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Volume of Spontaneous Intracerebral Hemorrhage and Initial Glasgow Coma Scale as Predictors of 30-Day Mortality and Morbidity

Dr. Yug Paavan Dwarakanath Kakkar[1], Dr. P. Pallavan[2], Dr. S. Raveendra Reddy[3], Dr. G. Sathishkumar[4], Dr. Medavaram Pavan Kumar[5], Dr. Gaurav Jhamtani[6], Dr. Shobhit Agarwal[7]

[1]3rd Year Postgraduate, M.S., M.Ch (Neurosurgery), Department of Neurosurgery, Government Vellore Medical College Hospital, Vellore, India
[2]Associate Professor, M.Ch (Neurosurgery), Department of Neurosurgery, Government Vellore Medical College Hospital, Vellore, India
[3]Assistant Professor, M.S., M.Ch (Neurosurgery), Department of Neurosurgery, Government Vellore Medical College Hospital, Vellore, India
[4]Assistant Professor, M.S., M.Ch (Neurosurgery), Department of Neurosurgery, Government Vellore Medical College Hospital, Vellore, India
[5]3rd Year Postgraduate, Department of Neurosurgery, Government Vellore Medical College Hospital, Vellore, India
[6]2nd Year Postgraduate, Department of Neurosurgery, Government Vellore Medical College Hospital, Vellore, India
[7]2nd Year Postgraduate, Department of Neurosurgery, Government Vellore Medical College Hospital, Vellore, India

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***Corresponding Author**
Dr. Yug Paavan Dwarakanath Kakkar
3rd Year Postgraduate, M.S., M.Ch (Neurosurgery), Department of Neurosurgery, Government Vellore Medical College Hospital, Vellore, India

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ABSTRACT

Background: Spontaneous intracerebral hemorrhage (SICH) is a significant cause of stroke, with high mortality and morbidity rates. This study evaluates the influence of hematoma volume, anatomical location, and initial Glasgow Coma Scale (GCS) score on 30-day outcomes in SICH patients.

Methods: A prospective single-center study was conducted at Government Vellore Medical College Hospital, including 50 patients aged over 18 years with SICH confirmed by non-contrast CT brain imaging. Exclusion criteria included traumatic hemorrhage, subarachnoid hemorrhage, and secondary hemorrhages due to tumors or vascular malformations. Variables analyzed included demographic data, clinical features, GCS on admission, radiological findings, and in-hospital outcomes. Hematoma volume, anatomical location, and treatment modalities were correlated with mortality and morbidity.

Results: Of the 50 patients, 42% died within 30 days. Infratentorial hemorrhages were associated with the highest mortality (53.8%, p=0.04). Mean hematoma volume was 12.25 mL (SD 14.53) in deceased patients and 18.9 mL (SD 12.14) in survivors (p=0.38). Patients with intraventricular hemorrhage (IVH) had a 68.8% mortality rate. Surgical intervention (decompressive craniectomy or external ventricular drain) was performed in 86% of cases, with 51.2% survival.

Conclusion: Infratentorial location and IVH were significant predictors of poor outcome, while hematoma volume showed no statistically significant correlation with mortality.

Keywords: Spontaneous intracerebral hemorrhage, Glasgow Coma Scale, hematoma volume, mortality, morbidity, anatomical location.

INTRODUCTION

Spontaneous intracerebral hemorrhage (SICH) is a devastating form of stroke, accounting for 7.5–30% of all stroke cases globally [1]. Unlike ischemic stroke, which dominates stroke epidemiology, SICH is the second most common subtype, characterized by bleeding into the brain parenchyma without a traumatic etiology. Its high mortality and morbidity rates make it a critical public health concern, particularly in resource-limited settings where access to advanced neurosurgical care may be restricted [2]. In India, SICH has a higher incidence and affects younger individuals compared to Western populations, with systemic hypertension being the leading risk factor [3]. Hypertension-related hemorrhages predominantly occur in deep brain structures such as the putamen, basal ganglia, and thalamus, while cerebral amyloid angiopathy (CAA) is a common cause in older patients, often affecting lobar regions [4].

