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Overview of Cerebral Angiography Results in Young Stroke Patients at Pelni Hospital

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ABSTRACT

Background and purpose: The average age of stroke patients is decreasing, with the majority of cases currently comprising young individuals. However, there are still limited cerebral angiography results in young stroke patients, both in terms of the number of studies and the scope of data. Therefore, this study aimed to determine the overview of cerebral angiography results and determinants influencing cerebral angiography results in young stroke patients at Pelni Hospital, Jakarta.

Methode: A retrospective cross-sectional study was conducted using medical record data at Pelni Hospital, Jakarta. The samples used were patients with stroke diagnoses that met the eligibility criteria. Meanwhile, the exclusion criteria were patients with incomplete medical records.

Result: This study consisted of 196 stroke patients aged 18-45 years at Pelni Hospital, Jakarta from April 2024 to January 2025. A total of 184 patients (93.9%) were categorized as having abnormal cerebral angiography status, while 12 (6.1%) had normal cerebral angiography status. There was a significant relationship between age and cerebral angiography status (p=0.021). Furthermore, patients in the 36-45 years age group had a tendency to find abnormal cerebral angiography 4.571 times greater than those aged 18-35 years (95% CI; 1.322-15.807). The results showed that patients with stroke risk factors ≥ 2 had a tendency to find abnormal cerebral angiography status 1.089 times compared to those with <2 stroke risk factors (p=0.04).

Conclusion: The incidence of abnormal cerebral angiography in young stroke patients was 93.9%. Age and multiple risk factors (≥ 2 stroke risk factors) were independently correlated with the incidence of abnormal cerebral angiography. After controlling by other variables, age 36-45 years was the dominant factor for the incidence of abnormal cerebral angiography in young stroke patients.

Keywords: Cerebral angiography, Stroke, Young Age, Multiple Risk Factors

INTRODUCTION

Stroke is a disease caused by impaired cerebral blood circulation and a major contributor to disability.[1,2] Currently, the average age of stroke patients is decreasing, with the majority consisting of young individuals. Previous studies reported that the prevalence of stroke at young age, namely 18-45 years old, was 10-15%.[3] Other reports stated that the prevalence of stroke occurring at young age was 57-65%, 17-20%, and 16-22% for ischemic, intracerebral hemorrhage, and subarachnoid hemorrhage.[4] However, there is no standard definition for the age category of young

stroke. Several studies stated that young stroke occurred at the age of 18-55, 18-45, 24-62, 18-64, <65, and <50 years.[5,6] The most consistent definition of young stroke in the literature is within 18-45 years.[7,8] Despite the numerous reports, there are still limited cerebral angiography results in young stroke in both the number of studies and data coverage.[9,10]

Several risk factors have been related to stroke at young age, predominantly consisting of chronic diseases (diabetes mellitus, hypertension, migraine, and nephrotic syndrome), vasculopathy (arteriovenous malformation, cerebral aneurysm, and Moyamoya disease), and heart disease (coarctation of the aorta, congenital heart disease, and atrial fibrillation).[6] Compared to other risk factors, hypertension is the main cause of hemorrhagic and ischemic stroke, with a prevalence of 45-53%. The proportion of diabetes mellitus at young age reaches 14%. Heart diseases that increase the risk of ischemic stroke are rhythm disturbances, myocardial infarction, cardiomyopathy, and heart valve disease.[4] Young ischemic stroke can be classified based on the TOAST (Trial of ORG 10172 in Acute Stroke Treatment) and ASCOD (Atherosclerosis, Small vessel disease, Cardiac pathology, Other causes, Dissection) criteria. TOAST divides ischemic stroke into Large Artery Atherosclerosis (6-15%), Small Vessel Occlusion (12-26%), Cardioembolism (10-24%), Stroke of other determined etiology (9-26%), and Stroke of undetermined etiology (24-53%). Meanwhile, ASCOD classification was compiled in 2009 to reduce the proportion of young stroke with undetermined etiology in the TOAST.[4,7,11] The pathophysiology of hemorrhagic stroke occurs in conditions abbreviated as SMASH-U, namely 1. structural causes are lesions in the brain such as arteriovenous malformations, aneurysms, neoplasms, and cavernomas; 2. Medication is the consumption or abuse of drugs such as anticoagulants, antiplatelets, thrombolytics, Selective serotonin reuptake inhibitors (SSRIs), amphetamines, and cocaine, 3. Amyloid angiopathy, 4. Systemic disease includes severe liver dysfunction, renal disease, infection, pregnancy and postpartum, venous thrombosis, connective tissue disease, and coagulopathy, 5. Hypertension causes microangiopathic hypertension, and 6. Undetermined etiology.[4]

