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CLINICAL EPIDEMIOLOGY OF PATIENTS ADMITTED WITH SPONTANEOUS INTRACEREBRAL HEMORRHAGE AT GEORGETOWN PUBLIC HOSPITAL CORPORATION: A CROSS-SECTIONAL STUDY

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ABSTRACT

Spontaneous intracerebral hemorrhage (sICH) is a critical public health issue in Guyana, yet local data remain limited. This retrospective cross-sectional study reviewed medical records of 59 adult patients admitted with sICH at Georgetown Public Hospital Corporation from October 1, 2023, to March 31, 2024, to assess prevalence, risk factors, clinical presentation, treatment, and outcomes. Of 137 stroke cases, sICH comprised 43.1%, predominantly affecting males (76.3%) aged 61-70 (30.5%), with hypertension (39%) as the leading risk factor. Most patients presented within 24 hours (58%) with altered mental status (50.8%), and 58% were discharged. Treatment adherence to guidelines was inconsistent, with only 10.1% receiving mannitol, hypertonic saline, antipyretics, and anti-seizure drugs. Despite early presentation, high prevalence and mortality underscore the need for improved prevention and management strategies in this setting.

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INTRODUCTION

Rationale and Background Information: Cerebrovascular accident (CVA), commonly known as stroke was defined by the World Health Organization as, "rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin." Although this definition was constituted in 1970, it is still widely accepted (Coupland *et al*., 2017). The American Heart Association and American Stroke Association in 2013 updated, stroke definition, which now includes silent infarctions (cerebral, spinal, and retinal) and silent hemorrhage (Sacco *et al*., 2013). There are two major categories of stroke: ischemic stroke is where a thrombus occludes blood flow to the brain, while hemorrhagic is where there is bleeding into the surrounding brain tissue as a consequence of a ruptured blood vessel. Hemorrhagic Cerebrovascular accident (HCVA) can be further subdivided into intracerebralhemorrhage (ICH) and subarachnoid hemorrhage (SAH). ICH is bleeding that occurs within the brain parenchyma, and SAH is where there is extravasation of blood into the subarachnoid space. Stroke is a major cause of morbidity, mortality, and also disability worldwide. The 2017 Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) supports the aforementioned statement as they revealed that CVA was the third most common cause of mortality and disability combined as well as the second-leading cause of death globally in 2017 (Safiri *et al*., 2019). Additionally, according to the World Stroke Organization, 12.2 million individuals are diagnosed with stroke every year around the world. These cases ultimately result in more than 143 million years of healthy life lost annually due to stroke-related mortality and disability. There are over 101 million individuals around the globe currently living and have experienced stroke (World Stroke Organization, 2022). Stroke is a life-threatening medical condition that not only places an immense burden on the families of the survivors but also the community and country as a whole. This is reflected as it is accountable for 42% of disability-adjusted life years of all neurological disorders and leads to longstanding disability in almost 50% of those who survive (Nutakki *et al*., 2021). Hemorrhagic CVA, particularly ICH, should not be overlooked as it is the second most common subtype of CVA and is notorious for its high morbidity and mortality (An *et al*., 2017). Of note, there are 3.4 million new cases of ICH each year, with nearly 3 million deaths annually. This is quite concerning due to the undesirable number of persons that are lost each year to ICH. As it pertains to SAH, 1.2 million people experience this per year, with more than 373,000 deaths each year (World Stroke Organization, 2022).

Guyana, the only English-speaking country located in South America, has been experiencing an increase in the burden of non-communicable diseases. These NCDs are the leading cause of death, responsible for 822 deaths per 100,000 persons annually. Cardiovascular disease accounts for the majority of deaths per year. However, in 2017, the leading causes of mortality were ischemic heart disease and stroke. Since 2007, stroke has increased by 17.8%. The age-adjusted CVA mortality rate in Guyana in 2006 was 87.6/100,000 (Sockalingam *et al*., 2021). Stroke is a major public health concern in Guyana, particularly hemorrhagic, because of its detrimental effects. However, significant gaps in knowledge in this area remain due to limited research conducted. As such, our research aimed to determine the prevalence, risk factors,and clinical presentation of spontaneous intracerebral hemorrhage (sICH) in patients presenting to the GPHC (the main referral hospital in the country) and evaluate the various treatment methods received by these patients and their outcomes.

LITERATURE REVIEW

Introduction: Hemorrhagic stroke poses a major public health challenge across local, regional, and global levels, as it leads to significant morbidity and mortality in affected patients. ICH has a 30-day mortality that ranges from 35% to 52%, which is alarmingly high and is approximated to be 5 times greater than the mortality for ischemic CVA (Smith *et al*., 2011).Hemorrhagic CVA is often associated with specific risk factors. These include hypertension, current smoking, excessive alcohol consumption, male sex, anticoagulation, antiplatelet therapy, old age, obesity, diabetes mellitus, and atrial fibrillation. Common clinical manifestations of HCVA are headaches, nausea, vomiting, hemiplegia, seizures, aphasia/speech impairment, focal neurological deficits, fatigue, loss of consciousness, and dizziness (An *et al*., 2017; Smith *et al*., 2017 & Safari *et al*., 2021). Upon diagnosis of HCVA, there are important pillars that management must be directed toward to achieve the best outcome for the patient. Principles of management include acute blood pressure control, reversal of anticoagulation and platelet dysfunction, management of elevated intracranial pressure (ICP), seizures, hyperglycemia, and oedema, as well as control of fever and venous thromboembolism prophylaxis (Thabet, 2017 & Montanoi *et al*., 2021). The outcome (death or discharge) of patients with HCVA depends on preexisting modifiable and non-modifiable risk factors as well as the presence of poor prognostic factors. Severe impairment on baseline examination, initial intracerebralhemorrhage of greater than 30 mL, expanding hematoma, preceding antithrombotic use, early withdrawal of support, and increasing age are all predictors of poor outcome with regards to hemorrhagic CVA (Unnithan 2023 & An *et al*., 2017).

Risk Factors: As it pertains to risk factors, hypertension has been identified as the strongest risk factor for both ischemic and hemorrhagic stroke but more so for HCVA. In HCVA, hypertension leads to bleeding in the penetrator arteries, which are exposed to high pressures as they branch at sharp angles (often at 90 degrees) off major intracerebral arteries (Rordorf, 2024). Namale*et al*. did a systematic review in Sub-saharan Africa and reported that patients with a blood pressure of >160/90 mmHg had an odds ratio (OR) of 3.80 for all strokes and an OR of 9.18 for developing HCVA. Similarly, the INTERSTROKE study that recruited 26,919 participants from 32 countries agreed with Namale*et al*. as they found that patients with previous hypertension or a blood pressure of more than 140/90 mmHg had an increased risk of developing a stroke (OR 2.98) (Namale *et al*., 2018). In addition, the INTERSTROKE study also highlighted that hypertension, diabetes mellitus, smoking, increased hip-to-waist ratio, and high alcohol intake were major risk factors for ICH as they accounted for 90% of the population-attributable risk (Zeng *et al*., 2017). Smoking, Alcohol intake, and obesity contribute indirectly to ICH as they contribute to hypertension (Rordorf, 2024). Rosales-Riamache *et al*. conducted an observational study in 2018-2019 that demonstrated that 57.6% of the patients were males, 37.9% had type 2 DM, and 34.5% were obese.

