EFFECT OF HEMATOMA VOLUME ON THE 30-DAY MORTALITY RATE OF PATIENTS WITH HYPERTENSIVE INTRACEREBRAL HEMORRHAGE

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Abbreviations and Acronyms

AaBET: Addis Ababa Burn, Emergency & Trauma Hospital

CBD: Global burden of disease

DBP: Diastolic Blood pressure

GCS: Glasgow Coma scale

ICH: Intracerebral hemorrhage

MOH: Ministry of Health

RIS: Radiology information system

SAH: Subarachnoid hemorrhage

SBP: systolic Blood pressure

SPHMMC: St. Paul's Hospital Millennium Medical College

Abstract

Background: Hypertensive intracerebral hemorrhage is a severe and often fatal condition, with the volume of the resulting hematoma being a critical factor influencing patient outcomes. Although few studies have been conducted previously the precise impact of hematoma volume on the short-term (30-day) mortality rate remains inadequately understood and quantified.

Objectives: To evaluate the effect of hematoma volume on the 30-day mortality rate of patients with hypertensive intracerebral Hemorrhage in patients who visited SPHMMC and AABET hospital from February 2023 GC-March 2024 GC

Methods: A retrospective record review was done on clinical information of patients who underwent treatment for hypertensive intracerebral hemorrhage. The study covered all patients who fulfilled the inclusion and exclusion criteria. The clinical indicators and risk factors that influence 30-day mortality were evaluated using both Bivariate and multivariate logistic regression.

Results: A total of 71 patients were involved in the study and 49 (69%) were alive and 22 (31%) were dead. Patients with a history of ICH are 18.67 times more likely to die within 30 days than patients who do not have a history of ICH (AOR= 18.67 95%CI=1.18-294.61). Patients who were admitted with a GCS of 3-8 are 26 times more likely to die within 30 days than patients admitted with a GCS of 9-15 (AOR=26 95%CI=1.08-63.8). Patients with hematoma volume of <30ml have an 88% lower 30-day mortality risk than patients with hematoma volume of >=60ml (AOR= 0.12 95%CI=0.01-0.85). Individuals with normal platelet counts at admission have a 94.8% lower 30-day mortality risk than those with platelet counts below normal (AOR= 0.052 95%CI=0.007-0.407).

Conclusion and recommendations: This study found hematoma volume; admission Glasgow Coma Scale, admission platelet count, and prior history of intracerebral hemorrhage were identified as independent and significant predictors of 30-day mortality. Prognostication and early intervention for this patient group are advised in light of our findings.

Key words: Hematoma Volume, 30-Day Mortality, Hypertensive Intracerebral Haemorrhage, Ethiopia

1. INTRODUCTION

1.1. Background of the study

A stroke can be defined as the sudden onset of a neurologic deficit caused by a disruption in the blood flow to the brain. Ischemic stroke and hemorrhagic stroke are the two primary forms of stroke (1). Intracerebral hemorrhage constituted 27·9%. The most important risk factor for ICH is hypertension, which is thought to be the root cause of 60–70% of cases of ICH (2).

According to the Global Burden of Disease (GBD) report, stroke ranks as the second leading cause of death and the third leading cause of disability-adjusted life years (DALYs) worldwide. Annually, stroke accounts for the deaths of approximately 5.5 million individuals globally and results in the loss of over 116 million years of healthy life (YLL) due to stroke-related mortality and disability (3). Despite its significant morbidity and mortality, stroke remains a neglected condition, particularly in Africa, where 86% of all stroke-related deaths occur. The diagnosis and treatment of stroke in sub-Saharan nations are notably inadequate, exacerbating the burden of this critical health.

Ethiopia has a high stroke rate; in 2004 alone, 39,409 people died there from strokes (1). The overall incidence of stroke in Ethiopia was attempted to be determined by one systematic review and meta-analysis. This comprehensive review and meta-analysis found that the prevalence of hemorrhagic and ischemic stroke was 46.42% and 51.40%, respectively (4).

Hypertensive intracerebral hemorrhage (ICH) is a severe form of stroke characterized by bleeding within the brain tissue, commonly attributed to chronic high blood pressure. This condition represents a significant cause of morbidity and mortality worldwide, particularly in populations with a high prevalence of hypertension. The clinical outcomes of patients with hypertensive ICH are influenced by various factors, including the location, size, and expansion of the hematoma.

Previous studies have highlighted the prognostic importance of hematoma volume in predicting patient outcomes following an ICH. However, the precise impact of hematoma volume on the short-term (30-day) mortality rate remains inadequately understood and quantified. This study aims to investigate the effect of hematoma volume on 30-day mortality rate of patients with ICH who

received treatment in SPHMMC and AABET hospital. The acute management of ICH aims to stabilize the patient, control blood pressure, and limit hematoma expansion, with the ultimate goal of reducing the risk of early mortality and long-term disability.

1.2 Statement of the problem

Hypertension is a significant contributing factor to cardiovascular disease. Over the world, hypertension is responsible for 51% of stroke-related fatalities and 45% of heart disease-related deaths(5). It is a primary contributor to cardiovascular disease, including stroke. It remains the leading contributor to the global disease burden. Similar to global trends, the African region is significantly impacted by the epidemic of non-communicable diseases and concurrently faces the dual burden of communicable and non-communicable diseases. According to projections by the World Health Organization (WHO), the number of deaths attributable to non-communicable diseases is expected to rise by 17% globally within the next decade, with the African region experiencing the highest increase (4,5).

Ethiopia is also experiencing a shift in the causes of mortality from infectious diseases to non-communicable diseases as a result of epidemiological changes. The prevalence of hypertension in Addis Ababa was estimated to be between 15% and 30% based on a systematic meta-analysis and observational studies (4–6).

Hemorrhagic stroke is due to bleeding into the brain by the rupture of a blood vessel. The two types of hemorrhagic stroke that can be distinguished further are subarachnoid hemorrhage (SAH) and intracerebral hemorrhage (ICH).An ICH is bleeding into the parenchyma of the brain. The most frequent cause of ICH and hemorrhagic stroke is hypertension (7,8).

