

ABSTRACT

Introduction: Ischemic stroke can cause major disability in any patient affected. Ischemic stroke in the young patients in Rajavithi hospital have not been well studied. This study aimed to determine prevalence and associated factor of ischemic stroke in the young patients.

Objectives:

1. To study the prevalence of ischemic stroke in the young patients in Rajavithi hospital.
2. To study any factors associated with acute ischemic stroke in the young patients.

Materials and Methods: Retrospective cross-sectional study in ischemic stroke patients admitted in Rajavithi Hospital during July 1, 2021 - June 30, 2023.

Results: From 770 ischemic stroke patients, 100 patients (12.99 %) were stroke in the young (age ≤ 45 years). Their mean age was 37.56 ± 7.52 years old. Fifty-five patients (55%) were male. Mean BMI in stroke in the young group is 25.99 ± 5.39 kg/m², which is statistically significantly higher than in the older group (p=0.003). Hypertension is statistically significant (p<0.001) more common in stroke in the young group. According to Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification, type of strokes was undetermined in 32%, large artery atherosclerosis in 25%, small artery occlusion in 21%, other determined cause in 15% and cardioembolism in 7% of ischemic stroke in the young patients.

Conclusion: Prevalence of ischemic stroke in the young is 12.99% among all stroke patients. Stroke of undetermined etiology was the most common type. Further prospective study in a larger population with more complete investigations is needed.

Prevalence and Associated Factors of Ischemic Stroke in the Young Patients

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Introduction

Ischemic stroke is a disease found globally affecting more than 5.7 million people, with approximately 2.1 million cases in the Asian region^{1,2}. It is a significant public health problem, with a mortality rate of 10% and a disability rate of 50-60%, and there is a rising trend in the future^{3,4}.

Ischemic stroke in the young refers to cases occurring in individuals under the age of 45⁵⁻⁷, constituting about 5% of all ischemic stroke cases⁵. The incidence varies in different countries. According to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification⁸, the majority of cases in the young fall into the category of 'stroke of undetermined etiology.' Other causes include cardioembolic and large artery atherosclerosis^{7,9-12}.

This study aims to accurately determine prevalence and causes of ischemic stroke in young patients through practical laboratory examinations. Identifying the etiology will aid in planning appropriate treatment, reducing mortality rates, and preventing recurrence¹³.

Materials and Methods

Study design: Retrospective cross-sectional study of ischemic stroke patients admitted in Rajavithi hospital during July 1, 2021 - June 30, 2023.

Characteristics of study samples:

Inclusion criteria

1. First-ever ischemic stroke patients who were admitted in Rajavithi hospital during July 1, 2021 - June 30, 2023, and divided into two groups:

aged \leq 45 years, and aged $>$ 45 years.

2. The patients aged 18 and over.

Exclusion criteria

1. Incomplete information in the medical record

Sample size calculation:

Sample size was calculated using an approximate formula based on proportions¹³.

$$n = \frac{Z_{\alpha/2}^2 P(1-P)}{d^2}$$

n = number of sample sizes for each group

$Z_{\alpha/2}$ = Statistical value under the standard curve when determining the level of statistical significance

α = 0.05 is 1.96

P = the incidence of ischemic stroke in patients with a young age is 13.6%, as referenced in the study by Guidetti D et al¹⁴ in 2013, $p = 0.136$

d = the allowable margin of error should not exceed 20% of the P

Therefore, $(d) = 0.20 \times 0.20 = 0.04$

The number of samples can be calculated as follows.

$$n = \frac{1.96^2 \times 0.136 \times (1-0.136)}{0.03^2}$$

$$\begin{aligned} n &= 502 + \text{missing data } 10\% \\ &= 550 \end{aligned}$$

In this study, the researchers will collect data from a total of 550 patients as the sample size.

Outcome

The primary outcome is prevalence of ischemic stroke in the young in Rajavithi hospital.