In addition to being male, old age (>69) is another non-modifiable risk factor that is associated with HCVA (Rosales-Riamache *et al*., 2023). This was demonstrated by a study by Kelly *et al*. in Germany (2014-2019), which found that 31,141 of 51,141 persons admitted for HCVA were 70 years and older. Anticoagulation and anti-platelet therapy also play a role in HCVA, particularly spontaneous ICH (Kelly *et al*., 2022). Depending on the intensity, patients on treatment with warfarin have a two to five-fold risk of developing an ICH, and persons with dual antiplatelet therapy (aspirin and clopidogrel) were more likely to develop an ICH when compared to persons on aspirin only (0.4% vs 0.2%) (An *et al*). Namale*et al*. also identified atrial fibrillation as a risk factor for all strokes, more so ischemic stroke than hemorrhagic stroke, as demonstrated by the pool prevalence of 9.6% vs 2.3% respectively (Namale *et al*., 2018). Acquiring knowledge about risk factors in patients is essentialto strengthen preventative measures for HCVA, hence why it is one of the major objectives of this study.

Clinical Presentation: The clinical manifestations of HCVA vary according to the size and location of the hemorrhage. Although the majority of cases of HCVA suddenly occur during routine activity, some bleeds occur with intense emotional activity and exertion (Van Etten *et al*., 2022.). Headache, nausea, and vomiting are common symptoms of ICH. Headaches are common in patients with increased intracranial pressure, large hematomas, and patients with blood in the cerebrospinal fluid (An *et al.,* 2017).Musung*et al*. conducted a study in the Republic of Congo involving 158 stroke patients and also found that headache (48.7%) was a common clinical sign. They also identified hemiplegia (63.3%), speech disorders (38.6%), dizziness (38.6%), fatigue (31.6%), facial paralysis (31.6%), unconsciousness (24%) and seizures (17%) as other prominent clinical signs of hemorrhagic stroke (Musung *et al*., 2022). Patients with intracranial hemorrhage can present with sudden onset focal neurological deficits, often associated with signs of increased intracranial pressure, including Cushing's triad and altered mental status. Of note, more than 20% of patients will deteriorate by 2 or more points in their Glasgow coma score from initial assessment by EMS to arrival at the emergency room (Thabet *et al*., 2017). Nutakki *et al*. also found that patients with hemorrhagic stroke are more likely to present with altered mental status at onset (47% hemorrhagic vs 27% ischemic vs 15% unknown stroke, $p<0.001$), and at 24 hours after stroke onset (20% hemorrhagic vs 4% ischemic vs 11% unknown strokes) (Nutakki *et al*., 2021). All things considered, it is of utmost importance that there is rapid assessment, diagnosis, and treatment of patients with HCVA.

Poor Prognostic Factors: Unfortunately, not all outcomes related to HCVA are favorable, and of note, there are specific factors that portend to a poor prognosis. Patients with severe impairment on baseline physical examination as measured by a Glasgow coma score (GCS) of less than 9 have elevated mortality rates. In addition to a low GCS, the initial intracranial hemorrhage volume is an important factor to consider when predicting the outcome of a patient with HCVA. In a study of 188 patients, the 30-day mortality of patients with a GCS of <9 and an ICH volume of 30 mL or less was 19%, while it was 75% in patients with an ICH of 60 mL or more (Rorodorf *at al*., 2024). Another factor that results in poor outcomes is enlargement of a hematoma. Davis *et al*. conducted a meta-analysis of 218 patients who had CT of the head within 3 hours and 24 hours of onset; for each 10% increase in hematoma volume, patients were 5% likely to die and 16 % less likely to have a good outcome (Chang, 2007). Patients on preceding anticoagulation therapy are not only at risk of developing a hemorrhagic stroke, but they are also at risk of having poor outcomes. This was demonstrated by Xian Y *et al*. who found that mortality was higher for patients who were on therapy with factor Xa inhibitors (2487 of 9202: 27.0%) and warfarin (7032 of 21430:32.8%) compared to 42,660 of 189,069 (22.6%) patients that were not on therapy with oral anticoagulants (Xian Y *et al*, 2022). Woo *et al*. as well as An *et al*. both agreed that patients of older age tend to have poorer outcomes than younger patients. This is likely because older patients tend to have more co-morbidities (Van Etten *at al.,* 2022). A prospective cohort study in which new do-not-

resuscitate (DNR) orders within the 5 days after ICH were avoided showed lower 30-day mortality, and many patients regained functional independence at 90 days (Morgenstern 2015). Oeinck*et al*. found similar patterns in 2010, as patients with early DNR had a 30-day mortality of 83.5%, while patients without early DNR had a 30-day mortality of 20.8% (Oeinck *et al.,* 2013). This stresses the importance of educating both the patient and their family.

Treatment Methods: It is paramount for early identification of HCVA followed by workup and treatment due to the detrimental effects that this condition poses. Regrettably, this condition is challenging for many physicians as there is no single therapy present to this date despite several years of research that can significantly improve mortality. However, some guidelines exist that provide a framework for management and care (Montaño *et al.,* 2021). As mentioned above, hypertension that is not well controlled is a major risk factor for HCVA. As an individual's blood pressure values worsen (more uncontrolled), their risk of HCVA increases as well; it has been linked to hematoma expansion and worse outcomes. When an ICH occurs due to hypertension, certain locations in the brain are more commonly affected than others; these include the putamen (46%), thalamus (18%), pons(13%),caudate(4%), and the cerebellum (4%) (Thabet *et al.,* 2017).

