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Original Article

The Relationship Between Cognitive Function And Stroke Severity In Bethesda Hospital, Yogyakarta

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ABSTRACT

Background: Stroke is an expression of compromised brain function, both locally and globally, which can be severe and persist for up to 24 hours. Damage to brain cells can lead to cognitive, sensory, and motor impairments, hindering stroke patients' functional abilities from daily tasks to communication. This study aims to explore the correlation between cognitive function and stroke severity at Bethesda Hospital, Yogyakarta.

Methods: A retrospective cohort approach was employed in studying 118 ischemic stroke patients with mild to moderate cognitive impairment within 1-3 months after their initial stroke episode, utilizing data from the secondary stroke registry. Cognitive function was assessed using the MMSE upon discharge, while stroke severity was evaluated using the NIHSS upon admission..

Results: Among the 118 patients, the majority were male (59.3%) and aged 60 years or older (57.6%). The analysis revealed no significant correlation between cognitive function and stroke severity (p = 0.106). Additionally, gender, age, history of hypertension, diabetes mellitus, dyslipidemia, and education level were not significantly associated with cognitive function (measured by MMSE score) or stroke severity (assessed by NIHSS score).

Conclusion: The study found no significant relationship between cognitive function (measured by MMSE score) and stroke severity (assessed by NIHSS score) in ischemic stroke patients.

INTRODUCTION

Stroke, according to the World Health Organization is defined as a clinical manifestation of brain dysfunction, both focal and global, that can cause lasting impairment for 24 hours or longer, leading to death without any other clear cause aside from vascular disorders. According to data from the World Stroke Organization, the prevalence of stroke is 12.2 million people each year. [1]

Additionally, the number of stroke patients in Indonesia ranks first in Asia. Based on the Basic Health Research in 2018, the prevalence of stroke in Indonesia, as diagnosed by doctors, is 10.9%, which means that 713,783 people suffer from stroke every year. [2]

The severity of stroke can be assessed using the National Institutes of Health Stroke Scale (NIHSS), which indicates mild to moderate indicators. There are 11 items in the NIHSS, including the level of consciousness, finger movement testing, visual assessment, facial paresis analysis, motor function of the limbs, limb ataxia, sensory function, language function, and dysarthria. [3] Damage to brain cells resulting in cognitive, sensory, and motor function impairments, as well as hindrance to functional abilities ranging from daily activities to communication, is caused by brain cells in stroke patients. [4]

To assess cognitive function decline in stroke patients, the MMSE Instrument is used. This instrument consists of 11 assessment items, including attention and orientation, memory, registration, recall, calculation, language ability, and the ability to draw complex polygons. The MMSE score range is examined. This research measures the relationship between cognitive function and the severity of stroke based on clinical data from patients at Bethesda Hospital in Yogyakarta.

METHODS

This study received ethical approval from the Research Ethics Commission of Bethesda Hospital Yogyakarta under No. 138/KEPK-RSB/XII/22. Employing a retrospective cohort design, this research investigates the retrospective relationship between cognitive function and stroke severity. The data utilized in this investigation are secondary records sourced from Bethesda Hospital Yogyakarta's stroke registry spanning from January to November 2022. Stroke severity was assessed using the NIHSS upon patients' admission to the hospital, while cognitive function was evaluated using the MMSE prior to patients' discharge.

Consecutive sampling was employed in this research, wherein samples were systematically selected by the researcher in accordance with predefined inclusion and exclusion criteria until the desired sample size was achieved. The inclusion criteria encompassed individuals of both genders aged 18 and above with mild to moderate cognitive function among ischemic stroke patients within 1-3 months following their initial onset, treated at Bethesda Hospital Yogyakarta (non-referral) during the specified period, and devoid of prior cognitive impairments. Conversely, patients previously diagnosed with advanced cognitive decline were excluded from the study. Sample size estimation conducted via OpenEpi yielded a total of 98 samples. Subsequent data analysis was carried out employing SPSS software, incorporating Pearson chi-square and Fisher's exact tests.

RESULTS

We recruited 118 ischemic stroke patients from Bethesda Hospital Yogyakarta who fulfilled the study's inclusion and exclusion criteria. The majority of participants were male, comprising a total of 70 individuals (59.3%). Among these, 68 patients (57.6%) were aged 60 years or older, 65 patients (55.1%) had a history of hypertension, 84 individuals (71.2%) had no previous diabetes mellitus diagnosis, 79 participants (66.9%) had no history of dyslipidemia, 64 individuals (54.2%) possessed a college-level education, 81 subjects (68.6%) exhibited moderate neurological deficits as indicated by stroke severity (NIHSS), and 94 individuals (79.7%) demonstrated normal cognitive function (MMSE). The characteristics of the study participants are detailed in Table 1.

