cc, and the mean ICH total score was 2.50 ± 0.51. The mean preoperative GCS score was 8.61 ± 1.78.

Table II
Clinical and radiological characteristics of the study subjects (*n* = 18).

Clinical and radiological variables	n (%) / Mean ± SD
Side of hematoma	
Right	11 (61.1)
Left	7 (38.9)
Intraventricular hemorrhage	9 (50.0)
ICH volume (cc)	59.88 ± 20.21
ICH total score	2.50 ± 0.51
Preoperative GCS score	8.61 ± 1.78

Table III illustrates the preoperative and postoperative clinical and radiological outcomes following decompressive craniectomy with hematoma evacuation. The mean GCS score increased from 8.61 ± 1.78 preoperatively to 9.22 ± 2.77 postoperatively. The mean midline shift decreased from 10.12 ± 2.59 mm to 5.70 ± 1.93 mm, with a mean midline shift correction of 44.19 ± 9.28%. The mean length of hospital stay was 23.94 ± 4.72 days.

Table III
Preoperative and postoperative clinical and radiological outcomes following decompressive craniectomy with hematoma evacuation (*n* = 18).

Outcome variables	Mean ± SD
GCS score	
Preoperative	8.61 ± 1.78
Postoperative	9.22 ± 2.77
Midline shift (mm)	
Preoperative	10.12 ± 2.59
Postoperative	5.70 ± 1.93
Midline shift correction (%)	44.19 ± 9.28
Length of hospital stay (days)	23.94 ± 4.72

Table IV presents the functional outcomes of the study subjects. Functional survival was observed in 9 (50.0%) patients, while 9 (50.0%) had a poor outcome. Among those with poor outcomes, 8 (44.4%) patients died and 1 (5.6%) remained in a persistent vegetative state. Among patients with functional survival, 6 (33.3%) had moderate disability and 3 (16.7%) had severe disability.

Table IV
Functional outcome of the study subjects (*n* = 18).

Functional outcome	n (%)
Functional survival	9 (50.0)
Poor outcome	9 (50.0)
Components of poor outcome	
Death	8 (44.4)
Persistent vegetative state	1 (5.6)
Components of functional survival	
Severe disability	3 (16.7)
Moderate disability	6 (33.3)

Table V shows the mortality outcome following surgery. Eight (44.4%) patients died within the study follow-up period, while 10 (55.6%) patients survived.

Table V
Mortality outcome following surgery (*n* = 18).

Outcome variable	n (%)
Mortality	8 (44.4)
Survival	10 (55.6)

Mortality was defined as death occurring during the postoperative follow-up period.

