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ORIGINAL ARTICLE

Observation of Both Early Clinical and Radiological Impacts on Deep-Seated Intracerebral Hemorrhage after Performing Decompressive Craniectomy with Durotomy

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ABSTRACT

Background: *Spontaneous deep-seated supratentorial ICH has high morbidity and mortality, while conventional evacuation may injure surrounding brain tissue. Decompressive craniectomy with durotomy and expansile duraplasty without planned hematoma evacuation may reduce mass effect with less brain injury. This study aimed to evaluate its early clinical and radiological outcomes.* ***Methods & Materials:*** *This prospective study included 18 patients with spontaneous ganglionic-thalamic ICH at Dhaka Medical College Hospital from October 2022 to March 2024. All underwent decompressive craniectomy with durotomy and expansile duraplasty without planned hematoma evacuation. Pre- and postoperative outcomes were assessed, with midline shift measured by CT on day 3 and 30-day function by GOS. GOS 3–5 indicated functional survival.* ***Results:*** *The mean age of the patients was 55.61 ± 13.50 years, and 11 (61.1%) were male. The mean hematoma volume was 53.55 ± 17.34 mL, while intraventricular hemorrhage was present in 10 (55.6%) patients. The mean GCS score increased from 8.50 ± 1.29 preoperatively to 10.05 ± 2.23 postoperatively. Mean midline shift decreased from 10.11 ± 2.64 mm to 7.06 ± 1.94 mm, corresponding to a mean correction of 29.64 ± 9.57%. Functional survival at 30 days was observed in 13 (72.2%) patients, including 6 (33.3%) with severe disability and 7 (38.9%) with moderate disability. Five (27.8%) patients died within 30 days. The mean hospital stay was 20.05 ± 5.27 days.* ***Conclusion:*** *Decompressive craniectomy with durotomy and expansile duraplasty without planned hematoma evacuation was associated with early improvement in GCS and reduction in midline shift among selected patients with spontaneous deep-seated supratentorial ICH. Functional survival at 30 days was observed in 72.2% of patients.*

Keywords: *Intracerebral hemorrhage; Decompressive craniectomy; Durotomy; Expansile duraplasty; Deep-seated hemorrhage; Midline shift; Glasgow Coma Scale; Functional survival.*

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INTRODUCTION

Spontaneous intracerebral hemorrhage (ICH) is a severe form of stroke associated with high early mortality and substantial neurological disability. Hematoma expansion, perihematomal edema, increased intracranial pressure, and secondary brain injury contribute to neurological deterioration, while outcome is influenced by hematoma size, location, intraventricular extension, and initial neurological status.[1] Deep-seated supratentorial ICH, particularly involving the basal ganglia and thalamic regions, is challenging because of its proximity to critical neural structures and the potential for significant mass effect. Management of spontaneous ICH includes rapid diagnosis, prevention of hematoma expansion, management of intracranial pressure, and treatment of complications. Non-contrast computed tomography (CT) is essential for assessing hematoma size, location, intraventricular extension, mass effect, and midline shift. Current guidelines emphasize early neurocritical care and individualized treatment, while the optimal role of surgery remains uncertain.[2] Early blood pressure control is also an important component of acute management to limit hematoma expansion and potentially improve outcomes.[3] The role of conventional hematoma evacuation remains controversial. The STICH trial did not demonstrate an overall functional benefit from early surgical evacuation compared with initial conservative treatment.[4] Similarly, STICH II did not show a significant improvement in the primary functional outcome with early surgery in selected patients with superficial lobar ICH.[5] These findings are particularly relevant to deep-seated hemorrhage, where direct surgical access may injure surrounding brain tissue. Decompressive craniectomy (DC) provides an alternative strategy aimed primarily at relieving intracranial pressure and mass effect without directly removing a deeply situated hematoma. Combined with durotomy and expansile duboplasty, DC may increase intracranial space and reduce cerebral displacement and midline shift while avoiding planned transgression of deep brain tissue. A systematic review and meta-analysis suggested that DC may reduce mortality in spontaneous ICH, although its functional benefit remains uncertain.[6] A systematic review of decompressive hemicraniectomy without clot evacuation also described its use in selected patients when direct hematoma evacuation may be hazardous.[7] The dural component may further influence the degree of decompression achieved, with evidence suggesting

