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Acute Ischemic Cerebrovascular Disease in a Tertiary-Level Hospital in Boyacá (Colombia)

Jaime Alberto Osorio Bedoya[1], Sandra Patricia Jurado López[2], Víctor Zein Rizo Tello[3], José Luis Bustos Sánchez[2], Benjamín Márquez Rosales[2], Alexander Aroca Posso[2], Martín Germán Ayala García[2], Jamir Muñoz Torres[2], Mónica Alexandra Alonso Niño[2]

ABSTRACT

Introduction: Acute ischemic cerebrovascular disease is caused by the occlusion of a blood vessel, which can result in either reversible or permanent damage. It is considered a public health issue due to its significant impact on morbidity, mortality, disability, and healthcare costs. **Objective:** To characterize ischemic cerebrovascular disease in a tertiary-level hospital in Boyacá (Colombia) from November 2019 to January 2021. **Materials and Methods:** This was a descriptive, cross-sectional analytical study involving adults aged 18 years or older who experienced an ischemic stroke or transient ischemic attack. Data were collected from medical records, and descriptive statistics and odds ratios were used for association analysis. **Results:** A total of 619 cases were analyzed. The average age was 70.2 years, with males representing 54% of the cases. The most common cause was cardioembolic stroke (36%), and the most frequent risk factor was systemic arterial hypertension (72%). The middle cerebral artery was the most commonly affected (73%). Thrombolysis was administered in 9.9% of the patients, and the National Institute of Health Stroke Scale score showed improvement in all categories after thrombolytic therapy. Stroke recurrence was observed in 24% of the cases, and the mortality rate was 22%. **Conclusion:** The most frequent causes of ischemic stroke were atrial fibrillation and systemic arterial hypertension, both of which were strongly associated with recurrence. Thrombolytic therapy improved patients' neurological conditions. These findings provide valuable insights for future research.

Keywords: ischemic stroke; transient ischemic attack; risk factors; epidemiology; thrombolytic therapy.

[1] Universidad de Boyacá (Tunja, Colombia).

[2] Hospital Universitario San Rafael de Tunja (Tunja, Colombia).

[3] Universidad El Bosque (Bogotá, Colombia).

Corresponding Author: Jaime Alberto Osorio Bedoya. Email Address: jaiosorio@uniboyaca.edu.co

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Enfermedad cerebrovascular isquémica aguda en un hospital de tercer nivel en Boyacá (Colombia)

RESUMEN

Introducción: La enfermedad cerebrovascular isquémica aguda la ocasiona una oclusión de un vaso sanguíneo que puede provocar daños reversibles o permanentes. Se considera un problema de salud pública, dado al alto impacto de morbimortalidad, discapacidad y costos en el sistema de salud.

Objetivo: Caracterizar la enfermedad cerebrovascular isquémica en un hospital de tercer nivel del departamento de Boyacá (Colombia) desde noviembre de 2019 a enero de 2021.

Materiales y métodos: Estudio descriptivo de corte transversal analítico que incluyó adultos mayores de 18 años con accidente cerebrovascular isquémico o ataque isquémico transitorio. Se recolectaron los datos de las historias clínicas, se utilizó estadística descriptiva y odds ratio para análisis de asociación.

Resultados: Se analizaron 619 casos. El promedio de edad fue de 70,2 años, el sexo masculino representó el 54 %, la causa más frecuente fue cardioembólica (36 %), el factor de riesgo más común fue la hipertensión arterial sistémica (72 %) y la arteria más afectada fue la cerebral media (73 %). Los pacientes trombolizados fueron el 9,9 %, el puntaje de la escala del National Institute of Health Stroke Score posterior a terapia trombolítica se redujo en todas las categorías; la recurrencia del accidente cerebrovascular fue del 24 % y la tasa de mortalidad fue del 22 %.

Conclusión: Las causas más frecuentes de accidente cerebrovascular isquémico fueron fibrilación auricular e hipertensión arterial sistémica, las cuales tienen una fuerte asociación a la recurrencia, y la terapia trombolítica mejoró la condición neurológica de los pacientes. Los resultados obtenidos proporcionan conocimientos para nuevas investigaciones.

Palabras clave: accidente cerebrovascular isquémico; ataque isquémico transitorio; factores de riesgo; epidemiología; terapia trombolítica.

Doença cerebrovascular isquêmica aguda em um hospital de terceiro nível em Boyacá (Colômbia).