The most current estimates of the Global Burden of Disease (GBD) indicate that there were around 12.2 million incident instances of stroke of which Hemorrhagic stroke accounts for about 20%. According to several researches, the incidence of ICH varies by ethnicity and ranges from 15 /100000 to over 60 /100000 (2,8). The high rates of mortality and morbidity with ICH are well recognized with 30-day case fatality ranging from 25% to 50 % (9). Ethiopia has a 6.23 percent

stroke-related fatality rate overall and an 89.82 percent age-adjusted stroke death rate per 100,000 people (4).

Worldwide, the overall prevalence of ischemic stroke is higher than that of hemorrhagic stroke. Even though there is little information accessible in Ethiopia, a prospective study conducted at Tikur Anbesa Specialized Hospital in Addis Ababa, Ethiopia, revealed a greater proportion of hemorrhagic strokes (10).

Despite advancements in medical imaging and acute stroke management, hypertensive ICH continues to present significant challenges in clinical practice. The volume of the hematoma at the time of diagnosis is a crucial prognostic factor, yet its direct impact on the 30-day mortality rate in patients with hypertensive ICH has not been thoroughly investigated.

Various studies identified the hemorrhage site and bleeding severity, as determined by hematoma volume and Glasgow Coma Scale score, were directly related to both short- and long-term outcomes of ICH patients (11–14).

Understanding the relationship between hematoma volume and short-term mortality is essential for several reasons:

1. Clinical Decision-Making: Accurate prognostication can guide treatment decisions, including the urgency of surgical interventions and the intensity of medical management.

2. Resource Allocation: Hospitals and healthcare systems can better allocate resources if they can predict which patients are at higher risk of mortality.

3. Patient and Family Counseling: Clear information on prognosis can aid in discussions with patients and their families about expected outcomes and care planning.

Therefore, this research seeks to address the following primary question: What is the effect of hematoma volume on the 30-day mortality rate of patients with hypertensive intracerebral hemorrhage who received treatment in SPHMMC and AABET hospital, Addis Ababa, Ethiopia?

1.3 Significant of the study

Numerous studies indicate an increasing prevalence of hemorrhagic stroke in Ethiopia. Hypertension is the single leading cause of intracranial hemorrhage. One of the SSA countries, Ethiopia, is experiencing the effects of stroke. Given Ethiopia's low socioeconomic status, it is important to use its resources efficiently.

Hypertensive intracerebral hemorrhage (ICH) is a severe and often fatal condition, with the volume of the resulting hematoma being a critical factor influencing patient outcomes. Despite advances in medical interventions, the 30-day mortality rate for patients with hypertensive ICH remains high. There is a pressing need to understand the precise impact of hematoma volume on short-term mortality to improve prognostic accuracy and guide effective treatment strategies. This study seeks to address this problem by investigating the correlation between hematoma volume and the 30-day mortality rate in patients suffering from hypertensive intracerebral hemorrhage.

The study's findings will improve prognostic models for more effective patient care and serve as a foundation for more research on the consequences of intracerebral hemorrhage. The information acquired from these studies can be applied to develop better hypertension management plans and lower the death rate from intracerebral hemorrhage.

2. LITERATURE REVIEW

In order to forecast the outcome of ICH, the ICH score has been utilized since the early 2000s as a simple and reliable tool. After conducting a retrospective analysis of records containing acute ICH by a group of researchers at the University of California. They created an analysis for each group and the overall ICH group, methodically classifying it into supratentorial and infratentorial groups based on the site of bleeding. Age over 80 years, ICH volume, and GCS score were identified as independent predictors of outcomes for supratentorial ICH patients; the GCS score exhibited the most robust correlation with the outcome. The GCS score was the only independent predictor of outcome statistically significant for patients with infratentorial intracerebral hemorrhage (ICH). Additionally, they claimed that in patients with infratentorial ICH, ICH volume was not a statistically significant predictor of prognosis (15).A prospective study was conducted in Uganda to validate the ICH score. It was discovered to be an effective predictive marker for 30-day case fatality (5).

There is a strong correlation between hematoma volume and both short- and long-term mortality. It is commonly accepted that the most significant ICH outcome predictor is ICH volume. Less than 30 mL of hematoma volume is associated with functional recovery after 90 days (12). Generally, the recommendation for acute stroke is a CT scan. The most commonly used technique for measuring hematoma volume is CT assessment.

There are multiple literatures done to analyze the prognosis of intracranial hemorrhage. A medical record review done in Greater Cincinnati assessed the 30-day mortality and morbidity of intracerebral hemorrhage. They discovered that the most powerful predictor of 30-day death was the combination of ICH volume and initial Glasgow coma scale (GCS). The 30-day mortality rate was found to be 44% (13).

A retrospective study conducted in China examined the impact of hematoma volume on the 30-Day Mortality Rate of patients with Primary Hypertensive Brainstem Hemorrhage. The results showed

that hematoma volume was an independent predictor with a nonlinear relationship (14). However, intraventricular extension and a limited hemorrhage volume were attributed to this outcome.

A retrospective study on patients with hypertensive caudate hemorrhage identified hydrocephalus as the most critical factor associated with poor outcomes. Contrary to findings in other intracerebral hemorrhage (ICH) studies, they determined that parenchymal hematoma volume did not correlate with poor outcomes in cases of caudate hemorrhage (16). Furthermore, the overall outcomes for caudate hemorrhage in their study were less favorable compared to those reported in similar studies.

In a large prospective research conducted in Korea to predict both functional recovery and 30-day mortality hematoma volume was shown to be linked with functional recovery rather than an independent predictor of 30-day death (17). Another retrospective investigation on primary brain stream hemorrhage revealed that hematoma volume was an independent predictor of both the survival and functional results (18).

According to a prospective study conducted at Chicago, Illinois' North Shore University Health System, smaller ICH volumes demonstrated the greatest difference with statistical significance that was adjusted for risk. Patients with higher ICH volumes showed lesser and non-statistically significant improvements in their outcomes (19).Consistent with previous research, mortality rates and functional outcomes were markedly poorer in older patients, those with larger intracerebral hemorrhage (ICH) volumes, and those with lower Glasgow Coma Scale scores, as observed in both univariate and multivariate analyses. Additionally, the presence and severity of associated intraventricular hemorrhage were significantly correlated with mortality and overall outcomes.

A larger research conducted in China to examine the clinical characteristics of ICH reported a 26.6% overall hospital death rate. After examining eight potential contributing variables to the prognosis of ICH, they discovered that only the serum glucose level and consciousness level were highly correlated with prognosis(20). The study does not include hemorrhagic volume as a predicting factor.