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physiological differences between decompression with and without dural opening or duraplasty.[8]Minimally invasive approaches have also been investigated to reduce hematoma volume while limiting surgical injury. The MISTIE III trial demonstrated that minimally invasive catheter-based evacuation safely reduced clot volume but did not significantly improve the primary functional outcome.[9] More recently, the SWITCH trial evaluated DC in severe deep supratentorial ICH and highlighted the continuing uncertainty regarding its effects on survival and functional outcome.[10]Midline shift is an important indicator of intracranial mass effect, while changes in the Glasgow Coma Scale (GCS) provide an early measure of neurological response. However, data on early clinical and radiological outcomes following DC with durotomy without planned hematoma evacuation in spontaneous deep-seated ICH remain limited. Therefore, this study evaluated postoperative changes in GCS and midline shift, length of hospital stays, functional survival, and 30-day mortality following this surgical approach.

METHODS & MATERIALS

This prospective observational study was conducted in the Department of Neurosurgery, Dhaka Medical College Hospital, Dhaka, Bangladesh, from October 2022 to March 2024, to evaluate the early clinical and radiological outcomes of decompressive craniectomy with durotomy in patients with spontaneous supratentorial deep-seated intracerebral hemorrhage (ICH). A total of 18 patients aged ≥30 years were enrolled using purposive sampling. Patients with spontaneous deep-seated ICH involving the ganglionic-thalamic region, a Glasgow Coma Scale (GCS) score ≥5, hematoma volume ≥30 mL, and midline shift (MLS) ≥5 mm were included. Patients with lobar ICH, traumatic hemorrhage, hemorrhage secondary to structural lesions such as aneurysms, arteriovenous malformations, or brain tumors, bilaterally fixed and dilated pupils, or refusal to provide informed consent were excluded. All patients underwent frontotemporoparietal decompressive craniectomy with durotomy and expansile duroplasty, without surgical evacuation of the hematoma. Demographic, clinical, and radiological data were collected using a pretested semi-structured questionnaire. Baseline clinical parameters included age, sex, comorbidities, preoperative GCS score, and hematoma characteristics. Hematoma volume was estimated using the ABC/2 method, and MLS was measured on preoperative and postoperative non-contrast computed tomography (CT) scans of the head. Postoperative CT assessment was performed on the third postoperative day to evaluate changes in hematoma-related mass effect and MLS. Early clinical outcomes were assessed within 30 days of surgery using the Glasgow Outcome Scale (GOS), with GOS scores of 3–5 categorized as functional survival and scores of 1–2 categorized as poor outcomes. The primary outcome measures were postoperative clinical recovery, MLS correction, functional survival, and 30-day mortality. Length of hospital stay and postoperative GCS score were also recorded. Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 23.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Descriptive statistical methods were used to summarize the clinical and radiological findings. Written informed consent was obtained from all participants or their legal guardians, and ethical approval was obtained from the Ethical Review Committee of Dhaka Medical College, Dhaka, Bangladesh.

RESULTS

Table I shows the demographic characteristics of the study subjects. The mean age was 55.61 ± 13.50 years, with the largest proportion aged 51–60 years (6, 33.3%), followed by >60 years 5(27.8%), 41–50 years 4(22.2%), and 30–40 years 3(16.7%). Male patients predominated, accounting for 11(61.1%) of the study population, while females comprised 7(38.9%).