RESUMO

Introdução: A doença cerebrovascular isquêmica aguda é causada pela oclusão de um vaso sanguíneo, o que pode provocar danos reversíveis ou permanentes. É considerada um problema de saúde pública devido ao alto impacto na morbimortalidade, na incapacidade e nos custos para o sistema de saúde.

Objective: Caracterizar a doença cerebrovascular isquêmica em um hospital de terceiro nível no departamento de Boyacá (Colômbia) de novembro de 2019 a janeiro de 2021.

Materiais e métodos: Estudo descritivo de corte transversal analítico que incluiu adultos maiores de 18 anos com acidente vascular cerebral isquêmico transitório. Foram coletados dados das fichas clínicas, e utilizou-se estatística descritiva e odds ratio para análise de associação.

Results: Foram analisados 619 casos. A média de idade foi de 70,2 anos, o sexo masculino representou 54%, a causa mais frequente foi cardioembólica (36%), o fator de risco mais comum foi a hipertensão arterial sistêmica (72%) e a artéria mais afetada foi a cerebral média (73%). Os pacientes trombolizados foram 9.9%, o escore na escala do National Institute of Health Stroke Score após a terapia trombolítica foi reduzido em todas as categorias; a recorrência do acidente vascular cerebral foi de 24% e a taxa de mortalidade foi de 22%.

Conclusão: As causas mais frequentes de acidente vascular cerebral isquêmico foram fibrilação atrial e hipertensão arterial sistêmica, que tem uma forte associação com a recorrência e a terapia trombolítica melhorou a condição neurológica dos pacientes. Os resultados obtidos fornecem conhecimentos para novas pesquisas.

Palavras-chave: acidente vascular cerebral isquêmico; ataque isquêmico transitório; fatores de risco; epidemiologia; terapia trombolítica.

INTRODUCTION

Cerebrovascular disease (CVD) is characterized by an alteration in cerebral blood flow, leading to decreased oxygen supply and neuronal damage. Based on the nature of the lesion, there are several subtypes: ischemic, hemorrhagic, and cerebral venous thrombosis. Ischemic CVD is caused by the occlusion of a blood vessel. It is classified into ischemic stroke (the most common type), which causes permanent neurological damage, and transient ischemic attack (TIA), which results in reversible neuronal damage (1).

According to the World Health Organization, ischemic heart disease was the leading cause of death worldwide in 2019, accounting for 16% of all deaths, followed by stroke, which accounted for 11% (2). In the Americas, cardiovascular diseases were the leading cause of disability, disease burden, and mortality in the same year. The main underlying cause was myocardial ischemia, followed by stroke, with mortality rates of 73.6 and 32.3 per 100,000 inhabitants, respectively (3).

In Colombia, ischemic heart disease was the leading cause of death in the general population in 2022 (50,159 inhabitants), followed by stroke (17,447 inhabitants) (4). Similarly, in Boyacá, ischemic heart disease was the leading cause of death in 2019, followed by stroke, with mortality rates of 54.4 and 25.4 per 100,000 inhabitants, respectively (5).

Acute ischemic stroke represents a public health problem due to its significant impact on morbidity, mortality, disability, and healthcare costs. It is essential to understand the current epidemiological situation in Boyacá, considering the limited number of studies addressing this pathology in the region (6). The objective of this research was to describe acute ischemic CVD in a tertiary-level hospital in Boyacá (Colombia) during the period from November 2019 to January 2021.

METHODOLOGY

An observational, descriptive, cross-sectional analytical study was conducted. The study population consisted of adults aged 18 years and older who were treated by the neurology service at a tertiary-level hospital in Boyacá (Colombia) with a diagnosis of acute ischemic stroke or TIA.

A non-probability convenience sampling method was used. The inclusion criteria were patients aged 18 years or older who were admitted to the neurology service with a diagnosis of ischemic stroke or TIA, including recurrent strokes. Exclusion criteria were patients with prior or concurrent neurological events other than ischemic stroke or TIA, as well as those with incomplete medical records. The information was collected from the institutional database.

The variables studied included the main sociodemographic characteristics of the population, the etiology according to the Trial of ORG 10172 in Acute Stroke Treatment (TOAST) Subtype Classification system, cardiovascular risk factors, clinical variables associated with stroke (National Institute of Health Stroke Score [NIHSS] and $ABCD^2$ for TIA), paraclinical variables: neuroimaging studies, transthoracic echocardiogram, carotid ultrasound, and electrocardiographic Holter; pharmacological therapy; in-hospital outcomes (NIHSS score at hospital discharge and in-hospital mortality), and factors related to recurrent stroke.