Cerebral angiography also known as DSA (Digital Subtraction Angiography) is an imaging method used to evaluate the blood vessels of the brain. This method provides a clear picture of the human cerebral blood vessels, showing the hemodynamic status, blood flow, and collateral system of the cerebral blood vessels in real-time.[12] Furthermore, cerebral angiography can help determine the etiology of stroke such as arterial stenosis, venous thrombosis, aneurysm, and arteriovenous malformation. It also has high sensitivity and specificity to detect vascular diseases associated with stroke, showing potential application as a diagnostic method in complex cases.[3]

MATERIALS & METHODS

This study was conducted at the Cathlab Unit of Pelni Hospital, Jakarta from April 2024 to January 2025, using a cross-sectional observational design. The experiment was approved by the Ethics Committee of the Faculty of Medicine, Universitas Islam Al-Azhar, Mataram (approval number 019/EC-04/FK-06/UNIZAR/II/2025). Informed consent was not required because the data were taken from medical records. Patients who met the eligibility criteria were included in the study consecutively. The inclusion criteria were 1. diagnosis of ischemic and hemorrhagic stroke based on the results of Computed Tomography (CT) of the head without contrast or Magnetic Resonance Imaging (MRI) of the head without contrast, 2. cerebral angiography was performed at Pelni Hospital, Jakarta, and 3. age 18-45 years. Meanwhile, the exclusion criteria were patients with incomplete medical records. From the medical records,

demographic data, stroke risk factors, clinical symptoms, and cerebral angiography results were collected. Cerebral angiography results were defined as normal and abnormal. Indicators of abnormal conditions included a picture of cerebral artery stenosis, cerebral aneurysm, arteriovenous malformation, dural arteriovenous fistula, venous thrombosis, and others. Other abnormal results were tortuous, hypoplasia, *looping*, occlusion, moya-moya, arterial dissection, and carotid web.

Based on the definition, cerebral artery stenosis is a narrowing that occurs in the blood vessels of the brain. This condition is divided into mild stenosis <50% and severe at ≥50%. In terms of occurrence, stenosis exists intracranially, extracranially, intracranially, and extracranially. Intracranial stenosis occurs in the anterior and middle cerebral artery, petrous/cavernous/supraclinoid segment of the internal carotid artery, basilar artery, vertebral artery segment V4, posterior cerebral artery, superior cerebellar artery, anterior, and posterior inferior cerebellar arteries. Meanwhile, extracranial stenosis occrs in the cervical segment of the internal carotid artery and the vertebral artery segments V1, V2, and V3. Venous thrombosis assessed in this study occurs in the transverse sinus, superior sagittal sinus, and both locations.[13]

STATISTICAL ANALYSIS

The data obtained were analyzed statistically using the Windows SPSS version 27 program in 2 stages, namely descriptive and analytical statistics. Descriptive statistics were used to determine the basic characteristics of patients, namely demographic data (gender) and risk factors including hypertension, diabetes mellitus, dyslipidemia, heart disease, history of stroke, and smoking. Analytical statistics were performed to determine the relationship between variables with Chi-Square bivariate analysis. Subsequently, multivariate analysis was performed using logistic regression analysis. The level of significance was stated as p <0.05 with Confidence Interval 95%.

RESULT

This study included 96 young stroke patients at Pelni Hospital, Jakarta from April 2024 to January 2025. The results showed that the number of male and female patients had the same proportion, namely 98 (50%), with the majority 132 (67.3%) aged 36-45 years. The incidence of ischemic stroke had a higher number, comprising 187 (95.4%) compared to hemorrhagic stroke at 9 (4.6%). Additionally, the incidence of intracerebral hemorrhage was found in 6 (66.7%) and subarachnoid hemorrhage in 3 (33.3%) patients. Further analysis showed that the incidence of ischemic stroke was found most in male, comprising 94 (50.3%), while hemorrhagic stroke was more common in female at 5 (55.6%). Hypertension was also found to be the most common risk factor found, both in ischemic 162 (82.2%) and hemorrhagic 9 (100%). In both types of stroke, the most common symptoms experienced by patients were focal deficits and headaches. Moreover, the characteristics of patients observed in this study are presented in Table 1.

