

CHARACTERISTICS OF ACUTE ISCHEMIC STROKE PATIENTS DUE TO SMALL VESSEL OCCLUSION

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ABSTRACT

Background: Ischemic stroke account for about 87% of all stroke cases. This study will focus on ischemic stroke due to small vessel occlusion as one of the subtypes based on TOAST (trial of ORG 10172 in acute stroke treatment).

Objective: To determine the characteristics of ischemic stroke patients caused by small vessel occlusion and are expected to be used as a basis for further research.

Methods: A descriptive observational retrospective study regarding the characteristics of acute ischemic stroke patients due to small vessel occlusion at Sanglah Hospital. Secondary data were obtained from patient medical records.

Results: The total number of cases of small vessel occlusion was 338. The majority of the sample were men (64.5%) between 40-60 years old (53.6%). Most of the samples were patients who had experienced an ischemic stroke for the first time (75.1%) with NIHSS (National Institute of Health Stroke Scale) scores showing mild (48.2%) and moderate (51.5%) symptoms. Around half of them had a history of hypertension (60.1%), dyslipidemia (59.5%), and diabetes mellitus (44.1%). The most common location of infarction was in the anterior circulation (77.5%) with almost the same ratio of right and left hemisphere locations.

Conclusion: Ischemic stroke due to occlusion of small vessels at Sanglah Hospital Denpasar for 3 years was 35.2% of the total ischemic stroke cases. Half of the total sample had classic vascular risk factors. Further research is needed to determine another effective treatment strategy other than just secondary prevention such as life style moderation to prevent recurrency.

Keywords: Ischemic stroke, small vessel occlusion, characteristics

Introduction

Acute ischemic stroke (AIS) is a sudden loss of blood flow to an area of the brain resulting in neurological deficits. Ischemic stroke account for about 87% of all stroke cases, while the rest are hemorrhagic strokes. Ischemic stroke can be caused by a thrombotic process or embolism in the anterior or posterior circulation. Vascular territory and the volume of ischemic brain tissue determine the type and severity of the neurological deficits that arise.^{1,2} In 2013, there were 25.7 million people living after stroke. In Indonesia, the prevalence of stroke is 0.02-8/1000 people. In 2010, the disability-adjusted life years lost/100.000 people in Indonesia was 3,382 years due to ischemic stroke.³

Stroke is a disease that is considered as a result of exposure to risk factors in the long term. Stroke risk factors are divided into non-modifiable and modifiable. Non-modifiable risk factors include gender, age, ethnicity, and race. Modifiable risk factors include hypertension, dyslipidemia, diabetes, atrial fibrillation, smoking, alcohol use and drug abuse. Previous studies has shown that

ischemic strokes patients 62.3% have hypertension, 58.1% have dyslipidemia, 34.7% are diabetics, and 41.3% are cigarette smokers.⁴

In 1993, a classification of ischemic stroke was introduced based on the etiologic mechanism thought to cause the stroke to test the efficacy of the drug in improving outcomes among patients with ischemic strokes with. The classification is known as TOAST (The Trial of Org 10172 in Acute Stroke Treatment) which divides ischemic stroke into 5, namely large vessel occlusion, small vessel occlusion, cardio embolism, other determined etiology, dan undetermined etiology.⁵

This study will focus on ischemic stroke due to small vessel occlusion, because based on daily practice, small vessel occlusions ischemic stroke presents with non life threatening conditions, so the patient usually forget about their stroke and moving on with their life without adjusting their life style nor taking the medicine and it leads to high recurrency of the stroke. Ischemic stroke due to small vessel occlusion is defined as a lacunar syndrome without cortical symptoms, with CT or MRI imaging showing a lesion less than 1.5 cm in diameter.⁵

Hypertension and diabetes mellitus are risk factors that are highly correlated with the incidence of small vessel ischemic stroke. The proportion of patients who were independent after lacunar stroke was 42% after 3 years after stroke.⁶ This study aims to obtain the characteristics of ischemic stroke patients caused by small vessel occlusion. It is vital to start collecting these data, so they can be used as the basis for further research on prognosis or good therapeutic methods in ischemic stroke patients due to small vessel occlusion.

