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INCIDENCE OF ACUTE ISCHEMIC STROKE IN HYPERTENSIVE PATIENTS IN LAHORE, PAKISTAN

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| ARTICLE INFO	ABSTRACT
	This study aimed to determine the incidence of acute ischemic stroke in hypertensive individuals in Lahore, Pakistan, and was conducted at the Department of Medicine, Chaudhary Muhammad Akram Teaching and Research Hospital. Hypertension was defined as blood pressure exceeding 140/90 mmHg on two separate occasions, ambulatory readings above 140/90 mmHg recorded at least 15 days apart, or a known history of antihypertensive medication use. Acute ischemic stroke was defined as sudden loss or weakness in function of one or more limbs on clinical examination, confirmed radiologically by a CT scan of the brain. A total of 200 hypertensive patients aged 18 years and older were included using non-probability consecutive sampling. Participants underwent evaluation for blood pressure control, antihypertensive therapy, comorbidities, and acute ischemic stroke. The results showed that acute ischemic stroke was present in 6.5% of patients. Chi-square analysis revealed that prolonged duration of hypertension, poor hypertension control, current treatment regimen, presence of diabetes mellitus, and ischemic heart disease had statistical associations with stroke. However, in logistic regression analysis, no variable was found to be a significant predictor of stroke. It is concluded that acute ischemic stroke is not an uncommon finding in hypertensive patients, being more prevalent in those with prolonged hypertension duration, poor control, and the presence of comorbidities.
	Keywords: Acute ischemic stroke, brain CT scan, diabetes mellitus, hypertension, ischemic heart disease, Lahore, Pakistan.
	ABSTRAK
	Penelitian ini bertujuan untuk menentukan insidensi stroke iskemik akut pada individu penderita hipertensi di Lahore, Pakistan, dan dilakukan di Departemen Penyakit Dalam, Rumah Sakit Pendidikan dan Riset Chaudhary Muhammad Akram. Hipertensi didefinisikan sebagai tekanan darah yang melebihi 140/90 mmHg pada dua kesempatan terpisah, atau pembacaan rawat jalan di atas 140/90 mmHg yang dicatat setidaknya selang 15 hari, atau adanya riwayat penggunaan obat antihipertensi. Stroke iskemik akut didefinisikan sebagai hilangnya fungsi atau kelemahan mendadak pada satu atau lebih anggota gerak melalui pemeriksaan klinis yang dikonfirmasi secara radiologis dengan CT scan otak. Sebanyak 200 pasien hipertensi berusia 18 tahun ke atas diikutsertakan menggunakan metode non-probability consecutive sampling. Partisipan menjalani evaluasi untuk kontrol tekanan darah, terapi antihipertensi, komorbiditas, dan stroke iskemik akut. Hasil penelitian menunjukkan bahwa stroke iskemik akut ditemukan pada 6,5% pasien. Analisis chi-square mengungkapkan bahwa durasi hipertensi yang lama, kontrol hipertensi yang buruk, rejimen pengobatan saat ini, adanya diabetes mellitus, dan penyakit jantung iskemik memiliki hubungan statistik dengan kejadian stroke. Namun, dalam analisis regresi logistik, tidak ditemukan variabel yang menjadi prediktor signifikan terhadap stroke. Disimpulkan bahwa stroke iskemik akut bukanlah temuan yang jarang pada pasien hipertensi, di mana kondisi ini lebih
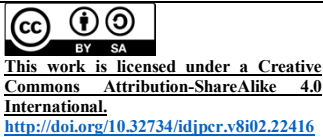
umum terjadi pada mereka dengan durasi hipertensi yang lama, kontrol yang buruk, serta adanya komorbiditas.

Kata Kunci: CT scan otak, diabetes mellitus, hipertensi, Lahore, Pakistan, penyakit jantung iskemik, stroke iskemik akut.

1. Introduction

Stroke is a major cause of death and disability in older adults worldwide. It occurs when blood flow to the brain is blocked, leading to a lack of oxygen and possible long-term damage or death [1]. The condition includes ischemic stroke, hemorrhagic stroke, and transient ischemic attack (TIA), with ischemic stroke being the most common globally, despite some reports suggesting hemorrhagic stroke is more fatal in certain regions [2]. Low- and middle-income countries, including Pakistan, have seen a rise in stroke cases in recent years, unlike high-income nations where rates have declined [3,4]. It has been estimated that stroke results in 6.5 million deaths per year and 113 million disability-adjusted life years (DALYs), with developing countries accounting for 75.2% of deaths and 81.0% of related DALYs [5]. ICU data shows stroke was the top cause of death (17%) and the third leading reason for admission (15.2%) [6]. Hypertension is a key risk factor for stroke and a leading cause of death in hypertensive patients [3,7]. Since it is modifiable, identifying associated factors is essential, although findings vary by region and ethnicity.