DISCUSSION

The present study evaluated the clinical and radiological outcomes following decompressive craniectomy with hematoma evacuation in patients with spontaneous intracerebral hemorrhage. The study population had a mean age of 55.39 ± 11.55 years and was predominantly male (77.8%). This demographic pattern is consistent with the recognized epidemiological distribution of intracerebral hemorrhage, in which older age and male sex are commonly associated with a higher disease burden. The high prevalence of hypertension (94.4%) and diabetes mellitus (66.7%) in the present cohort also reflects the major vascular risk factors associated with spontaneous intracerebral hemorrhage. Current evidence emphasizes aggressive management of modifiable vascular risk factors, particularly hypertension, in reducing the incidence and recurrence of intracerebral hemorrhage [9]. The clinical severity of the present cohort was substantial, as indicated by a mean preoperative GCS score of 8.61 ± 1.78, mean hematoma volume of 59.88 ± 20.21 cc, and mean ICH score of 2.50 ± 0.51. Intraventricular hemorrhage was present in 50.0% of patients. These characteristics represent a population at considerable risk of neurological deterioration and death. Hematoma volume, reduced level of consciousness, intraventricular extension, and other components incorporated into established prognostic scores have been consistently associated with poor outcome after intracerebral hemorrhage [10]. The predominance of right-sided hematomas (61.1%) in this series is likely a sample-specific observation rather than a clinically meaningful difference. Following surgery, the mean GCS increased from 8.61 ± 1.78 to 9.22 ± 2.77, while mean midline shift decreased substantially from 10.12 ± 2.59 mm to 5.70 ± 1.93 mm, corresponding to a mean correction of 44.19 ± 9.28%. The radiological improvement suggests effective reduction of mass effect following hematoma evacuation and decompression. Reduction of intracranial pressure and mass effect is one of the principal physiological objectives of decompressive surgery in patients with severe intracerebral hemorrhage [11]. However, radiological improvement does not necessarily translate into equivalent functional recovery because the initial parenchymal injury and secondary neurological damage may remain substantial. The functional outcome in the present study showed functional survival in 50.0% of patients, whereas 50.0% had a poor outcome. Among the survivors, 33.3% had moderate disability and 16.7% had severe disability. Overall mortality was 44.4%, demonstrating the considerable severity of illness despite surgical intervention. These findings should be interpreted in the context of the poor baseline neurological status and relatively large hematoma volume of the study population. Previous systematic evidence has suggested that decompressive craniectomy may reduce mortality in selected patients with severe spontaneous intracerebral hemorrhage, although its effect on long-term functional independence remains uncertain [12]. The role of decompressive craniectomy in spontaneous intracerebral hemorrhage remains an area of ongoing investigation. Contemporary guidelines indicate that decompressive craniectomy may be considered in selected patients with large supratentorial hematomas, coma, significant midline shift, or refractory intracranial hypertension, while acknowledging uncertainty regarding functional benefit [13]. Importantly, evidence from systematic reviews has shown heterogeneity among studies with respect to patient selection, hematoma location, surgical technique, and outcome definitions, limiting direct comparison between individual series [14]. A recent randomized trial evaluating decompressive craniectomy in severe deep supratentorial intracerebral hemorrhage further highlights the importance of carefully selecting patients for this intervention [15]. The mean hospital stay of 23.94 ± 4.72 days in the present series reflects the substantial postoperative care requirements of these critically ill patients. Decompressive procedures can be associated with complications related to cerebral edema, cerebrospinal fluid disturbances, infection, seizures, and other postoperative events, which may influence recovery and length of hospitalization [16]. Nevertheless, the combination of a 50.0% functional survival rate and substantial postoperative reduction in midline shift indicates that decompressive craniectomy with hematoma evacuation can achieve meaningful survival with neurological recovery in a proportion of appropriately selected patients. The present findings therefore contribute to the growing clinical evidence regarding surgical management of severe spontaneous intracerebral hemorrhage, while emphasizing that treatment outcomes are strongly influenced by initial disease severity and patient selection [17–21].

CONCLUSION

Decompressive craniectomy with hematoma evacuation was followed by substantial radiological improvement, with a mean 44.19% correction of midline shift and modest improvement in GCS. Functional survival was observed in 50.0% of patients, while mortality was 44.4% during the postoperative follow-up period. These findings suggest that decompressive craniectomy with hematoma evacuation may be a feasible surgical option for carefully selected patients with severe intracerebral hemorrhage and significant mass effect.

LIMITATIONS

The study was limited by its small sample size of 18 patients and single-center design, which restrict the statistical power and generalizability of the findings. The absence of a non-surgical control group precluded direct comparison of outcomes with conservative or alternative treatment strategies. The relatively short postoperative follow-up may also have limited assessment of long-term functional recovery. Furthermore, potential differences in hematoma location, timing of surgery, postoperative care, and other clinical factors could have influenced outcomes.

RECOMMENDATIONS

Larger, prospective multicenter studies with appropriate comparison groups and standardized surgical and postoperative protocols are recommended to better evaluate the effectiveness of decompressive craniectomy with hematoma evacuation for severe spontaneous intracerebral hemorrhage. Future studies should incorporate longer-term functional outcomes and examine the influence of hematoma volume, intraventricular hemorrhage, neurological status, timing of surgery, and other prognostic factors to facilitate more appropriate patient selection and optimize surgical management.

REFERENCES

1. van Asch CJ, Luitse MJ, Rinkel GJ, van der Tweel I, Algra A, Klijn CJ. Incidence, case fatality, and functional outcome of intracerebral haemorrhage over time, according to age, sex, and ethnic origin: a systematic review and meta-analysis. Lancet Neurol. 2010;9(2):167-76.
2. Mendelow AD, Gregson BA, Fernandes HM, Murray GD, Teasdale GM, Hope DT, et al. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): a randomised trial. Lancet. 2005;365(9457):387-97.
3. Mendelow AD, Gregson BA, Rowan EN, Murray GD, Gholkar A, Mitchell PM; STICH II Investigators. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial lobar intracerebral haematomas (STICH II): a randomised trial. Lancet. 2013;382(9890):397-408.
4. Hanley DF, Thompson RE, Rosenblum M, Yenokyan G, Lane K, McBee N, et al. Efficacy and safety of minimally invasive surgery with thrombolysis in intracerebral haemorrhage evacuation (MISTIE III): a randomised, controlled, open-label, blinded endpoint phase 3 trial. Lancet. 2019;393(10175):1021-32.
5. Greenberg SM, Ziai WC, Cordonnier C, Dowlatshahi D, Francis B, Goldstein JN, et al. 2022 Guideline for the management of patients with spontaneous intracerebral

