

Clinical Characteristics of Ischemic Stroke Patients with Middle Cerebral Artery Stenosis at Hasan Sadikin General Hospital Bandung

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Abstract

Background and Objective: Globally, over 7.6 million new cases of ischemic stroke occur annually, with intracranial artery stenosis identified in 30-50% of cases. The middle cerebral artery is the most frequently affected vessel. Limited data are available regarding the clinical characteristics of ischemic stroke associated with middle cerebral artery stenosis in Indonesia. Recognizing these characteristics aids clinicians in accurate diagnosis and management. To identify characteristics of patients with ischemic stroke and middle cerebral artery stenosis.

Subject and Method: This retrospective descriptive observational study using medical records examine ischemic stroke patients with middle cerebral artery stenosis at Hasan Sadikin General Hospital Bandung.

Results: Among 107 cases, the majority of patients were over 45 years old (86.9%) and predominantly male (69.2%). Hypertension was the most prevalent risk factor (87.9%), followed by dyslipidemia (63.6%) and smoking (56.1%). A significant portion of patients (89.7%) had multiple risk factors, and 62.6% experienced recurrent strokes. Most patients presented more than 4.5 hours after symptom onset (95.3%). The majority had an ASPECTS score of ≤ 7 (86.0%) and exhibited moderate stroke symptoms (86.0%). Common symptoms included motor weakness (100%) and language impairment (87.9%). Most patients survived (98.1%).

Conclusion: Ischemic stroke with MCA stenosis predominantly affected older male patients with multiple vascular risk factors, particularly hypertension. Delayed hospital presentation and moderate stroke severity were common findings, emphasizing the need for improved stroke awareness and earlier access to acute care.

Keywords: middle cerebral artery, ischemic, characteristics, stenosis, stroke

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Introduction

Stroke is a medical condition defined by the abrupt onset of specific neurological symptoms resulting from damage to the blood vessels in the brain. This damage can be caused by either a blockage or hemorrhage in the central nervous system.¹ There are more than 7.6 million new ischemic strokes each year, with global data indicating that over 62% of stroke events are ischemic strokes.² A study conducted in Indonesia and West Java also reported a higher frequency of ischemic stroke compared to intracerebral hemorrhage.^{3,4} This

type of stroke results in long-term neurological damage and disability in adults, imposing a significant health and economic burden.⁵ The etiology of stroke is heterogeneous, necessitating the implementation of diverse strategies in treatment and secondary prevention. According to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification, ischemic stroke in Asian populations is most commonly caused by large artery atherosclerosis, in contrast to Western populations. This suggests that cerebral artery stenosis may be an important cause of stroke in Asian populations.⁶

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The prevalence of cerebral artery stenosis varies according to its location. The risk of intracranial artery stenosis is considerably higher than that of extracranial artery stenosis in Asian populations. It is estimated that intracranial artery stenosis is responsible for 30 to 50% of ischemic strokes, with the middle cerebral artery being the most commonly affected vessel. This type of stroke results in long-term neurological damage and disability in adults, imposing a significant health and economic burden, and also have a tendency to recurrent strokes.^{5,7}

Limited data are available regarding the clinical characteristics of ischemic stroke associated with middle cerebral artery stenosis in Indonesia. To the best of our knowledge, no study has comprehensively described the clinical characteristics of ischemic stroke associated with MCA stenosis in Indonesia, particularly in West Java. This study was aimed to describe the demographic and clinical characteristics, vascular risk factors, stroke severity, presentation patterns, and short-term outcomes of ischemic stroke patients with MCA stenosis at Hasan Sadikin General Hospital Bandung, Indonesia.

Methods

Study design

This retrospective descriptive observational study reviewed medical records of ischemic stroke patients with MCA stenosis admitted between January 2023 and January 2024.

Inclusion and exclusion criteria

The inclusion criteria for this study were medical records of patients with a final diagnosis of ischemic stroke with middle cerebral artery stenosis, as determined by transcranial Doppler examination. MCA stenosis was diagnosed using transcranial Doppler ultrasonography according to institutional neurovascular criteria. Patients were classified as having MCA stenosis based on abnormal flow velocity suggestive of intracranial arterial narrowing, with mean flow velocity less than 30 or more than 80 cm/seconds. Consecutive sampling was applied to all eligible patients meeting inclusion criteria. Medical records that

were incomplete and had duplication data were excluded from the study.