A thorough study on the incidence rates and outcomes of primary intracerebral hemorrhage (ICH) in Izumo City, Japan found that the hemorrhage site and bleeding severity, as determined by hematoma volume and Glasgow Coma Scale score, were directly related to both short- and long-term outcomes. The study also revealed that the proportion of hypertensive ICH was lower for lobar hemorrhages compared to ICHs at other sites (21).

In a retrospective study conducted in Barcelona, Spain, the researchers found that hematoma volume, ventricular extension, and midline shift were linked with poor outcomes in intraparenchymal hematoma with ventricular haemorrhage. Their study also revealed that intraparenchymal hematoma with ventricular extension had a high mortality rate of 56% (22).

A retrospective analysis conducted on patients with spontaneous intracerebral hemorrhage at a neurosurgical hospital in Southeast Nigeria revealed a correlation between increased age, low Glasgow Coma Scale (GCS) scores, and the presence of chest infections with higher mortality rates. The study also determined that the anatomical location of the hemorrhage, in isolation, does not significantly influence six-month mortality (23). Additionally, the volume of hematoma was not analysed separately in relation to mortality in this study.

Upon searching Google, PubMed, or Google Scholar, I couldn’t locate any literature assessing the impact of hematoma volume on the prognosis of ICH in Ethiopia.

2.1. Conceptual framework

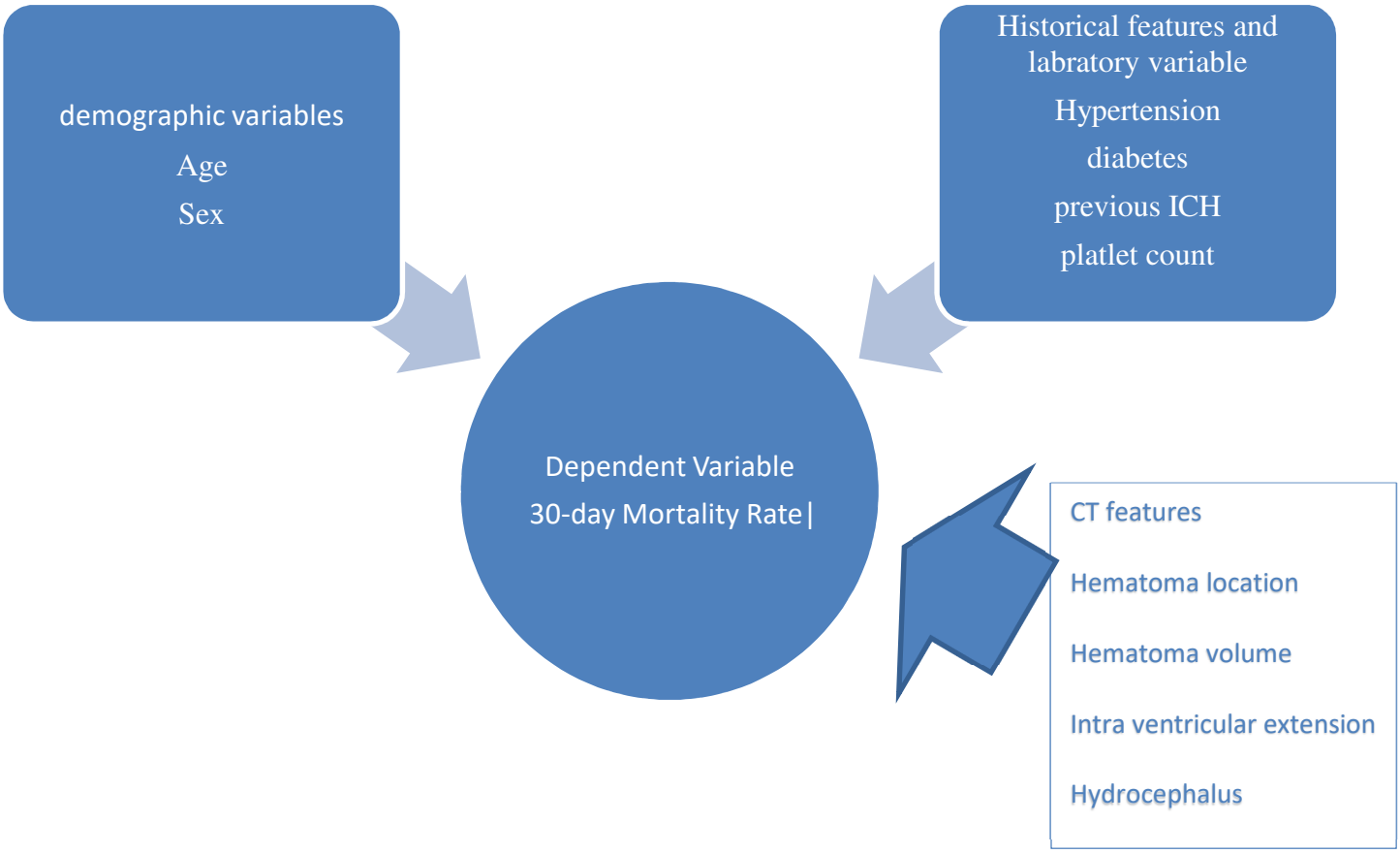

Figure 1 Conceptual framework represents the relationship between hematoma volume and the 30-day mortality rate in patients with hypertensive intracerebral hemorrhage

3. OBJECTIVES OF THE STUDY

3.1 General Objective:

To evaluate the impact of hematoma volume on the 30-day mortality rate in patients with hypertensive intracerebral hemorrhage, aiming to identify significant correlations and potential threshold volumes that could inform clinical decision-making and improve patient outcomes.

3.2. Specific objectives:

To determine the 30-day mortality rate in the study population

To analyze the relationship between hematoma volume and 30-day mortality rate

To compare mortality rates across different hematoma volume categories

4. METHODS AND MATERIALS

4.1 Study setting/area and period

This study was undertaken in the capital of Ethiopia, Addis Ababa. The capital Addis Ababa is located 2,500 meters above sea level at 9.03 N and 38.7E and is 540,000 square kilometers wide. Addis Ababa has a total of 608 health facilities. The study will be conducted between April 2024 and June 2024 GC at St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Ababa Burn, Emergency & Trauma hospital (AaBET) Hospital.