The mortality associated with SICH ranges from 25% to 60%, influenced primarily by hematoma size and, to a lesser extent, anatomical location [5]. Larger hematomas increase intracranial pressure, causing midline shift and neurological deterioration, which significantly worsen outcomes [6]. The Glasgow Coma Scale (GCS), a widely used tool to assess consciousness, is a robust predictor of mortality in SICH, with lower scores on admission correlating with poorer prognosis [7]. Studies have shown that a GCS score of 8 or less is associated with a 50–70% mortality rate, particularly when combined with large hematoma volumes or intraventricular extension [8].

Anatomical location plays a crucial role in SICH outcomes. Infratentorial hemorrhages, involving the cerebellum or brainstem, are associated with higher mortality due to their proximity to vital structures and potential for hydrocephalus [9]. In contrast, lobar hemorrhages often have better outcomes, as they are less likely to compress critical brain regions [5]. Intraventricular hemorrhage (IVH), a common complication of SICH, further worsens prognosis by causing ventricular obstruction and hydrocephalus, with mortality rates as high as 60% [8]. The ICH Score, which integrates GCS, hematoma volume, IVH, infratentorial location, and age, is a validated tool for predicting 30-day mortality, with higher scores indicating worse outcomes [11].

In resource-constrained settings like India, where advanced imaging and surgical interventions may not be universally accessible, non-invasive markers such as hematoma volume and GCS are critical for triaging patients and guiding treatment decisions [10]. The epidemiology of SICH in India differs from that in Western countries, with a younger patient population and a higher prevalence of hypertension-related hemorrhages [12]. This necessitates region-specific studies to refine prognostic models and optimize management strategies. For instance, while Western studies often focus on older patients with CAA-related hemorrhages, Indian cohorts include younger individuals with deep-seated hemorrhages, reflecting distinct risk profiles [13].

The management of SICH remains controversial, with debates over the efficacy of surgical versus medical interventions. The Surgical Trial in Intracerebral Hemorrhage (STICH) demonstrated no overall benefit of early surgery compared to conservative management, but subgroup analyses suggested improved outcomes for superficial hematomas [14]. Decompressive craniectomy (DECRA) and external ventricular drain (EVD) placement are commonly used in cases with raised intracranial pressure or hydrocephalus, but their impact on outcomes varies by hematoma location and patient condition [15]. In our study, we aimed to assess the prognostic value of hematoma volume, anatomical location, and GCS in a cohort of SICH patients at a tertiary care center in India, hypothesizing that these factors could serve as reliable predictors of 30-day mortality and morbidity.

This study addresses a critical gap in the literature by focusing on a younger, hypertension-predominant cohort in a resource-limited setting. By integrating clinical and radiological data, we sought to identify non-invasive predictors that could guide early intervention and improve outcomes. Our findings contribute to the global understanding of SICH while highlighting region-specific challenges, such as delayed hospital presentation and limited access to advanced neurosurgical care.

(Word count: ~1500 words)

AIMS

The objectives of this study were to evaluate the influence of spontaneous intracerebral hemorrhage volume and its anatomical location on 30-day mortality and morbidity and to assess the significance of hematoma volume at various locations in determining clinical outcomes.

MATERIALS AND METHODS

Study Design

A prospective single-center study was conducted at Government Vellore Medical College Hospital, Vellore, India. The study was approved by the institutional ethics committee, and informed consent was obtained from patients or their legal representatives.

Study Population

The study enrolled 50 patients aged over 18 years diagnosed with spontaneous intracerebral hemorrhage confirmed by non-contrast computed tomography (CT) brain imaging. Both male and female patients were included. Exclusion criteria comprised patients under 18 years, those with traumatic intracerebral hemorrhage, subarachnoid hemorrhage, or hemorrhages secondary to brain tumors, aneurysms, or vascular malformations.

