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Original Research Article

Comparison of Outcomes and Factors Responsible for the Difference in Outcomes of Patients With Ischemic Versus Hemorrhagic Stroke

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Abstract: *Stroke remains a leading cause of morbidity and mortality worldwide. Understanding stroke types' distribution and associated risk factors is essential to improve prevention and treatment strategies.* ***Objective:*** *To assess the frequency of different types of stroke, identify the factors contributing to stroke, evaluate their outcomes, and compare the prevalence of these factors across various stroke types.* ***Methods:*** *The study, conducted at The Aga Khan University Hospital from 1st July to 31st December 2023; included male and female patients aged 30 to 85 years admitted with a first ischemic or hemorrhagic stroke. Exclusion criteria were previous stroke, transient ischemic attacks, normal radiology, or intracranial hemorrhage due to brain tumor, trauma or post-surgery. Data was collected via a proforma with patient details, stroke confirmation, and risk factors (diabetes, hypertension, ischemic heart disease, dyslipidemia, and atrial fibrillation). Outcomes were assessed using the Modified Rankin Scale (mRS). Data analysis was performed using SPSS, comparing ischemic and hemorrhagic stroke subgroups using the t-test and post-stratification analysis via the chi-squared test, with significance set at $p \leq 0.05$.* ***Results:*** *A total of 140 patients with a first episode of stroke (ischemic or hemorrhagic) were enrolled, with 89 males and 51 females. The mean age was 60 ± 14.03 years, and the stroke types were evenly split: 50% ischemic (70 cases) and 50% hemorrhagic (70 cases). Diabetes was present in 56% of participants, and hypertension in 82%. Ischemic heart disease affected 35%, atrial fibrillation 17%, and dyslipidemia 42%. Diabetes was significantly associated with ischemic stroke ($p = 0.041$), while hypertension ($p = 0.825$), ischemic heart disease ($p = 0.595$), and atrial fibrillation ($p = 0.178$) showed no significant association. Dyslipidemia had a highly significant association with ischemic stroke ($p = 0.000$). The mean Modified Rankin Scale (mRS) score for ischemic stroke patients was 2.16 ± 1.519, indicating slight to moderate disability, while hemorrhagic stroke patients had a higher mean score of 4.50 ± 1.164, reflecting more severe disability ($p = 0.000$). Ischemic stroke patients had a shorter mean hospital stay (3.04 ± 1.324 days) compared to hemorrhagic stroke patients (6.73 ± 4.603 days), with this difference being statistically significant ($p = 0.000$). Of the 140 patients, 14 died, with cardiopulmonary arrest being the leading cause of death (12 cases), followed by hypoxic respiratory failure/aspiration pneumonia and respiratory failure (1 case each).* ***Conclusion:*** *The study highlights the need for further investigation into hypertension and ischemic heart disease while reinforcing that hemorrhagic strokes cause more severe disability and prolonged recovery times.*

Keywords: Ischemic stroke, Hemorrhagic stroke, Frequency, Outcomes, Risk factors

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Introduction

Stroke stands as one of the world's most significant health problems that causes substantial mortality as well as long-term disability. Stroke creates considerable harm to millions of people globally because the number of affected individuals keeps growing from aging populations combined with increasing lifestyle related diseases (1). Stroke stands as the leading reason for both mortality rates and disability throughout the world since it substantially affects global health outcomes. The World Health Organization (WHO) reports stroke ranks as the second cause of worldwide fatalities producing 11% of global fatalities (2). Over 6.6 million people died from stroke while brain damage caused a total of 143 million disability-adjusted life years (DALYs) in 2019 according to the Global Burden of Disease (GBD) study (2). Stroke exists in two forms: ischemic and hemorrhagic which present different origins of damage and distinct medical features and end results (3). The vast majority of stroke cases (approximating 87%) occur as ischemic stroke (3). Although the risk factors overlap between stroke types they produce different underlying consequences with unique harm patterns. Proper prevention methods alongside treatment and rehabilitation strategies benefit from understanding how commonly stroke types occur and their risk factor patterns.

Stroke types differ among populations according to age, gender, ethnicity, and local health conditions and demographic distributions. Hemorrhagic strokes appear more frequently than ischemic strokes specifically in populations with high hypertension levels (4). Problems related to healthcare access and high blood pressure management in a particular region can lead to increased hemorrhagic stroke rates within that area. The potential risks for stroke differ according to age groups since older adults experience a higher susceptibility to ischemic strokes yet younger people encounter elevated risks for hemorrhagic strokes because of trauma or genetic factors (5). The correct understanding of stroke distribution frequencies enables healthcare organizations to allocate resources and develop prevention programs best suited for diverse population needs. Various elements which are both changeable and unalterable contribute to the development of stroke. Hypertension stands as the leading risk component which increases the chances of stroke whether it is ischemic or hemorrhagic (6). Atrial fibrillation along with diabetes and smoking elevated cholesterol levels and poor diabetes control represent key major stroke risk factors (7). Health-related decisions that involve unhealthy eating habits coupled with insufficient exercise and heavy alcohol consumption enhance the risk of stroke occurrence. The risk of experiencing a stroke depends greatly on unchangeable characteristics including age as well as gender and genetic predispositions. Studies on risk factor prevalence and stroke-type associations allow researchers to establish prevention measures that confront both personal lifestyle changes and community-wide public health impact (8).