hemorrhage: a guideline from the American Heart Association/American Stroke Association. Stroke. 2022;53(7):e282-e361.
6. Beck J, Fung C, Strbian D, Bütikofer L, Z'Graggen WJ, Lang MF, et al. Decompressive craniectomy plus best medical treatment versus best medical treatment alone for spontaneous severe deep supratentorial intracerebral haemorrhage: a randomised controlled clinical trial. Lancet. 2024;403(10442):2395-404.
7. Pantazis G, Tsitsopoulos P, Mihas C, Katsiva V, Stavrianos V, Zymaris S. Early surgical treatment vs conservative management for spontaneous supratentorial intracerebral hematomas: a prospective randomized study. Surg Neurol. 2006;66(5):492-501.
8. Prasad K, Mendelow AD, Gregson B. Surgery for primary supratentorial intracerebral haemorrhage. Cochrane Database Syst Rev. 2008;(4):CD000200.
9. O'Donnell MJ, Chin SL, Rangarajan S, Xavier D, Liu L, Zhang H, et al. Global and regional effects of potentially modifiable risk factors associated with acute stroke in 32 countries (INTERSTROKE): a case-control study. Lancet. 2016;388(10046):761-775. doi:10.1016/S0140-6736(16)30506-2.
10. Hemphill JC 3rd, Bonovich DC, Besmertis L, Manley GT, Johnston SC. The ICH score: a simple, reliable grading scale for intracerebral hemorrhage. Stroke. 2001;32(4):891-897.
11. Mendelow AD, Gregson BA, Fernandes HM, Murray GD, Teasdale GM, Hope DT, et al. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): a randomised trial. Lancet. 2005;365(9457):387-397. doi:10.1016/S0140-6736(05)17826-X.
12. Yao Z, Ma L, You C, He M. Decompressive craniectomy for spontaneous intracerebral hemorrhage: a systematic review and meta-analysis. World Neurosurg. 2018;110:121-128.
13. Greenberg SM, Ziai WC, Cordonnier C, Dowlatshahi D, Francis B, Goldstein JN, et al. 2022 Guideline for the management of patients with spontaneous intracerebral hemorrhage: a guideline from the American Heart Association/American Stroke Association. Stroke. 2022;53(7):e282-e361.
14. Pedro KM, Chua AE, Lapitan MCM. Decompressive hemicraniectomy without clot evacuation in spontaneous intracranial hemorrhage: a systematic review. Clin Neurol Neurosurg. 2020;192:105730.
15. Beck J, Fung C, Stricker J, et al. Decompressive craniectomy plus best medical treatment versus best medical treatment alone for spontaneous severe deep supratentorial intracerebral haemorrhage: a randomised controlled clinical trial. Lancet. 2024;403(10442):2395-2404.
16. Kurland DB, Khaladj-Ghom A, Stokum JA, Carusillo B, Karimy JK, Gerzanich V, et al. Complications associated with decompressive craniectomy: a systematic review. Neurocrit Care. 2015;23(2):292-304.
17. Aly M, Abbas A, Serag I, Mousa AH, Alnaami IM, Elhammady MS, et al. Does adding decompressive craniectomy to hematoma evacuation improve the outcome for spontaneous supratentorial intracerebral hematoma? A GRADE-assessed systematic review and meta-analysis. Acta Neurochir (Wien). 2026;49(1):124.
18. Reis de Oliveira R, Silva YP, Ansari YZ, et al. Decompressive craniectomy versus best medical treatment alone for spontaneous intracerebral hemorrhage: a systematic review and meta-analysis. J Stroke. 2026;21(2):177-187.
19. da Costa RM, Filho UF, Barbosa KS, Oliveira AS. Decompressive craniectomy for spontaneous supratentorial intracerebral hemorrhage: a systematic review and meta-analysis. J Neurosurg Sci. 2026;70(1):56-65.
20. Lepine HL, Semione G, Povoa RG, Almeida GO, Abraham D, Figueiredo EG. Decompressive craniectomy with or without dural closure: systematic review and meta-analysis. Neurocrit Care. 2025;42(2):635-643.
21. Mendelow AD, Unterberg A. Surgical treatment of intracerebral haemorrhage. J Neurol Neurosurg Psychiatry. 2007;78(12):1271-1277.