Data collection

The data collected included the demographic characteristics and distribution of the study sample, as well as information on other risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking, hyperuricemia, the number of risk factors present, history of stroke, onset of arrival, ASPECTS and NIHSS scores on admission, and the severity of symptoms, signs, and symptoms present upon arrival, as well as outcomes. The ASPECTS score was determined by a neurologist. The data were subsequently subjected to descriptive statistical analysis.

Statistical analysis

Statistical analysis was performed descriptively using frequencies, percentages, medians, and ranges.

Ethical Clearance

This study has been granted ethical approval by the Ethics Commission of the Faculty of Medicine, Padjadjaran University (number 231/UN6.KEP/EC/2024).

Results

During the study period, 532 stroke patients were identified. Of these, 442 had ischemic stroke, and 120 met eligibility criteria for MCA stenosis. Following exclusion of incomplete medical records, 107 patients were included in the final analysis. As illustrated in Table 1, the majority of patients were above the age of 45 years (86.9%), with a median age of 59 years (range: 21–85 years). The majority of patients were male (69.2%). The most prevalent risk factors were hypertension (87.9%), dyslipidemia (63.6%), and smoking (56.1%). A total of 89.7% of patients exhibited the presence of multiple risk factors, while 62.6% had a history of recurrent stroke. Hypertension emerged as the predominant vascular risk factor, affecting nearly nine out of ten patients. The vast majority of patients (95.3%) presented with a time interval exceeding 4.5 hours, with a median duration of 12 hours

Table 1. Characteristic of Demographic

Variable	Total n	P (%)
Age	Median	59
	Range	21-85
>55 year	93	86.9%
≤55 year	14	13.1%
Gender		
Female	33	30.8%
Male	74	69.2%
Risk factor		
Diabetes	25	23.4%
Hypertension	94	87.9%
Dyslipidemia	68	63.6%
Smoking	60	56.1%
Hyperuricemia	16	15.0%
History of stroke	18	16.8%
Others	10	9.3%
Amount of risk factors		
Monorisk (1)	11	10.3%
Multiple risk (>1)	96	89.7%
Stroke event		
First event	40	37.4%
Recurrent	67	62.6%
Onset	Median	12
	Range	1-20
Non-delay(0-4.5 hour)	5	4.7%
Delay (>4,5 hour)		95.3%

(ranging from 1 to 120 hours). The majority of patients exhibited an ASPECTS score of ≤7, with a median of 7 (range 4–8). The majority of patients exhibited moderate stroke severity (NIHSS 5–15) with a median of 8 (3–16). The most prevalent symptoms were motor weakness (100%) and language impairment (87.9%). The majority of patients (98.1%) were alive at the time of the study (table 2).

Discussion

Age

This observational study, conducted over a one-

Table 2a. Clinical Characteristic of MCA Stenosis Stroke Patients

Variable	n	%
ASPECTS score	Median	7
	Range	4-8
≤7	92	86.0%
>7	15	14.0%
NIHSS	Median	8
	Range	3-16
Mild stroke (1-4)	12	11.2%
Moderate stroke (5-15)	92	86.0%
Severe stroke (16-20)	2	1.9%
Very severe stroke (21-42)	0	0.0%
Sign and symptoms		
Decreased of consciousness	35	32.7%
Sensory problem	23	21.5%
Aphasia	94	87.9%
Visual loss	9	8.4%
Balance disorder	9	8.4%
Headache	13	12.1%
Motor weakness	107	100.0%
Outcome		
Dead	2	1.9%
Survive	105	98.1%
Delay (>4,5 hour)	102	95.3%
ASPECTS score	Median	7
	Range	4-8
≤7	92	86.0%
>7	15	14.0%
NIHSS	Median	8
	Range	3-16
Mild stroke (1-4)	12	11.2%
Moderate stroke (5-15)	92	86.0%
Severe stroke (16-20)	2	1.9%
Very severe stroke (21-42)	0	0.0%
Sign and symptoms		
Decreased of consciousness	35	32.7%
Sensory problem	23	21.5%
Aphasia	94	87.9%