The data were organized using licensed MS Excel 2013 and analyzed with Epi Info version 7.2. Qualitative variables were compared using absolute and relative frequencies, and quantitative variables using measures of central tendency and dispersion. For bivariate analysis, the chi-square (χ^2) statistic was used for categorical variables, and statistical significance was set at $p < 0.05$. The measure of association used was the odds ratio (OR) with a 95% confidence interval (CI). The results were presented in tables.

This study adhered to the ethical considerations outlined in Resolution 8430 of 1993, Title II, Chapter I, Article 11, issued by the Colombian Ministry of Health, which classifies the study as risk-free due to the use of retrospective information from medical records without any patient intervention (7). The study received approval from the institution's Research Committee.

RESULTS

During the study period, 619 cases of acute ischemic CVD were reported. Of these, 87.9% (n = 544) were ischemic strokes, and 12.1% (n = 75) were TIAs. Males represented 54.9% (n = 340) of the cases, with a mean age of 70.2 years and a standard deviation of 14.4. The municipality with the highest percentage of events was Tunja, accounting for 20.4% (n = 126) of cases. Mestizo ethnicity was reported in 67.5% (n = 418) of the patients, and the most frequent occupation was household activities, at 35.5% (n = 220). Primary education was the most common level of schooling, with 48.1% (n = 298), and socioeconomic status level 2 was predominant, representing 59.6% (n = 291) (Table 1).

Table 1. Sociodemographic Characteristics of Patients with Ischemic Stroke and Transient Ischemic Attack

Characteristics	n = 619	%
	Sex	
Male	340	54.9
Female	279	45.1
Age (mean)	70.2 [SD: 14.4]	

Characteristics	n = 619	%
Municipality		
Tunja	126	20.4
Duitama	29	4.7
Chiquinquirá	28	4.5
Moniquirá	18	2.9
Paipa	15	2.4
Others	403	64.9
Ethnicity		
Mestizo	418	67.5
No information	136	22.0
White	50	8.1
Others	15	2.4
Occupation		
Household activities	220	35.5
Unemployed or not working	136	22.0
No information	116	18.7
Agriculture	84	13.6
Merchant	47	7.6
Others	16	2.6
Education		
Primary	298	48.1
None	157	25.4
Secondary	76	12.3
No information	56	9.1
Technical	21	3.4
University	11	1.8
Socioeconomic Stratum		
2	291	59.6
1	105	21.5
3	89	18.2
4	3	0.6

SD: standard deviation

According to the TOAST classification system, the most common etiology was cardioembolic, accounting for 36% (n = 223) of the cases. Among cardiovascular risk factors, the majority of patients had systemic arterial hypertension (SAH), at 72.2% (n = 447), and the NIHSS scale at hospital admission indicated that more than half of the patients had moderate neurological deficits, representing 51.3% (n = 279). Analysis of the ABCD² scale applied to patients with TIA revealed that 58.7% (n = 44) were at moderate risk of experiencing an ischemic stroke within the first 48 hours (Table 2).

Table 2. Characteristics by Etiology, Risk Factors, and Clinical Findings in Patients with Ischemic Stroke and Transient Ischemic Attack

Characteristics		
TOAST Etiology	**n = 619**	**%**
Cardioembolic	223	36.0
Stroke from undetermined cause	216	34.9
Atherosclerotic	129	20.8
Lacunar	29	4.7
Stroke from another determined cause	22	3.6
Risk Factors Associated with CVA	**n = 619**	**%**
Systemic arterial hypertension	447	72.2
Diabetes mellitus	123	19.9
Chronic obstructive pulmonary disease (COPD)	118	19.1
Atrial fibrillation	116	18.7

Risk Factors Associated with CVA	n = 619	%
Smoking	97	15.7
Dyslipidemia	90	14.5
Obesity	58	9.4
Alcohol consumption	49	7.9
NIHSS Score at Admission	**n = 544**	**%**
Moderate neurological deficit: NIHSS 5–15	279	51.3
Mild neurological deficit: NIHSS ≤ 4	156	28.7
Severe neurological deficit: NIHSS 16–20	55	10.1
Very severe neurological deficit: NIHSS > 20	54	9.9
ABCD² in TIA	**n = 75**	**%**
Score 4 to 5 (moderate risk)	44	58.7
Score 0 to 3 (low risk)	21	28.0
Score > 5 (high risk)	10	13.3