Table 1. Basic Characteristics of Patients

Variable	**Total n=196 (%)**	**Stroke Types**	
		Ischemic n=187 (95,4%)	**Hemorrhagic n=9 (4,6%)**
Gender			
Male	98 (50,0)	94(50,3)	4(44,4)
Female	98 (50,0)	93(49,7)	5(55,6)
Age			
36-45 year	132 (67,3)	126(95,5)	6(4,5)
18-35 year	64(32,7)	61(95,3)	3(4,7)
Stroke Type Hemorrhagic (n=9)			

Intracerebral Hemorrhage	6(66,7)	N/A	N/A
Subarachnoid Hemorrhage	3(33,3)	N/A	N/A
Stroke Risk Factors			
Hypertension	171(87,2)	162(86,6)	9(100,0)
Diabetes Mellitus	31(15,8)	31(16,6)	0(0,0)
Dyslipidemia	17(8,7)	17(9,1)	0(0,0)
Heart Disease	38(19,4)	37(19,8)	1(11,1)
History of stroke	1(0,5)	1(0,5)	0(0,0)
Smoking	15(7,7)	15(8,0)	0(0,0)
Multiple risk factors			
≥ 2 factors	49(25,0)	49(100,0)	0(0,0)
< 2 factors	147(75,0)	138(93,9)	9(6,1)
Stroke Symptoms			
Focal Deficit	113(57,7)	107(57,2)	6(66,7)
Seizures	1(0,5)	1(0,5)	0(0,0)
Headache	79(40,3)	75(40,1)	4(44,4)
Others	7(3,6)	7(3,7)	0(0,0)

The majority of patients were categorized as having abnormal cerebral angiography status, comprising 184 (93.9%). Meanwhile, only 12 (6.1%) patients were categorized as normal cerebral angiography status. From the results of abnormal cerebral angiography, a total of 108 (55.1%), 62 (31.6%), and 5 (2.6%) had cerebral artery stenosis, venous thrombosis, and cerebral aneurysm, respectively, without arteriovenous malformation. As shown in Table 5.2, 79 (73.1%) patients were included in the severe stenosis category while 29 (26.9%) were in the mild category. Based on the location of stenosis, 46 (42.6%) patients were intracranial, 35 (32.4%) were extracranial, while 27 (25.0%) were intracranial and extracranial. Venous thrombus location was most often found in the transverse sinus at 56 (90.3%) patients, followed by superior sagittal sinus 2 (3.2%) and in both locations 4 (6.5%). The description of cerebral angiography status is presented in Table 2.

Table 2. Description of Cerebral Angiography Status, Degree of Stenosis, Type of Stenosis, and Location of Venous Thrombosis in Young Stroke Patients

Variable	**Total n=196 (%)**
Cerebral Angiography Status	
Abnormal	184(93,9)
Normal	12(6,1)
Cerebral Angiography Results	
Cerebral Artery Stenosis	108(55,1)
Cerebral Aneurysm	5(2,6)
Arteriovenous Malformation	0(0,0)
Dural Arteriovenous Fistula	4(2,0)
Venous Thrombosis	62(31,6)
Normal	12(6,1)
Others, Specify DSA Results (n=56)	
Tortuous	27(48,2)
Hypoplasia	13(23,2)
Looping	10(17,8)
Moya-moya	2(3,6)
Occlusion	1(1,8)
Artery Dissection	2(3,6)
Carotid Web	1(1,8)
Degree of Stenosis (n=108)	
Mild Stenosis	29(26,9)

Severe Stenosis	79(73,1)
Type of Stenosis	
Extracranial	35(32,4)
Intracranial	46(42,6)
Both	27(25,0)
Venous Thrombosis Location (n=62)	
Transverse Sinus	56(90,3)
Superior Sagittal Sinus	2(3,2)
Both Locations	4(6,5)

This study also analyzed other determinants related to cerebral angiography assessment status. These determinants were age, gender, hypertension, diabetes mellitus, dyslipidemia, heart disease, history of stroke, and smoking. The results showed that abnormal cerebral angiography status occurred in 91 (92.9%) male and 93 (94.9%) female patients. The group aged 36-45 years showed higher abnormal cerebral angiography status, comprising 128 (97%) patients compared to the 18-35 age group of 56 (87.5%). In those with abnormal angiography status, there were 161 (94.2%) cases of hypertension, 30 (96.8%) diabetes mellitus, 16 (94.1%) dyslipidemia, 36 (94.7%) heart diseases, 1 (100%) of history of stroke, and 14 (93.3%) cases of smoking. Furthermore, all 49 cases (100%) of abnormal cerebral angiography status were found in patients with multiple stroke risk factors (≥ 2 stroke risk factors). The analysis results of other determinants are presented in Table 3.

