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Original Article

Prevalence and Outcome of Intracranial Artery Stenosis in Patients with Acute Ischemic Stroke in a Tertiary Care Hospital

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ABSTRACT

Introduction: *A stroke, also known as a cerebrovascular accident (CVA), remains a significant contributor to mortality and morbidity in both developed and developing nations. For individuals experiencing an acute ischemic stroke, intravenous thrombolysis can help restore neurological function if given promptly, and it is advised to be administered as soon as intracranial bleeding is ruled out through CT imaging.* ***Aim of the study:*** *This study aimed to analyze the prevalence and clinical outcome of intracranial artery stenosis in patients with acute ischemic stroke in a tertiary care hospital.* ***Methods and materials:*** *This cross-sectional observational study was conducted at a Tertiary Care Hospital in Dhaka, Bangladesh from July 2021 to July 2022. This study used a purposive sampling technique to select a total of 100 patients as the study population. Data processing and analysis were conducted using MS Office tools, and a descriptive analysis approach was adopted.* ***Result:*** *Intracranial artery stenosis was found in 13% of patients. Besides, 36% had occlusion, and 4% had both. Most of the patients (69%) had hypertension, 72% had diabetes, and 23% had atrial fibrillation. Notably, 92.30% achieved a good outcome after early thrombolysis and thrombectomy if needed, as per the Modified Rankin Scale score. Notably, all patients achieved a good outcome after early thrombolysis, with aspirin and clopidogrel, and with surgical intervention.* ***Conclusion:*** *This study highlights acute ischemic stroke related to intracranial artery stenosis. Patients often have pre-existing conditions, emphasizing risk factor management. Timely intervention, including thrombolysis and thrombectomy, leads to favorable outcomes.*

Keywords: *Acute ischemic stroke, Intracranial artery, Thrombolysis, Hypertension*

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INTRODUCTION

A stroke, often referred to as a cerebrovascular accident (CVA), stands as one of the leading causes of mortality and morbidity, affecting both developed and developing countries [1]. Currently, stroke holds the position as the third leading cause of death on a global scale [2]. Intracranial atherosclerotic disease (ICAD) ranks among the most prevalent contributors to ischemic stroke worldwide. Each year, roughly 100,000 patients experience ischemic events related to ICAD in the United States, and its estimated prevalence affects 20-40 individuals per 100,000 people across the world [3]. Studies have consistently shown that intracranial factors are the primary culprits behind most stroke cases, with disruptions in intracranial circulation accounting for the majority of stroke incidents [4]. Approximately 10% (12.9%) of ischemic strokes result from atherosclerotic intracranial arterial stenosis [5]. Research indicates that individuals with middle cerebral artery stenosis face a risk of around 24% of developing ischemic stroke [6]. Various reports have highlighted the geographical differences in the prevalence of intracranial artery stenosis, noting that it tends to be more common in black and Asian populations compared to Caucasians [7]. Research has provided evidence that symptomatic steno-occlusion (SYSO) in acute ischemic stroke correlates with the initial severity of neurological symptoms and influences stroke outcomes [8]. In North America, intracranial large artery stenosis and occlusion diseases are responsible for 8-10% of ischemic strokes, while the numbers are significantly higher in the Chinese population, contributing to 30-50% of all strokes and more than 50% of transient ischemic attacks [9]. Despite the age-specific incidence and mortality of strokes being higher in men, the clinical impact of stroke is often greater in women [10]. Patients with acute ischemic stroke (AIS) resulting from intracranial atherosclerosis, stenosis, or occlusion face a heightened risk of early neurological deterioration (END). This elevated risk may be attributed to factors such as hemodynamics, hypoperfusion, or thrombus extension [11]. Various methods, including transcranial Doppler (TCD) ultrasonography, cerebral angiography, computed tomography angiography (CTA), and magnetic resonance angiography (MRA), have been developed to assess intracranial blood flow in asymptomatic patients. Among these methods, transcranial Doppler (TCD) stands out as an available, straightforward, and non-invasive approach for evaluating intracranial blood flow and monitoring hemodynamic changes [12]. In cases of acute ischemic stroke, intravenous thrombolysis is a recommended treatment to restore neurological function when administered promptly and after intracranial bleeding has been ruled out through CT scans [13]. Intravenous thrombolysis (IVT) involves the use of recombinant tissue plasminogen activator (rt-PA) and has been the standard treatment when administered within 4.5 hours of an acute ischemic stroke (AIS). However, patients with stroke resulting from large-artery occlusion may not respond optimally to intravenous rt-PA alone, leading to the consideration of bridging therapy, where intravenous thrombolysis precedes mechanical thrombectomy as an alternative option [14-16]. Despite significant advancements in intra-arterial mechanical thrombectomy (IAT), recanalization failure rates of up to 24% have been reported. More recently, the use of permanent stent placement, known as rescue stent (RS), during IAT has emerged as a potential option to enhance reperfusion and improve outcomes for these patients [17]. The final recanalization status is considered the most powerful predictor of clinical outcomes in patients undergoing thrombectomy [18]. The primary objective of this study is to evaluate the prevalence of intracranial artery stenosis in patients with acute