Table 2b. Clinical characteristic of MCA stenosis stroke patients

Visual loss	9	8.4%
Balance disorder	9	8.4%
Headache	13	12.1%
Motor weakness	107	100.0%
Outcome		
Dead	2	1.9%
Survive	105	98.1%

year period, involved the examination of 107 cases of ischemic stroke with middle cerebral artery stenosis among patients hospitalized at Hasan Sadikin General Hospital Bandung.

The majority of patients in this study were over the age of 45, with a median age of 59 years (range 21–85 years). This suggests a higher prevalence of elderly patients than young adults. This finding is consistent with the results of several previous studies that have demonstrated a higher prevalence of ischemic stroke with middle cerebral artery stenosis in older age groups.^{7–10} Additionally, numerous studies have consistently shown that as age increases, there is a corresponding increase in the prevalence and severity of intracranial arterial stenosis, including in the middle cerebral artery.^{11,12} With age, there are structural and functional changes in both the microcirculation and macrocirculation of the brain. The microcirculatory changes associated with increasing age are thought to be mediated by endothelial dysfunction and impaired brain autoregulation, as well as neurovascular interrelationships. Endothelial dysfunction has been demonstrated to promote neuroinflammation, impair cerebral autoregulation, and lead to microvascular injury, as well as affect neurovascular linkages and cortical function.¹³

Recent studies have revealed an increasing incidence of ischemic stroke among young adults.¹⁴ A retrospective study conducted at a single center in China identified LAA (large artery atherosclerosis) as the predominant cause of middle cerebral artery stenosis in young

patients with ischemic stroke.⁶ This finding may be attributed to the rising prevalence of traditional vascular risk factors among children and young adults, which can precipitate early-onset atherosclerosis. Atherosclerosis subsequently progresses to middle cerebral artery stenosis, resulting in ischemic stroke. It is probable that these risk factors will become more significant with advancing age.¹⁵

Sex

With regard to gender, the study population was predominantly male. Epidemiological surveys conducted at home and abroad have revealed that the incidence of ischemic stroke is higher in men than in women.^{16–18} Similarly, studies that have examined the characteristics of patients with ischemic stroke and middle cerebral artery stenosis have found that the majority of patients were male.^{7–10,19} The study revealed that men are at a higher risk of suffering an ischemic stroke with middle cerebral artery stenosis than women.¹⁹ Additionally, an autopsy study indicated that from the fourth to the sixth decade, men demonstrated a higher prevalence and severity of atherosclerosis than women.²⁰

This discrepancy is frequently attributed to the lack of protective effects of estrogen in men and heightened exposure to vascular risk factors.¹² Estrogen exerts protective effects in numerous tissues, including the brain, adipose tissue, heart, and blood vessels. In the context of ischemic stroke, estrogen has been demonstrated to possess highly neuroprotective properties at multiple levels of biological organization. These include the suppression of risk factors for stroke pathology through anti-atherogenic effects in the vasculature and the regulation of adipogenesis. Furthermore, estrogen has been demonstrated to improve stroke pathology through the dilation of coronary arteries and the neuroprotective effects on brain and glial cells during ischemia.¹³

Risk Factor

In this study, hypertension was identified as the most prevalent risk factor among patients, followed by dyslipidemia and smoking. This

finding is consistent with those of previous studies, which have demonstrated that the majority of patients with ischemic stroke and middle cerebral artery stenosis have hypertension, dyslipidemia, and a history of smoking.^{7-10,19} Furthermore, traditional risk factors for intracranial stenosis, including middle cerebral artery that can progress to ischemic stroke, include age, hypertension, diabetes mellitus, hyperlipidemia, metabolic syndrome, a sedentary lifestyle, and smoking.¹⁵