TOAST: Trial of ORG 10172 in Acute Stroke Treatment Subtype Classification; NIHSS: National Institute of Health Stroke Score; CVA, cerebrovascular accident; TIA, transient ischemic attack

From neuroimaging studies, the most affected area was the middle cerebral artery territory, in 73.5% (n = 455) of cases. Transthoracic echocardiograms performed on 588 patients showed findings related to embolic sources, the most common being left atrial enlargement, which was observed in 34.2% (n = 201) of cases. Doppler ultrasound of the neck vessels was performed on 608 patients, and 37.4% (n = 228) showed some degree of obstruction. As shown in Table 3, electrocardiographic Holter monitoring in 618 patients revealed atrial fibrillation (AF) in 24.6% (n = 152) of the cases.

Table 3. Characteristics Based On Paraclinical Tests in Patients with Ischemic Stroke and Transient Ischemic Attack

Neuroimaging	n = 619	%
Cranial computed tomography (CT)	459	74.2
Brain magnetic resonance imaging (MRI)	160	25.9
Vascular Territory Affected According to Neuroimaging	**n = 619**	**%**
Middle cerebral artery territory	455	73.5
Affected territory other than the middle cerebral artery	139	22.5
Two or more affected territories other than the middle cerebral artery	25	4.0
Transthoracic Echocardiogram	**n = 588**	**%**
Left atrial enlargement		
No enlargement	387	65.8
Moderate enlargement	136	23.1
Severe enlargement	65	11.1
Left ventricular ejection fraction (LVEF)		
LVEF > 50%	476	80.9
LVEF 40–49%	72	12.2
LVEF < 40%	40	6.8
Mitral insufficiency		
No insufficiency	535	91.0
Moderate insufficiency	42	7.1
Severe insufficiency	11	1.9
Presence of patent foramen ovale		
No	570	96.9
Yes	18	3.1
Presence of aneurysm		
No	578	98.3
Yes	10	1.7

Carotid Doppler ultrasound	n = 608	%
Normal findings	380	62.5
Stenosis < 50%	185	30.4
Stenosis 50–70%	24	3.9
Stenosis > 70%	19	3.1
Electrocardiographic Holter	**n = 618**	**%**
No findings	424	68.6
Atrial fibrillation	152	24.6
Supraventricular/ventricular tachycardia	42	6.8

LVEF: left ventricular ejection fraction

Thrombolytic therapy was administered to 9.9% (n = 54) of ischemic stroke patients who met the treatment protocol. NIHSS was applied, showing that upon hospital admission, 63% (n = 34) had moderate neurological deficits, while at discharge, 50% (n = 27) exhibited mild neurological deficits, indicating an improvement across all categories. During the hospital stay, only one case (1.85%) showed neurological deterioration due to hemorrhagic transformation after the procedure (Table 4).

At hospital discharge, 24.2% (n = 150) of the patients received anticoagulant medications, with rivaroxaban being the most common, administered to 48.7% (n = 73). Antiplatelet therapy was used in 94.2% (n = 583) of cases; of these, 63.6% (n = 371) received aspirin (monotherapy), and 10.5% (n = 61) received a combination of aspirin and clopidogrel (dual therapy). The majority of patients were prescribed statins, accounting for 92.9% (n = 575), and at least one antihypertensive was given to 69.4% (n = 430) (Table 5).

Table 4. NIHSS Scores at Hospital Admission and Discharge for Patients with Ischemic Stroke and Transient Ischemic Attack

NIHSS	Admission NIHSS (n = 54)	%	Discharge NIHSS (n = 54)	%
Mild neurological deficit (≤ 4 points)	4	7.4	27	50.0
Moderate neurological deficit (5–15 points)	34	63.0	20	37.0
Severe neurological deficit (16–20 points)	13	24.1	5	9.3
Very severe neurological deficit (> 20 points)	3	5.6	2	3.7

NIHSS: National Institute of Health Stroke Score

Table 5. Characteristics Based On Medications in Patients with Ischemic Stroke and Transient Ischemic Attack