In HCVA, specifically non-traumatic ICH, the ideal blood pressure to target is debatable, and this has been a recent subject of investigation in randomized clinical trials. The aim generally is to minimize the expansion of the hematoma or, in other words, continued bleeding while simultaneously sustaining adequate cerebral perfusion pressure (CPP) (Montaño *et al*., 2021). In the Intensive Blood Pressure Reduction in Acute Cerebral Hemorrhage Trial 2 (INTERACT-2), there were a total of 2794 participants with ICH. This study compared intensive systolic blood pressure lowering to a target of ≤140 mmHg versus the control guideline group, which aimed for systolic pressure of ≤180 mmHg. Overall, the study found that early intensive blood pressure reduction (≤140 mmHg group) did not result in a significant decline in the rate of mortality or major disability; however, an ordinal analysis of scores on the modified Rankin scale showed that there were improvements in functional outcomes (Hill *et al*., 2013). In a similar study, the Antihypertensive Treatment of Acute Cerebral Hemorrhage II (ATACH-2) trial where patients with spontaneous supratentorial ICH were randomly placed on intensive blood pressure lowering to systolic blood pressure 110-139 (intensive treatment) versus systolic blood pressure 140-179 (standard treatment).

Ultimately, the intensive treatment group had a nonsignificant rate of lower mortality and major disability (no pronounced difference in functional outcome) as compared to the standard treatment group (Qureshi *et al*., 2016). The 2015 American Heart Association/ American Stroke Association (AHA/ASA) ICH guidelines state that for patients who present with systolic blood pressure between 150mmHg and 220mmHg and are without any contraindication to acute blood pressure treatment, then acute lowering of their systolic blood pressure to 140mmHg is safe and may be effective in lowering functional outcome (Hemphill *et al*., 2015). However, while it is deemed safe, as mentioned previously in the above trials, there is no outstanding decrease in mortality and morbidity. Hence, in the setting of ICH, the optimal blood pressure to aim for in the acute stage is still unclear. Nevertheless, there is a general agreement that overtly high blood pressure (generally >220mmHg) should be cautiously lowered on initial presentation. It is recommended that short-acting intravenous beta-blockers such as labetalol and calcium channel blockers such as nicardipine be used during the acute phase of management while avoiding hydralazine and nitrates since they lead to significant venodilation, impaired autoregulation, and intracranial pressure (ICP) elevation (Thabet *et al*., 2017).

Coagulopathy is another important risk factor for ICH, otherwise known as antithrombotic-associated ICH. It is more frequently associated with using vitamin K antagonists (VKA), popularly warfarin. There has also been an increasing use of direct oral anticoagulants (DOACs) such as factor Xa inhibitors:rivaroxaban, apixaban, and endoxaban, and direct thrombin inhibitor:dabigatran. Other causes of coagulopathy include heparin, congenital or acquired coagulation factor deficiencies, liver disease, and, to a lesser extent, antiplatelet agents (Montaño *et al*., 2021). The mainstay of managing coagulopathy in ICH patients lies in the correct use of reversal agents, which is still an area being investigated. In ICH, as caused by VKA, the international normalised ratio (INR) is elevated. Physicians usually then use the INR for guidance in managing these patients. The specific goal for INR is not clear; however, it should be corrected to less than 1.3 and definitely less than 1.5. The 2015 AHA/ASA guidelines recommend vitamin K-dependent factor replacement with correction of INR and intravenous vitamin K therapy. They also recommend usingprothrombin complex concentrate (PCC) over fresh frozen plasma due to its ability to correct the INR rapidly and result in fewer complications. Recombinant activated factor VIIa (rFVIIa) is not recommended for VKA reversal in ICH (Hemphill *et al*., 2015). This agrees with Thabet *et al*., who states that PCCs are now preferred, particularly the recent preparations which contain four clotting factors (II, VII, IX, and X) instead of the traditional 3 factors (II, IX, and X). Intravenous vitamin K should be given at the same time to prevent any rebound coagulopathy (Thabet *et al*., 2017).

As it relates to DOACs, there is insufficient evidence for specific reversal therapies. Treatment with Anti-inhibitor coagulant complex (FEIBA), PCCs, and rFVIIa can be considered depending on the patient. If dabigatran, apixaban, or rivaroxabanwere taken within a 2-hour period, then activated charcoal could be considered. Hemodialysis can be considered for dabigatran (Hemphill *et al*., 2015). Idarucizumab, a specific monoclonal antibody fragment, can be administered if dabigatran was usedwithin 3-5 half-lives and there is no concomitant renal failure (Montaño *et al*., 2021). In two randomised trials (ANNEXA-A and ANNEXA-R) conducted by Siegal *et al*., it was shown that Andexanetalfa, a recombinant Xa decoy protein, rapidly restored factor Xa activity, the generation of thrombin and reduced the concentrations of unbound factor Xa inhibitors in older patients treated with apixaban and rivaroxaban. This makes it a promising antidote for both direct and indirect factor Xa inhibitors (Siegal *et al*., 2015). In individuals with heparin-related ICH, protamine sulfate should be considered as the reversal agent. In patients who have been on antiplatelet medications (aspirin and clopidogrel), evidence to support the use of platelet transfusions remains unclear. If there is severe coagulation factor deficiency or severe thrombocytopenia, then patients should be treated with the appropriate coagulation factor or platelet replacement (Hemphill *et al*., 2015).

Mass Effect, perihematomaloedema, and hydrocephalus from intraventricularhemorrhage (IVH) all contribute to increased intracranial pressure (ICP) in ICH, which can be detrimental to the patient. Risk factors associated with increased risk of developing elevated ICP include younger age, supratentorial ICH, and IVH (Thabet *et al*., 2017 & Montaño *et al*., 2021). ICP is definitively monitored via the placement of an invasive ICP monitor. Initial standard management of elevated ICP includes elevation of the head of the bed to 30^{o}, administration of sedation agents, brief hyperventilation, and the use of osmotic agents such as mannitol and hypertonic saline (Magid-Bernstein *et al*., 2022). Seizures mostly occur within the first 24-48 hours after ICH, and studies suggest that clinical and electrographic seizures are a common phenomenon. Electroencephalographic monitoring is ideal for patients with an unexpectedly decreased level of consciousness (Thab *et al*., 2017). Clinical seizures should be treated. However, prophylactic anticonvulsant use is not recommended by the 2015 AHA/ASA guidelines (Hemphill *et al*., 2015). Fever is a typical occurrence in patients with ICH and has been shown to be associated with expansion of the hematoma and worse outcomes. Despite this, studies have not shown better outcomes in a setting of controlled normothermia. Nevertheless, fever should be treated in order to holistically care for the patient (Thabet *et al*., 2017). Most individuals who suffer from an ICH are bedridden or have reduced mobility afterward and, as such, are at an increased risk for venous thromboembolism (VTE). Hence, intermittent pneumatic compression

should be used to prevent VTE events from day 1 of admission. Low-dose subcutaneous low-molecular-weight heparin or unfractionated heparin may be considered after bleeding ceases for prevention in patients who are immobile after 1 to 4 days from onset. For those who develop symptomatic DVT or PE, IVC filter placement or systemic anticoagulation may be indicated. Hyperglycemia has an elevated risk of mortality and, subsequently, poor outcomes in these patients. Therefore, glucose levels should be monitored, and hyperglycemia and hypoglycemia should be prevented (Hemphill *et al*., 2015).