ischemic stroke in a tertiary care hospital and assess their clinical outcomes.

OBJECTIVE

General Objective

- To assess the prevalence and clinical outcome of intracranial artery stenosis in patients with acute ischemic stroke in a tertiary care hospital.

Specific Objectives

- To see the age and gender distribution among the study population.
- To see the distribution of patients according to risk factors.

METHODS & MATERIALS

This cross-sectional observational study was carried out at the Department of Medicine at a Tertiary Care Hospital in Dhaka, Bangladesh spanning from July 2021 to July 2022. The study employed a purposive sampling technique to carefully select a total of 100 patients for inclusion in the study population. Properly written consent was taken from all the participants.

Inclusion criteria:

- Patients who were diagnosed with acute ischemic stroke.
- Patients who came within 3 days of stroke.
- Patients who had given consent to participate in the study.

Exclusion Criteria

- Patients who had extracranial causes of stroke.
- Young patients with stroke.
- Drug abusers with stroke.
- Patients who did not give consent to participate in the study.

A structured questionnaire was used to assess common vascular risk factors such as hypertension, diabetes, use of tobacco, alcohol and illicit drugs, migraine, and, in women, oral contraceptive use. A systematic screening was performed, including CT angiogram in 25 patients, transcranial doppler (TCD) in 60 patients, and digital subtraction angiography (DSA) in 15 patients. After a definite diagnosis, early thrombolysis (by tissue plasminogen activator; tPA) was done in the patients who came within 4.30 hours of onset of stroke, some patients were managed with aspirin and/or clopidogrel, and others needed ring placement. For outcome assessment, the Modified Rankin Scale score was used [19]. Laboratory blood investigations were performed. All data was processed and analyzed by MS Office tools. A descriptive analysis was adopted in this study. Ethical clearance was obtained from the ethical committee of Combined Military Hospital, Dhaka, Bangladesh.

RESULTS

The largest segment of participants (52%) was aged over 61 years, signifying a higher prevalence of older individuals in the sample. The next most common age group, representing 30% of the total, ranged from 51 to 61 years. Gender distribution indicated that 57% of the patients were male, with the remaining 43% being female. The diagnostic findings of the study revealed that the majority of the patients (56%) had intracranial artery stenosis, while the remaining patients (44%) had extracranial artery stenosis. Among the 56 patients with intracranial artery stenosis, the highest proportion (58.92%) had stenosis in the middle cerebral artery, followed by 28.57% with anterior communicating artery stenosis, and 12.60% of the patients had posterior communicating artery stenosis. Hypertension was the most prevalent risk

factor among patients with middle cerebral artery stenosis (57.0%), and it was also common among patients with anterior communicating artery stenosis (62.5%). Patients with posterior communicating artery stenosis had both hypertension and diabetes mellitus as major risk factors. Satisfactory outcomes were observed in all of the patients, including those who underwent early thrombolysis (8.99%) within 4.30 hours, the patients who were treated with aspirin and clopidogrel (87.50%), and a small number of patients (3.57%) who required intra-arterial stent placement.