Many Asian nations, including Pakistan, face a high stroke burden due to poor hypertension control and lifestyle factors such as diabetes and obesity [8,9]. One-third of stroke survivors in Pakistan experience cognitive impairment, highlighting the need for early detection and better hypertension management [3,10]. Despite advances in managing hypertension, its complications and associated comorbidities remain prevalent and contribute significantly to morbidity, with cardiovascular disease being the primary cause of mortality [10,11]. The global prevalence of acute ischemic stroke among hypertensive patients varies widely, and there is a marked shortage of data specific to the Pakistani population. Due to differences in ethnicity, healthcare infrastructure, and disease awareness, findings from other countries may not be fully applicable to Pakistan. This gap underlines the need for localized research, motivating the current study aimed at determining the incidence of acute ischemic stroke in hypertensive patients in Pakistan.

2. Methods

This cross-sectional observational study was conducted from March to June 2025 in the Department of Medicine at Chaudhary Muhammad Akram Teaching and Research Hospital, affiliated with Azra Naheed Medical College, Superior University, Lahore, Pakistan. The primary objective was to evaluate the incidence of acute ischemic stroke among patients with hypertension. Hypertension was defined as blood pressure measurements exceeding 140/90 mmHg on two separate occasions, ambulatory readings above 140/90 mmHg recorded at least 15 days apart, or a documented history of antihypertensive medication use. Acute ischemic stroke was defined as a sudden loss or weakness in the function of one or more limbs (monoplegia or hemiplegia) on clinical examination, confirmed radiologically via a CT scan of the brain. Diabetes mellitus was defined by HbA1c levels above 7.0%, at least two random blood glucose values of ≥200 mg/dL, a previously established diagnosis, or ongoing treatment with antidiabetic medications. Ischemic heart disease (IHD) was identified in individuals with a clinical history of acute myocardial infarction or unstable angina.

The study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki, as revised in 2000. All subjects were informed of the study's purpose, benefits, and procedures, after which written informed consent was obtained prior to data collection. Anonymity and confidentiality were strictly maintained. Based on an anticipated stroke prevalence of 13.84% among hypertensive individuals [4], the required sample size was calculated as 184 using a 95% confidence interval and a 5% margin of error. Ultimately, a total of 200 hypertensive patients aged 18 years and older of both sexes were included. Exclusion criteria comprised patients with hemorrhagic stroke, cortical venous thrombosis, and neurological diseases such as multiple sclerosis or brain malignancy. Additionally, patients with pregnancy, hypertensive emergencies, psychiatric illness, seizures, acute or chronic kidney disease, ongoing myocardial infarction, malignancy, or chronic liver disease were excluded.

Following informed consent, 200 hypertensive patients meeting the inclusion criteria were enrolled using a non-probability consecutive sampling method. Demographic data, including age, gender, employment status, marital status, and duration of hypertension, were recorded. Each participant underwent clinical evaluation for blood pressure control, current antihypertensive therapy, and the presence of diabetes mellitus or ischemic heart disease. Patients were then evaluated for acute ischemic stroke through history and clinical

examination; those with positive clinical findings underwent a brain CT scan for confirmation. All data were entered and analyzed using SPSS version 23. Continuous variables were presented as mean and standard deviation, while categorical variables were summarized using frequencies and percentages. To assess associations between categorical variables, the chi-square test was applied after stratification. A p-value of less than 0.05 was considered statistically significant. Additionally, logistic regression analysis was performed to identify potential predictors of acute ischemic stroke among the hypertensive population.

3. Results

Out of the 200 hypertensive patients enrolled, the majority were female (n=157, 78.5%), as depicted in Table 1. The mean age of the study population was 45.8 ± 8.9 years, with 104 (52.0%) participants aged 45 years or older. Regarding socioeconomic and marital status, more than half of the participants were unemployed (n=106, 53.0%), and the vast majority were married (n=173, 86.5%).

The mean duration of hypertension was 7.3 ± 5.1 years, with 114 (57.0%) patients having a disease duration of 6 years or more. Blood pressure control was achieved in 128 (64.0%) patients. In terms of pharmacological management, a dual antihypertensive drug combination was the most prevalent regimen, utilized by 100 (50.0%) individuals, followed by triple-drug combinations in 55 (27.5%) patients (Table 1). Regarding comorbidities and risk factors, ischemic heart disease (IHD) was present in 67 (33.5%) patients, while diabetes mellitus was identified in 101 (50.5%). Additionally, a positive family history of hypertension was highly prevalent, observed in 162 (81.0%) participants.