Conclusion

Hemorrhagic CVA poses a significant public health issue both locally and globally, particularly affecting persons with hypertension, excessive alcohol consumption, smoking, old age, anticoagulation, and diabetes mellitus, and is responsible for high morbidity and mortality in the population. This research aimed to determine the prevalence of sICH, the risk factors, clinical presentation, evaluate the treatment method received by patients and its correlation with current treatment guidelines, as well as the outcome (death or discharge) of patients with sICH. The information gathered will hopefully makean important contribution to Guyana's health sector, allowingfor more proficient diagnosis and management of sICH and, most of all, enabling the identification of risk factors and initiation of early preventative measures at the primary care level, which will possibly translate to lower morbidity and mortality.

Study Goals & Objectives

The study was conducted at the GPHC in patients admitted with sICHfrom 1st October 2023 to 31st March 2024 with the following objectives:

1. To determine theprevalence of sICH.
2. To determine the risk factors associated withsICH.
3. To determine the clinical presentation at admission of patientsdiagnosed withsICH.
4. To evaluate the treatment method received by patients diagnosed with sICH and its correlationwithcurrent treatment guidelines.
5. To determine the outcome (death or discharge) of patients diagnosed withsICH.

METHODOLOGY

Study design, patient population, and duration of study: A retrospective cross-sectional review of patient's medical records was carried out for patients who were admitted with sICH from 1st October 2023 to 31st March 2024 at GPHC.

Inclusion criteria: Patients ages 18 and above who were admitted and diagnosed with sICH to the Department of Internal Medicine at GPHC from 1 October 2023 to 31 March 2024.

Exclusion criteria

- Patients that were below the age of 18.
- Patients that were not within the specific time period of 1st October2023 to 31st March 2024.

Withdrawal criteria: Not Applicable.

Sample population size: Unable to calculate due to the following reasons:

1. Ethical approval was needed before the researchers could access the patient's data, which was needed to determine the sample size.
2. Archival data- the sample size was determined based on available data.

Data Collection Tool: Data acquisition was made using archival data collection methods, where access was requested to review the patient's medical charts within the inclusion criteria range. The data collection tool was a standardized form created in English on Google Forms (See Appendix). Data collected included the following:

Data Collection Tool: Demographics

- Unique Identifying Number
- Gender
- Age
- Occupation
- Ethnicity
- Timing of symptom onset to presentation
- Admitted to: Open ward, HDU, ICU

Data Collection Tool: Clinical Presentation

History

- Headaches
- Speech impairment
- Dizziness
- Seizure
- Nausea or vomiting
- Medication history: anticoagulation, antiplatelet, NSAID use
- Social history: Smoking and Alcohol consumption

Physical Examination

Vitals at triage:

- Hypertensive
- Hypertensive urgency/Emergency (> 180/110mmHg)
- Tachypnea (RR>20)
- Tachycardia (HR >100) or Bradycardia (HR <60)
- Fever (>38/100.4)
- SPO2

Cushing's Triad on admission
Facial weakness
Hemiplegia
Altered mental status: GCS
Comorbidities:

- Diabetes Mellitus or RBS > 200mg/dL at triage
- Hypertension
- Atrial Fibrillation

Data Collection Tool: Diagnostic Evaluation

- Glucose range:
- Renal impairment (Cr/CrCL):
- Cholesterol profile:
- Coagulopathy:
- Head imaging: location of the bleed (parenchymal, non-traumatic subarachnoid, and subdural), size, midline shift

Data Collection Tool: Management and Outcome

- Need for mechanical ventilation: ICU reviewed
- SBP at triage: >150-220 mmHg, lowered to <140mmHg within 1hr
- SBP at triage: > 220 mmHg , lowered to 140mmHg-160mmHg within 1hr
- Antihypertensive medications: name, number, route
- Blood pressure after 24 hrs
- Mannitol or hypertonic saline:

- Vitamin K:
- FFP:
- Platelet(<150,000):
- Protamine sulfate:
- Insulin:
- Anti-seizure medication:
- Surgical intervention:
- Patient Outcome: Alive or Died

Procedure: This project lasted 39 weeks, of which the first 13 weeks were dedicated to completing, correcting, and submitting the research proposal to the Institutional Review Board (IRB) of Guyana and the GPHC research board for approval. Once approval was granted, project implementation commenced. Four weeks were dedicated to data collection, and the remaining weekswere dedicated to data analysis and presentation.

Safety Consideration: To maintain confidentiality, a four-digit numeric code (starting with 1-001) called 'Unique Identifying Number' was designated to each patient's name in the Data Collection Table to prevent personal information from being revealed or utilized in the data analysis and presentation. Additionally, since medical records were used to acquire data, the researchers exercised caution when accessing the information, as the charts can be easily torn and dismantled.

Data Management and Statistical Analysis: Data gathered using the Data Collection Tool was stored on a laptop where all data analyses were performed, and an encrypted copy was stored on a password-protected drive. The password was known only to the principal researchers and the project supervisor. Steps were taken to ensure that the data onthe Google Sheets is 'clean'- a term used to refer to data free from inconsistencies, miscodes, and errors. This eliminated extra spaces, identified missing data, removed duplicates, highlighted errors, and checked spell-checked. The data obtained was tabulated, including the patients' demographics, clinical presentation, diagnostic evaluation, and management methods. Pie charts were used to compare the timing of symptoms, patients' outcomes (dead or alive), and antihypertensive required at discharge, and a bar graph showed the varying areas patients were admitted to. Categorical variables were reported as percentages.

The prevalence was calculated manually using the formula:

$$\frac{\#\ of\ persons\ with\ sICH}{Total\ population\ within\ sample\ frame} \times 100$$

Quality Assurance: To establish and uphold high quality and consistency in this research, the researchers evaluated and recorded all decisions, data collected, and measures taken concerning this study. All members were briefed on how to use the data collection tool. Discussion among all group members played an integral role in this research. This guaranteed the involvement of all members in the decision-making process at each stage to reduce errors, increase the credibility and validity of the research, ensure all records were correctly conveyed and stored, and prevent any loss or misplacement of data. Additionally, any decision taken to change the aim of the study was documented. To establish and guarantee transparency within the research methods, the staff monitored and documented the sessions when the members visited the Department of Records at GPHC. The data from the medical records was entered into the Data Collection Form on Google Forms and updated and backed up immediately.

Ethics: The following ethical principles helped uphold the integrity of this research.