Table 1. *The characteristics of the research subjects*

Respondent Characteristic Variables	Frequency (n)	Percentage (%)
Gender		
Man	70	59.3
Woman	48	40.7
Age		
<60 years	50	42.4
>60 years	68	57.6
History of Hypertension		
Yes	65	55.1
No	53	44.9
History Of Diabetes Mellitus		
Yes	34	28.8
No	84	71.2
History of Dyslipidemia		
Yes	40	32.2
No	79	66.9
Level of Education		
No School	0	0
Primary School	0	0
Junior High School	6	5.1
Senior High School	48	40.7
College	64	54.2
Stroke Severity Rate (NIHSS)		
Mild neurological deficit (Score5)	37	31.4
Moderate neurological deficit (Score 6 - 14)	81	68.8
Cognitive Function (MMSE)		
Normal (24-30)	94	79.7
Probable Cognitive Impaired (17-23)	16	13.6
Cognitive impairment (0 – 16)	8	6.8

Table 2. *Correlation between Cognitive Function (MMSE Score) and Stroke Severity (NIHSS Score)*

Variable	Neurological deficit light (%)	Neurological deficit currently (%)	p-value
Normal	26 (27.2)	68 (73.3)	0.106*
Probable disturbance cognitive	6 (37.5)	10 (62.5)	
Definite disturbance cognitive	5 (62.5)	3 (37.5)	

***Pearson chi-square**

The results of this study showed that there was no significant relationship between cognitive function assessed by the MMSE score and stroke severity assessed by the NIHSS score (p = 0.106). The results of this study showed that there was no significant relationship between gender (p = 0.684), age (p = 0.469), history of hypertension (p = 0.478), history of diabetes mellitus (p = 0.322), history of dyslipidemia (p = 0.398), and education level (p = 0.499) with cognitive function as assessed by the MMSE score.

Table 3. *Relationship of Confounding Variables with Cognitive Function (MMSE Score)*

Variables	Normal (%)	*Probable* Cognitive Impairment (%)	*Definite* Cognitive Impairment (%)	P Value
Gender				
Man	54 (77.1	11 (15.7)	5 (7.1)	0.684*
Woman	40 (83.3)	5 (10.4)	3 (6.3)	
Age				
<60 years	39 (78)	6 (12)	5 (10)	0,473**
>60 years	55 (80.9)	10 (14.7)	3 (4.4)	
History of Hypertension				
Yes	51 (78.5)	8 (12.3)	2 (3.8)	0.478*
No	43 (81.1)	8 (15.1)	6 (9.2)	
History Of Diabetes Mellitus				
Yes	30 (88.2)	3 (8.8)	1 (2.9)	0.285**
No	64 (76.2)	13 (15.5)	7 (8.3)	
History of Dyslipidemia				
Yes	29 (76.3)	8 (21.1)	1 (2.6)	0.784**
No	64 (81)	8 (10.1)	7 (8.9)	
Level of Education				
Junior High School	6 (100)	0 (0)	0 (0)	
Senior High School	35 (72.9)	9 (18.8)	4 (8.3)	0,845**
College	53 (82.8)	7 (13.6)	8 (6.8)	

**Pearson chi-square*
*** Fisher's exact test*

Table 4. *Relationship between confounding variables and stroke severity (NIHSS)*

Variable	Neurological deficit light (%)	Neurological deficit currently (%)	P Value
Gender			
Man	19 (27.1)	51 (72.9)	0.234*
Woman	18 (37.5)	30 (62.5)	
Age			
<60 years	16 (32)	34 (68)	0.897*
>60 years	21 (30.9)	47 (69.1)	
History of Hypertension			
Yes	21 (32.2)	44 (67.7)	0.805*
No	16 (30.2)	37 (69.88)	
History Of Diabetes Mellitus			
Yes	14 (41.2)	20 (58.8)	0.143*
No	23 (27.4)	61 (72.6)	
History of Dyslipidemia			
Yes	11 (28.9)	27 (71.1)	0.624**
No	26 (32.9)	53 (67.1)	
Level of Education			
Junior High School	1 (16,7)	5 (83.3)	0.234*
Senior High School	18 (37.5)	30 (62.5)	
College	18 (28.1)	46 (71.9)	

**Pearson chi-square*
*** Fisher's exact test*

The results of this study showed that there was no significant relationship between gender (p = 0.234), age (p = 0.897), history of hypertension (p = 0.805), history of diabetes mellitus (p = 0.143), history of dyslipidemia (p = 0.624), and education level (p = 0.405) with stroke severity as assessed by the NIHSS score.

DISCUSSION

In this study, the evaluation of stroke severity using the NIHSS indicated that the majority of stroke patients experienced moderate neurological deficits (68.6%). This finding parallels the results of the investigation conducted by Soliman et al., wherein the majority of stroke patients also exhibited moderate neurological deficits (61.7%)[6]. Conversely, the assessment of cognitive function using the MMSE revealed that a significant portion of patients in our study demonstrated normal cognitive function (79.7%).