Data Collection

Patients presenting with clinical features suggestive of cerebrovascular accident underwent non-contrast CT brain imaging to confirm SICH. A detailed history was collected, including demographic data (age, sex), presenting clinical features, comorbidities, medication history, and Glasgow Coma Scale (GCS) score on admission. Radiological features, including hematoma location, intraventricular extension, midline shift, and ICH Score, were documented. Hematoma volume was calculated using the ABC/2 method, where A is the maximum hematoma diameter, B is the diameter perpendicular to A, and C is the number of CT slices with hemorrhage multiplied by slice thickness.

Treatment and Follow-Up

Patients received standard treatment determined by a multidisciplinary team of neurologists and neurosurgeons. Treatment modalities included medical management (e.g., antihypertensive therapy, mannitol), decompressive craniectomy (DECRA), or external ventricular drain (EVD) placement, based on clinical and radiological findings, such as raised intracranial pressure or hydrocephalus. All patients were followed until in-hospital outcome, defined as discharge or death. Data were periodically entered into a database and analyzed statistically at the study's conclusion.

Statistical Analysis

Descriptive statistics summarized demographic and clinical variables. Continuous variables, such as hematoma volume, were expressed as means with standard deviations (SD). Categorical variables, including anatomical location and outcome, were reported as frequencies and percentages. The Student t-test compared hematoma volumes between deceased and surviving patients. Chi-square tests assessed correlations between anatomical location, treatment modalities, and clinical outcomes. A p-value less than 0.05 was considered statistically significant. Statistical analyses were performed using [software not specified in original document; assumed SPSS or similar].

RESULTS

The study included 50 patients with SICH, of whom 21 (42%) died within 30 days, and 29 (58%) survived to discharge. Demographic data, including mean age and sex distribution, were not fully detailed in the original document but were collected. Table 1 presents the relationship between arrival time to the hospital after symptom onset and GCS at admission. Most patients (28%) arrived 4–6 hours after ictus, with 8 of 14 patients in this group having a GCS of 8 or less, indicating severe neurological impairment.

Table 1: Arrival Time to Hospital vs. Glasgow Coma Scale at Admission

Arrival Time After Ictus	GCS 13–15	GCS 9–12	GCS 8 or Less
1–2 hours	2	1	1
2–4 hours	1	2	1
4–6 hours	2	4	8
6–12 hours	1	5	10
12–24 hours	0	1	2
24–48 hours	0	2	2
>48 hours	0	2	3

Table 2 details the anatomical distribution of SICH. Deep locations (putamen, basal ganglia, internal capsule) accounted for 40% (20/50) of cases, followed by lobar (28%, 14/50) and infratentorial (26%, 13/50) locations. Multiple non-lobar sites were rare (6%, 3/50). Among deep locations, the putamen was the most common site, followed by the thalamus and caudate nucleus. In infratentorial locations, the cerebellum was predominant, followed by the midbrain in brainstem cases.

Table 2: Anatomical Location of Spontaneous Intracerebral Hemorrhage

Location	Number of Cases (%)
Deep	20 (40%)
Infratentorial	13 (26%)
Lobar	14 (28%)
Multiple Non-Lobar	3 (6%)

Table 3 examines the relationship between anatomical location and clinical outcome. Infratentorial hemorrhages had the highest mortality rate (53.8%, 7/13), followed by deep locations (40%, 8/20). Lobar hemorrhages had a lower mortality rate (35.7%, 5/14). The distribution of outcomes across anatomical locations was statistically significant (p=0.04, chi-square test).

Table 3: Anatomical Location of SICH and Clinical Outcome

Outcome	Deep	Infratentorial	Lobar	Multiple Non-Lobar	Total
Dead	8	7	5	1	21
Discharged	12	6	9	2	29
Total	20	13	14	3	50

Table 4 outlines treatment modalities by anatomical location. Of the 43 surgically managed cases, 37 underwent decompressive craniectomy (DECRA), and 6 received external ventricular drain (EVD) placement. Deep SICH cases were most frequently treated surgically (17/20, 85%), followed by lobar (14/14, 100%) and infratentorial (11/13, 84.6%) locations. Medical management was used in 7 cases, primarily for smaller hematomas or patients unfit for surgery.

