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Comparison of Oxygen Saturation Dynamics Between Types of Acute Stroke in Early Hospitalization Period

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ABSTRACT

Introduction. Stroke is the number one cause of death and disability in Indonesia. It was found that the incidents of stroke were higher at ages over 45 years. The use of pulse oximeter is an efficient step in monitoring oxygenation in stroke patients. Decreased oxygen levels can cause neurological deficits such as cognitive impairment, causing patients to have problems in attention and executive functions. This study aims to determine the relationship between the type of acute stroke and oxygen saturation in early hospitalization period. **Methods.** This research was carried out from November to December 2023 at the National Brain Center Hospital, Jakarta, using a cross sectional approach. Information on diagnosis and oxygen saturation values were obtained through medical records, with a total of 70 patients as subjects. Subjects selected through simple random sampling with patients age over 45 years. Statistical analysis used the Mann Whitney test with a significantly different p value <0.05. **Results.** A total of 68.6% of the subjects were male with ages of 45-59 dominated the subjects at 51.4%. Statistical tests on the type of acute stroke with oxygen saturation values produced a value of p = 0.044 (p < 0.05) on the 3rd day of hospitalization. These results indicate a significant relationship between the type of acute stroke and the oxygen saturation value on the 3rd day of hospitalization. **Conclusion.** There is a significant correlation between the type of acute stroke and oxygen saturation in the 3rd day of hospitalization.

1. Introduction

Indonesia has entered the aging population period, marked by a 3% increase in the percentage of elderly individuals over the span of a decade. The pre-elderly group (ages 45-59) experiences an elevated risk of various health issues. Individual vulnerability to degenerative and chronic diseases increases with age.[1]

Stroke is the leading cause of death in Indonesia. The prevalence of stroke is higher in individuals over the age of 45. According to the Indonesian Stroke Registry for the years 2012-2014, 67% of total stroke cases are ischemic strokes, while the remaining 33% are hemorrhagic strokes. Stroke is a collection of neurological deficit symptoms caused by blood vessel injuries in the central nervous system. Ischemic stroke occurs when blood flow to the brain is obstructed, while hemorrhagic stroke occurs when blood vessels rupture, leading to bleeding into the intracranial space. Both conditions can result in decreased oxygen levels in the brain, followed by death of brain cells.[2–4]

Oxygen saturation indicates the amount of oxygen bound to hemoglobin. Assessing oxygen saturation using a pulse oximeter is an efficient non-invasive method for monitoring oxygenation in stroke patients. Reduced oxygen levels can lead to neurological deficits such as cognitive impairment. In healthy adults with normal cerebral blood circulation, a decrease in oxygen saturation can be compensated by an increased cerebral blood flow. However, this compensation mechanism is not effective in patients with ischemic strokes.[5–8]

Stroke ranks as the number one cause of death in Indonesia, and epidemiologically, there is an increased incidence in individuals over the age of 45. Research on the relationship between stroke types and oxygen saturation in the early stages of treatment has not been extensively explored. Nevertheless, a decreased oxygen saturation in stroke patients is associated with a deterioration in the patient's condition and neurological deficits. Based on the above information, researchers are interested in studying the relationship between stroke types and

oxygen saturation in the early period of hospitalization.

2. Methods

This study is analytical observational research with a cross-sectional approach to evaluate the relationship between acute stroke types and oxygen saturation in the early hospitalization period. The research was conducted at the National Brain Center Hospital (RS PON) from November 2023 to December 2023. The population in this study consists of the medical records of acute stroke patients who were hospitalized at RS PON and met the inclusion criteria from January 2023 to June 2023. Data collection was derived from the patients' medical records. Subject selected through simple random sampling by randomly selecting subjects from the population in a specific month. The sample size was determined using finite and infinite formulas, precision levels, prevalence, and accounting for dropouts, resulting in a total of 70 samples.

Stroke types were categorized into ischemic and hemorrhagic strokes. Oxygen saturation values were recorded upon the patient's admission to the hospital in the ER and on days 1, 2, and 3 of hospitalization. Oxygen saturation values were categorized as normal (95-100%) and low (<95%). After obtaining the necessary data, it will be processed and analyzed.

The research has obtained the Research Ethics Approval letter from the Research Ethics Commission of Trisakti Faculty of Medicine with the number 151//KER-FK/VII/2023 on July 24, 2023. This study also has been approved and authorized by the Research Ethics Committee of the National Brain Center Hospital (RS PON), Jakarta, with the approval letter number DP.04.03/D.XXIII.9/140/2023 on October 25, 2023.

3. Results

Table 1 shows that the age group of 45-59 years has the highest number with a total of 36 subjects (51.4%). Males constitute the majority of subjects by gender, accounting for 68.8%. Subjects with a diagnosis of ischemic stroke and hemorrhagic stroke have an equal number.

Based on Table 2, the majority of patients' oxygen saturation values fall into the normal category. Oxygen saturation below 95% was found in 2 patients at the time of admission to the Emergency Department (ER). After conducting a normality test, the oxygen saturation values at the time of admission to the IGD, on the first, second, and third days of hospitalization were found not to be normally distributed.

Through table 3, significant results were only found in the relationship between acute stroke types and oxygen saturation on day 3 of hospitalization ($p = 0.044$), where the test results yielded p-values > 0.05 for measurements taken at the Emergency Department (ER), day 1, and day 2 of hospitalization.