Table I: Age distribution of patients (N=100)

Age (years)	n	%
40-50	18	18.0
51-61	30	30.0
>61	52	52.0

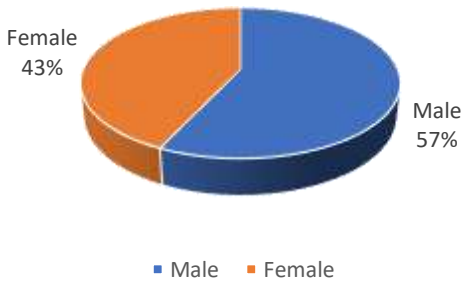

Figure 1: Gender distribution of participants (N=100)

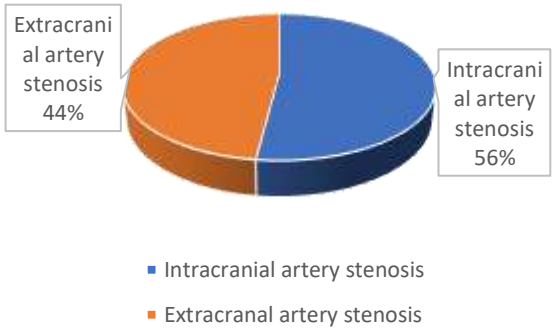

Figure 2: Type of stroke (N=100)

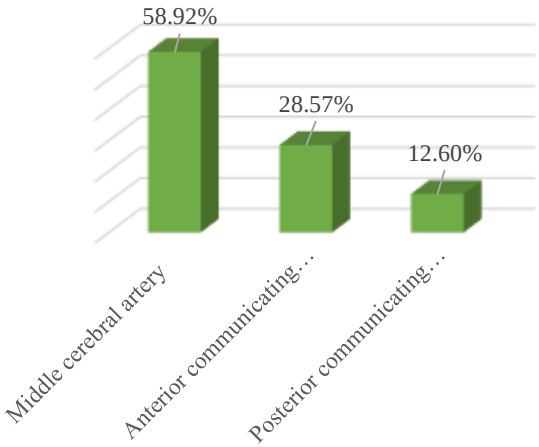

Figure 3: Prevalence of intracranial artery stenosis (n=56)

Table II: Risk factors among intracranial artery stenotic patients (n=56)

Risk factor	Middle cerebral artery n (%)	Anterior communicating artery n (%)	Posterior communicating artery n (%)
Hypertension	19 (57.0)	10 (62.5)	2 (28.57)
Diabetes mellitus	11 (33.34)	3 (18.75)	2 (28.57)
Alcohol consumption	1 (3.5)	2 (12.5)	0 (0.0)
Smoking	2 (6.06)	1 (6.25)	3 (42.90)

Table III: Outcomes of intracranial artery stenosis (n=56)

Mode of treatment	n (%)	Outcome*
Early thrombolysis (within 4.30 hours)	5 (8.99)	Satisfactory
Aspirin, clopidogrel	49 (87.50)	Satisfactory
Intra-arterial ring placement	2 (3.57)	Satisfactory

