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Original Research Article

EVALUATION OF OUTCOME IN PATIENTS OF HYPERTENSIVE BLEED AT A TERTIARY CENTRE, UTTARAKHAND

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ABSTRACT

Background: Spontaneous hypertensive intracerebral hemorrhage (ICH) remains a devastating neurological emergency associated with high morbidity and mortality worldwide. In the mountainous terrain of Uttarakhand, socioeconomic and geographical barriers often compound delays in definitive neurosurgical care. This study evaluates the clinical profiles, radiological characteristics, and structural treatment outcomes of patients presenting with hypertensive brain bleeds at a regional tertiary care referral center.

Materials and Methods: A hospital-based observational study was conducted among 210 consecutive patients diagnosed with hypertensive ICH admitted to the Department of Neurosurgery at a tertiary center in Uttarakhand over a 5-year duration (2020-2025). Demographics, clinical presentations, Glasgow Coma Scale (GCS) scores at admission, hematoma volumes, anatomical sites, and management strategies (conservative vs. surgical intervention) were systematically recorded. Primary outcomes were measured using the modified Rankin Scale (mRS) at 3-month follow-up, alongside an analysis of in-hospital mortality.

Results: The cohort demonstrated a clear male predominance (64.3%, n = 135) with a mean age of 59.4 +/-11.2 years. The baseline site analysis revealed that the basal ganglia was the most frequent site of hemorrhage (47.6%, n = 100), followed by thalamic (21.9%, n = 46), lobar (16.2%, n = 34), and infratentorial regions (14.3%, n = 30). Intraventricular hemorrhage (IVH) extension was documented in 35.7% (n = 75) of cases. Surgical evacuation via craniotomy or decompressive craniectomy was executed in 38.1% (n = 80) of patients, while 61.9% (n = 130) were managed conservatively. At 3 months, functional independence (mRS 1-2) was attained by 31.4% (n = 66) of survivors. The overall in-hospital mortality rate was 24.3% (n = 51). Multivariate regression established that a low baseline GCS score (<8), large hematoma volume (> 30cm^3), and the presence of IVH were powerful, independent predictors of unfavorable functional outcomes and mortality (p< 0.001).

Conclusion: Hypertensive bleeds carry a substantial burden of mortality and long-term disability in the Uttarakhand region. Early clinical risk-stratification using the admission GCS score and hematoma volume is critical to optimizing triage between aggressive neurosurgical evacuation and specialized intensive care management.

Keywords: Intracerebral hemorrhage (ICH), hypertensive Bleed, Outcome, tertiary care centre, Neurosurgery.

INTRODUCTION

Spontaneous intracerebral hemorrhage (ICH) accounts for approximately 10% to 30% of all acute stroke hospital admissions globally, yet it carries a disproportionately high share of stroke-related mortality and long-term severe disability.[1,2] Among non-traumatic etiologies, chronic uncontrolled systemic hypertension remains the premier modifiable risk factor, directly driving the mechanical rupture of small, penetrating parenchymal arteries structurally weakened by lipohyalinosis and Charcot-Bouchard microaneurysms.[3]

Despite substantial contemporary strides in neurocritical monitoring, neuroanesthesia, and minimally invasive neurosurgical techniques, the overarching prognosis for hypertensive brain bleeds remains poor. Global literature indicates 30-day case fatality rates oscillating between 30% and 50%, with only a distinct minority of survivors reclaiming full functional independence at 1 year.[2,4]

The state of Uttarakhand presents a unique set of geographic challenges, characterized by difficult mountainous terrains, remote rural settlements, and a centralized distribution of advanced healthcare facilities. Consequently, a vast majority of patients sustaining an acute intracranial catastrophe encounter prolonged transit timelines before arriving at a dedicated tertiary care neurosurgical unit. Delayed presentation frequently intersects with unchecked hematoma expansion, secondary peri-lesional edema, and progressive mass effect—severely undermining clinical outcomes.

While multiple stroke registries exist across urban India, there remains a paucity of localized, methodologically sound neurosurgical data detailing the precise prognostic determinants of hypertensive parenchymal bleeds within the unique demographic territories of Uttarakhand. This study was structured to evaluate the clinical profiles, radiological indices, and 3-month functional outcomes of a cohort of hypertensive ICH admitted to the department of Neurosurgery at a tertiary center in Uttarakhand over a 5-year duration (2020–2025) seeking to illuminate key predictors of survival and recovery.

MATERIALS AND METHODS

Study Design and Setting

This study was designed as a hospital-based observational study. Data collection was done within the Department of Neurosurgery at a tertiary care teaching hospital and referral centre located in Uttarakhand, India. The study period a fixed 5-year operational period encompassing patients admitted between January 2020 and December 2025.

Study Population

A total of 210 patients diagnosed case of hypertensive ICH confirmed by initial non-contrast computed tomography (NCCT) of the head were included in study.

Inclusion Criteria

- **Age:** 18years and above, Gender: male and female both
- Spontaneous, non-traumatic intracerebral hemorrhage confirmed on initial non-contrast computed tomography (NCCT) of the head.
- Documented clinical history of systemic hypertension or documented blood pressure more than 140/90 {mmHg} at the time of emergency admission.