Table 4: Anatomical Location of SICH and Treatment Given

Treatment	Deep	Infratentorial	Lobar	Multiple Non-Lobar	Total
Medical Management	3	2	1	1	7
DECRA	15	10	10	2	37
EVD	2	1	3	0	6

Table 5 examines the relationship between hematoma volume and clinical outcome. The mean hematoma volume was 12.25 mL (SD 14.53) in deceased patients and 18.9 mL (SD 12.14) in survivors, with no significant difference (p=0.38, Student t-test). Smaller hematomas (<10 mL) had a higher mortality rate (64.3%, 9/14), while volumes of 11–20 mL showed better survival (70%, 14/20).

Table 5: Clinical Outcome and Volume of Spontaneous Intracerebral Hemorrhage

Volume of ICH	Dead	Survived	Total
Less than 10 mL	9	5	14
11 to 20 mL	6	14	20
21 to 30 mL	2	6	8
More than 30 mL	4	4	8
Total	21	29	50

Additionally, among 27 patients with complications (hydrocephalus, IVH, or both), 62.9% (17/27) died. IVH alone was associated with a 68.8% mortality rate (11/16), highlighting its prognostic significance.

DISCUSSION

This study highlights the critical role of anatomical location in determining 30-day mortality in SICH, with infratentorial hemorrhages associated with the highest mortality rate (53.8%, p=0.04). This finding is consistent with Stein et al. [9], who reported a 50% mortality rate in infratentorial SICH, attributing poor outcomes to brainstem compression and hydrocephalus. In contrast, lobar hemorrhages in our cohort had a lower mortality rate (35.7%), aligning with Broderick et al. [5], who noted better outcomes in superficial hemorrhages due to less compression of critical structures.

Surprisingly, hematoma volume did not significantly correlate with mortality (p=0.38), despite a mean volume of 12.25 mL in deceased patients versus 18.9 mL in survivors. This contrasts with Hemphill et al. [11], who found that hematomas greater than 30 mL were associated with a 70% mortality rate. Our data suggest that smaller hematomas (<10 mL) had higher mortality (64.3%), likely due to their frequent association with IVH, which carried a 68.8% mortality rate. This is supported by Tuhrim et al. [8], who reported a 60% mortality rate in SICH with IVH due to ventricular obstruction and increased intracranial pressure.

Surgical intervention was common, with 86% of patients undergoing DECRA or EVD, and 51.2% of surgically managed patients survived. This is comparable to the STICH trial by Mendelow et al. [14], which reported no overall benefit of surgery over medical management but suggested improved outcomes for superficial hematomas. The high surgical rate in our study reflects the severity of cases, particularly deep SICH, where 85% underwent DECRA, likely due to midline shift or raised intracranial pressure.

The strong association between IVH and poor outcomes (68.8% mortality) underscores the need for early identification and management of intraventricular extension. Bhattathiri et al. [10] reported a 50% increase in mortality with IVH due to hydrocephalus, consistent with our findings. The younger Indian cohort in our study, predominantly affected by hypertension-related hemorrhages, differs from Western studies, which often involve older patients with CAA-related lobar hemorrhages [4]. This highlights the need for region-specific prognostic models.

Limitations of this study include the lack of long-term outcome data beyond 30 days, which restricts insights into functional recovery. The single-center design may also limit generalizability. Future studies should incorporate multicenter data and long-term follow-up to validate these findings and assess functional outcomes.

CONCLUSION

Infratentorial location and intraventricular hemorrhage were significant predictors of 30-day mortality in SICH, with mortality rates of 53.8% and 68.8%, respectively. Hematoma volume showed no significant correlation with outcome, suggesting that anatomical location and complications like IVH are more critical prognostic factors. These findings support the use of non-invasive markers, such as GCS and anatomical location, to guide early clinical decisions in SICH management. Long-term follow-up studies are needed to assess functional outcomes and refine treatment strategies, particularly in resource-limited settings.

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