**Outcome was assessed by mRs score (Modified Rankin Score)*

DISCUSSION

Intracranial arterial stenosis (IAS) refers to the narrowing of large intracranial arteries. IAS is primarily associated with atherosclerosis, although embolic events can occasionally lead to severe stenosis. Other causes of IAS include arterial dissection, inflammatory disorders (vasculitis), infections of the central nervous system, radiation, sickle cell disease, and myoma [20]. In our study, the majority of patients (52%) were in the age group above 61 years, followed by the 51-61 years age group (30%). Li W et al.'s study showed a similar distribution [10]. Among our participants, 57% were male and 43% were female. Yu C et al. also found in their study that men had a significantly higher prevalence of intracranial artery stenosis compared to women (23.11% vs. 17.45%), which aligns with our findings [9]. In our study, intracranial artery stenosis was identified in 56% of the patients, while the remaining 44% had extracranial artery stenosis. Mattioni A. et al. conducted a study on stroke and transient ischemic attack, involving 220 patients (187 with stroke and 33 with TIA) with a mean age of 65 years, and they found that intracranial stenosis was present in 6.4% of the cases, intracranial occlusion in 34.5%, and both occlusion and stenosis in 2.3% [8]. Another study reported a prevalence of 25.4% for intracranial artery stenosis in patients with acute ischemic stroke [21]. In a study by de Weerd et al., the pooled prevalence of moderate stenosis was 4.2%, and the prevalence of severe stenosis was 1.7% [22]. Among the patients with intracranial artery stenosis in our study, the majority (58.92%) had middle cerebral artery stenosis, followed by 28.57% with anterior communicating artery stenosis, and 12.60% with posterior communicating artery stenosis. Among patients with middle cerebral artery (MCA) stenosis in your study, hypertension was the most prevalent risk factor (57.0%). This trend was also observed in anterior communicating artery (ACA) stenotic patients (62.5%). In contrast, patients with posterior communicating artery (PCA) stenosis had both hypertension and diabetes mellitus as major risk factors. A study by Xu W. et al. categorized patients into uni-MCA stenosis (50%) and multiple stenosis (50%) subgroups, and the most common traditional vascular risk factors included hypertension, hyperlipemia, smoking, and alcohol consumption, which aligns with the findings in your study [23]. Another study by Huang HW et al. found that MCA stenosis was present in 5.9% of their subjects and identified hypertension, diabetes, and systolic blood pressure as significant risk factors for MCA stenosis [24]. Satisfactory outcomes were observed in your study, with 8.99% of patients who underwent early thrombolysis within 4.30 hours, 87.50% treated with aspirin and clopidogrel, and a small proportion (3.57%) requiring intra-arterial ring placement. These findings are in line with a study conducted by Arnold M et al. [25]. The study by Endo S. et al. demonstrated that recanalization was achieved in eight patients through intra-arterial local thrombolysis, and four of these patients had a favorable clinical outcome [26].

Regarding the cardiovascular risk factors associated with different subtypes of ischemic stroke, your statement aligns with established patterns. Atrial fibrillation and ischemic heart disease are more prevalent in patients with cardioembolic infarction, while hypertension and diabetes are commonly seen in patients with lacunar stroke. Patients with atherothrombotic infarction tend to have vascular peripheral disease, hypertension, diabetes, a history of previous transient ischemic attacks, and chronic obstructive pulmonary disease [27]. For patients with stroke due to internal carotid artery (ICA) occlusion, thrombolytic therapy has been found to significantly reduce the proportion of patients dependent on activities of daily living [12]. This agrees with the study conducted by Minnerup J et al., which showed that thrombolysis alone improves functional outcomes and reduces mortality in patients with ischemic stroke [28].

Limitations of the study

This study had some limitations that should be acknowledged. It was conducted at a single hospital, which may limit the generalizability of the findings to a broader community. Additionally, the sample size was relatively small, which could impact the statistical power and precision of the results. Therefore, caution should be exercised when extrapolating these findings to larger and more diverse populations.

CONCLUSION

In this study, a significant prevalence of acute ischemic stroke attributed to intracranial artery stenosis is evident, affecting 56% of the patients, among which middle cerebral artery stenosis was most common (58.92%). Hypertension, diabetes mellitus, smoking and alcohol consumption act as major risk factors therefore, underscoring the importance of actively managing these factors to prevent strokes. Importantly, the outcomes remain satisfactory, with early thrombolysis (by tPA), drug management and intra-arterial ring placement in a few patients.