Exclusion Criteria

- Intracranial hemorrhage secondary to craniospinal trauma.
- Hemorrhagic transformation of a primary ischemic cerebral infarction.
- Underlying structural lesions including ruptured intracranial aneurysms, arteriovenous malformations (AVMs), dural arteriovenous fistulas, or primary/metastatic brain tumors.
- Pre-existing severe hematological coagulopathies or bleeding disorders.

Methodology

In this observational study data were collected from hospital medical records, operative registers, discharge summaries, and imaging archives. The patient details, presenting clinical profile, clinical history and other findings were recorded.

Demographics and Clinical Parameters: Age, sex, history of hypertension/comorbidities, duration of symptoms prior to emergency arrival, systolic and diastolic blood pressure at admission, and baseline neurological status quantified via the Glasgow Coma Scale (GCS).

Radiological Parameters: All subjects underwent baseline cranial NCCT scans. Key variables evaluated by senior neuroradiologists and neurosurgeons included the primary anatomical site of hemorrhage (basal ganglia, thalamus, lobar, or infratentorial [cerebellum/brainstem], presence of intraventricular hemorrhage (IVH) extension, midline shift (measured in millimeters), and total hematoma volume.

Hematoma volume was computed using the validated, standard linear formula:

{Volume} = {AX B X C}/{2}

where A represents the maximum longitudinal diameter on the slice with the largest hemorrhage area, B is the maximum transverse diameter perpendicular to A on the same slice, and C represents the total number of slices multiplied by the slice thickness in centimeters.

Therapeutic Interventions

Management pathways were classified into:

Conservative Management

Intensive medical blood pressure control, antiepileptic prophylaxis, anti-edema measures (osmotic therapy using mannitol or hypertonic saline), and mechanical ventilation when clinically indicated.

Surgical Intervention

Tailored surgical maneuvers including emergency craniotomy or decompressive craniectomy for clot evacuation, and/or placement of an external ventricular drain (EVD) in cases complicated by acute hydrocephalus.

Outcome Assessment

The primary endpoints analyzed were in-hospital mortality and functional status at 3 months post-ictus. Functional outcome was quantified during out-patient review or structured telephonic interviews utilizing the modified Rankin Scale (mRS). Outcomes were bifurcated into:

Favorable Outcome

mRS scores of 0, 1, or 2 (ranging from no residual symptoms to slight disability with preserved functional independence).

Unfavorable Outcome:

mRS scores of 3 to 6 (moderate-to-severe disability, bedridden states, or death).

Statistical Analysis

Statistical processing was completed using using Epi Info 7.1.1. version. Continuous variables were expressed as mean ± standard deviation or median with interquartile range. Categorical variables were expressed as frequencies and percentages. Associations between categorical variables were assessed using chi-square test or Fisher's exact test. Continuous variables were compared using Student's t-test or Mann-Whitney U test as appropriate. Variables significant on univariate analysis were entered into multivariate logistic regression to identify independent predictors of poor outcome. A p-value < 0.05 was considered statistically significant.

RESULTS

Demographic and Clinical Characteristics

Of the 210 patients, 135(64.3%) were males and 75(35.7%) were females, with a male:female ratio of 1.8:1. The mean age was [59.4±11.2] years, with the majority of patients belonging to the [60-69/70-79] years age group and mean Systolic Blood pressure was 184.5± 22.1 mmHg.

Table 1: Demographic and clinical profile of study cases

Variables	Value (N=210)	Percentage (%)
Age (Years)		
Mean/SD	59.4/11.2	—
Range	32 - 84	—
Sex		
Male	135	64.3%
Female	75	35.7%
Admission GCS Score		
Mild (13–15)	48	22.9%
Moderate (9–12)	86	41.0%
Severe (<8)	76	36.2%
Mean Admission Systolic BP	184.5/ 22.1{ mmHg}	—

Radiographic Profile

The anatomical distribution and morphological layout of the parenchymal clots are detailed in the following analysis:

Basal Ganglia: 47.6% (n = 100)

Thalamus: 21.9% (n = 46)

Lobar Cortex: 16.2% (n = 34)

Infratentorial (Cerebellum/Brainstem): 14.3% (n = 30)

The calculated median hematoma volume at initial presentation stood at 28.5 cm^3 (IQR: 12.0 - 46.5 cm^3). Concomitant intraventricular hemorrhage (IVH) extension was tracked in 35.7% (n = 75) of the study population. Midline shift exceeding 5 mm was seen in 28.6% (n = 60) of cases.

Table 2: Radiological characteristics of study cases

Variables	Frequency (n=210)	Percent (%)
Basal Ganglia	100	47.6%
Thalamus	46	21.9%
Lobar Cortex	34	16.2%
Infratentorial (Cerebellum/Brainstem)	30	14.3%
Concomitant intraventricular hemorrhage (IVH)	75	37.5%
Midline shift exceeding 5 cm	60	28.6%

Treatment Distribution

Neurosurgical clot evacuation was performed on 38.1% (n = 80) of the cohort. Out of these 80 surgical cases, 18 patients required concurrent or isolated EVD placement for acute obstructive hydrocephalus secondary to ventricular clotting. The remaining 61.9% (n = 130) of patients were managed under a standardized neuro-intensive medical protocol.

