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Original Research Article

Management of Intracerebral Hemorrhage in Hypertensive Patients: Comparison of Conservative and Surgical Intervention Outcomes at a Tertiary Centre in Eastern India

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Abstract

Background/Objective: Hypertensive intracerebral hemorrhage (ICH) is associated with substantial mortality and long-term disability. The decision between conservative medical management and surgical evacuation remains challenging in routine clinical practice. This study compared clinical outcomes of surgical versus conservative treatment in patients with hypertensive supratentorial ICH at a tertiary care center.

Methods: A prospective observational cohort study was conducted at Rajendra Institute of Medical Sciences, Ranchi, from April 2023 to March 2025. A total of 402 consecutive adults with CT-confirmed hypertensive supratentorial ICH were included; 142 underwent early surgical evacuation and 260 received conservative management. Clinical data, radiological characteristics, complications, and 90-day outcomes were recorded. Primary outcome was 90-day mortality; secondary outcome was functional status assessed by modified Rankin Scale (mRS).

Results: At 90 days, mortality was 38.0% in the surgical group and 45.4% in the conservative group. Surgical management was associated with lower adjusted risk of mortality (adjusted RR 0.78; 95% CI 0.63–0.96). Poor functional outcome (mRS 4–6) occurred in 62.0% of surgical patients and 68.8% of conservative patients (adjusted RR 0.89; 95% CI 0.80–0.99). Postoperative pneumonia and rebleeding were more frequent among surgical patients.

Conclusion: Early surgical evacuation improved survival and modestly enhanced functional outcomes in selected patients with hypertensive supratentorial ICH. Optimal patient selection based on hematoma characteristics and neurological status is essential to balance benefits and risks.

Keywords: Intracerebral Hemorrhage, Hypertension, Surgical Evacuation, Conservative Management, Functional Outcome.

Introduction

Intracerebral hemorrhage (ICH) remains one of the most disabling forms of stroke and carries a high risk of early mortality. In India, the burden is particularly prominent due to the widespread prevalence of chronic and often uncontrolled hypertension [1]. Persistent elevation of blood pressure leads to degenerative changes in the small penetrating arteries, making them prone to rupture and hemorrhage into the brain parenchyma. The resulting hematoma causes sudden neurological deterioration through direct tissue disruption and rising intracranial pressure [2, 3]. Despite improvements in emergency care and neuroimaging, outcomes for hypertensive ICH continue to be poor, especially when diagnosis or definitive management is delayed. Management of hypertensive ICH generally follows one of two approaches: conservative medical treatment or

surgical evacuation of the hematoma. Medical treatment focuses on stabilization—lowering blood pressure to safe targets, preventing hematoma enlargement, controlling intracranial pressure, and addressing respiratory and metabolic complications [4]. This approach is indispensable and forms the basis of care for all patients.

However, when a large hematoma exerts substantial mass effect or when neurological function declines, medical therapy alone may not be sufficient to prevent secondary brain injury [5, 6]. In such circumstances, surgery is considered with the aim of reducing intracranial pressure, relieving compression, and improving cerebral perfusion.

The role of surgery, however, is not uniform across all cases. Outcomes depend strongly on hematoma location, volume, depth from the cortical surface, and the level of consciousness at presentation [7]. Deep hemorrhages involving the basal ganglia or thalamus are difficult to evacuate safely and may not yield functional benefit.

In contrast, lobar hematomas situated close to the cortical surface are more accessible and more likely to benefit from timely removal, particularly in patients showing signs of mass effect but who are not deeply comatose [8, 9]. Therefore, the challenge in clinical practice lies not in choosing between surgery and conservative care in general, but in identifying which patients are most likely to benefit from surgical intervention.

Rajendra Institute of Medical Sciences (RIMS), Ranchi, serves as a major referral center for Jharkhand and neighboring regions, managing a large number of hypertensive ICH cases. Many patients present with inadequate prior blood pressure control and limited awareness of stroke symptoms, making clinical decisions complex. While international guidelines highlight the importance of individualized assessment, there is limited outcome data from Eastern India to guide such decisions in routine practice.

This study was undertaken to compare the outcomes of patients managed surgically and conservatively at our center, and to identify the clinical and radiological features associated with better results following surgical evacuation. The findings are intended to support more informed and context-appropriate decision-making in the management of hypertensive ICH.

Materials and Methods

Study Design and Setting: A prospective observational cohort study was conducted at the Departments of Neurology and Neurosurgery, RIMS Ranchi, from April 2023 to March 2025.