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

Demographic variables	n (%)
Age (years)	
30–40	3 (16.7)
41–50	4 (22.2)
51–60	6 (33.3)
>60	5 (27.8)
Mean ± SD	55.61 ± 13.50
Sex	
Male	11 (61.1)
Female	7 (38.9)

Table II describes the distribution of comorbidities among the study subjects. Hypertension was the most common comorbidity, present in 16(88.9%) patients, followed by diabetes mellitus in 10(55.6%). Chronic kidney disease and ischemic heart disease were each present in 2(11.1%) patients.

Table II: Distribution of comorbidities among the study subjects (*n* = 18)

Co-morbidities	n (%)
Hypertension	16 (88.9)
Diabetes mellitus	10 (55.6)
Chronic Kidney Disease	2 (11.1)
Ischemic Heart Disease	2 (11.1)

Table III performs the clinical characteristics of intracerebral hemorrhage among the study subjects. The hematoma was located on the left side in 12(66.7%) patients and on the right side in 6(33.3%). Intraventricular hemorrhage was present in 10(55.6%) patients. The mean ICH volume was 53.55 ± 17.34 cc, and the mean ICH total score was 2.56 ± 0.51.

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Table III: Clinical characteristics of intracerebral hemorrhage (*n* = 18)

Clinical variables	n (%) / Mean ± SD
Side of hematoma	
Right	6 (33.3)
Left	12 (66.7)
Intraventricular hemorrhage	10 (55.6)
ICH volume (cc)	53.55 ± 17.34
ICH total score	2.56 ± 0.51

Table IV denotes the preoperative and postoperative clinical parameters of the study subjects. The mean GCS score increased from 8.50 ± 1.29 preoperatively to 10.05 ± 2.23 postoperatively. The mean length of hospital stay was 20.05 ± 5.27 days.

Table IV: Preoperative and postoperative clinical parameters (*n* = 18)

Clinical parameters	Mean ± SD
Preoperative GCS score	8.50 ± 1.29
Postoperative GCS score	10.05 ± 2.23
Length of hospital stay (days)	20.05 ± 5.27

Table V narrates the radiological outcomes following decompressive craniectomy with durotomy. The mean midline shift decreased from 10.11 ± 2.64 mm preoperatively to 7.06 ± 1.94 mm postoperatively, with a mean midline shift correction of 29.64 ± 9.57%.

Table V: Radiological outcomes following decompressive craniectomy with durotomy (*n* = 18)

Radiological outcome variables	Mean ± SD
Preoperative midline shift (mm)	10.11 ± 2.64
Postoperative midline shift (mm)	7.06 ± 1.94
Midline shift correction (%)	29.64 ± 9.57

Table VI displays the early clinical outcomes following decompressive craniectomy with durotomy. Functional survival was observed in 13(72.2%) patients, while 5(27.8%) had poor outcomes, all of whom died. Among the functional survivors, 6(33.3%) had severe disability and 7(38.9%) had moderate disability. No patient remained in a persistent vegetative state, and 30-day mortality was 5(27.8%).

Table VI: Early clinical outcomes following decompressive craniectomy with durotomy (*n* = 18)

Outcome variables	n (%)
Overall outcome	
Functional survival	13 (72.2)
Poor outcome	5 (27.8)
Poor outcome	
Death	5 (27.8)
Persistent vegetative state	0 (0.0)
Functional survival	
Severe disability	6 (33.3)
Moderate disability	7 (38.9)
Mortality	
Mortality within 30 days	5 (27.8)