The mechanisms to be described may explain the effects of hypertension, dyslipidemia, and smoking on the incidence of ischemic stroke. Hypertension, or elevated blood pressure, can impair the ability of cerebral vasculature to regulate blood flow effectively. This occurs because hypertension causes the blood vessels to become more rigid and deformed, thereby impeding the ability to regulate blood pressure. Consequently, specific regions of the brain, particularly those situated at the border between distinct arterial territories, may undergo damage.¹³

Dyslipidemia, defined as abnormal blood fat levels, also plays a significant role in the pathogenesis of cerebral vascular disease. A definitive correlation exists between total cholesterol levels, particularly low-density lipoprotein (LDL), and ischemic stroke. Oxidized LDL cholesterol has been demonstrated to cause inflammation and form plaques in the walls of blood vessels, which then result in blood flow obstruction.¹⁷ Additionally, the risk of stroke is increased by smoking, as smoking causes blood clots and facilitates platelet aggregation, thus disrupting the equilibrium between cerebral vascular coagulation and abnormal fibrinolysis. Furthermore, smoking impairs the function of the blood-brain barrier and disrupts the normal functioning of cells in the blood vessels of the brain.¹⁶

Number of Risk Factors

The majority of patients exhibited a multitude of risk factors. This result is consistent with the study¹⁵ which found that many patients who had experienced an ischemic stroke had various

underlying causes, including middle cerebral artery stenosis. The patients were of varying ages, including both young and old individuals. They had at least two known risk factors that increased the likelihood of having an ischemic stroke. As the majority of individuals possess multiple risk factors, the incidence of stroke is significantly elevated. One hypothesis is that patients with multiple risk factors are unable to effectively regulate their risk factors, rendering them susceptible to stroke events. Another factor pertains to the pathological process underlying ischemic stroke caused by atherosclerosis. The formation of blood clots in ruptured atherosclerotic plaques constitutes the pathological basis of acute arterial thrombotic events. Several risk factors play a pivotal role in the development of atherosclerosis and plaque instability.¹³

History of Stroke

A review of the medical history revealed that the majority of patients had experienced recurrent strokes. This finding aligns with the results of a study conducted at the Jakarta Islamic Hospital Sukapura, which indicated that the onset of ischemic stroke attacks with various etiologies, including middle cerebral artery stenosis, is frequently a recurrent event.^{19,20} The recurrence rates and stroke patterns observed vary depending on the specific stroke subtype. LAA (large artery atherosclerosis) has a higher recurrence rate and tends to manifest as the same subtype on subsequent occasions.

In contrast, the recurrence rate of small vessel occlusion stroke is lower, yet its recurrence pattern is less predictable, necessitating meticulous diagnostic evaluation. Furthermore, the presence of additional risk factors, including smoking, hypertension, diabetes mellitus, atrial fibrillation, previous cerebrovascular events, and increased stroke severity, independently increased the likelihood of stroke recurrence. The findings of this study suggest that secondary prevention measures may not have been adequately implemented in patients who have experienced a stroke within this population, as has been previously demonstrated.¹⁸

Arrival Onset

The majority of patients arrived at the hospital after a delay of more than 4.5 hours, with a median of 12 hours (ranging from 1 to 120 hours). This is analogous to a study conducted at Bathesda Hospital Yogyakarta, wherein the majority of ischemic stroke patients with diverse etiologies, including middle cerebral artery stenosis, manifested after a period exceeding^{4,5} hours.¹⁹ Over half of the instances of pre-hospital delay were attributable to a delay in contacting emergency medical services. This may be attributed to the family or patient perceiving that the symptoms are not sufficiently severe to necessitate a hospital visit.