Inclusion Criteria

- Age ≥18 years
- Spontaneous supratentorial ICH confirmed on NCCT head
- Known history of hypertension or current antihypertensive therapy
- Presentation within 24 hours of symptom onset

Exclusion Criteria

- Infratentorial hemorrhage
- Secondary ICH due to aneurysm, AV malformation, venous infarct, tumor, trauma
- Pre-stroke mRS (Modified Rankin Scale) ≥4
- Pregnancy

Management Protocols

Surgical Group: Craniotomy with hematoma evacuation ± decompressive hemicraniectomy performed within 48 hours based on neurological deterioration, mass effect, midline shift, or superficial lobar hematoma.

Conservative Group: Blood pressure control, osmotherapy, neurocritical monitoring, seizure prophylaxis, ventilatory care where required.

Outcome Measures

Primary outcome: 90-day mortality, defined as death from any cause within 90 days of the index hospitalization; vital status was confirmed through hospital records and telephonic follow-up.

Secondary outcomes: Functional outcome at 90 days (mRS), hospital stay duration, in-hospital complications.

Results

Patient Enrollment and Baseline Profile: A total of 402 hypertensive supratentorial ICH patients were included in the analysis between April 2023 and March 2025. Of these, 142 patients (35.3%) underwent early surgical evacuation, while 260 patients (64.7%) received conservative medical management. The mean age of the study population was 58.3 ± 10.1 years, and 32% were female. The median GCS at presentation was 11 (IQR 9–14). The median hematoma volume was 32 mL (IQR 22–46 mL), with 44% located in lobar regions and 56% in deep ganglionic locations. Patients selected for surgery more often had lobar hematomas and evidence of mass effect, whereas conservative management was more common in patients with deep hemorrhages.

Primary and Secondary Outcomes: At 90 days, mortality was 38.0% in the surgical group and 45.4% in the conservative group. After adjusting for age, GCS, hematoma volume, location, and intraventricular extension, surgical treatment demonstrated a lower risk of death (adjusted RR 0.78, 95% CI 0.63–0.96). Poor functional outcome

(mRS 4–6) occurred in 62.0% of surgically treated patients compared to 68.8% in the conservatively managed group (adjusted RR 0.89, 95% CI 0.80–0.99). Surgical patients, however, experienced a slightly higher rate of complications, including pneumonia and postoperative rebleeding.