Anticoagulant Medications	n = 150	%
Rivaroxaban	73	48.7
Apixaban	28	18.7
Dabigatran	19	12.7
Full-dose LMWH for anticoagulation	14	9.3
Vitamin K agonists (warfarin)	12	8.0
Prophylactic-dose LMWH	4	2.7
Antiplatelet Medications	**n = 583**	**%**
Monotherapy	371	63.6
None	151	25.9
Dual therapy	61	10.5

Statins	n = 619	%
Yes	575	92.9
No	44	7.1
Antihypertensive Medications	**n = 619**	**%**
Two antihypertensives	186	30.0
None	189	30.5
One antihypertensive	162	26.2
Three or more antihypertensives	82	13.2

LMWH: low-molecular-weight heparin

The recurrence rate of ischemic stroke during the study period was 24.1% (n = 149), with a fatality rate of 22.1% (n = 33). Bivariate analysis showed a statistically significant association between recurrent stroke cases and the following variables: very severe NIHSS, with an OR of 2.2 and a 95% CI of 1.2–4.1; a modified Rankin score of 4, with an OR of 2.7 and a 95% CI of 1.3–5.7; a modified Rankin score of 6, with an OR of 2.3 and a 95% CI of 1.4–3.8; cardioembolic events, with an OR of 2.2 and a 95% CI of 1.5–3.2; systemic arterial hypertension (SAH), with an OR of 2.3 and a 95% CI of 1.4–3.8; chronic obstructive pulmonary disease (COPD), with an OR of 1.8 and a 95% CI of 1.1–2.8; and atrial fibrillation (AF), with an OR of 1.7 and a 95% CI of 1.1–2.6. No statistically significant differences were found in other analyzed variables (Table 6).

Table 6. Patient-Related Factors Associated with Ischemic Stroke Recurrence

NIHSS According to Recurrent CVA	n = 135	%	OR	95% CI	p-Value
Very severe neurological deficit: ≥ 21 points	22	16.3	2.29	1.2–4.1	0.007
Severe neurological deficit: 16–20 points	14	10.4	1.03	0.5–1.9	1.000
Moderate neurological deficit: 5–15 points	69	51.1	0.99	0.6–1.4	1.000
Mild neurological deficit: ≤ 4 points	30	22.2	0.64	0.4–1.0	0.070
Modified Rankin Score According to Recurrent CVA	**n = 149**	**%**	**OR**	**95% CI**	**p-Value**
1	33	22.1	0.47	0.3–0.7	0.001
2	35	23.5	0.68	0.4–1.1	0.100
3	24	16.1	1.26	0.7–2.1	0.440
4	14	9.4	2.76	1.3–5.7	0.009
5	10	6.7	1.53	0.7–3.3	0.379
6	33	22.1	2.3	1.4–3.8	0.001
Etiology According to Recurrent CVA	**n = 147**	**%**	**OR**	**95% CI**	**p-Value**
Cardioembolic event	75	51.0	2.20	1.5–3.2	0.000
Stroke from undetermined cause	42	28.6	0.69	0.4–1.0	0.090
Atherosclerotic	19	12.9	0.40	0.2–0.8	0.007
Lacunar	7	4.8	1.00	0.4–2.3	1.000
Stroke from another determined cause	4	2.7	0.78	0.2–2.3	0.860

Risk Factors Associated with Recurrent CVA	n = 149	%	OR	95% CI	p-Value
Systemic arterial hypertension	73	49.0	2.30	1.4–3.8	0.000
Chronic obstructive pulmonary disease (COPD)	23	15.4	1.80	1.1–2.8	0.007
Smoking	23	15.4	0.60	0.3–1	0.130
Diabetes mellitus	18	12.1	1.33	0.8–2.0	0.240
Dyslipidemia	12	8.1	1.00	0.5–1.6	0.900
Obesity	10	6.7	0.40	0.2–1.0	0.070
Alcohol consumption	6	4.0	0.50	0.2–1.2	0.200
Cardiac Arrhythmia According to Recurrent CVA	**n = 148**	**%**	**OR**	**95% CI**	**p-Value**
Atrial fibrillation	49	33.1	1.76	1.1–2.6	0.008
Supraventricular/ ventricular tachycardia	11	7.4	1.13	0.5–2.3	0.860
No findings	88	59.5	0.58	0.3–0.8	0.008

NIHSS: National Institute of Health Stroke Score; CVA, cerebrovascular accident

Discussion

In the description of acute ischemic CVD, men were the most affected (54.9%), and the average age was 70.2 years. This aligns with the findings of Pinilla-Monsalve and colleagues (8), who also reported that this condition predominantly affects older individuals and males. Martín and colleagues (9) found that the most frequent cause was undetermined (39%), which does not align with this study, where the most common etiology was cardioembolic (36%). In this study, systemic arterial hypertension was the most prevalent risk factor (72.2%), followed by diabetes mellitus (19.9%). Similar findings (79.3% and 38.7%) were reported by Sepúlveda-Contreras (10). Additionally, atrial fibrillation was found in 18.7% of cases in this study, which is similar to the 17% reported by Martínez (11).