ASPECTS and NIHSS Score

The National Institutes of Health Stroke Scale (NIHSS) is a widely recognized method for assessing the severity of a stroke. The NIHSS is a tool that can be used to assess stroke severity by calculating a score based on the clinical symptoms and neurological function of the patient.¹¹ Additionally, the Alberta Stroke Program Early CT Score (ASPECTS) has been found to have an inverse correlation with the NIHSS, which means that it can be used to support the assessment of stroke severity.^{11,13} The ASPECTS score is assessed by counting the number of lesional areas on a CT scan.¹⁴

A number of studies have demonstrated that there is an inverse correlation between ASPECTS and NIHSS scores, whereby a lower ASPECTS score is associated with a higher NIHSS score, and vice versa.^{12,13} This finding was consistent in the present study, where the majority of patients had ASPECTS scores of ≤ 7 , with a median score of 7 (4–8), while the majority of patients were classified as having a moderate stroke based on their NIHSS score, with a median score of 8 (30–16).¹⁵ The severity of ischemic stroke with various etiologies, including stenosis of the middle cerebral artery, is influenced by several factors, including the underlying stroke etiology, age, fasting serum triglyceride levels, active smoking, and pre-stroke medications. These factors play

an important role in determining the severity of ischemic stroke.¹³ Furthermore, ischemic stroke with middle cerebral artery stenosis is considered more severe than stroke with stenosis at other locations. This may be attributed to the fact that the middle cerebral artery is responsible for supplying blood to a considerable portion of the brain, including regions that are vital for motor control, sensory perception, and cognitive function.¹⁶ Additionally, this artery is more susceptible to stenosis and occlusion due to its high blood flow rate and limited collateral circulation, which can lead to increased risk of hemorrhage, ischemia, stroke, cognitive impairment, motor deficits, and sensory deficits.¹⁷ This artery is also relatively close to the brainstem, which is responsible for controlling many vital functions.¹⁸

Sign and Symptoms of Arrival

The most prevalent signs and symptoms observed in the patients included in this study upon their initial presentation were motor weakness and language impairment, respectively. A similar pattern was observed in a study conducted on patients with ischemic stroke of various etiologies, including middle cerebral artery stenosis, in Uganda. In this study, the majority of patients exhibited unilateral limb weakness.¹⁹ The primary function of the middle cerebral artery is to supply oxygenated blood to specific parenchymal regions of the brain. The cortical branches of the middle cerebral artery provide blood supply to the primary motor brain parenchyma and somatosensory cortical areas of the face, trunk, and upper limbs, in addition to the insular and auditory cortices. The middle cerebral artery gives rise to smaller branches in its middle section, which supply the basal ganglia and internal capsule.

The superior division of the middle cerebral artery supplies the lateral inferior frontal lobe, which includes Broca's area, responsible for speech production, language comprehension, and writing. The inferior division of the middle cerebral artery supplies the superior temporal gyrus, which includes Wernicke's area, responsible for speech comprehension and language development.²⁰ The

most common symptoms observed in patients suffering from an ischemic stroke affecting the middle cerebral artery are contralateral paralysis of the arm, leg, and face. These symptoms may manifest as muscle weakness, spasticity, hyperreflexia, and resistance to movement. This may result from necrosis of the primary motor cortex. A dominant hemisphere stroke, which most commonly occurs on the left side, causes Broca's aphasia if the superior division of the middle cerebral artery is affected. In contrast, Wernicke's aphasia or conduction aphasia may be seen if the inferior division of the middle cerebral artery is affected.²⁰

Outcomes

In terms of treatment outcomes, the majority of patients went home alive. A similar outcome was observed in a study conducted on patients with ischemic stroke of various etiologies, including middle cerebral artery stenosis, in ten hospitals. The results demonstrated that the majority of patients (97.11%) were discharged in an improved condition, while 2.89% died. NIHSS and ASPECTS scores are contributing factors in post-stroke clinical outcomes.¹⁸ In this study, the majority of patients exhibited moderate NIHSS scores, with a median of 8 and a range of 3-16. The NIHSS score is a highly predictive indicator of a patient's likelihood of recovery following a stroke. Scores of 16 or above indicate a high probability of mortality or severe disability, whereas scores of 6 or below suggests a favorable prognosis.¹⁸

The ASPECTS results for patients in this study also demonstrated that the majority of scores were below 7, with a median of 7 and a range of 4-8. ASPECTS is a predictor of mortality, with a negative correlation between score and severity/progression. This confirms good predictability with good specificity, sensitivity, and area under the curve.¹⁸ A study demonstrated that 95% of patients with an ASPECTS score of more than 3 points at hospital admission survived, resulting in good outcomes and excellent predictability of the score.¹⁸ In addition to NIHSS and ASPECTS scores, favorable clinical outcomes may be

attributable to enhancements in individual lifestyle and the management of risk factors linked to stroke, including strategies to reduce the incidence and mortality associated with stroke. Furthermore, meticulous monitoring in the hospital setting can effectively manage the majority of cardiac, respiratory, and vascular complications if identified promptly and correctly. It is important to consider the limitations of this study, which include that using of a purposive sampling method may introduce a degree of selection bias, as the sample was selected based on specific criteria by the researcher, potentially limiting its representativeness of the wider population.