Table 3. Bivariate Analysis of Other Determinants with Cerebral Angiography Status

Variable	**Cerebral angiography**		**p-value**	**Crude OR (C.I. 95%)**
	Abnormal n=184	**Normal n=12**		
Gender				
Male	91(92,9)	7(7,1)	0,766	0,699(0,214-2,282)
Female	93(94,9)	5(5,1)		
Age				
36-45 years	128(97,0)	4(3,0)	0,021	4,571(1,322-15,807)
18-35 years	56(87,5)	8(12,5)		
Hypertension				
Yes	161(94,2)	10(5,8)	1,000	1,400(0,288-6,796)
No	23(92,0)	2(8,0)		
Diabetes Mellitus				
Yes	30(96,8)	1(3,2)	0,695	2,143(0,267-17,224)
No	154(93,3)	11(6,1)		
Dyslipidemia				
Yes	16(94,1)	1(5,9)	1,000	1,048(0,127-8,644)
No	168(93,9)	11(6,1)		
Heart Disease				
Yes	36(94,7)	2(5,3)	1,000	1,216(0,255-5,795)
No	148(93,7)	10(6,3)		
History of stroke				
Yes	1(100,0)	0(0,0)		
No	183(93,8)	12(6,2)	1,000	1,066(1,028-1,105)
Smoking				
Yes	14(93,3)	1(6,7)		
No	170(93,9)	11(6,1)	1,000	0,906(0,109-7,535)
Multiple risk factors				
≥ 2 factors	49(100,0)	0(0,00)		
< 2 factors	135(91,8)	12(8,2)	0,040	1,089(1,038-1,143)

Table 3 found a significant relationship between age and cerebral angiography assessment status (p = 0.021). Patients in the 36-45 year age group had a tendency to find abnormal cerebral angiography 4.571 times greater than those aged 18-35 years (95% CI; 1.322-15.807). Data evaluation related to risk factors independently found no relationship between hypertension, diabetes mellitus, dyslipidemia, heart disease, history of stroke, and smoking to cerebral angiography assessment status (p <0.05).

In this study, an analysis was conducted to determine the possibility of a relationship between multiple risk factors and cerebral angiography status. The results showed that patients with ≥ 2 stroke risk factors had a tendency to find abnormal cerebral angiography status 1.089 times compared to those who were <2. Furthermore, a multivariate analysis was conducted on variables with a p-value <0.25. Based on the results presented in Table 4, age was identified as an independent factor for the occurrence of abnormal cerebral angiography status. This suggested that age ranging from 36 to 45 years increased the tendency towards abnormal cerebral angiography results by 4.279 times compared to 18-35 years.

Table 4. Multivariate Analysis of Age Determinants and Multiple Risk Factors with Cerebral Angiography Status

	B	S.E.	Sig.	Adjusted OR	95% C.I. for EXP(B)	
					Lower	Upper
Age	1,454	0,640	0,023	4,279	1,222	14,990
Multiple Risk Factors	18,635	5576,203	0,997	123873102,201	0,000	,

DISCUSSION

Previous studies on the relationship between gender and stroke incidence are inconsistent in several reports. In this study, the incidence of stroke in male and female was the same, namely 50%. This result was in accordance with previous reports in France, where there was no significant difference in the incidence of stroke in male and female aged 35-44 years. Similarly, a study in Cincinnati showed that the incidence of stroke between gender was not significantly different at the age of 20-44 years. Different results were obtained from a report in the Netherlands, where stroke was more prevalent in female of young age group stroke. However, another study in Indonesia reported that stroke was more common in males.[3,9]