Table 1. Demographic and clinical variables

Demographic and clinical variables		Frequency (n)	Percent (%)
Gender	Female	157	78.5
	Male	43	21.5
Age	≤44 years	96	48.0
	≥45 years	104	52.0
Employment status	Employed	94	47.0
	Unemployed	106	53.0
Marital status	Married	173	86.5
	Unmarried	27	13.5
Duration of hypertension	≤5 years	86	43.0
	≥6 years	114	57.0
Hypertension control	Good / Controlled	128	64.0
	Poor / Uncontrolled	72	36.0
Current hypertension treatment regimen	One drug	41	20.5
	Two drugs combination	100	50.0
	Three drugs combination	55	27.5
	Four drugs or more	4	2.0
Ischemic heart disease	Present	67	33.5
	Absent	133	66.5
Diabetes mellitus	Present	101	50.5
	Absent	99	40.5
Family history of hypertension	Present	162	81.0
	Absent	38	19.0
Acute ischemic stroke	Present	13	6.5
	Absent	187	93.5

Acute ischemic stroke was identified in 13 (6.5%) patients within the study population. Post-stratification chi-square analysis revealed that a prolonged duration of hypertension (p=0.008), poor hypertension control (p=0.047), the current treatment regimen (p=0.000), the presence of diabetes mellitus (p=0.049), and ischemic heart disease (p=0.005) demonstrated statistically significant associations with the occurrence of acute ischemic stroke, as detailed in Table 2. Conversely, other demographic and clinical variables, including gender (p=0.579), age (p=0.063), employment status (p=0.609), marital status (p=0.837), and family history of hypertension (p=0.439), did not show significant associations with the incidence of stroke. In the logistic regression analysis, none of the evaluated variables emerged as significant independent

predictors of acute ischemic stroke (Table 3). This included gender (p=0.487), age (p=0.486), employment status (p=0.446), marital status (p=0.918), duration of hypertension (p=0.175), hypertension control (p=0.831), diabetes mellitus (p=0.599), ischemic heart disease (p=0.460), and family history of hypertension (p=0.118).

Table 2. Stratification of data with regards to ischemic stroke

Demographic and clinical variables		Ischemic stroke		Pearson chi-square value	p-value
		Absent	Present		
Gender	Female	146 (93.0%)	11 (7.0%)	0.308	0.579
	Male	41 (95.3%)	2 (4.7%)		
Age	≤44 years	93 (96.9%)	3 (3.1%)	3.460	0.063
	≥45 years	94 (90.4%)	10 (9.6%)		
Employment Status	Employed	87 (92.6%)	7 (7.4%)	0.262	0.609
	Unemployed	100 (94.3%)	6 (5.7%)		
Marital Status	Married	162 (93.6%)	11 (6.4%)	0.042	0.837
	Unmarried	25 (92.6%)	2 (7.4%)		
Duration of hypertension	≤5 years	85 (98.8%)	1 (1.2%)	7.072	0.008*
	≥6 years	102 (89.5%)	12 (10.5%)		
Hypertension control	Good / Controlled	123 (96.1%)	5 (3.9%)	3.936	0.047
	Poor / Uncontrolled	64 (88.9%)	8 (11.1%)		
Current Hypertension Treatment regimen	One drug	41 (100.0%)	0 (0.0%)	19.842	0.000
	Two drugs combination	96 (96.0%)	4 (4.0%)		
	Three drugs combination	48 (87.3%)	7 (12.7%)		
	Four drugs or more	2 (50.0%)	2 (50.0%)		
Ischemic heart disease	Present	58 (86.6%)	9 (13.4%)	7.968	0.005
	Absent	129 (97.0%)	4 (3.0%)		
Diabetes mellitus	Present	91 (90.1%)	10 (9.9%)	3.883	0.049
	Absent	96 (97.0%)	3 (3.0%)		
Family history of hypertension	Present	150 (92.6%)	12 (7.4%)	1.155	0.282
	Absent	37 (97.4%)	1 (2.6%)		