The outcome of stroke depends on the stroke type together with the extent of brain damage and the speed of medical treatment. The disability impact from ischemic strokes is usually higher than the consequences of hemorrhagic strokes because of bleeding and pressure increase (9).The knowledge of stroke risk factors and types enhances both prevention and patient care and treatment outcomes which leads to improved quality of life after stroke (10).

Analysis of outcomes and determining the contributing factors to ischemic and hemorrhagic stroke aid in improving patient care and developing efficient medical strategies. Healthcare professionals who understand stroke differences can make better predictions of outcomes while tailoring treatment for each patient which leads to improved stroke patient life quality.

Methodology

The study was conducted at The Aga Khan University Hospital, Department of Medicine, over six months, from 1st July 2023 to 31st December 2023 after the approval of the Ethical Review Committee and CPSP. The study included both male and female patients, aged 30 to 85 years, who were admitted with a first episode of ischemic or hemorrhagic stroke. Exclusion criteria were patients with a previous history of stroke, transient ischemic attacks, normal radiology (CT or MRI), or intracranial hemorrhage secondary to a brain tumor, trauma or post-intracranial surgery. Data was collected using a predesigned proforma, which included patient details such as ID, sex, age, previously diagnosed comorbid conditions and stroke confirmation (via CT or MRI for ischemic). Ischemic stroke was defined as a neurological deficit stroke due to brain ischemia, identified by hyperintense areas on Diffusion Weighted Imaging (DWI) and corresponding dropout on Apparent Diffusion Coefficient (ADC) MRI, while hemorrhagic stroke was defined by hyperdense lesions on CT. Risk factors, including diabetes (HbA1c ≥ 6.5% or on anti-diabetic drugs), hypertension (systolic >140 mmHg, diastolic >90 mmHg), ischemic heart disease (history of myocardial infarction or ejection fraction <55%), dyslipidemia (abnormal cholesterol, triglyceride, HDL, LDL, or VLDL levels), and atrial fibrillation (irregular ECG rhythm or history on medication for >6 months), were documented. Outcomes were measured using the Modified Rankin Scale (mRS) from 0 (no symptoms) to 6 (death), with length of stay and mortality defined as death within seven days. Data analysis was performed using SPSS (version 16.0), with descriptive statistics for continuous variables and frequencies for qualitative data. Comparisons between ischemic and hemorrhagic stroke subgroups were made using the t-test test, and stratification by age, gender, stroke type, and mRS was followed by post-stratification analysis with the chi-squared test, considering $p \leq 0.05$ as significant.

Results

There were 140 patients enrolled in the study with the first episode of stroke (either ischemic or hemorrhagic stroke). Of them, 89 were males and 51 were females which constitute about 64% and 36% respectively. The mean age of patients was 60 ± 14.03 years.

The data reveals that 56% of participants had diabetes. Hypertension was observed in 82% of participants, making it the most prevalent risk factor. Ischemic heart disease was identified in 35% of participants (n=49). Atrial fibrillation and dyslipidemia were observed in 17% and 42% of cases, respectively.Ischemic stroke was observed in 45 diabetic patients compared to 25 non-diabetic participants, showing a significant association (p = 0.041). No significant association was observed between hypertension and stroke risk, as ischemic and hemorrhagic stroke rates were comparable in hypertensive and non-hypertensive participants (p = 0.825). Ischemic heart disease was not significantly associated with stroke occurrence (p = 0.595). Atrial fibrillation showed no significant correlation with stroke occurrence (p = 0.178). A significant relationship was observed between dyslipidemia and stroke occurrence (p = 0.000), with ischemic strokes being more frequent in participants with dyslipidemia (n=44), while hemorrhagic strokes were more common in those without dyslipidemia (n=55). The outcomes were measured for the type of stroke in our study. The research data demonstrated that patients with ischemic stroke exhibited moderate disability according to a mean Modified Rankin Scale (mRS) score of 2.16 ± 1.519 whereas hemorrhagic stroke patients presented with significantly higher disability levels with a mean score of 4.50 ± 1.164. The analysis demonstrated a statistically substantial difference (t = -10.241, p = 0.000) between both groups. Patients who experienced ischemic stroke spent fewer days in hospital at 3.04 ± 1.324 days compared to hemorrhagic stroke patients who stayed 6.73 ± 4.603 days according to statistical analysis (t = -6.439, p = 0.000). The results reveal that recovery from hemorrhagic strokes takes longer combined with greater disability when compared to recovery from ischemic strokes.