The findings of this study are limited to patients at Hasan Sadikin General Hospital Bandung and may not be generalizable to stroke patient populations in other hospitals or regions. Furthermore, the data may have originated from medical records or patient self-report, which could be subject to inaccuracies or incomplete information. Given that the study was conducted over a one-year period, it may not have been sufficiently long to observe long-term trends or changes in patient characteristics. It is challenging to ascertain the significance and uniqueness of the findings in this study, given the absence of a comparison group. These limitations must be taken into account when interpreting the results and when designing future studies, with the aim of gaining a more comprehensive understanding of the characteristics of patients with ischemic stroke and middle cerebral artery stenosis.

Conclusion

This observational study underscores that ischemic stroke secondary to middle cerebral artery (MCA) stenosis at Hasan Sadikin General Hospital, Bandung, predominantly afflicts men and individuals aged over 45. The clinical profile is heavily characterized by a high burden of atherosclerotic disease recurrence and a dense clustering of multiple co-morbid risk factors, with hypertension acting as the primary driving pathological catalyst. A critical systemic challenge identified is the prolonged pre-hospital delay,

with the majority of patients arriving beyond the crucial 4.5 hour therapeutic window (median: 12 hours), thereby severely limiting eligibility for acute reperfusion therapies. At presentation, the neurological deficit profile typically manifests as a moderate clinical stroke (median NIHSS of 8) coupled with significant early ischemic changes on neuroimaging (median ASPECTS of 7). The hallmark clinical signs—motor weakness and language impairment—directly map to the vulnerable cortical and deep penetrating vascular territories supplied by the MCA. Despite the anatomical severity and high flow velocity of the MCA, short-term clinical outcomes remain favorable, with high acute survival rates driven by comprehensive, multidisciplinary inpatient monitoring.

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Conflict of Interest

None.

References

1. Murphy SJX, Werring DJ. Stroke: causes and clinical features. *Med (Abingdon)*. 2020 ;48(9):561–6. doi: 10.1016/j.mpmed.2020.06.002
2. Pratama LB, Amalia L, Juli C, Gamayani U, Hermawan AN. Clinical outcome of stroke patients based on the National Institutes of Health Stroke Scale (NIHSS) in a tertiary hospital. *MNJ Malang Neurol J*. 2023;9(1):17-23. doi:10.21776/ub.mnj.2023.009.01.4.
3. Pu L, Wang L, Zhang R, Zhao T, Jiang Y, Han L. Projected global trends in ischemic stroke incidence, deaths and disability-adjusted life years from 2020 to 2030. *Stroke*. 2023;54(5):1330-9. doi:10.1161/STROKEAHA.122.040073.
4. Xu W, Zhang X, Chen H, Zhao Z, Zhu M. Prevalence and outcome of young stroke patients with middle cerebral artery stenosis. *BMC Neurol*. 2021;21(1):99. doi:10.1186/s12883-021-02125-8.
5. Lee HN, Ryu CW, Yun SJ. Vessel-wall magnetic resonance imaging of intracranial atherosclerotic plaque and ischemic stroke: a systematic review and meta-analysis. *Front Neurol*. 2018;9:1032. doi:10.3389/fneur.2018.01032.
6. Jeng JS, Hsieh FI, Yeh HL, Chen WH, Chiu HC, Tang SC, et al. Impact of MCA stenosis on the early outcome in acute ischemic stroke patients. *PLoS One*. 2017;12(4):e0175434. doi:10.1371/journal.pone.0175434.
7. Telman G, Hurani H, Sprecher E, Kouperberg E. Middle cerebral artery stenosis in patients with acute ischemic stroke and TIA in Israel. *AJNR Am J Neuroradiol*. 2015;36(1):46-9. doi:10.3174/ajnr.A4069.
8. Gong X, Zou X, Liu L, Pu Y, Wang Y, Pan Y, et al. Prognostic value of inflammatory mediators in 1-year outcome of acute ischemic stroke with middle cerebral artery stenosis. *Mediators Inflamm*. 2013;2013:850714. doi:10.1155/2013/850714.
9. Pinzon R, Asanti L, Sugianto S, Widyo K. Risk factors of intracranial stenosis among older adults with acute ischemic stroke. *Universa Med*. 2009;28(1):1-7. doi:10.18051/UnivMed.2009.v28.1-7.
10. Alqahtani SA, Abdulmutali HM, Alwabel HH, AbdelGhaffar NF, Ahmad AM, Alahmari F, et al. Frequency, risk factors, and outcomes of intracranial atherosclerotic stenosis in stroke patients from the Southern Region of Saudi Arabia. *Cureus*. 2023;15(8). doi:10.7759/cureus.43499.
11. Bukhari S, Yaghi S, Bashir Z. Stroke in young adults. *J Clin Med*. 2023;12(15):4999. doi:10.3390/jcm12154999.