Saint Paul's Hospital Millennium Medical College (SPHMMC) is one of the few tertiary referral hospitals under the Ministry of Health (MOH). It currently has 700+ beds, an annual average of 200,000 patients and a catchment population of more than 5 million. There are over 1300 clinical and non-clinical staff in over 13 departments

Addis Abeba Burn, Emergency & Trauma hospital (AaBET) Hospital comprises four primary departments: Emergency Medicine and Critical Care, Plastic Reconstructive and Hand Surgery, Orthopedics & Traumatology, and Neurosurgery. It is affiliated with St. Paul's Hospital Millennium Medical College. AaBET Hospital is an upper-level teaching hospital that is well-managed and progressive. It has 190 bed-ward departments and a center for spinal disorders, physiotherapy, and traumatology.

4.2 Study design

A retrospective, institution-based record review was conducted using clinical data and brain CT images of patients who sought emergency care and were admitted to St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Ababa Burn, Emergency & Trauma Hospital (AaBET) from February 2023 to March 2024.

4.3. Population

4.3.1 Source population

All patients who sought emergency care and were admitted to St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Ababa Burn, Emergency & Trauma Hospital (AaBET) with hypertensive intracerebral hemorrhage from February 2023 to March 2024,

4.3.2 Study population

Patients admitted to St. Paul's Hospital Millennium Medical College (SPHMMC) or Addis Ababa Burn, Emergency & Trauma Hospital (AaBET) between February 2023 and March 2024 and who met the inclusion criteria.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

- Patients admitted to St. Paul's Hospital Millennium Medical College (SPHMMC) or Addis Ababa Burn, Emergency & Trauma Hospital (AaBET) between February 2023 and March 2024.
- All patients with Hypertensive intracerebral hemorrhage and hypertension defined as SBP 140 mmHg and/or DBP 90 mmHg
- Age must be > 18 years
- Complete clinical case information and CT scan

4.4.2 Exclusion criteria

- Non hypertensive haemorrhage
- Patients with significant comorbid conditions that could independently affect mortality rates, such as advanced malignancies or severe liver or kidney disease.
- Those cases who left against medical advice

- Incomplete clinical data

4.5 Sample size determination and sampling technique

4.5.1 Sample size determination

Sample size

According to a 2009 study in Masan ,Korea, to predictors of 30-day mortality and 90-day functional recovery after primary intracerebral hemorrhage(17) ,The expected mortality rate is 15.9 % .based on this:

$$n = \frac{(Z\alpha/2)^2 * P * (1 - P)}{d^2}$$

Where: n = sample size

$Z\alpha/2$ = the standard normal deviate (set at 1.96 for a 95% level of precision)

P = the expected prevalence (set at 15.9 % for this example)

d = the acceptable margin of error (set at 5% for this example)

Therefore, the sample size would be: n = (1.96^2 * 0.159 * (1-0.621)) / (0.05^2)

n = 205

Considering 10 % non-response rate

205+ (205*0.1) = 226

To calculate the sample size for my second specific objective I used double population proportion with a 95% confidence interval and 80% power, detailed in table below:

$$n = [Z(\alpha/2) + Z(\beta)]^2 * [P1(1 - P1) + P2(1 - P2)] / (P1 - P2)^2$$

Table 1: Sample size determination for associated factors of using previous study done 2023 on Effect of hematoma volume on the 30-day mortality rate of patients with primary hypertensive brainstem hemorrhage (17).

No.	Associated factor	AOR	Power	CI	% Among unexposed	Total sample size	10% non response rate	Reference

	Consciousness	3.36	80%	95%	6.00%	72	79	(17)
	Pupillary abnormality	4.53	80%	95%	9.8 %	52	57	

With this, I took the highest of the of all sample size which is 226

Distributed between the two hospital based on bed number- St paul millennium medical college 177 participants and Addis Ababa Burn, Emergency & Trauma Hospital 49 participants

4.5.2 Sampling technique

A convenience sampling method was employed for this study. All patients with intracerebral hemorrhage who presented to emergency care and were subsequently admitted to the wards during the study period, and who met the established inclusion and exclusion criteria, were included. A list of card numbers for patients admitted with intracerebral hemorrhage at St. Paul's Hospital Millennium Medical College and Addis Ababa Burn, Emergency, and Trauma Hospital (AaBET) during the study period was compiled from the registration sheets. Subsequently, all complete charts, as per the data collection checklist, were included in the analysis.

4.6 Study variables

4.6.1 Dependent variables

- 30-day mortality rate

4.6.2 Independent variables

- Age
- Sex
- Hypertension
- Diabetes
- Previous ICH
- Hematoma volume
- Location
- Intraventricular extension
- Hydrocephalus
- Initial GCS level

- platelet count

4.7 Operational definitions

- Hematoma volume - The amount of blood that has accumulated in the brain due to hypertensive intracerebral hemorrhage, expressed in milliliters (ml) and assessed by CT scans. It is calculated by the formula A × B × C/2, where A represents the diameter of the hematoma with the greatest diameter on the axial plane of the CT scan, B represents the diameter of the hematoma perpendicular to A on the same plane, and C represents the total length on the vertical plane (14,15).
- 30-Day Mortality Rate: The proportion of patients who die within 30 days after the onset of this time frame by the total number of patients included in the study and expressed as a percentage. It is expressed as alive or dead.
- Hypertension- Hypertension was defined as SBP 140 mmHg and/or DBP 90 mmHg (14)
- Glasgow coma scale- practical method for assessment of impairment of conscious level. The GCS score at the time of arrival to the hospital is used. Three to eight value representing severe deterioration in consciousness and 9-15 values representing mild to moderate deterioration in consciousness.
- Hydrocephalus- defined as axial width of temporal horn lateral ventricle more than or equal to 5 mm or distension of recesses in third ventricles/bulging third ventricular floor
- Platelet count- determined as normal or below normal. Normal >100000 and below normal <100000

4.8 Data collection tool, methods and procedures

Data was collected by two medical doctors using a data abstraction sheet, which was prepared on the Kobo toolbox. The data collectors was trained for two days on the objectives of the study, which is the effect of hematoma volume on the 30-Day Mortality Rate of patients with Primary Hypertensive intracerebral hemorrhage at St Paul's Hospital Millennium Medical College and the use of the Kobo toolbox.