Finally, the study revealed 14 patients out of 140 stroke cases died because of cardiopulmonary arrest which proved to be the most fatal cause. Hypoxic respiratory failure/aspiration pneumonia together with respiratory failure led to the deaths of two patients

Table 1 Demographics of study population

N= 140	N/ Mean ± SD	Percentage
Age in years	60 ± 14.03	
Gender		
Male	89	(64%)
Female	51	(36%)
Stroke (Type)		
Ischemic	70	(50%)
Hemorrhagic	70	(50%)
Factors responsible		
Diabetes	78	(56%)
Hypertension	115	(82%)
Ischemic Heart disease	49	(35%)
Atrial fibrillation	24	(17%)
Dyslipidemia	59	(42%)
Outcome		
Mean Modified Rankin Scale scores.	3.33 ± 1.789	
The mean length of hospital stay (in days)	4.89 ± 3.848	

Table: 2 Comparison of Outcomes

		Stroke		Chi-square (χ^2)	P-value
		Ischemic	Hemorrhagic		
Diabetes	Yes	45	33	4.168	0.041*
	No	25	37		
Hypertension	Yes	58	57	0.049	0.825
	No	12	13		
Ischemic heart disease	Yes	26	23	0.283	0.595
	No	44	47		

Atrial fibrillation	Yes	15	9	1.810	0.178
	No	55	61		
Dyslipidemia	Yes	44	15	24.637	0.000*
	No	26	55		

Discussion

The research investigated stroke characteristics and determining factors along with analyzing how subtypes of ischemic and hemorrhagic stroke vary from each other. The research revealed several key patterns alongside previously validated connections and additionally discovered novel associations.

According to our clinical analysis, hypertension affected 82% of participants thus emerging as the main preventable stroke risk element. Research by Hägg-Holmberg and colleagues (2019) through the systematic review confirmed hypertension plays a dominant role in producing both ischemic and hemorrhagic strokes (11). However, our study revealed no statistically meaningful connection between hypertension levels and the stroke subtype. The study may not identify significant differences in stroke types due to the prevalence of hypertension which exists equally between patients presenting with ischemic or hemorrhagic stroke. Furthermore, our research study failed to identify a relationship between ischemic heart disease and stroke while other research has established heart disease as a risk factor for increasing stroke frequency (12).

The study results showed diabetes strongly associated with an increased risk for ischemic stroke since participants with diabetes presented 45 cases while those without diabetes showed 25 cases. Research conducted by Olesen KK et al. (2019) through meta-analysis reveals diabetes as a risk factor that increases the chance of experiencing ischemic stroke (13). The severity of vascular health deterioration due to hyperglycemia leads to atherosclerosis and thromboembolic events and thus increases the risk of suffering an ischemic stroke.

The analysis of our study showed dyslipidemia functions as a major risk factor for ischemic stroke since stroke events occur frequently among dyslipidemic individuals. Baral S et al. (2022) reported similar results in their study when they established that dyslipidemia significantly increases ischemic stroke risk through artery plaque development and vascular blockage (14). The research results indicate dyslipidemia serves as a vital target condition for stroke prevention, especially within groups who face high ischemic event risks.

Our research demonstrated hemorrhagic stroke patients presented a greater disability level through their higher mean Modified Rankin Scale (mRS) score of 4.50 ± 1.164 when compared to the mRS score of 2.16 ± 1.519 exhibited by ischemic stroke patients. Ghoreishi A. et al. (2024) established similar findings through their research which demonstrated hemorrhagic stroke patients typically face poor functional recovery and elevated mortality rates above ischemic stroke patients (15). The findings from our study support previous research which shows that hemorrhagic stroke patients need extended periods in hospital because they require prolonged intensive care services and rehabilitation support.

Data analysis showed that cardiopulmonary arrest deaths made up most (10%) of all 14 recorded deaths with hypoxic respiratory failure and respiratory failure resulting in a single death each. The recorded mortality rate matches the numbers identified in other mortality research about strokes. An evaluation by Sloane KL et al. (2024) in a systematic review demonstrated that stroke mortality rates differ per stroke type and hemorrhagic strokes lead to higher death risks (16). Death by cardiopulmonary arrest plays an essential role in our study data which underscores the necessity for rapid stroke patient management to counter dysfunction that leads to fatal events such as arrhythmias and cardiac arrest.

Conclusion

While the findings regarding diabetes and dyslipidemia support existing knowledge, the lack of significant associations with hypertension and ischemic heart disease warrants further investigation. Current evidence reinforces that hemorrhagic stroke leads to more severe disabilities and prolonged recovery compared to ischemic stroke. Research needs to improve stroke sub-classifications while decoding stroke subtype causes and create precise prevention and treatment methods for patients with high risk of stroke.

Some of the cases of ischemic stroke were missed because of lack of confirmatory imaging and incomplete records of the patients. Because of shorter duration of study functional outcomes were measured using the Modified Rankin Scale (mRS) at hospital discharge, which does not capture long-term recovery and mortality**.** Future research should incorporate longitudinal follow-ups to assess long-term disability and survival. The data regarding difference in outcomes in both types of stroke in our population will be helpful for prognostication of patients and early decision making. Further stroke type differentiation depending upon area of stroke.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-TC-038-23)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

RB

Manuscript drafting, Study Design,

SAA

Review of Literature, Data entry, Data analysis, and drafting article.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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