In this study, upon hospital admission, 51.3% of the cases presented with a moderate NIHSS score, a result similar to that of Zarama-Valenzuela and colleagues (12), who reported 48.7%. Among patients with TIA who were assessed using the ABCD² scale, 13.3% were at high risk for ischemic stroke; similar findings (17.6%) were documented in the study by Palacios Sánchez and Barrero (13), where it was noted that the most affected artery was the middle cerebral artery, obstructed in 73.5% of cases. This finding aligns with the research of Pineda and Tolosa (14), who reported an involvement rate of 50%–80%, likely due to the large area that the artery supplies.

The most frequent echocardiographic finding in the study was left atrial enlargement, observed in 34.2% of cases, which is a marker of atrial dysfunction and myopathy, and a predictor of recurrent ischemic stroke of cardioembolic origin. This result is similar (23%) to those found in studies by Gąsiorek and colleagues (15) and Harris and colleagues (16). In the research by Wasay and

colleagues (17), using Doppler ultrasound of the neck vessels, the authors found that 21% of cases had stenosis greater than 50%, a higher percentage than the 7% reported in this study.

Globally, there is evidence of the benefit of thrombolytic therapy in ischemic stroke patients (18). The findings of this study documented that the NIHSS score improved in the majority of treated cases, consistent with the study by Zarama-Valenzuela and colleagues (12). In this research, the rate of hemorrhagic transformation associated with neurological deterioration following thrombolysis was 1.8%, which does not align with the 6.9% reported by Khan and colleagues (19) or the 5.7% reported by Soto and colleagues (20). In the present study, the recurrence rate of ischemic stroke was 24%, higher than the 16.1% at two years documented by Lin and colleagues (21). Additionally, this study recorded a case-fatality rate of 22% for recurrent ischemic stroke, similar to the findings of Albright and colleagues (22).

The factors associated with recurrent stroke were systemic arterial hypertension, with an OR of 2.3 and a 95% CI of 1.4–3.8, and atrial fibrillation with an OR of 1.7 and a 95% CI of 1.1–2.6. These results are similar to those of Martínez, who found an OR of 2.0 with a 95% CI of 1.3–3.2 and an OR of 1.6 with a 95% CI of 1.06–2.68 (11). In the study by Park and Ovbiagele (23), the authors concluded that a higher NIHSS score after a recent stroke increases the risk of a recurrent stroke. This is in line with the current research, which demonstrated a very severe NIHSS score with an OR of 2.2 and a 95% CI of 1.2–4.1.. Furthermore, in the publication by Hobeanu and colleagues (24), it was documented that recurrent stroke increases the risk of disability, with an OR of 3.5 and a 95% CI of 2.3–5.2, a finding similar to the present study, which showed a modified Rankin score of four with an OR of 2.7 and a 95% CI of 1.3–5.7.

During the research, the limitation of data quality was noted, which could introduce selection and information biases. However, efforts were made to minimize these biases by applying restriction criteria and supplementing the information with individual patient medical records.

CONCLUSIONS

In this study, ischemic stroke accounted for 87.9% of acute ischemic cerebrovascular diseases. The most common etiology was cardioembolic in origin (atrial fibrillation), and the most frequent risk factor was systemic arterial hypertension, both of which are strongly associated with recurrent stroke. Additionally, it was documented that a higher NIHSS score increases the risk of recurrence, and thrombolytic therapy showed a reduction in this score, implying a decrease in disability and better rehabilitation outcomes.

It is crucial for healthcare professionals to be trained in early diagnosis, appropriate identification of causes, timely treatment that includes stroke protocols, and adequate prevention of recurrences. These findings provide valuable insights for future research.

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CONFLICT OF INTERESTS

The researchers declare no conflict of interest.

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