Table 1. Diagnosis and sociodemographic distribution

Variable	Frequency (n)	Percentage (%)
Age (y.o)		
45 – 59	36	51,4
60 – 69	18	25,7
> 70	16	22,9
Sex		
Man	48	68,6
Woman	22	31,4
Diagnosis		
Ischemic stroke	35	50
Hemorrhagic stroke	35	50

Table 2. Oxygen saturation dynamic in acute stroke patients

Oxygen Saturation (%)	Frequency (n)	Percentage (%)	Mean	Median
Initial in ER				
Normal (95 – 100)	68	97,1	97,43	98,00
Low (<95)	2	2,9		
H-1				
Normal (95 – 100)	70	100	97,93	98,00
Low (<95)	0			
Spo2 H-2				
Normal (95 – 100)	70	100	97,90	98,00
Low (<95)	0			
Spo2 H-3				
Normal (95 – 100)	70	100	97,56	97,00
Low (<95)	0			

Table 3. Relationship between acute stroke types and oxygen saturation in early hospitalization period

	p
SpO2 ER	
Ischemic stroke	0,588
Hemorrhagic stroke	
SpO2 H-1	
Ischemic stroke	0,508
Hemorrhagic stroke	
SpO2 H-2	
Ischemic stroke	0,128
Hemorrhagic stroke	
SpO2 H-3	
Ischemic stroke	0,044*
Hemorrhagic Stroke	

Mann-Whitney Test, p<0,05

4. Discussion

The characteristic data of the subjects in this study are as shown in Table 1. Out of 70 subjects, a higher percentage was found among males (68.8%) compared to females (31.4%). This finding aligns with research conducted by Ali et al., where the incidence of stroke was higher in males (53.5%) than in females. This is also supported by literature stating that males are 2 times higher in risk of stroke than females in the 60-69 age group. Higher estrogen hormone levels in females provide a neuroprotective effect that potentially suppresses stroke risk factors through the regulation of adipogenesis and anti-atherogenic effects on blood vessels. [9,10] This study found a higher incidence of ischemic stroke in females, while hemorrhagic stroke was more common in males. This result contrasts with a study by Vyas, et al, which stated that subarachnoid hemorrhage (SAH) tends to occur more frequently in females than in males.[11]

Based on the findings of this research, the number of acute stroke patients is relatively higher in the 45-59 age group at 51.4% compared to the 60-69 age group at 48.6%. This is supported by the 2018 Riskesdas provincial report for DKI Jakarta, where the prevalence of stroke continues to increase from the age of 45.[12] According to a study by Murphy et al., the incidence doubles every decade after the age of 55.[3] This research found a higher incidence of hemorrhagic stroke in the 45-59 age group, while the incidence of ischemic stroke was higher in the >60 age group. A study by Seo et al. suggests variations in the distribution of stroke subtypes and age, with 30% of ischemic stroke cases occurring in individuals aged 75 and above.[13]

The statistical test results indicate a significant relationship between acute stroke types and oxygen saturation values on the third day of hospitalization (p < 0.044). This finding aligns with the research hypothesis, revealing a significant relationship between acute stroke types and oxygen saturation values. Research on the relationship between acute stroke types and oxygen saturation (SpO2) has not been extensively conducted before. However, a secondary analysis of the HeadPoST Study conducted by Ouyang, et al, found a significant relationship between patient diagnosis and SaO2 values (p < 0.0001).[14] In contrast, Rincon, et al, reported opposite results, finding no significant relationship between patient diagnosis and oxygen levels obtained from blood gas analysis. This study also found a higher average oxygen saturation value in the hemorrhagic stroke group compared to the ischemic stroke group.[15]

Different mechanisms in stroke types have an impact on changes in oxygen saturation values. In ischemic stroke, a decrease in oxygen saturation occurs when blood vessels to the brain are blocked due to plaque or emboli. Blockage in blood flow leads to a decrease in the supply of nutrients and oxygen to brain cells, causing brain cell death and resulting in neurological deficits. In hemorrhagic stroke, bleeding increases intracranial pressure, leading to compression of blood vessels and surrounding tissues. Vessel compression disrupts blood flow, causing a decrease in oxygen to brain tissue.[10,16,17]

Oxygen saturation in stroke patients is influenced by several factors resulting from stroke complications. Pneumonia is a common complication in acute stroke cases, known as stroke-associated pneumonia (SAP), presenting a spectrum of lower respiratory tract disorders that occur 7 days after stroke onset. Sleep apnea is a common cause of intermittent nocturnal hypoxia after stroke, affecting at least 60% of stroke patients. This condition has also been proven to be a risk factor for future strokes if not properly managed. Poor respiratory muscle function has the potential to cause a direct decrease in oxygen due to muscle paralysis or secondary infection. Several studies have shown a significant decrease in forced vital capacity, forced expiratory volume, peak expiratory flow rate, inspiratory and expiratory pressure, and maximal expiratory flow, indicating additional respiratory muscle and diaphragm dysfunction.[18]

A decrease in oxygenation in stroke patients can lead to neurological deficits, both in the acute and chronic phases. In the acute phase, deficits can cause disturbances in decision-making, confusion, and a

decline in executive function. Prolonged oxygen reduction can disrupt physical and neuropsychological conditions. Partial complex seizures can occur within a day after exposure to hypoxia. Cognitive impairments, including amnesia, executive function disorders, and language disorders, can arise from prolonged hypoxia.[8,18,19]

5. Conclusion

This study concludes that there is a significant relationship between acute stroke types and oxygen saturation on the third day of hospitalization (p = 0.044). Suggestions for future research include conducting direct observations and assessing all variables that may influence oxygen saturation.

6. Acknowledgements

7. References

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