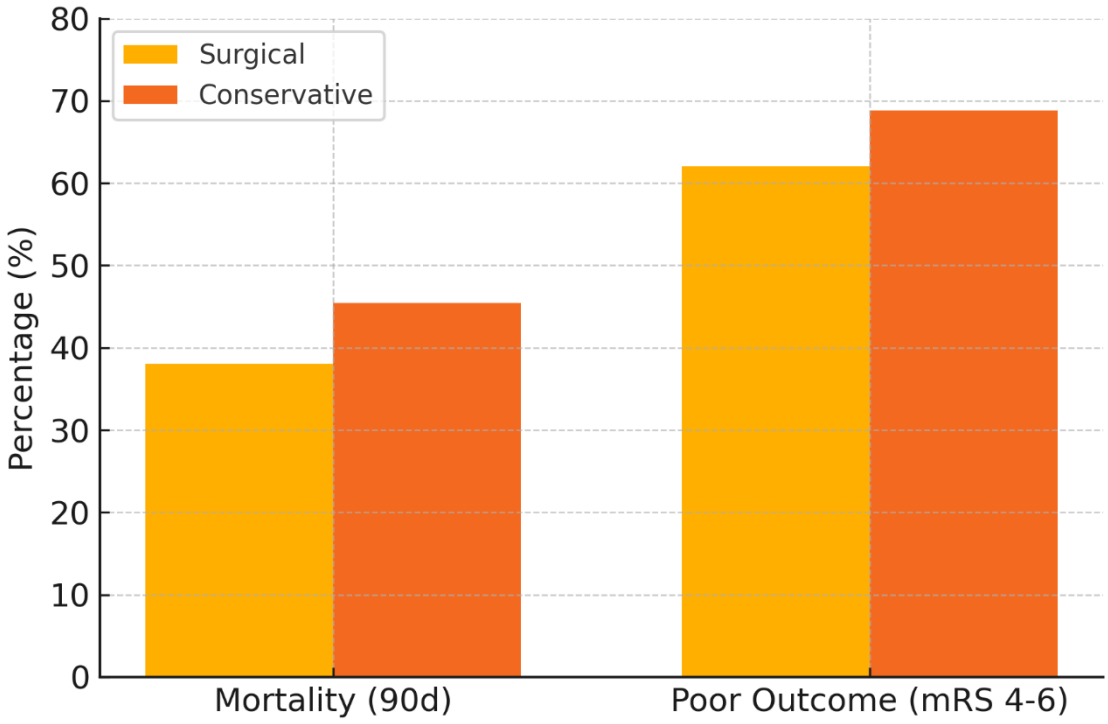

Figure 1: 90-Day Mortality and Functional Outcome Comparison

Table 1: Clinical Characteristics and 90-Day Outcomes

Variable	Surgical Group (n=142)	Conservative Group (n=260)
Mean Age (years)	56.9 ± 9.4	59.0 ± 10.4
Female (%)	30.3%	33.1%
Median GCS at Admission	11 (IQR 9–13)	12 (IQR 9–14)
Median Hematoma Volume (mL)	35 (IQR 26–48)	30 (IQR 21–43)
Lobar Location (%)	58.5%	36.2%
Intraventricular Extension (%)	23.2%	30.4%
90-Day Mortality (%)	38.0%	45.4%
Poor Functional Outcome, mRS 4–6 (%)	62.0%	68.8%
Pneumonia (%)	18.3%	13.8%
Rebleeding (%)	4.9%	0.8%
Median Hospital Stay (days)	12 (IQR 8–16)	10 (IQR 7–14)

Discussion

The findings of this study indicate that early surgical evacuation, when applied in selected cases of hypertensive supratentorial intracerebral hemorrhage, is associated with improved survival at 90 days compared with conservative medical management. The difference in mortality observed between the two groups remained significant even after adjusting for initial neurological status and hematoma volume, suggesting that the benefit of surgery in these patients is not simply a reflection of baseline clinical severity. The improvement in survival highlights the role of timely mechanical relief of intracranial pressure and restoration of anatomical space, but the results must still be interpreted within the context of careful patient selection. An important aspect of the outcome differentiation between the two treatment groups in this study relates to the structural characteristics of the hemorrhage.

Patients who underwent surgery more often had lobar hematomas located nearer to the cortical surface [10]. These hematomas are comparatively more amenable to evacuation without risking extensive surgical disruption of surrounding tissue. In such situations, surgical access is technically feasible, and decompression may prevent further local and regional tissue compromise [11, 12]. The

more favorable outcomes associated with these cases strengthen the clinical relevance of using hematoma location and depth as principal criteria in the surgical decision-making process.

The degree of neurological impairment at presentation also had a clear association with treatment benefit. Patients with moderate impairment (GCS 9–12) demonstrated the greatest relative improvement with surgical management, whereas those presenting with deeply depressed consciousness did not show comparable benefit [13]. This suggests that when the neurological injury is not yet irreversible, removal of the hematoma may provide an opportunity for recovery. On the other hand, when profound neurological decline exists at the time of hospital arrival, surgical intervention may not significantly alter the clinical trajectory [14]. These observations support a clinical threshold approach rather than universal operative intervention.

Functional outcomes, as reflected by modified Rankin Scale scores at 90 days, demonstrated a modest but meaningful improvement in the surgical group. While some degree of disability was still common among survivors, the proportion with severe functional dependence was lower among those receiving operative treatment [15]. This finding reinforces that survival benefit was not achieved at the cost of substantially worsened neurological outcomes. Importantly, it underscores that the goal of surgery in ICH should extend beyond preventing mortality to also preserving daily functional capacity wherever feasible [16].

The study also observed a higher frequency of postoperative complications in the surgical cohort, particularly pneumonia and rebleeding. These events are recognized risks associated with neurosurgical interventions, prolonged immobilization, and ventilatory support [17]. Their occurrence underlines the need for stringent perioperative monitoring protocols and early rehabilitation involvement. Yet, the overall complication rates in this study did not negate the survival and functional advantages of surgery. Rather, these findings emphasize that centers offering surgical management for ICH must maintain coordinated critical care pathways to mitigate these risks [18].

From a system-level perspective, the results of this study highlight the importance of timely triage and structured surgical evaluation in patients with ICH. Many patients in our region present without prior optimization of blood pressure and often reach tertiary care centers only after significant clinical delay. The outcomes observed in this study suggest that improved pre-hospital recognition and faster transfer to neurosurgical facilities may meaningfully increase the number of patients eligible for beneficial surgery. Strengthening referral linkages and emergency evaluation frameworks is therefore essential to achieving sustained improvements in ICH outcomes.

This study has limitations. Treatment allocation was based on clinical judgment rather than randomization, introducing the possibility of selection bias despite adjustment. Functional assessment at follow-up included telephonic evaluation in some cases, which may influence accuracy of mRS scoring.

Additionally, the data represent the experience of a single tertiary center, and external validity may vary depending on surgical expertise, ICU availability, and rehabilitation facilities in other settings. Nevertheless, the strengths of the study include a consecutive patient cohort, prospective data capture, and analysis reflective of real-world decision-making rather than trial-restricted criteria. The findings support a selective surgical approach, applied according to hematoma accessibility and neurological reserve, as a rational strategy in the management of hypertensive supratentorial ICH.

Conclusion

Early surgical evacuation in selected hypertensive ICH patients resulted in lower mortality and improved functional outcomes compared to conservative management, with acceptable complication rates. Integration of clinical judgement with radiological markers remains essential for optimizing outcomes.

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