RECOMMENDATION

These findings emphasize the continued significance of early and appropriate interventions in the effective management of acute ischemic stroke within this patient population. Moreover, facility and efficacy of emergency intracranial artery stent placement should be addressed to improve neurologic symptoms and clinical outcome.

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Conflict of interest: None declared.

Ethical approval: The study was approved by the institutional ethics committee.

REFERENCES

1. *Hamad A, Hamad A, Sokrab TE, Momeni S, Mesraoua B, Lingren A. Stroke in Qatar: a one-year, hospital-based study. Journal of Stroke and Cerebrovascular Diseases. 2001 Sep 1;10(5):236-41.*
2. *Tran J, Mirzaei M, Anderson L, Leeder SR. The epidemiology of stroke in the Middle East and North Africa. Journal of the Neurological Sciences. 2010 Aug 15;295(1-2):38-40.*
3. *Bang OY. Intracranial atherosclerotic stroke: specific focus on the metabolic syndrome and inflammation. Current atherosclerosis reports. 2006 Jul;8(4):330-6.*
4. *Elmore EM, Mosquera A, Weinberger J. The prevalence of asymptomatic intracranial large-vessel occlusive disease: the role of diabetes. Journal of Neuroimaging. 2003 Jul;13(3):224-7.*
5. *Corston RN, Kendall BE, Marshall JO. Prognosis in middle cerebral artery stenosis. Stroke. 1984 Mar;15(2):237-41.*
6. *Wityk RJ, Lehman D, Klag M, Coresh J, Ahn H, Litt B. Race and sex differences in the distribution of cerebral atherosclerosis. Stroke. 1996 Nov;27(11):1974-80.*