1. **Ethical approval and permission:**Since data was collected via patient charts instead of live subjects, this was sought from the Ministry of Health's IRB, the Director of Medical and Professional Services (DMPS), and the Records Department of GPHC, respectively.
2. **Integrity:** Each researcher ensured this research was conducted honestly, without fabricating, falsifying, or plagiarizing data.
3. **Anonymity and Confidentiality:** Patients' names were de-identified using a unique code, and all information was shared among the researchers. All data collected was stored, backed up, and transferred in a safe manner using encrypted folders to prevent unauthorized access or loss. Additionally, upon completion of the study, all data was disposed of responsibly to protect participants from harm.

Results Presentation

Study Population and Prevalence: 137 CVA cases were found within the study period, 59 of which were sICH, accounting for a prevalence of 43.1% compared to Ischemic Stroke.

Demographic characteristics of patients with sICH: Most patients with sICH were within the age range of 61-70 (30.5%), whereas the minority of the patients were within the age range > 80 (3.4%). Furthermore, males accounted for most cases (76.3%), compared to females (23.7%) and Africans were more likely to have sICH compared to East Indians (39%) and Amerindians (5.10%). See Table 1.1.

Table 1.1. Shows the demographic characteristics of patients with sICH

Variables		Result
Age Range in Years	< 40	6.80%
	>80	3.40%
	40- 50	13.60%
	51- 60	27.10%
	61- 70	30.50%
	71-80	18.60%
Gender	Female	23.70%
	Male	76.30%
Ethnicity	African	45.80%
	Amerindian	5.10%
	Indian	39.00%
	Mixed	10.20%

Clinical features of patients with sICH: The majority of the study population presented to the hospital within < 24 hours of the onset of symptoms (58%), with only a minority presenting to the hospital one week or more after the onset of symptoms (10%). See Figure 1.1. Most patients presented with a combination of complaints (dizziness, seizures, speech impairments, nausea/vomiting and headaches) (44.1%), with only a minority presenting with nausea/ vomiting only (1.7%). Most patients used antiplatelets (15.3%), whereas a minority used NSAID (1.7%). See Table 1.2. Furthermore, most of the study population consumed alcohol and/or smoked (50.8%). Additionally, the most common co-morbid condition noted in the patients with sICH was hypertension (39.0%), followed by hypertension and diabetes (20.3%). See Table 1.2.

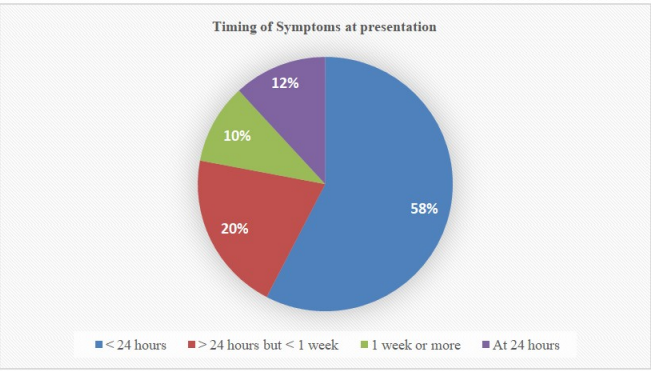

Figure 1.1. Shows the timing of symptoms at presentation

Table 1.2. Shows the clinical characteristics of patients presenting with sICH

Variables		Results
Chief Complaint	Dizziness only	0.00%
	Seizures only	6.80%
	Headaches only	6.80%
	Speech Impairment only	18.60%
	Nausea/ Vomiting only	1.70%
	Combinations of the above-mentioned complaints	44.10%
	Others	13.56%
	Unknown	8.44%
Medication History	Anticoagulation	3.40%
	Antiplatelets	15.30%
	NSAIDS	1.70%
	Unknown	8.40%
	None	71.20%
Social History	Alcohol	28.80%
	Smoking	5.10%
	Both	16.90%
	Unknown	8.50%
	None	40.70%
Comorbidities	Diabetes Mellitus	5.10%
	Diabetes Mellitus, Hypertension	20.30%
	Diabetes Mellitus, Hypertension, Atrial Fibrillation	1.70%
	Hypertension	39.00%
	Hypertension, Atrial Fibrillation	1.70%
	None	32.20%

On physical examination, most of the study population was in hypertensive emergency (11.9%) or was in hypertensive emergency and tachypneic (11.9%) at triage; however, no one presented with Cushing's triad (96.6%). Additionally, most persons with sICH had no detectable abnormalities on the neurologic examination (39.0%), followed by 25.4% of the study population with facial weakness and hemiparesis/ hemiplegia. Furthermore, 50.8% of the patients with sICH had an altered mental status, with a GCS of 9-12 (23.7%) or a GCS of 3-8 (27.1%). See Table 1.3.

Table 1.3. Shows the physical examination of patients with sICH

Variables		Results
Physical examination: Vitals at Triage	Hypertension (Blood Pressure: >140/90mmhg)	10.20%
	Hypertension (Blood Pressure: >140/90mmhg), Bradycardia (HR < 60)	3.40%
	Hypertension (Blood Pressure: >140/90mmhg), Tachycardia (HR > 100)	1.70%
	Hypertension (Blood Pressure: >140/90mmhg), Tachypnea (RR > 20)	10.20%
	Hypertension (Blood Pressure: >140/90mmhg), Tachypnea (RR > 20), Bradycardia (HR < 60)	3.40%
	Hypertension (Blood Pressure: >140/90mmhg), Tachypnea (RR > 20), Oxygen Saturation (< 95%)	1.70%
	Hypertension (Blood Pressure: >140/90mmhg), Tachypnea (RR > 20), Tachycardia (HR > 100)	3.40%
	Hypertension (Blood Pressure: >140/90mmhg), Tachypnea (RR > 20), Tachycardia (HR > 100), Fever (Temperature > 38 c/ 100.4 f)	1.70%
	Hypertension (Blood Pressure: >140/90mmhg), Tachypnea (RR > 20), Tachycardia (HR > 100), Oxygen Saturation (< 95%)	5.10%
	Hypertensive Emergency (Blood Pressure: > 180/110mmhg)	11.90%
	Hypertensive Emergency (Blood Pressure: > 180/110mmhg), Tachycardia (HR > 100)	3.40%
	Hypertensive Emergency (Blood Pressure: > 180/110mmhg), Tachypnea (RR > 20)	11.90%
	Hypertensive Emergency (Blood Pressure: > 180/110mmhg), Tachypnea (RR > 20), Tachycardia (HR > 100)	6.80%
	Hypertensive Emergency (Blood Pressure: > 180/110mmhg), Tachypnea (RR > 20), Tachycardia (HR > 100), Fever (Temperature > 38 c/ 100.4 f)	1.70%
	Hypertensive Emergency (Blood Pressure: > 180/110mmhg), Tachypnea (RR > 20), Tachycardia (HR > 100), Fever (Temperature > 38 c/ 100.4 f), Oxygen Saturation (< 95%)	1.70%
	Hypertensive Emergency (Blood Pressure: > 180/110mmhg), Tachypnea (RR > 20), Tachycardia (HR > 100), Oxygen Saturation (< 95%)	3.40%
	Normal	10.20%
	Oxygen Saturation (< 95%)	1.70%
	Tachycardia (HR > 100)	1.70%
	Tachycardia (HR > 100), Fever (Temperature > 38 c/ 100.4 f)	1.70%
	Tachypnea (RR > 20)	3.40%
Cushing`s Triad	Intubated	3.40%
	No	96.60%
Neurologic Examination	Facial Weakness	13.60%
	Facial Weakness, Hemiparesis/Hemiplegia	25.40%
	Hemiparesis/Hemiplegia	22.00%
	No abnormalities detected	39.00%
AMS/Orientation	Altered Mental Status	50.80%
	Oriented to Person	3.40%
	Oriented to Place, Person	1.70%
	Oriented to Time, Place, Person	44.10%
GCS	13-15	49.20%
	9-12	23.70%
	3-8	27.10%