Methods

This is a descriptive observational retrospective study regarding the characteristics of patients with acute ischemic stroke due to small blood vessel occlusion at Sanglah Hospital, Denpasar, Bali during the period 2019 to 2021. The sample was taken based on the patient's medical record, where all patients who met the inclusion criteria were included in this study. In this study, the number of samples was 338 patients and all were collected by 1 person. This research has been approved by Udayana University Ethic Committee and received ethical exemption No:1958/UN14.2.2.VII.14/LT/2022.

The inclusion criteria for samples were as follows: (1) A clinical diagnosis of acute ischemic stroke (2) A CT scan or MRI of the head was performed (3) Meeting the clinical or radiological criteria for small vessel occlusion (4) Data of the history taking and risk factors are available (5) Data of vital signs and neurological examinations are available (6) Data of lipid profiles and blood sugar are available. Exclusion criteria for patients were patients with decreased consciousness and cardiac arrhythmias. The data were inputted in the Microsoft Excel 2019 in time order, starting with demographic data, risk factors, CT, and neurological deficits. Those data were transferred to SPSS to be analyzed.

The collected data is demographic characteristics on the distribution of the research sample which includes age, gender, and other risk factors such as hypertension, diabetes mellitus, dyslipidemia, cigarette smoking, location of infarct on CT, grade of paralysis, NIHSS on admission to determine symptoms severity, and choice of anti-platelet aggregation. Hypertension, diabetes, dyslipidemia, and cigarette smoking were determined by history taking and laboratory results on admission. The infarct location was determined by the radiologist.

Results

This study used a sample of acute ischemic stroke patients who were treated at Sanglah Hospital Denpasar from January 2019 to December 2022. The total number of acute ischemic stroke patients was 958. From the 958 samples, samples were re-selected that met the criteria for stroke due to small vessel occlusion, so that the sample in this study is 338 (35.2%). Demographic data, risk factors, symptom severity from the NIHSS score, location of infarction, recurrence, and the type of antiplatelet aggregation therapy used in those samples are noted.

The majority of the sample in this study were men (64.5%) with the highest age range between 40-60 years (53.6%). Most of the samples were patients who had experienced an

ischemic stroke for the first time (75.1%) with NIHSS scores showing mild (48.2%) and moderate (51.5%) symptoms. Most of the samples experienced disturbances in the cranial nerves and motor system and only 9.5% of the samples experienced symptoms of sensory disturbances.

Based on the risk factors studied, around half of the samples had a history of hypertension (60.1%), dyslipidemia (59.5%), and diabetes mellitus (44.1%). Meanwhile, only a small part of the total sample is an active smoker or has a history of smoking (16.9%).

The results of the CT scan show various infarct locations. In this study, the most common location of infarction was in the anterior circulation (77.5%) such as the internal capsule and basal ganglia. The comparison of the locations of the infarcted hemispheres is almost the same, namely on the right side of 145 samples and on the left side of 141 samples.

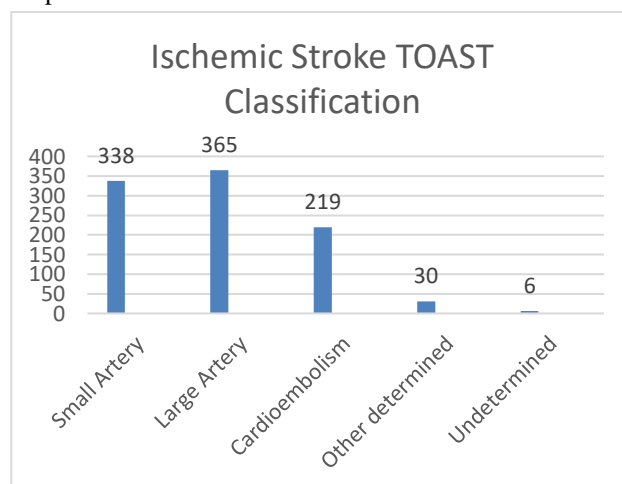


Figure 1. TOAST classification of acute ischemic stroke Sanglah Hospital 2019-2021. The majority was large and small artery occlusion.