The data abstraction form has four parts which contain socio-demographic information of the patients, CT finding, confounding factors, and outcome. The tool was in English only since the trained data collector filled out the abstraction form and it is not translated into Amharic version. Hematoma volume was measures from patients CT scan by the principal investigator. Retrospectively, patient records registered from February 2023- march 2024 GC was extracted.

4.9 Data quality

Pretest was done by taking 5% of the sample from Feb 1-6, 2023 at St Paul's Hospital Millennium Medical College. Data collected from the medical records was entered into an electronic database (Kobo toolbox) by the data collectors. The completeness of the data was monitored on the electronic database so that it was not passed to the next question unless the required part complete. After entry, the PI was investigated and checked for proper data entry and validate the information. The Primary investigator of the study constantly evaluated the data quality and completeness. Then the data was exported to Excel and transferred to SPSS version 26. All incomplete data was discarded.

4.10 Data processing and analysis

Data was analyzed using SPSS version 26. Descriptive analysis was used to analyze patients' demographic, clinical, and CT findings, and other related factors and it was presented in frequency tables, graphs, and charts. Bivariable logistic regression analysis was performed to assess the effect

of exposure variable on the outcome. From the bivariable analysis, those variables with $p < 0.2$ were selected for multivariable binary logistic regression analysis. The multivariable logistic regression analysis was also used to test for independent association and to estimate the odds ratios (OR), 95% confidence intervals (CI) and p-values. The association was declared significant at $p < 0.05$.

4.11 Ethical considerations

Ethical clearance was obtained from the SPHMMC research review board. The privacy of individual patient's data and confidentiality of information was respected. There was no risk or benefit participating in the survey of individual patients.

4.12 Plan for dissemination of results

The results of the study recorded and shared with the SPHMMC neurology and radiology departments, as well as any other relevant organisations. Publications in various international journals as well as the Ethiopian Journal of Health Sciences are planned.

5. RESULT

5.1 Sociodemographic characteristics and frequency distribution of response status

A total of 71 study subjects with a response rate of 32.8% participated in this study of which 37 (52.1%) were males and 34 (47.9%) were females. The mean age of the respondents was 55.27 (±14.12) years. The age of participants ranges between 30 and 85 years (See Table 1 below).

Table 1: Socioeconomic characteristics of patients with ICH who visited St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Ababa Burn, Emergency & Trauma hospital (AaBET) Hospital between April 2024 and June 2024 GC

Variable	Description	Frequency	Percentage
Age	30-44	19	26.8
	45-59	22	31.0
	>=60	30	42.3
Sex	Male	37	52.1
	Female	34	47.9

5.2 Historical features and laboratory variables

Table 2 features 30-Day mortality in patients with Historical features and laboratory variables. Forty two (59.2%) of the patients have a previous history of hypertension. On the other hand, 57 (80.3%), and 52 (73.2%) have no prior history of diabetes, or intracranial hemorrhage respectively. Twenty (28.2%) of the patients have an admission platelet value of below normal (Table 2).

Table 2: Historical features and laboratory variables of the study participants who visited St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Abeba Burn, Emergency & Trauma hospital (AaBET) Hospital between April 2024 and June 2024 GC

Variable	Description	Frequency	Percent (%)
History of hypertension	Yes	42	59.2
	No	29	40.8
previous history of diabetes	Yes	14	19.7
	No	57	80.3
Previous history of Intracerebral hemorrhage (ICH)	Yes	19	26.8
	No	52	73.2
admission Platelet count	Normal	51	71.8
	Below normal	20	28.2

5.3 Physical examination

Of the patients 50 (70.4%) had admission systolic blood pressure of >= 140 mmHg and 21 (29.6%) had admission diastolic blood pressure of >= 90 mmHg. The majority of the patients 58 (81.7%), were admitted with a GCS of 9-15 (Table 3).

Table 3: Physical examination of the study participants who visited St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Ababa Burn, Emergency & Trauma hospital (AaBET) Hospital between April 2024 and June 2024 GC

Variable	Description	Frequency	Percent (%)
admission systolic blood pressure	<= 139	21	29.6
	>= 140	50	70.4
Admission diastolic blood pressure	<= 89	50	70.4
	>=90	21	29.6
Admission GCS	3-8	13	18.3
	9-15	58	81.7

5.4 CT features

In this study 42 (59.2%) patients have hematoma volume of <30 ml, and 24 (33.8%) have the presence of intraventricular extension in their CT imaging. Otherwise, most of the patients56 (78.9%) have no presence of hydrocephalus (Table 4).

Table 4: CT features of patients who visited St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Abeba Burn, Emergency & Trauma hospital (AaBET) Hospital between April 2024 and June 2024 GC

Variable	Description	Frequency	Percent (%)
Hematoma volume	< 30	42	59.2
	30-59	12	16.9
	>= 60	17	23.9
presence of intraventricular extension	Yes	24	33.8
	No	47	66.2
presence of hydrocephalous	Yes	15	21.1
	No	56	78.9
hemorrhage location	Basal ganglia	45	63.4
	Brainstem	12	16.9
	Lobar	14	19.7

5.5 30-day mortality rate

A total of 71 patients were involved in the study and 49 (69%) were alive and 22 (31%) were dead. Giving a 30-day mortality rate of 31% (Figure 2).