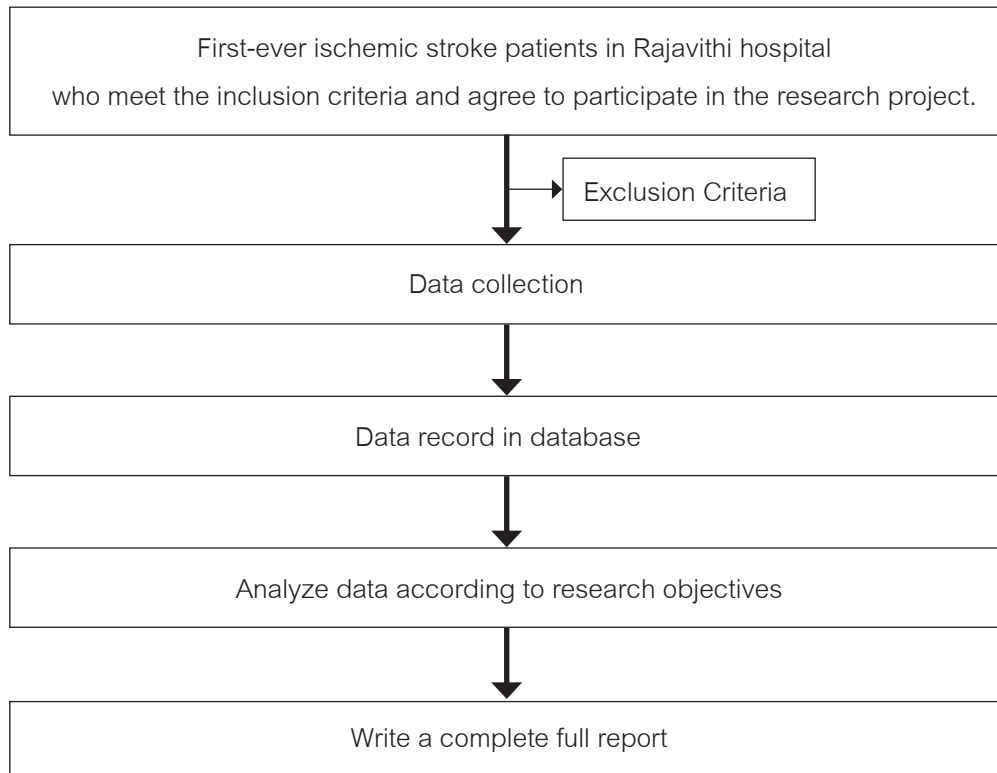
The secondary outcome is associating factors of ischemic stroke in the young in Rajavithi hospital.

Data collection

1. Demographic data of all ischemic stroke patients and associated factors of ischemic stroke included age, sex, BMI, systolic blood pressure, smoking, underlying disease, laboratory tests

2. Clinical outcome of all ischemic stroke patients included the severity of stroke using the National Institutes of Health Stroke Scale (NIHSS), and the etiology of stroke based on TOAST classification

Research Methodology



Statistical Analysis

Descriptive statistics: The categorical data is reported by percentage. Continuous data with normal distribution is reported as means and standard deviation. If the data is not a normal distribution data, it is reported with median, minimum, maximum, and interquartile range and percentile Rank.

Inferential statistics: Categorical data were compared using the Chi-square test or Fisher's exact test or McNemar test. The uncorrelated data is compared with Student t-test for normal distribution data and Mann-Whitney U-test was used for non-normal distribution data. All tests were as-

signed a level of statistical significance at a p-value < 0.05.