Laboratory evaluation and imagining of patients with sICH: The majority of the study population had no derangement in laboratory values (38.9%), whereas only 16.9% presented with renal impairment (creatinine >1.4 mg/dl) or renal impairment (creatinine > 1.4 mg/dl) and hyperglycemia (RBS > 200mg/dl) (13.6 %), and only 1.7% presented with hyperglycemia (RBS > 200 mg/dl), and thrombocytopenia (platelets < 150, 000). See Table 1.4. Furthermore, most patients with sICH had intraparenchymal bleeds, with no cerebral edema or midline shift noted (44.07%), and only a minority of patients had subdural bleeds accompanied by cerebral edema only (1.69%) or cerebral edema and midline shift (1.69%). See Table 1.5.

Table 1.4 shows the laboratory evaluation of patients with sICH

Laboratory Evaluation	Percentage (%)
Coagulopathy (Elevated PT/PTT/INR)	10.2
Hyperglycemia (RBS > 200mg/dl)	11.9
Hyperglycemia (RBS > 200mg/dl), Renal Impairment (Creatinine > 1.4mg/dl)	13.6
Hyperglycemia (RBS > 200mg/dl), Thrombocytopenia (Platelet <150, 000)	1.7
No Abnormal Laboratory Values	38.9
Renal Impairment (Creatinine > 1.4mg/dl)	16.9
Renal Impairment (Creatinine > 1.4mg/dl), Thrombocytopenia (Platelet <150, 000)	3.4
Thrombocytopenia (Platelet <150, 000)	3.4

Management and outcome of patients with sICH: Most patients with sICH were admitted to the open ward (47), with only 2 admitted to the intensive care unit (ICU). See Figure 1.2.

Table 1.5. Shows the location of the bleed on imaging for patients with sICH

		Bleeding Severity on Imaging			
		Cerebral Edema	Midline Shift	Midline Shift, Cerebral Edema	None Detected
Location of the Bleed on Imaging	Intraparenchymal	35.60%	6.78%	6.78%	44.07%
	Multiple sites	0	0	0	3.39%
	Subdural	0	1.69%	1.69%	0

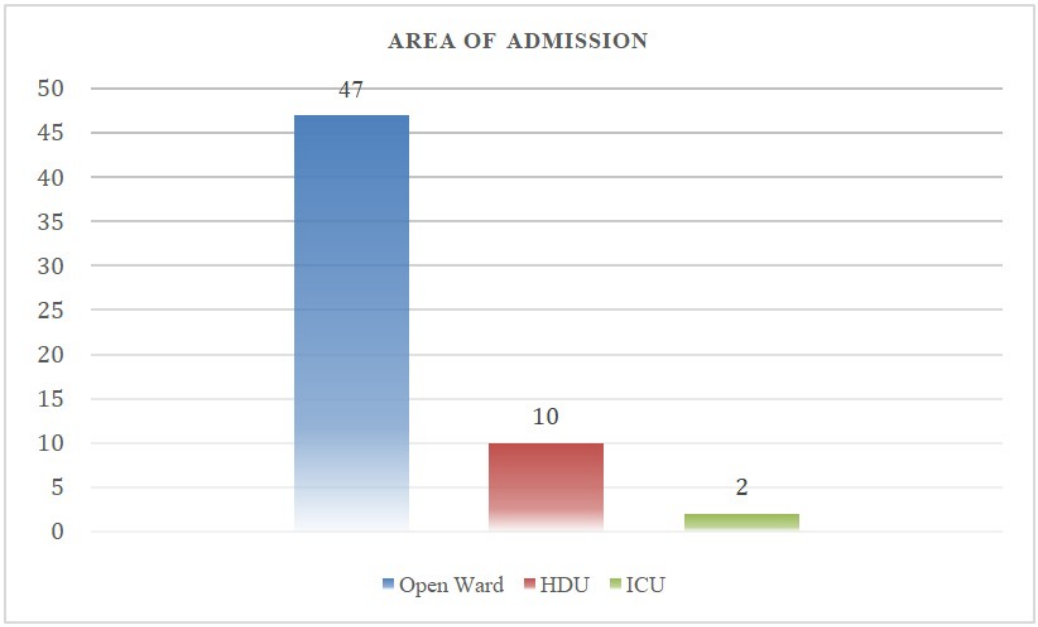

Figure 1.2 shows the area of admission for patients with sICH

Table 1.6. Shows the various management methods used in the patients with sICH

Management	Results (%)
Antipyretics was required	10.1
Antipyretics was required, Antiseizure Medication was required	5.1
Antiseizure Medication was required	6.8
Insulin was required	5.1
Insulin was required, Antiseizure Medication was required	1.7
Mannitol or Hypertonic Saline was required	8.5
Mannitol or Hypertonic Saline was required, Antipyretics was required	6.8
Mannitol or Hypertonic Saline was required, Antipyretics was required, Antiseizure Medication was required	10.1
Mannitol or Hypertonic Saline was required, Antiseizure Medication was required	3.4
Mannitol or Hypertonic Saline was required, Insulin was required, Antipyretics was required	3.4
Mannitol or Hypertonic Saline was required, Insulin was required, Antipyretics was required, Antiseizure Medication was required	1.7
Mechanical or Invasive Ventilation was required	1.7
Mechanical or Invasive Ventilation was required, Mannitol or Hypertonic Saline was required	1.7
Mechanical or Invasive Ventilation was required, Mannitol or Hypertonic Saline was required, Antipyretics was required, Antiseizure Medication was required	1.7
Mechanical or Invasive Ventilation was required, Mannitol or Hypertonic Saline was required, Antiseizure Medication was required	3.4
Mechanical or Invasive Ventilation was required, Mannitol or Hypertonic Saline was required, Insulin was required, Antiseizure Medication was required	1.7
Others	20.3
SBP at Triage > 150-220mmhg and lowered to <140 mmhg within 1 hr, Insulin was required	1.7
SBP at Triage > 150-220mmhg and lowered to <140 mmhg within 1 hr, Mannitol or Hypertonic Saline was required	1.7
SBP at Triage > 150-220mmhg and lowered to <140 mmhg within 1 hr, Mannitol or Hypertonic Saline was required, Antiseizure Medication was required	1.7
SBP at Triage > 220mmhg and lowered to <140 – 160 mmhg within 1 hr, Surgical Intervention was done, Antiseizure Medication was required	1.7