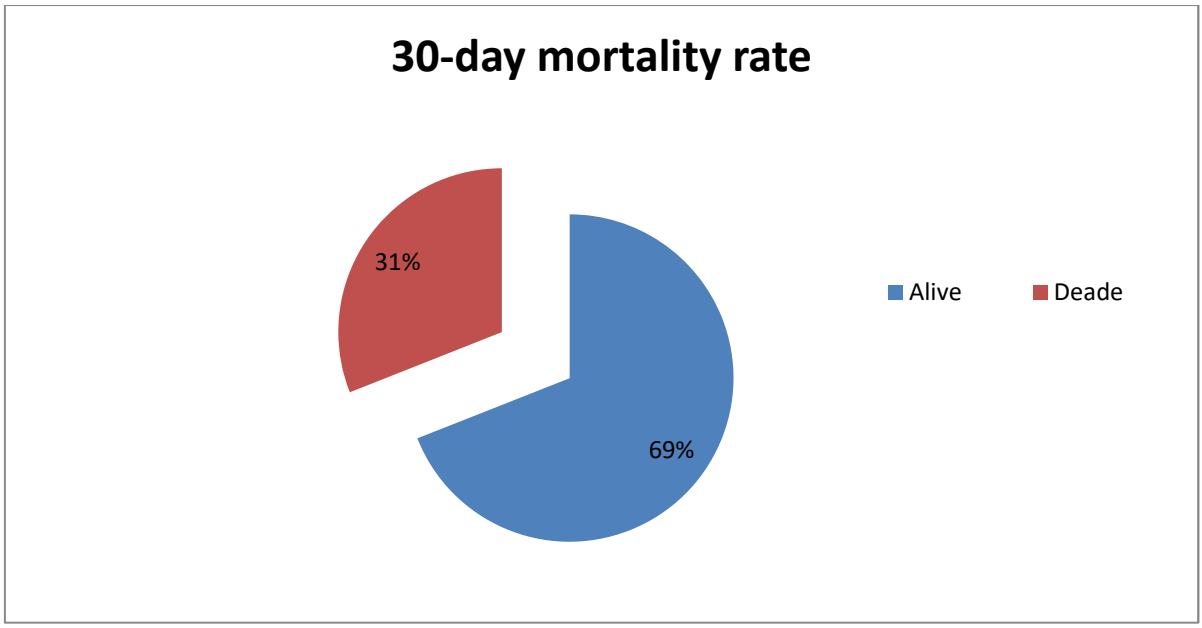

Figure 2: 30-days mortality rate of patients who visited St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Abeba Burn, Emergency & Trauma hospital (AaBET) Hospital between April 2024 and June 2024 GC

5.6 Mortality rate across different hematoma volume categories

As table 5 shows in my study, mortality rate differs in different hematoma volume categories. Patients with a hematoma volume of <30 ml have a mortality rate of 11.9%, and it increases as the hematoma volume increases, like patients with a hematoma volume of >=60 ml have a mortality rate of 70.6 %. This shows that the rise in hematoma volume increases the probability of death (Table 5).

Table 5: 30-day mortality with different hematoma volume categories of patients who visited St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Abeba Burn, Emergency & Trauma hospital (AaBET) Hospital between April 2024 and June 2024 GC

Variable	**Categories**	**30-day mortality**	
		Alive	Dead
Hematoma volume	< 30 ml	37 (88.1%)	5 (11.9%)
	30-59 ml	7 (58.3%)	5 (41.7%)
	>=60 ml	5 (29.4%)	12 (70.6%)

5.7 Mortality rate across different haemorrhage location categories

As table 6 shows in my study the mortality rate differs in different hemorrhage locations. Patients with hemorrhage on the basal ganglia have a mortality rate of 20% and patients with hemorrhage on the brain stem have a 53.8% mortality rate (Table 6).

Table 6: Mortality rate across different hemorrhage location categories of patients who visited St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Abeba Burn, Emergency & Trauma hospital (AaBET) Hospital between April 2024 and June 2024 GC

Variable	**Categories**	**30-day mortality**	
		Alive	Dead
Hemorrhage location	Basal ganglia	36 (80%)	9 (20%)
	Brainstem	6 (46.2%)	7 (53.8%)
	Lobar	7 (53.8%)	6 (46.2%)

5.8 Factors associated with a 30-day mortality rate

To find factors associated with 30-day mortality the binary logistic regression was done and nine variables with a significant level of P<0.2 were retained for subsequent multivariable logistic regression. These variables were age, history of hypertension, history of ICH, admission DBP, admission GCS, hematoma volume, presence of intraventricular extension, presence of hydrocephalus, and admission platelet count. After multivariable regression was done four variables were found statistically significant with P<0.05. These variables were history of ICH, admission GCS, hematoma volume, and admission platelet count.

The results in table 6 show that patients with a history of ICH are 18.67 times more likely to die within 30 days than patients who do not have history of ICH (AOR= 18.67 95%CI=1.18-294.61). This shows that the presence of a history of ICH increases the likelihood of death in 30 days.

Patients who were admitted with a GCS of 3-8 are 26 times more likely to die within 30 days than patients admitted with a GCS of 9-15 (AOR=26 95%CI=1.08-63.8). This shows that the decrease in admission GCS increases the likelihood of death in 30 days.

Patients with hematoma volume of <30ml have an 88% lower 30-day mortality risk than patients with hematoma volume of >=60ml (AOR= 0.12 95%CI=0.01-0.85). This shows that the increase in hematoma volume increases the likelihood of death in 30 days.

Individuals with normal platelet counts at admission have a 94.8% lower 30-day mortality risk than those with platelet counts below normal (AOR= 0.052, 95%CI=0.007-0.407). This shows that the decrease in platelet count during admission increases the likelihood of death in 30 days (Table 7).

Table 7: Bivariate and multivariate logistics regression analysis of factors associated with 30-day mortality who visited St. Paul's Hospital Millennium Medical College (SPHMMC) and Addis Abeba Burn, Emergency & Trauma hospital (AaBET) Hospital between April 2024 and June 2024 GC

Variable	**Categories**	**30-day mortality**		**COR (95% CI)**	**AOR (95% CI)**	**P-value**
		Dead (%)	Alive (%)			
Sex	Male	13 (35.1)	24 (64.9)	1.5 (0.544-4.16)		
	Female	9 (26.5)	25 (73.5)	1		
Age	30-44	9 (47.4)	10 (52.6)	2.475 (0.73-8.3)*	1.01 (0.11-8.95)	0.99
	45-59	5 (22.7)	17 (77.3)	0.8 (0.22-2.921)	1.45 (0.155-13.64)	0.742
	>=60	8 (26.7)	22 (73.3)	1	1	
History of HTN	Yes	16 (38.1)	26 (61.9)	2.35 (0.79-7.03)*	1.82 (0.31-10.69)	0.506
	No	6 (20.7)	23 (79.3)	1	1	
History of Diabetes	Yes	5 (35.7)	9 (64.3)	1.3 (0.38-4.48)		
	No	17 (29.8)	40 (70.2)	1		
History of ICH	Yes	13 (68.4)	6 (31.6)	10.3 (3.1-34.)*	18.67 (1.18-29.6) **	0.038
	No	9 (17.3)	43 (82.7)	1	1	