Results

Baseline characteristics, underlying disease, and laboratory testing were demonstrated in Table 1. There were 770 ischemic stroke patients included in this study, which comprised 100 patients(12.99%) in ischemic stroke age \leq 45 years group, and 660 patients(87.01%) in ischemic stroke age >45 years group. In ischemic stroke in the young group, 55.0% are male, and mean age is 37.56 years (SD 7.52). In the age >45 years group,

57.9% are male and mean age is 65.56 years (SD 11.07). Age is a statistically significant difference between the two groups ($p < 0.001$). Common risk factors in all stroke patients were smoking, hypertension, dyslipidemia and diabetes. Mean BMI in stroke in the young group is 25.99 ± 5.39 , which is statistically significantly higher than in the older group ($p = 0.003$). Mean systolic blood pressure in stroke in the young group is 148.62 ± 30.14 , which is statistically significantly lower than in the older

group ($p = 0.001$). The underlying disease were statistically significant difference between the two group ($p < 0.001$), which hypertension is statistically significant ($p < 0.001$) more common in stroke in the young group (89.1%) compared to the older group (86.2%), whereas dyslipidemia in stroke in the young group is 63%, and diabetes mellitus in the stroke in the young group is 39%, which are statistically significant less common than in the older group ($p < 0.001$ and $p = 0.003$, respectively).

Table 1 Demographic data of the patients (n = 770)

Factors	Total	Age ≤ 45 years (n=100)	Age > 45 years (n=670)	p-value
Sex				0.583
Male	443 (57.5)	55 (55.0)	388 (57.9)	
Female	327 (42.5)	45 (45.0)	282 (42.1)	
Age (years)	61.92 ± 14.24	37.56 ± 7.52	65.56 ± 11.07	<0.001*
BMI	24.51 ± 4.48	25.99 ± 5.39	24.29 ± 4.29	0.003*
Systolic blood pressure	157.33 ± 29.45	148.62 ± 30.14	158.63 ± 29.15	0.001*
Smoking	358 (46.5)	45 (45.0)	313 (46.7)	0.748
Underlying disease	564 (73.2)	46 (46.0)	518 (77.3)	<0.001*
Hypertension	486 (86.2)	41 (89.1)	445 (85.9)	<0.001*
Dyslipidemia	368 (65.2)	29 (63.0)	339 (65.4)	<0.001*
Diabetes mellitus	238 (42.2)	18 (39.1)	220 (42.4)	0.003*
Atrial fibrillation	66 (11.7)	7 (15.2)	59 (11.4)	0.547
Coronary heart disease	62 (11.0)	4 (8.7)	58 (11.2)	0.110
Laboratory Testing				
HbA1C ≥ 7.0 mg%	192 (24.9)	23 (23.0)	169 (25.2)	0.632
LDL ≥ 70 mg/dL	688 (89.4)	87 (87.0)	601 (89.7)	0.414

Value are represented as number (percent), Mean ± SD, * significant as $p < 0.05$

Clinical outcomes of the ischemic stroke patients in this study including the severity of stroke and etiology of stroke were demonstrated in Table 2. The severity of stroke according to NIHSS score are similar between stroke in the young and the older group in mild (72% and 70.9%) and moderate

stroke (23% and 26.7%), but there are more patients in stroke in the young group are in severe stroke (5% and 2.4%). However, there is no statistically significant difference of the severity between the two groups ($p = 2.666$).

Table 2 Clinical outcomes of the patient (n = 770)

Factors	Total	Age ≤ 45 years (n=100)	Age > 45 years (n=670)	p-value
NIHSS				2.666
1 - 4	547 (71.0)	72 (72.0)	475 (70.9)	
5 - 15	202 (26.3)	23 (23.0)	179 (26.7)	
16 - 20	21 (2.7)	5 (5.0)	16 (2.4)	
21 - 42	0 (0.0)	0 (0.0)	0 (0.0)	
TOAST classification				<0.001*
Small artery occlusion	427 (55.5)	21 (21.0)	406 (60.6)	
Large artery atherosclerosis	228 (29.6)	25 (25.0)	203 (30.3)	
Cardioembolism	63 (8.2)	7 (7.0)	56 (8.4)	
Undetermined cause	34 (4.4)	32 (32.0)	2 (0.3)	
Other determined cause	18 (2.3)	15 (15.0)	3 (0.4)	
Hematologic conditions	7 (38.9)	6 (40.0)	1 (33.3)	
Noninflammatory	5 (27.8)	3 (20.0)	2 (66.7)	
Inflammatory and infectious	4 (22.1)	4 (26.6)	0 (0.0)	
Genetic	1 (5.6)	1 (6.7)	0 (0.0)	
Cardiac abnormalities	1 (5.6)	1 (6.7)	0 (0.0)	