Table 1. Characteristics of the Research Sample

Variable	n (%)	Variable	n (%)
Gender		Age (years old)	
Male	218 (64,5)	< 40	13 (3,8)
Female	120 (35,5)	40-60	181 (53,6)
		> 60	144 (42,6)
NIHSS		Infarct Location	
0-4	163 (48,2)	Anterior circulation	262 (77,5)
5-15	174 (51,5)	Posterior circulation	24 (7,1)
16-20	1 (0,3)	Normal	52 (15,4)
>20	0		
Risk Factors		Antiplatelet aggregation drug	
Diabetes	149 (44,1)	Aspirin	259 (76,6)
Mellitus	203 (60,1)	Clopidogrel	12 (3,6)
Hypertension	201 (59,5)	DAPT	63 (18,6)
Dyslipidemia	57 (16,9)	Others	4 (1,2)
Cigarette smoking			
Infarct Site			
Right	145 (42,9)		
Left	141 (41,7)		
Normal	52 (15,4)		

*DAPT: Double Anti-Platelet Therapy

Discussion

In this 3-year observation study, 958 cases of acute ischemic stroke were hospitalized at Sanglah Hospital, Denpasar. After categorizing stroke subtypes based on TOAST classification, acute ischemic stroke patients due to occlusion in small arteries amounted to 338 or equivalent to 35.2% of all ischemic strokes. This result is higher when compared to several epidemiological studies in Europe, where the presentation of stroke due to small vessel occlusion ranges from 16-23%.⁷ Data in Indonesia based on research by Harris et al from 18 hospitals during 2012-2014, acute ischemic stroke due to small vessel occlusion was 1635 cases out of a total of 3627 cases (45.07%).⁸

In this study, the majority of samples were male (64,5%). Several studies have shown that the incidence of ischemic stroke is more in men than women. These data are consistent with a study by Sanchez et al which showed that men 1.67 times more likely to have small vessel occlusion strokes than women. However, when viewed in more detail, based on research data, women are more at risk of suffering from ischemic stroke, with post-stroke mortality and morbidity which are also higher than men.^{9,10,11}

The majority of the sample in this study were the age group 40-60 years (53.6%) and the age group above 60 years old (42.6%). This data is in accordance with research data by Harris et al, where for both ischemic stroke and hemorrhagic stroke groups, the 40-60 years old group is always the group with the highest prevalence. For ischemic stroke in small vessels, the study by Harris et al also showed similar results, namely 49.22% for the 40-60 years old group and 46.2% for age group above 60 years old.⁸

If combined, in this study the age group over 40 years old reached 96.2% of the total sample. This is because the older you get, the higher the individual's risk of having a stroke. It is also related to the increasing number of degenerative diseases suffered as risk factors such as diabetes mellitus, hypertension, dyslipidemia, exposure to free radicals such as cigarette smoke which makes the anatomy of blood vessels and physiology of blood flow in the elderly not as good as young individuals.¹²

In this study, the majority of the samples were male (63.6%) with an average sample age of 60.8 years. This study identified the incidence of lacunar stroke in patients with risk factors for hypertension, diabetes mellitus, dyslipidemia, smoking, heart disease, and cancer. There was a similar study conducted by Nair et al regarding the risk factors for lacunar stroke in India. This study included 4 of the 6 risk factors presented by Nair et al, excluding heart disease and cancer.¹³

This study found that the percentage of patients with hypertension is 60.1% and diabetes mellitus is 44.1%, which was almost similar to a study by Nair et al who found the prevalence of hypertension was 74.2% and diabetes mellitus 37.9% in lacunar stroke. Meanwhile, for dyslipidemia, the results in this study were much higher, namely 59.5% compared to 17.4% in the Indian study. This is due to the different definitions of dyslipidemia used. In the study by Nair et al, dyslipidemia was defined as LDL cholesterol levels > 160 while in this study, LDL > 100 and triglycerides > 150 were used.¹³