Admission SBP	<= 139	6 (28.6)	15 (71.4)	0.85 (0.27-2.59)		
	>= 140	34 (68)	16 (32)	1		
Admission DBP	<= 89	13 (26)	37 (74)	0.46 (0.16-1.13)*	0.19 (0.02-1.51)	0.118
	>= 90	9 (42.9)	12 (57.1)	1	1	
Admission GCS	3-8	8 (61.5)	5 (38.5)	5.02 (1.41-17.88)*	26 (1.08-63.8)**	0.045
	9-15	14 (24.1)	44 (75.9)	1	1	
Hematoma volume	< 30	5 (11.9)	37 (88.1)	0.056 (0.014-0.22)*	0.12 (0.01-0.85)**	0.034
	30-59	5 (41.7)	7 (58.3)	0.29 (0.06-1.4)*	0.25 (0.023-2.78)	0.262
	>= 60	12 (70.6)	5 (29.4)	1	1	
Presence of intraventricular extension	Yes	11 (45.8)	13 (54.2)	2.76 (0.97-7.9)*	0.33 (0.03-3.55)	0.362
	No	11 (23.4)	36 (76.6)	1	1	
Presence of hydrocephalus	Yes	8 (53.3)	7 (46.7)	3.42 (1.05-11.16)*	0.29 (0.01-7.63)	0.459
	No	14 (25)	42 (75)	1	1	
Hemorrhage	Basal ganglia	9 (20)	36 (80)	0.29 (0.07-		

location				1.08)		
	Brainstem	7 (53.8)	6 (46.2)	1.36 (0.29-6.36)		
	lobar	6 (46.2)	7 (53.8)	1		
Admission platelet count	Normal	9 (17.6)	42 (82.4)	0.11 (0.03-0.37)*	0.052 (0.007-0.407)**	0.005
	Below normal	13 (65)	7 (35)	1	1	

*=P< 0.2, **= P<0.05

6. DISCUSSION

The study involved 71 participants. The gender distribution was fairly even. The participants were, on average, middle-aged. A significant portion of the participants had a history of hypertension, which is consistent with several literatures(8,19,21,22,24). In contrast, most did not have a history of diabetes or intracranial hemorrhage. Physical examination results showed that a majority (70.4%) of the participants had elevated systolic blood pressure upon admission, and a smaller proportion (29.6%) had elevated diastolic blood pressure.

Our study examined the 30-day mortality rate among patients, revealing an overall mortality rate of 31%. This rate aligns with similar findings from research conducted in Australia (25). However, compared to other studies, this mortality rate is higher in some instances and lower in others. These results highlight the variability in 30-day mortality rates across different studies and suggest that factors such as patient demographics, healthcare quality, and specific treatment protocols may influence outcomes. A higher brain stem mortality rate of 53.8 % is seen, which is compatible with the studies done at (14,18). This discrepancy may be due to the sample size difference, the method used to analyze or the area of interest for the principal investigator, or because of a real difference in the quality of services provided.

The study investigated the impact of hematoma volume on 30-day mortality rates among patients. Results indicated a significant correlation between larger hematoma volumes and increased mortality within 30 days. Specifically, patients with larger hematoma volumes exhibited higher mortality rates compared to those with smaller volumes. This finding underscores the importance of early intervention and management strategies aimed at reducing hematoma size to improve patient outcomes within the critical first month post-injury. These results align with existing literature, highlighting hematoma volume as a crucial prognostic factor in patient survival (14,18,19,21).

The results indicate that a normal platelet count upon admission is a strong protective factor against 30-day mortality. Conversely, a below-normal platelet count is associated with a significantly higher risk of death within 30 days. This is consistent with a study done in Australia (25). Patients

with below-normal platelet counts may require closer monitoring and more aggressive interventions to mitigate the higher risk of mortality. Platelets play a crucial role in blood clotting and maintaining hemostasis, so a deficiency in platelet can lead to increased bleeding risk, including within the brain.

Patients with a history of intracerebral hemorrhage (ICH) are significantly more likely to experience 30-day mortality compared to those without such a history. Previous research has not separately analyzed the impact of prior ICH, making this finding particularly notable. This suggests that individuals with a history of ICH may require more intensive monitoring and management to address underlying causes and prevent recurrent hemorrhagic events. Furthermore, it underscores the necessity for continued research into preventive strategies and treatments tailored to individuals with a history of ICH.

The Glasgow Coma Scale (GCS) at admission is a well-established predictor of outcomes in patients with intracerebral hemorrhage. Lower GCS scores on admission typically correlate with higher severity of neurological impairment and poorer outcomes, including increased 30-day mortality. The data from our study supports this relationship, indicating that patients presenting with GCS scores <9 are at a significantly higher risk of mortality within the first 30 days.

In our study, Age did not show a strong independent association with 30-day mortality. This finding contrasts with a large retrospective study conducted in Thailand (26), which identified age as a prognostic factor after performing multivariable analysis. Our finding is also consistent with several other studies (16,18,20).

Hydrocephalous had not been found to have a strong independent association with 30-day mortality. While there is a general consensus that hydrocephalus can complicate the clinical course of ICH, its role as a consistent and independent prognostic factor for mortality remains debated? This might be attributed to differences in study design, patient populations, and the methods used to diagnose hydrocephalous. More extensive and standardized studies are needed to clarify its prognostic value fully.

The reliability of these data is influenced by confounding variables not accounted for in the study, such as random blood glucose levels, the presence of additional comorbidities, and serum electrolyte levels.

7. LIMITATIONS OF THE STUDY

As the study was retrospective record reviewing there was some incomplete and inaccurate data's. Since the study relies on previous recorded information, there were gaps and inconsistencies in the record that can impact the validity and reliability of the finding. Additionally, retrospective studies are often limited by the scope of the existing data, which may not include all variables of interest or detailed contextual information necessary for thorough analysis.

8. CONCLUSION

In conclusion, the 30-day mortality was higher than most study areas. Regarding this study, major predictors of 30-day mortality were history of ICH, admission GCS, hematoma volume, and admission platelet count.

In our study as hematoma volume increases the 30-day mortality rate increases, This shows that the rise in hematoma volume increases the probability of death

Additionally, lower platelet counts at admission correlate with higher 30-day mortality, highlighting the importance of early thrombocytopenia correction to enhance survival rates. Furthermore, lower GCS scores on admission are strongly linked to increased 30-day mortality, underscoring the necessity of prompt and accurate neurological assessment to guide treatment decisions effectively.