Additionally, most patients required other methods of treatment (20.3%), followed by 10.1% requiring antipyretics only and 10.1% requiring mannitol or hypertonic saline, antipyretic, and antiseizure medications. See Table 1.6. Furthermore, the majority of the patients with sICH were discharged (58%) (See Figure 1.3), with the majority requiring two antihypertensives at discharge (38%) and the minority requiring more than three (9%). See Figure 1.4.

DISCUSSION

Overall this study sought to establish the clinical epidemiology of patients admitted with spontaneous intracerebral hemorrhage.

Based on the results, the prevalence of sICH was high with regards to ischemic stroke, however ischemic CVA still accounted for the vast majority of CVA cases within our study period. The bulk of our study population presented to the hospital within 24 hours and were within the age range of 61-70. The most frequent clinical presentations were dizziness, seizures, speech impairment, nausea/vomiting and headache.The majority of patients were male and most consumed alcohol. Additionally, hypertension and diabetes mellitus were the predominant co-morbidities. As it relates to treatment, nearly all of the patients were admitted to the open ward and appropriate blood pressure lowering, a pivotal aspect of management, was only performed in a few cases.

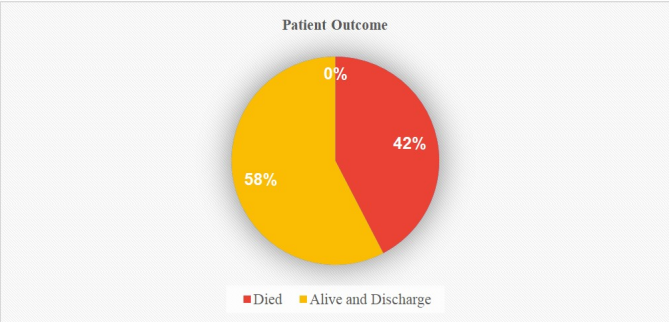

Figure 1.3. Shows the outcomes of patients with sICH

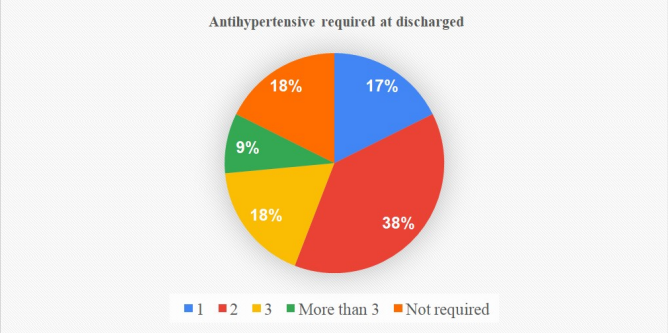

Figure 1.4. Shows the number of antihypertensive required at discharge

The preponderance of cases were discharged and required two anti-hypertensive medications to adequately control their blood pressure. Globally, hemorrhagic CVA particularly ICH, places an immense burden on the health care sector. Importantly, our study found that just under half of the CVA cases were sICH. This is in agreement with a study conducted by Lim et al., who found that a similar value, however the WHO fact sheet 2022 stated that only a fifth of the stroke cases were attributed to sICH (Lim et al., 2023, World Stroke Organization, 2022). With regards to age, most persons were within the age range of 61-70 in our study population, which is slightly younger when compared to studies conducted by Rosales-Riamache et al., and Kelly et al., who found majority cases being 70 years and older. (Rosales-Riamache et al., 2023, Kelly et al., 2022) Of note, however, the fact that Guyana's life expectancy in 2021 is 66.1 years should be taken into account (World Health Organization, 2024). Males were more than three times likely to have sICH than females thus solidifying the male gender as a risk factor for sICH. Additionally, the most common ethnicity was found to be persons of African descent followed by persons of East Indian descent. This predominance can be due to the fact that 69% of the country's population is either from these two ethnicities (Bureau of Statistics, 2016).

There are several factors that increase an individual's risk for developing HCVA, of substance, hypertension poses the strongest risk for developing HCVA. In our study nearly two-fifths of patients had hypertension as their only risk factor and an additional 20% had both hypertension and diabetes mellitus. Therefore, this research found that more than half of persons presenting with sICH had hypertension as a risk factor while a quarter had diabetes mellitus. Concurrently in a case control and case series study spanning a period of 36 years in Sub-Saharan Africa, hypertension was present in almost three quarter of HCVA cases (Namale et al., 2018). Another study found 68.9% of participants had hypertension and 37.9% had diabetes mellitus (Rosales-Riamache et al., 2023). Smoking and alcohol consumption contribute to the development of the well-established risk factor of sICH; hypertension (Rordorf et al., 2024). This aligns with our findings, where half the patients smoked, consumed alcohol, or both. The researchers in this study recommend more widespread health promotion and stringent screening programmes beginning at the primary level of care to identify both hypertension and diabetes mellitus. This would facilitate early initiation of appropriate life style modifications and treatment to prevent progression to adverse events such as a sICH. Also continuing health promotion efforts towards the cessation of smoking and limiting alcohol consumption. Prior anticoagulation and antiplatelet use are critical risk factors that contribute to ICH, particularly with the increasing rates of use among the elderly population. This is reiterated in studies done by An et al., and Kelly et al., who conferred that both anticoagulation and antiplatelet therapy increases risk (An et al., 2017, Kelly et al., 2022). However, this research found most persons diagnosed with ICH were not on therapy with either. Anticoagulation and antiplatelet use only accounted for a fifth of the study population and those without any prior medication history were more than three times more likely to develop a sICH. Atrial fibrillation is a recognized risk factor for ischemic stroke and to a lesser degree for hemorrhagic stroke as demonstrated in a meta-analysis conducted in Sub-Saharan Africa (Namale et al., 2018). Patients presented with atrial fibrillation in conjunction with both hypertension which are both established risk factors for HCVA, therefore, it is unclear whether atrial fibrillation contributed to development of sICH.