Table 3. Logistic regression analysis of data with regards to ischemic stroke

Demographic and clinical variables	Beta coefficient (B)	S.E.	Wald	df	p-value	Exp (B)	95% C.I. for EXP (B)	
							Lower	Upper
Gender	-0.695	1.000	0.484	1	0.487	0.499	0.070	3.539
Age	0.656	0.943	0.484	1	0.486	1.928	0.304	12.246
Employment	-0.543	0.713	0.581	1	0.446	0.581	0.144	2.350
Marital status	0.099	0.955	0.011	1	0.918	1.104	0.170	7.175
Hypertension duration	-1.546	1.139	1.842	1	0.175	0.213	0.023	1.987
Hypertension control	0.153	0.715	0.046	1	0.831	1.165	0.287	4.734
Ischemic heart disease	-0.776	0.896	0.750	1	0.387	0.460	0.080	2.664
Diabetes mellitus	-0.512	0.780	0.431	1	0.512	0.599	0.130	2.764
Family history	2.144	1.372	2.443	1	0.118	8.535	0.580	125.569

4. Discussion

This study identifies a 6.5% incidence of acute ischemic stroke among hypertensive patients at a tertiary care hospital in Lahore, Pakistan. Although this prevalence is lower than the 13.84% previously reported in Karachi [4], it nonetheless represents a substantial stroke burden within this high-risk population. In comparison, Misgana et al. reported an 18.18% incidence of stroke among hypertensive individuals [3], while studies in Nigeria and Sidama documented incidences of 13.2% and 3.15%, respectively [12]. Key factors significantly associated with ischemic stroke in this study included a prolonged duration of hypertension, poor blood pressure control, the use of multi-drug antihypertensive regimens, and the presence

of diabetes mellitus and ischemic heart disease. These findings align with existing regional and international literature [13,14,15]. Given that stroke is influenced by multifactorial elements, it is imperative for at-risk individuals to recognize and mitigate their exposure to these risks.

Identifying concurrent health conditions is fundamental to understanding individualized stroke risk. Healthcare providers must prioritize patient education regarding rigorous disease management, including medication adherence, physical activity, and dietary modifications [16,17]. While hypertension independently elevates stroke risk, the hazard is compounded when combined with modifiable lifestyle factors such as smoking, alcohol consumption, physical inactivity, obesity, dyslipidemia, and poor nutrition [17,18]. Managing these factors is essential for stroke prevention and the improvement of long-term health outcomes [18,19]. Interestingly, while chi-square analysis demonstrated several statistically significant associations, logistic regression did not identify these variables as independent predictors. This discrepancy may be attributed to the limited number of stroke events (n=13), which likely constrained the statistical power of the regression model. Nevertheless, the association of stroke with poor hypertension control and comorbidities, such as diabetes and ischemic heart disease, corroborates previous research emphasizing the necessity of early intervention and aggressive risk factor management [20,21,22].

Several limitations of the present study warrant acknowledgment. Conducted at a single center, the findings may not be fully generalizable to the broader population. Furthermore, the cross-sectional design precludes the ability to establish causal relationships between the variables studied. To more comprehensively understand the impact of acute ischemic stroke within the Pakistani hypertensive population, further research utilizing larger and more diverse cohorts is recommended. Given the global variability in stroke incidence and the unique sociodemographic and healthcare challenges in Pakistan, localized data remain vital. These results underscore an urgent need for enhanced hypertension monitoring, public awareness initiatives, and integrated management strategies. Future longitudinal studies with larger sample sizes are required to establish causality and identify robust predictors. Increasing awareness among both healthcare providers and patients regarding the nexus between hypertension and acute ischemic stroke is crucial for facilitating early diagnosis and timely intervention, ultimately reducing the disease burden and enhancing patient well-being.

5. Conclusion

Acute ischemic stroke was identified in a notable proportion (6.5%) of hypertensive patients in this study. Post-stratification chi-square analysis revealed that a prolonged duration of hypertension, poor blood pressure control, the complexity of the current treatment regimen, and the presence of comorbidities—specifically diabetes mellitus and ischemic heart disease—demonstrated statistically significant associations with the occurrence of acute ischemic stroke. However, in the logistic regression analysis, no individual variable, including gender, age, employment, marital status, hypertension duration, blood pressure control, diabetes mellitus, ischemic heart disease, or family history of hypertension, emerged as a significant independent predictor of stroke. These findings underscore the critical importance of routine stroke screening and vigilant monitoring in hypertensive patients. Enhancing early detection and risk factor management is essential to improve symptom control, mitigate the overall disease burden, and elevate the quality of life for this high-risk population.

6. Acknowlwdgwments

7. Conflict of Interest

All authors declare that they have no conflict of interest related to this study and its publication.

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