7. *Kang J, Park TH, Lee KB, Park JM, Ko Y, Lee SJ, Hong KS, Cho YJ, Lee JS, Lee J, Lee BC. Symptomatic steno-occlusion in patients with acute cerebral infarction: prevalence, distribution, and functional outcome. Journal of stroke. 2014 Jan;16(1):36.*
8. *Mattioni A, Cenciarelli S, Biessels GJ, van Seeters T, Algra A, Ricci S. Prevalence of intracranial large artery stenosis and occlusion in patients with acute ischaemic stroke or TIA. Neurological Sciences. 2014 Mar; 35:349-55.*
9. *Yu C, An Z, Zhao W, Wang W, Gao C, Liu S, Wang J, Wu J. Sex differences in stroke subtypes, severity, risk factors, and outcomes among elderly patients with acute ischemic stroke. Frontiers in Aging Neuroscience. 2015 Sep 8; 7:174.*
10. *Li W, Xiao WM, Luo GP, Liu YL, Qu JF, Fang XW, Wang F, Chen YK. Asymmetrical cortical vein sign predicts early neurological deterioration in acute ischemic stroke patients with severe intracranial arterial stenosis or occlusion. BMC neurology. 2020 Dec;20(1):1-7.*
11. *Shariat A, Niknam L, Izadi S, Salehi A. Prevalence of intracranial artery stenosis in Iranian patients with acute ischemic stroke using transcranial Doppler ultrasonography. Iranian journal of neurology. 2016 Jul 7;15(3):133.*
12. *Paciaroni M, Balucani C, Agnelli G, Caso V, Silvestrelli G, Grotta JC, Demchuk AM, Sohn SI, Orlandi G, Leys D, Pezzini A. Systemic thrombolysis in patients with acute ischemic stroke and Internal Carotid ARtery Occlusion: the ICARO study. Stroke. 2012 Jan;43(1):125-30.*
13. *Bhatia R, Hill MD, Shobha N, Menon B, Bal S, Kochar P, Watson T, Goyal M, Demchuk AM. Low rates of acute recanalization with intravenous recombinant tissue plasminogen activator in ischemic stroke: real-world experience and a call for action. stroke. 2010 Oct 1;41(10):2254-8.*
14. *Chang YH, Wu KC, Harn HJ, Lin SZ, Ding DC. Exosomes and stem cells in degenerative disease diagnosis and therapy. Cell transplantation. 2018 Mar;27(3):349-63.*
15. *He R, Moisan A, Detante O, Rémy C, Krainik A, Barbier EL, Lemasson B. Evaluation of parametric response mapping to assess therapeutic response to human mesenchymal stem cells after experimental stroke. Cell Transplantation. 2017 Aug;26(8):1462-71.*
16. *Kim JH, Choi JI. Feasibility of rescue stenting technique in patients with acute ischemic stroke due to middle cerebral artery occlusion after failed thrombectomy: A single-center retrospective experience. Plos one. 2022 Sep 27;17(9): e0274842.*
17. *Nogueira RG, Liebeskind DS, Sung G, Duckwiler G, Smith WS. Predictors of good clinical outcomes, mortality, and successful revascularization in patients with acute ischemic stroke undergoing thrombectomy: a pooled analysis of the Mechanical Embolus Removal in Cerebral Ischemia (MERCI) and Multi MERCI Trials. Stroke. 2009 Dec 1;40(12):3777-83.*
18. *Dubow JS, Salamon E, Greenberg E, Patsalides A. Mechanism of acute ischemic stroke in patients with severe middle cerebral artery atherosclerotic disease. Journal of Stroke and Cerebrovascular Diseases. 2014 May 1;23(5):1191-4.*
19. *Weisscher N, Vermeulen M, Roos YB, De Haan RJ. What should be defined as a good outcome in stroke trials; a modified Rankin score of 0–1 or 0–2? Journal of Neurology. 2008 Jun; 255:867-74.*
20. *Carvalho M, Oliveira A, Azevedo E, Bastos-Leite AJ. Intracranial arterial stenosis. Journal of Stroke and Cerebrovascular Diseases. 2014 Apr 1;23(4):599-609*
21. *Shariat A, Niknam L, Izadi S, Salehi A. Prevalence of intracranial artery stenosis in Iranian patients with acute ischemic stroke using transcranial Doppler ultrasonography. Iranian journal of neurology. 2016 Jul 7;15(3):133.*
22. *de Weerd M, Greving JP, de Jong AW, Buskens E, Bots ML. Prevalence of asymptomatic carotid artery stenosis according to age and sex: systematic review and meta-regression analysis. Stroke. 2009 Apr 1;40(4):1105-13*
23. *Xu W, Zhang X, Chen H, Zhao Z, Zhu M. Prevalence and outcome of young stroke patients with middle cerebral artery stenosis. BMC neurology. 2021 Dec;21(1):1-0.*
24. *Huang HW, Guo MH, Lin RJ, Chen YL, Luo Q, Zhang Y, Wong KS. Prevalence and risk factors of middle cerebral artery stenosis in asymptomatic residents in Rongqi County, Guangdong.*

Cerebrovascular diseases. 2007 Jun 1;24(1):111-5.

25. *Arnold M, Schroth G, Nedeltchev K, Loher T, Remonda L, Stepper F, Sturzenegger M, Mattle HP. Intra-arterial thrombolysis in 100 patients with acute stroke due to middle cerebral artery occlusion. Stroke. 2002 Jul 1;33(7):1828-33.*
26. *Endo S, Kuwayama N, Hirashima Y, Akai T, Nishijima M, Takaku A. Results of urgent thrombolysis in patients with major stroke and atherothrombotic occlusion of the cervical internal carotid artery. American Journal of Neuroradiology. 1998 Jun 1;19(6):1169-75.*
27. *Arboix A. Cardiovascular risk factors for acute stroke: Risk profiles in the different subtypes of ischemic stroke. World Journal of Clinical Cases: WJCC. 2015 May 5;3(5):418.*
28. *Minnerup J, Wersching H, Teuber A, Wellmann J, Eyding J, Weber R, Reimann G, Weber W, Krause LU, Kurth T, Berger K. Outcome after thrombectomy and intravenous thrombolysis in patients with acute ischemic stroke: a prospective observational study. Stroke. 2016 Jun;47(6):1584-92.*