In this study, ischemic stroke had a higher incidence of 187 (95.4%) cases compared to hemorrhagic at 9 (4.6%). The results showed that the incidence of ischemic stroke was more common in male, accounting for 50.3%. This was in accordance with reports in Cincinnati and Morocco which showed a fairly high proportion of ischemic stroke at young age.[9] However, in Ethiopia, the proportion of hemorrhagic stroke was higher than ischemic at young age.[10] In Indonesia, the prevalence of ischemic stroke was higher in male.[3] Different results were obtained in Uganda, where the incidence of ischemic stroke was more common in female.[10]

Based on the results, hemorrhagic stroke was more common in female, namely 55.6%. A similar trend was observed in Canada, where female experienced hemorrhagic strokes, specifically subarachnoid hemorrhage.[14] In this study, the proportion of hemorrhagic stroke was 4.6% with an incidence of intracerebral hemorrhage of 66.7% and subarachnoid hemorrhage of 33.3%. These results are consistent with a study in Indonesia, where the incidence of intracerebral was higher than subarachnoid hemorrhage.[3] However, reports from Bosnia and Herzegovina stated a higher proportion of subarachnoid hemorrhage.[10] Yahya et al. reported that the proportion of patients with intracerebral and subarachnoid hemorrhage was not different.[4]

In line with the results, hypertension was the main risk factor for ischemic and

hemorrhagic stroke. This was consistent with previous reports, where hypertension was the main risk factor for ischemic and hemorrhagic stroke.[4] Another study reported that the main risk factor for young strong patients was hypertension.[3] However, different results were reported from Germany, where the most common risk factors were lack of physical activity followed by hypertension, excessive alcohol consumption, and smoking.[4]

Cerebral angiography images were assessed in young stroke patients of the 18-45 year age group. The images were grouped as normal and abnormal cerebral angiography status. Based on the results, 184 (93.3%) patients were included in the abnormal cerebral angiography status category. From the results of abnormal cerebral angiography, 108 (55.1%) patients had cerebral artery stenosis, 62 (31.6%) showed venous thrombosis, and 5 (2.6%) had cerebral aneurysm. This was in accordance with previous studies, where the most common abnormal cerebral angiography result was cerebral artery stenosis. The most common location of arterial stenosis was intracranial, namely 42.6%. Similarly, it was found that cerebral artery stenosis most often occurred intracranially.[3,15] This study reported that the incidence of venous thrombosis was significantly high at 31.6% with the location of thrombus mostly found in the transverse sinus. However, Tini et al., (2023) found the incidence of venous thrombosis to be 8.17%.[3]

In this study, the main stroke risk factor associated with abnormal angiography status was hypertension. The results were consistent with previous reports, where 66.7% of patients with hypertension had abnormal cerebral angiography.[3,15] This study observed that abnormal cerebral angiography status was more common in the 36-45 year age group, comprising 97%. Patients in the 36-45 year age group had a tendency to find abnormal cerebral angiography 4.571 times greater than those aged 18-35 years (95% CI; 1.322-15.807). Based on the multivariate analysis, the 36-45 year age group had a tendency to find abnormal cerebral angiography 4.279 times greater compared to 18-35 year age group. This suggested that age was an independent risk factor for abnormal cerebral angiography status. Similarly, a study conducted in Uganda found the proportion of young strokes to be highest in the 36-45 year age group.[10] Tini et al. also reported that patients with abnormal cerebral angiography were most commonly found in the 36-45 year age group.[3] This study showed that abnormal cerebral angiography status was most commonly found in patients who had ≥ 2 stroke risk factors. Furthermore, multivariate analysis showed that patients with multiple risk factors had a 1.089 times greater tendency to find abnormal cerebral angiography status. According to Yahya et al., (2020), there was an increased risk of stroke with abnormal cerebral angiography results in patients who had more than 2 stroke risk factors.[9]

Despite the significant contributions, this study has several weaknesses, namely the use of cross-sectional design, non-random/consecutive sampling method, and single center. Therefore, further studies are needed with larger samples, prospective design, randomization, and multi-center to assess the relationship between age and multiple stroke risk factors on the incidence of abnormal cerebral angiography.

CONCLUSION

In conclusion, this study showed that the incidence of abnormal cerebral angiography in young stroke patients was 93.9%. Independently, age and multiple risk factors were associated with the incidence of abnormal cerebral angiography. After controlling by other variables, age 36-45 years was the dominant factor in the incidence of abnormal cerebral angiography in young stroke patients.

Declaration by Authors

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