Cigarette smoking habit itself has become a risk factor that is agreed to play a role in the process of stroke. In this study, the prevalence was 16.9% which was lower than the research in India by Nair et al (28.8%) or in Indonesia by Harris et al (28.6%). Among the four risk factors, hypertension was the factor that had the highest role in increasing the risk of lacunar stroke (OR 1.71) compared to diabetes (OR 1.24), dyslipidemia (OR 1.26), and cigarette smoking (OR 1.08).^{8,13}

The results of the CT scans in this study did not all show abnormalities but were still included in the sample because there was a neurological deficit that clearly indicated a stroke. The majority of abnormal CT scan results showed abnormalities in the anterior circulation system such as the internal capsule, basal ganglia, and corona radiata which reached 77.5%. Meanwhile, strokes in the posterior circulation system such as the thalamus and brain stem are only 7.1%. This is also in accordance with the study by Nair et al where the number of strokes in the anterior circulation was more than the stroke in the posterior circulation, but the ratio was 66.7% in the posterior circulation and 33.3% in the posterior circulation.¹³ The study by Nair et al used MRI while in this study a CT scan was used. MRI is much better at showing posterior circulation lesions than CT scan, so it is possible that posterior circulation lesions in this study were underdiagnosed. This also explains the many normal features on CT scans that can result from illegible posterior circulation lesions or unseen acute lesions.¹⁴

In this study, the majority of the sample had NIHSS which showed mild to moderate symptoms where 99.7% of the sample had NIHSS <16. The severity of stroke is assessed by the severity of the neurological deficit. The parameter that can be used to assess the degree of neurological deficit is the NIHSS (National Institute of Health Stroke Scale) with a value range of 0-42 which classifies stroke symptoms as mild, moderate, moderate-severe, and severe. A study conducted by Aldriweesh et al also showed that the NIHSS value of lacunar stroke was significantly lower than the other TOAST subclassifications.¹⁵ This is because a smaller infarct area will result in minimal neurologic deficits compared to occlusion that occurs in a larger area.

In this study, all samples received antiplatelet aggregation therapy. Most received monotherapy with aspirin (76.6%) or clopidogrel (3.6%), while 18.6% of the sample received combination therapy with 2 antiplatelet agents (aspirin and clopidogrel). Therapeutic guidelines for small vessel ischemic stroke are essentially risk factor control. Pharmacological therapy in the form of antiplatelet aggregation can also be given. According to the AHA/ASA guidelines, combination therapy with 2 anti-platelet aggregation as secondary prevention therapy for ischemic stroke or in cases of transient ischemic attack in the first 90 days is superior to monotherapy, with approximately the same bleeding risk. However, if continued for more than 90 days, the efficacy becomes similar while there is an increased risk of bleeding. Therefore, for lacunar stroke, the use of antiplatelet aggregation monotherapy for long-term secondary prevention of stroke is an appropriate option.^{16,17}

The literature has shown that lacunar stroke has a high recurrence rate. Arboix et al found that over an 18-year observation period in hospital, 122 of 695 (17.5%) lacunar

stroke patients had a previous history of lacunar stroke.¹⁸ Despite of all therapeutic strategies including antiplatelet therapy, the recurrence rate is still high. Effective comprehensive management strategies are needed to prevent small vessel ischemic strokes. Life style moderation and risk factors control will be on the top of the list.

The strength of this study is it has a lot of samples that hopefully can represent the demographic and characteristics of general ischemic stroke patients due to small vessel occlusion. The limitations are there are still some non-modifiable risk factors that cannot be assessed due to limitations of patients medical history data such as cardiac problems, alcohol intake history, height and weight, stress level, job, excercises habit, and job.

Conclusion

This study found that there were 338 people with ischemic stroke due to occlusion of small arteries at Sanglah Hospital, Denpasar from 2019 to 2021. The majority of patients were men aged >40 years with mild-moderate stroke symptoms based on the NIHSS score. About half of the total sample had risk factors for hypertension, diabetes, and dyslipidemia. Further research is needed to determine another effective treatment strategy other than just secondary prevention such as life style moderation to prevent recurrence of small vessel ischemic stroke.

Acknowledgement

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Conflict of Interest

None.

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