Clinical and Functional Outcomes

The cumulative in-hospital mortality rate for the entire sample was 24.3% (n = 51). At the conclusion of the 3-month observational milestone, 31.4% (n= 66) achieved a favorable functional recovery (mRS: l-2). Conversely, 44.3% (n= 93) exhibited moderate-to-severe neurological disabilities (mRS: 3–5), and

cumulative mortality (including post-discharge attrition) adjusted to 24.3% at the final analysis.

Predictors of Unfavorable Outcome

Univariate and multivariate analysis confirmed three distinct clinical parameters that correlate strongly with poor functional outcomes and overall mortality:

Low Admission GCS (<8): Patients presenting in a comatose or semi-comatose state experienced an unfavorable outcome rate of 82.9% compared to only 18.8% in those presenting with mild neurological deficits ($p < 0.001$).

Hematoma Volume >30 cm^3: Large initial mass volume was strongly tied to progressive brain herniation and death ($p < 0.001$).

Presence of IVH: Ventricular blood extension significantly elevated the hazard ratio for poor outcomes due to secondary hydrocephalus and intrinsic brainstem compression ($p= 0.002$).

DISCUSSION

This retrospective review of 210 cases highlights the profound clinical burden that spontaneous hypertensive brain bleeds impose on the neurosurgical infrastructure of Uttarakhand. The observed demographic patterns—notably a mean age of 59.4 years and a strong male predominance (64.3%)—align closely with larger, established Indian and South Asian cohorts, reflecting a vulnerability among working-age, middle-aged males.[1,3]

The structural distribution of the hematomas traced in our study reaffirms the traditional pathophysiology of hypertensive vascular disease. The basal ganglia (47.6%) and thalamus (21.9%) represented the major sites of damage, mirroring global trends where deep subcortical grey matter structures bear the brunt of elevated hydrostatic pressures transmitted through the lenticulostriate and thalamoperforating vessels.[4]

Our observed in-hospital mortality rate of 24.3% falls within the expected global boundaries of 30-day ICH mortality.[2] However, the finding that only 31.4% of patients recovered to a state of functional independence at 3 months underlines the severe, lasting disability caused by primary parenchymal destruction and secondary ischemic cascades. The multivariate analysis highlights that a baseline GCS score < 8 and an initial hematoma volume exceeding >30cm3 serve as the most dependable predictors of poor prognosis and survival.

The optimal management of hypertensive ICH—specifically regarding surgical evacuation versus conservative care—remains a subject of intense debate in global neurosurgery. The landmark International Surgical Trial in Intracerebral Haemorrhage (STICH) and STICH II trials demonstrated no significant overall survival or functional benefit for early open surgery compared to initial conservative medical management for supratentorial hematomas. However, these trials primarily featured stabilized patients and excluded those with severe neurological deficits or deep-seated clots with significant mass effect.[5,6]

This surgical limitation has driven a global shift toward ultra-early, minimally invasive surgery (MIS), as explored in the Minimally Invasive Surgery Plus Rt-PA for Intracerebral Hemorrhage Evacuation (MISTIE) trials.[7] Stereotactic or endoscopic clot aspiration combined with catheter-directed thrombolysis seeks to reduce hematoma volume and toxic blood exposure while minimizing surgical trauma to the overlying cortex. Given the transit delays inherent to Uttarakhand, establishing protocols for rapid neuroimaging and exploring the feasibility of minimally invasive clot aspiration at regional hubs could bridge the gap between geographic delay and timely clot removal.[7,8]

These findings echo the foundational principles of the international ICH Score, validating its utility even when managing patients across diverse, geographically isolated mountain communities. Furthermore, managing acute neurosurgical emergencies in Uttarakhand involves distinct spatial and logistical considerations. Due to the rugged, high-altitude terrain and remote settlements, many patients in this cohort experienced extended transit times before reaching definitive care. This delay can allow unhindered hematoma expansion during the critical early hours after rupture.

While surgical evacuation in 38.1% of our patients effectively alleviated mass effect and preserved life in severe presentations, it did not completely eliminate residual neurological deficits. This observation highlights the need for prospective trials to better define the optimal surgical period for these patients, as well as the potential benefits of ultra-early minimally invasive clot aspiration.

CONCLUSION

Hypertensive intracerebral hemorrhage represents an important public health concern in Uttarakhand, causing mortality and long-term disability. This study confirms that a low Glasgow Coma Scale score at admission, a hematoma volume greater than 30cm3, and intraventricular extension are strong, independent predictors of a poor 3-month functional outcome.

Early clinical risk-stratification using the admission GCS score and hematoma volume is critical to optimizing triage between aggressive neurosurgical evacuation and specialized intensive care management.

Improving clinical outcomes across the region will require a multi-pronged approach: strengthening primary care networks to ensure rigorous, community-level blood pressure control, establishing rapid-transit protocols for stroke emergencies, and expanding dedicated neurocritical care resources at regional tertiary centers.

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