In ICH one of the main mechanisms of brain injury occurs via expansion of the hematoma formed and perilesional edema; both of which ultimately leads to increased intracranial pressures (ICP) (Rordorf et al., 2024). This study revealed that the most common presentations were either a single symptom of increased ICP or a combination of clinical manifestations consistent with increased ICP. Most patients presented within less than 24 hours of symptom onset. This could have been attributed tothe fact that majority of the Guyanese population are centralized and as such can access GPHC in a timely manner. Also services provided at this institution are free of cost. Lastly a vast majority of our population are able to recognize initial presentations of a stroke particularly, hemiparesis and speech impairment, thus, facilitating immediate transport to a medical facility. To reiterate the significance of hypertension in sICH, more than three quarter of our population were hypertensive on presentation with 40.8% being in hypertensive emergency. Of note, no one presented with Cushing's triad and half of the patients had altered mental status with a GCS of 12 and below. This correlates with a retrospective study done in Zambia where individuals with HCVA were more likely to present with altered mentation than those who with an ischemic CVA (Thabet et al., 2022). Hemiparesis/hemiplegia in combination with facial weakness was present in a quarter of patients and hemiparesis/hemiplegia was the only physical examination abnormality in 22 %. Thus, hemiparesis/hemiplegia was present in just under half of the patient population. Musung et al., found a significant amount of persons with this neurological abnormality in their study (Musung et al., 2022) indicating this is a prominent physical finding in persons with sICH.
Ideally any individual with an acute sICH should be admitted to a tertiary institution with an intensive care unit or designated stroke unit. This is of importance since these patients are at risk of neurologic deterioration due to adverse events such as hematoma expansion, elevation in ICP, seizures or brain herniation (Rordorf et al., 2024). In contrast to the recommended admission guidelines, majority of our study population were admitted to the open ward. This may be attributed to the fact that GPHC does not have a designated stroke unit and personnel trained in neurocritical care to manage these patients. At initial management airway maintenance always takes precedence, therefore, we need to rapidly assess the patient's ability to protect their airway. In this study, 27.1 % presented with a GCS of 8 or less but surprisingly only 10.2% of patients were intubated. In patients with sICH, the tamponade effect produced by the rigid cranial vault in combination with the intrinsic hemostatic pathways are usually sufficient to stop the bleeding that occurs in a sICH. However, factors such as antithrombotic medications and uncontrolled blood pressures delay this process. At GPHC, 3.4% of patients that presented within our study period were on anticoagulation therapy but on analysis of treatment administered, no one received any reversal agent. Uncontrolled blood pressure was the most common premorbid condition found in individuals with sICH. In keeping with Hemphill et al., from the American Heart

Association/American Stroke Association, the systolic blood pressure (SBP) should be kept within an appropriate range to prevent undesired complications (Hemphill et al., 2015). Although a specific blood pressure target is debatable, as demonstrated by the INTERACT-2 and ATACH-2 trials, it was found that intensive lowering of blood pressure resulted in better functional outcomes (Hill et al., 2013, Qureshi et al., 2016). Of note, at presentation more than three quarter of the patients presented with uncontrolled hypertension, however, the SBP was only lowered appropriately in 6.8% of cases. Since adequate blood pressure control is vital within the first hour this finding may indicate a possible knowledge gap with the management of these patients within the initial hour with regard to their blood pressure control. An acute ICH increases the risk for progressive neurologic impairment from compression of brain tissue as a result of increased ICP. In keeping with this risk, specific measures should be put in place to mitigate morbidity associated with increased ICP. For those who do not require immediate surgical evaluation, appropriate measures would include elevation of the head of the bed to 30^0, administration of sedation agents, brief hyperventilation, use of antipyretics and osmotic agents such as mannitol or hypertonic saline. In our study, there was no clear documentation of patients who had increased ICP. This may be due to the fact that there isn't any documentation of fundoscopy being done. However, the finding of midline shift on CTscan would have been indicative of increased ICP. Hence the reason for two fifths of the patients being treated with an antipyretic and mannitol or hypertonic saline. This then highlights the role for fundoscopy in patients with an acute ICH, as itcan be helpful in identifying signs of increased ICP in those who might have initially had no midline shift on CT scan. Additionally, just over a half of patients presented with either seizures as the only clinical manifestation or in combination with other manifestations and anti-seizure medications were administered in 39% of cases. This is not in accordance with the AHA/ASA guidelines which recommend, that any patient with a sICH who have had a seizure should be treated with anti-seizure medication to prevent the risk of recurrent seizures (Hemphill et al., 2015). Any individual who has had an acute ICH is at an increased risk for medical complications as a result of preexisting comorbidities or associated immobility. At evaluation, approximately over a quarter of patients were hyperglycemic and insulin were required in 15.3 % of cases. This was appropriate management as hyperglycemia after a stroke is associated with adverse outcomes (Rordorf et al., 2024). Other preventative measures are needed to decrease the risk of broncho-aspiration, ventilator-associated pneumonia, venous thromboembolism and pressure induced skin injury, however, these were not assessed in our study and we recommend further studies for investigation.Finally, our study showed a 42% mortality rate among sICH patients, aligning with a similar range as the study conducted by Smith et al and further emphasizes the significant mortality associated with sICH. (Smith et al. 2011)

Strength and Limitation: As strength, our study was conducted at GPHC, which is the main referral hospital in Guyana, thus it included all the referral cases from the varying district and regional hospitals across the country. As a limitation of the study, the data collection was retrospective; as such, medical records were missing entirely, some data were not available in some patient charts, and some patients' charts were incorrectly filed. Therefore, we recommend that future researchers gather patients' clinical records mainly from a computerized database management system to minimize errors. Furthermore, the sample size was small, as it only covered a6-month period.As such, a longer duration and a larger sample size can be recommended, as they would give a more accurate reflection of the hospital prevalence of sICH. Additionally, the current study was a hospital-based study, so it may be difficult to generalize the findings to the country. Thus, we recommend that future studies collaborate withGPHC andPrivate Medical Institutions for a true reflection.

CONCLUSION

This study reveals a 43.1% prevalence of sICH among stroke cases at GPHC, with 42% mortality despite early presentation (<24 hours) and a 58% discharge rate. Key risk factors—advancing age, male gender, hypertension, diabetes, smoking, alcohol use, and antithrombotic therapy—drive these outcomes, compounded by inconsistent guideline adherence. These findings underscore the urgent need for enhanced preventive strategies, stricter treatment protocols, and specialized care units in Guyana, offering a foundation for reducing sICH's toll in resource-limited settings.

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