A decline in cognitive function has been linked with stroke severity, mortality, and disability among patients. Nevertheless, the findings of this investigation indicated no significant correlation between cognitive function, evaluated by the MMSE score, and stroke severity, assessed through the NIHSS score ($p = 0.106$). This outcome is corroborated by research conducted by Nakamori et al. in Japan, which similarly found no significant relationship between the NIHSS score and the MMSE score among patients with acute ischemic stroke ($p = 0.108$)[8]. Conversely, a prior study by Li et al. in China, investigating the interplay between inflammatory cytokines, cognitive impairment, anxiety, and depression in 176 acute ischemic stroke patients, revealed that an NIHSS score ≥ 5 was significantly associated with an elevated risk of cognitive impairment, as assessed by the MMSE (OR = 1.009; $p = 0.004$)[9]. Furthermore, a study by Surawan, exploring the prevalence and factors associated with cognitive impairment post-acute ischemic stroke, also yielded similar findings. Their results indicated a significant association between cognitive function, assessed using the MMSE, and stroke severity both during the stroke hospitalization period ($p < 0.001$) and at 3 months post-stroke ($p < 0.001$). These discrepancies could stem from variations in sample size, sociodemographic profiles, comorbidities, and the assessment tools utilized to evaluate cognitive function and stroke severity among patients[10].

The decline in cognitive function leading to post-stroke dementia varies depending on stroke characteristics such as type, volume, location, and severity. Infarct volume correlates with the occurrence and progression of cognitive impairment. Stroke severity is linked with the volume of brain tissue affected by stroke, with larger strokes having more detrimental effects. Greater lesion size exacerbates neurological deficits.[11]

In this study, the majority of stroke patients were male (59.3%), aligning with findings from Fekadu et al., where males predominated with a male-to-female stroke incidence ratio of 1.70:1. This gender discrepancy may be attributed to heightened risk factors such as smoking or alcohol consumption among males. Conversely, females benefit from endogenous estrogen hormone, which aids in protecting cerebral circulation.[12]

Additionally, most stroke patients in this study were aged 60 years or older (57.6%), consistent with Marwat et al., who reported an increased incidence of ischemic stroke with age, particularly with 47.7% of cases occurring in those over 60 years old.[7] This age-related shift may be mediated by endothelial dysfunction, impaired cerebral autoregulation, and neurovascular dysfunction, leading to neuroinflammation and vascular injury. Moreover, older age often coincides with comorbidities like diabetes mellitus, hypertension, atrial fibrillation, coronary artery disease, and peripheral disease, all contributing to elevated ischemic stroke risk among the elderly.[6]

The majority of patients in this study had a history of hypertension (55.1%), no history of diabetes mellitus (71.2%), and no history of dyslipidemia (66.9%). This mirrors the findings of Soliman et al., who investigated ischemic stroke risk factor prevalence and its association with stroke severity in 167 stroke patients. Their study revealed that most patients had comorbid hypertension (62.3%), and hypertension was significantly linked with

stroke severity (p = 0.023). The adverse impact of hypertension on cerebrovascular autoregulation may be explained by alterations in cerebral blood vessels, such as remodeling and stiffness, alongside myogenic tone effects. These autoregulation changes can lead to periventricular white matter damage and brain tissue hypoperfusion.[13]

The findings of this investigation revealed no statistically significant associations between gender (p = 0.234), age (p = 0.897), history of hypertension (p = 0.805), history of diabetes mellitus (p = 0.143), and history of dyslipidemia (p = 0.723) with stroke severity, as assessed by the NIHSS score. This aligns with previous research, such as the study conducted by Soliman et al., which explored the prevalence of ischemic stroke risk factors and their correlation with stroke severity in 167 stroke patients. In their study, gender (p = 0.359), history of diabetes mellitus (p = 0.927), and history of dyslipidemia (p = 0.201) were not found to have significant associations with stroke severity. However, age and hypertension exhibited significant associations with stroke severity, with p-values of < 0.001 and < 0.001, respectively (Soliman et al., 2018)13. Similarly, research by Lee et al. in South Korea produced analogous outcomes, where hypertension (p = 0.532) and dyslipidemia (p = 0.802) did not demonstrate significant associations with stroke severity (NIHSS score), while age (p < 0.001), gender (p = 0.011), and history of diabetes mellitus (p = 0.006) exhibited significant associations with stroke severity[14]. Likewise, a study by Kim et al. in South Korea, which investigated factors related to the severity of ischemic stroke as assessed by the NIHSS score, indicated that gender (p = 0.100), diabetes mellitus (p = 0.420), and dyslipidemia (p = 0.205) were not significantly linked to stroke severity, while age (p = 0.000) and hypertension (p = 0.037) demonstrated significant associations[15]. These disparities may stem from differences in sample size, sociodemographic characteristics, comorbidities among participants, and variations in the assessment instruments utilized to evaluate stroke severity.

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CONCLUSION

No significant correlation was found between cognitive function, evaluated through MMSE scores, and stroke severity, assessed by NIHSS scores. This study is subject to several limitations, notably the absence of pre-stroke cognitive ability data and the lack of information regarding the dementia spectrum preceding the occurrence of stroke.

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