Value is represented as number (percent), * significant as $p < 0.05$

The etiology of stroke according to the TOAST classification in stroke in the young group are as followed; undetermined cause (32.0%), large artery atherosclerosis (25%), small artery occlusion (21%), other determined cause (15%), and cardioembolism (7%), while the most common etiology of stroke in the older age group is small artery occlusion (60.6%), followed by large artery atherosclerosis (30.3%), and cardioembolism (8.4%). The difference of stroke etiology is statistically significant between the two groups ($p < 0.001$). In stroke in the young group, the cause of other determined etiology was cerebral venous sinus thrombosis, antiphospholipid

syndrome, polycythemia vera, vasospasm, Moyamoya disease, vasculitis, HIV-related, neurofibromatosis, and atrial septal defect.

Specific investigations in stroke in the young patients were demonstrated in Table 3. ANA is positive in 13% of patients, echocardiogram or Holter monitoring is positive in 8% of patients, ESR is positive in 6% of patients, lupus anticoagulant is positive in 2% of patients, urine substance is positive in 2% of patients, and anti-HIV is positive in 1% of patient. However, tests for urine substances were not done in 72% of patients.

Table 3. Specific investigations (n = 100)

Specific investigations	Positive	Negative	Not done
ANA	13 (13)	81 (81)	6 (6)
Echocardiogram/Holter	8 (8)	84 (84)	8 (8)
ESR	6 (6)	88 (88)	6 (6)
Lupus Anticoagulant	2 (2)	92 (92)	6 (6)
Urine substance	2 (2)	26 (26)	72 (72)
Anti-HIV	1 (1)	93 (93)	6 (6)
Anti Beta2 Glycoprotein	0 (0)	94 (94)	6 (6)
Anti Cardiolipin	0 (0)	94 (94)	6 (6)
Anti Thrombin III	0 (0)	86 (86)	14 (14)
Protein C	0 (0)	86 (86)	14 (14)
Protein S	0 (0)	86 (86)	14 (14)
RPR	0 (0)	94 (94)	6 (6)

Value is represented as number (percent)

Discussion

The prevalence of ischemic stroke in the young in this study was 12.99%, which was similar to the prevalence in the previous study¹⁴. In ischemic stroke in the young group, BMI was significantly higher and hypertension was more common than the older age group, which both are the traditional cardiovascular risk factors.

The cause of stroke in this study was undetermined in 32% of cases, which was higher than the other study¹⁵, due to limited availability of the diagnostic investigation in our hospital, some investigations were done only in clinically suspected cases, and sometimes due to financial problems. Small artery occlusion and large artery atherosclerosis were more common in this study than the previous study¹⁶, in which BMI, high blood pressure, diabetes mellitus and other atherosclerotic risk are associated with these types of strokes.

The limitation of this study included incomplete information related to family history and incomplete investigation as the study was a retrospective cross-sectional study. Further prospective study in a larger population should be able to collect more data and do broader investigations for stroke in the young patients.

However, the results from this study could emphasize the importance of modifying stroke risk factors as a preventive strategy even in the people of young age.

Conclusion

Prevalence of ischemic stroke in the young is 12.99% among all stroke patients. Stroke of undetermined etiology was the most common type according to TOAST classification. Further prospective study in a larger population with more complete investigations is needed.

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