12. Wang Y, Zhao X, Liu L, Soo YOY, Pu Y, Pan Y, et al. Prevalence and outcomes of symptomatic intracranial large artery stenoses and occlusions in China: the Chinese Intracranial Atherosclerosis (CICAS) Study. *Stroke*. 2014;45(3):663–9. doi:10.1161/STROKEAHA.113.003508.
13. Huang HW, Guo MH, Lin RJ, Chen YL, Luo Q, Zhang Y, et al. Prevalence and risk factors of middle cerebral artery stenosis in asymptomatic residents in Rongqi County, Guangdong. *Cerebrovasc Dis*. 2007;24(1):111–5. doi:10.1159/000103125.
14. Yaghi S, Prabhakaran S, Khatri P, Liebeskind DS. Intracranial atherosclerotic disease. *Stroke*. 2019 May;50(5):1286–93. doi:10.1161/STROKEAHA.118.024147.
15. Amalia L. Factors affecting the delay of intravenous thrombolysis in hyperacute ischemic stroke patients: a single centre study. *Int J Gen Med*. 2023;16:2157–63. doi:10.2147/IJGM.S412262.
16. Farooque U, Lohano AK, Kumar A, Karimi S, Yasmin F, Bollampally VC, et al. Validity of National Institutes of Health Stroke Scale for severity of stroke to predict mortality among patients presenting with symptoms of stroke. *Cureus*. 2020;12(9):e10255. doi:10.7759/cureus.10255.
17. Esmael A, Elsherief M, Eltoukhy K. Predictive value of the Alberta Stroke Program Early CT Score (ASPECTS) in the outcome of the acute ischemic stroke and its correlation with stroke subtypes, NIHSS, and cognitive impairment. *Stroke Res Treat*. 2021;2021:5935170. doi:10.1155/2021/5935170.
18. Amalia L, Furqani MA, Parwati I, Rizal A, Panigoro R. Correlation between Alberta stroke programme early computed tomography score (ASPECTS) and National Institute of Health Stroke Score (NIHSS) in ischemic stroke. *Sains Malaysiana*. 2020;49(5):1115–20. doi:10.17576/jsm-2020-4905-16
19. Fang H, Leng X, Pu Y, Zou X, Pan Y, Song B, et al. Hemodynamic significance of middle cerebral artery stenosis associated with the severity of ipsilateral white matter changes. *Front Neurol*. 2020 Apr 15;11:214. doi:10.3389/fneur.2020.00214.
20. Lin G, Song J, Huang T, Fu N, Zhong L. Relationship between the stroke mechanism of symptomatic middle cerebral artery atherosclerotic diseases and culprit plaques based on high-resolution vessel wall imaging. *Front Neurol*. 2022;13:968417. doi:10.3389/fneur.2022.968417.