DISCUSSION

The present study evaluated early clinical and radiological outcomes following decompressive craniectomy (DC) with durotomy and expansile duraplasty without planned hematoma evacuation in patients with spontaneous deep-seated supratentorial intracerebral hemorrhage (ICH). The mean age was 55.61 ± 13.50 years, with males comprising 11(61.1%) patients. Hypertension and diabetes mellitus were the most frequent comorbidities, present in 16(88.9%) and 10(55.6%) patients, respectively, consistent with established vascular risk factors for spontaneous ICH.[11] The cohort had substantial disease severity, with a mean hematoma volume of 53.55 ± 17.34 cc, intraventricular hemorrhage in 10(55.6%) patients, mean ICH score of 2.56 ± 0.51, and preoperative GCS of 8.50 ± 1.29. The mean postoperative GCS increased to 10.05 ± 2.23, indicating early neurological improvement. Previous evidence suggests that DC may reduce mortality in selected patients with spontaneous ICH, although its effect on functional outcome remains uncertain. [12,13] A notable finding was the reduction in mass effect, with mean midline shift decreasing from 10.11 ± 2.64 mm preoperatively to 7.06 ± 1.94 mm postoperatively, representing 29.64 ± 9.57% correction. This supports the physiological rationale of decompression, particularly for deep-seated hematomas where direct clot evacuation may risk additional injury to surrounding eloquent brain tissue.[14] The decision to avoid planned hematoma evacuation is also consistent with the absence of a clear overall functional benefit from early conventional surgery in the STICH trial.[15] At 30 days, 13(72.2%) patients achieved functional survival, while 5(27.8%) died. Among survivors, 7(38.9%) had moderate disability and 6(33.3%) had severe disability, indicating that survival was not necessarily accompanied by

functional independence. Recent randomized evidence from the SWITCH trial similarly reflects ongoing uncertainty regarding the clinical benefit of DC in severe deep supratentorial ICH.[16] Durotomy with expansile duraplasty may enhance decompression by permitting greater intracranial volume expansion; however, current evidence has not established a definitive difference in mortality or neurological outcome according to dural management.[17] The mean hospital stay was 20.05 ± 5.27 days, reflecting the substantial clinical needs of this population. Current guidelines therefore emphasize individualized management according to neurological status, hematoma characteristics, mass effect, and overall clinical condition.[18] Similarly, MISTIE III demonstrated that minimally invasive hematoma reduction can be achieved safely but does not necessarily translate into improved functional outcome.[19]The 30-day mortality of 27.8% occurred in a cohort with large hematomas, frequent intraventricular extension, substantial midline shift, and low initial GCS, all recognized determinants of ICH outcome.[20] Recent randomized and meta-analytic evidence continues to indicate uncertainty regarding the role of DC in severe deep ICH, while supporting continued evaluation of decompressive strategies in appropriately selected patients.[21,22] The reduction in midline shift observed in this study suggests that decompression achieved its intended effect on intracranial mass effect. The concomitant improvement in GCS further indicates a favorable early neurological response in some patients. However, the persistence of severe disability among survivors emphasizes that radiological decompression alone may not fully reverse the consequences of primary deep-brain injury. Thus, decompression may have a role as part of a broader individualized management strategy for selected patients with severe deep-seated ICH.Overall, DC with durotomy and expansile duraplasty without planned hematoma evacuation was associated with early reduction in mass effect and neurological improvement in this selected cohort. The combination of functional survival and persistent disability underscores the distinction between survival and functional recovery and supports further evaluation of this surgical strategy in deep-seated spontaneous ICH.

CONCLUSION

Decompressive craniectomy with durotomy and expansile duraplasty without planned hematoma evacuation was associated with early reduction in midline shift and improvement in GCS among selected patients with spontaneous deep-seated supratentorial ICH, with 72.2% achieving functional survival at 30 days.

LIMITATIONS

This study was conducted at a single center with a small sample size of 18 patients, purposive sampling, no control group, and short-term follow-up, limiting the generalizability of the findings and preventing definitive assessment of treatment effectiveness.

RECOMMENDATIONS

Larger multicenter prospective comparative studies with standardized patient selection, longer follow-up, and validated functional outcome measures are recommended to determine the clinical effectiveness, appropriate patient selection, and longer-term outcomes of decompressive craniectomy with durotomy and expansile duraplasty without hematoma evacuation in deep-seated spontaneous ICH.

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