9. RECOMMENDATIONS

Based on the findings of our study on the effect of hematoma volume on the 30-day mortality rate of patients with hypertensive intracerebral haemorrhage (HICH), we recommend the following:

1. Early and Accurate Assessment: Clinicians should prioritize early and precise assessment of hematoma volume using advanced imaging techniques upon patient admission. This can aid in stratifying patients based on the severity of their condition and guide appropriate treatment strategies.

2. Standardized Protocols: Implementing standardized protocols for the measurement and documentation of hematoma volume across healthcare facilities will enhance the consistency and comparability of data, leading to more reliable clinical decision-making and research outcomes.

3. Targeted Interventions: Based on the correlation between larger hematoma volumes and higher 30-day mortality rates observed in our study, targeted interventions should be developed and tested to manage patients with significant hematoma volumes more effectively. This could include more aggressive medical or surgical treatments tailored to reduce hematoma expansion and mitigate adverse outcomes.

4. Prospective Multicentre Studies: Further prospective multicentre studies are needed to validate our findings and explore additional variables that may influence the relationship between hematoma volume and patient outcomes. Larger and more diverse patient populations will help to generalize the results and refine treatment guidelines.

5. Continued Monitoring and Research: Continuous monitoring of patient outcomes and on-going research into the mechanisms underlying HICH will be crucial in developing innovative approaches to reduce mortality rates. Future studies should also consider the impact of other factors such as patient demographics, comorbidities, and treatment modalities on the prognosis of HICH patients.

By implementing these recommendations, healthcare providers can improve the prognosis and survival rates of patients with Hypertensive ICH, ultimately enhancing the quality of care and patient outcomes in this critical area.

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Annex

Annex 1:Data Collection tool (English version)

	number	1	2	3	4	5	6	7	8
Age									
Sex	M								
	F								
Hypertension	Y								
	N								
Diabetes	Y								
	N								
Previous history of ICH	Y								
	N								
Admission BP	SBP								
	DBP								
GCS									
Hematoma volume									
Intraventricular extension	Y								
	N								

Location									
Hydrocephalous	Y								
	N								
Platlet count	N								
	Below Normal								
30 day mortality	D								
	A								

Annex 2- GCS Chart

Glasgow Coma Scale and Score (NICE 2003)		
Feature	Response	Score
Best eye response	Open spontaneously	4
	Open to verbal command	3
	Open to pain	2
	No eye opening	1
Best verbal response	Orientated	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No verbal response	1
Best motor response	Obeys commands	6
	Localising pain	5
	Withdrawal from pain	4
	Flexion to pain	3
	Extension to pain	2
	No motor response	1

Annex 3- Representative CT Scan

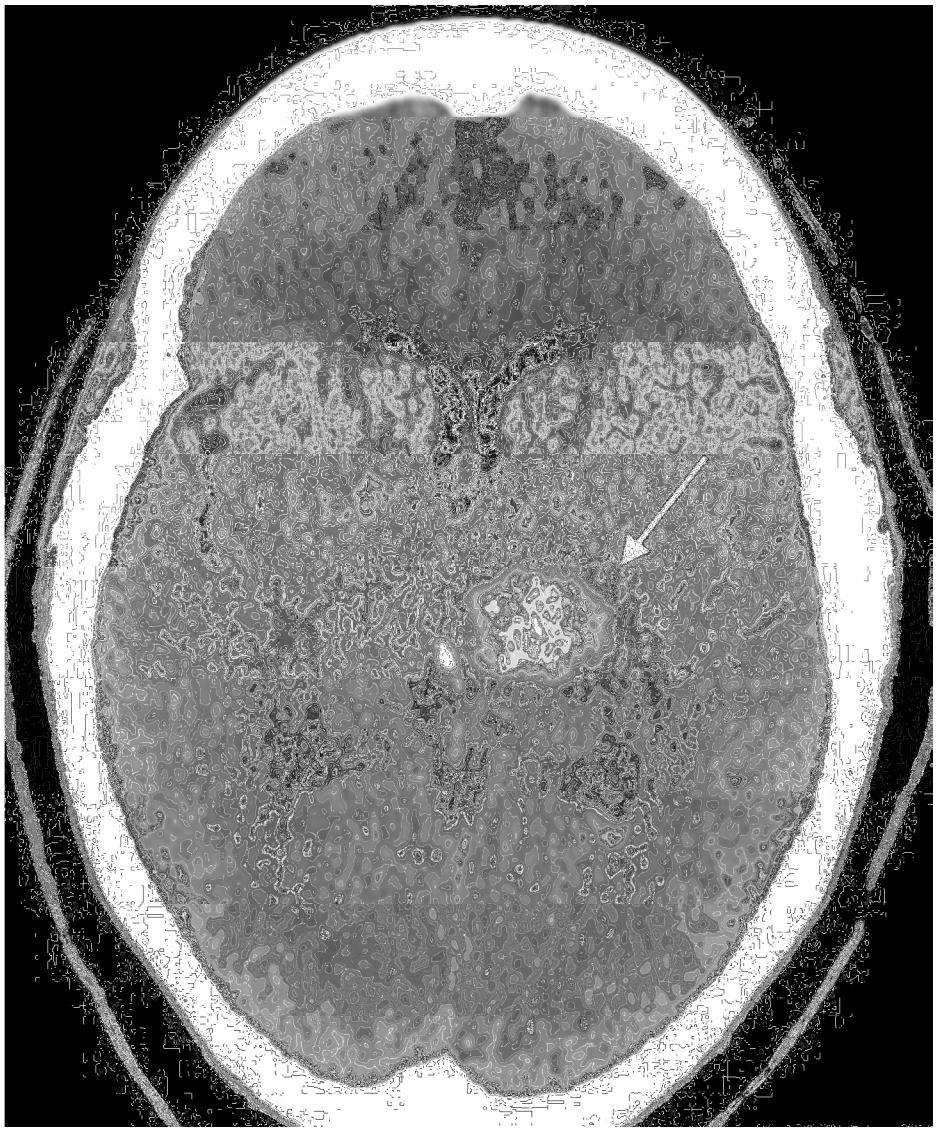

Figure 3- Left thalamic haemorrhage

Declaration

I, the principal investigator of this study, agree to accept all responsibilities for the scientific and ethical conduct of this research project.

Name of the student: _____

Signature: _____

Date: _____

Approval of the Primary Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

Approval of the Co-Advisor

Name of the Co-advisor: _____

Signature: _____

Date: _____