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ORIGINAL RESEARCH

Stroke-Associated Pneumonia: Risk Factors and Discharge Status

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Abstract

Background: Stroke-associated Pneumonia (SAP) is one of the complications that occur in stroke patients and is associated with worse clinical outcomes. Risk factors for SAP and its impact on discharge status remain unclear.
Purpose: This study aimed to determine the factors influencing the incidence of stroke-related pneumonia in the hospital and the patient's discharge status.
Methods: A case-control study was conducted at a private hospital in Surabaya from January 2021 to 2022. Medical record data were reviewed to identify stroke patients with suspected or confirmed pneumonia, after which risk factors (age, gender, stroke type, length of stay, stroke frequency, dysphagia, diabetes mellitus, hypertension, COVID-19, and discharge status) associated with the occurrence of SAP were examined. We excluded diagnoses of diseases with clinical manifestations such as tuberculosis-like pneumonia, lung tumor, pulmonary edema, pulmonary embolism, pulmonary atelectasis, and incomplete or missing medical record data. Data analysis used the Chi-square test to identify the risk factors for stroke-associated pneumonia.
Results: One hundred sixty-three stroke patients treated in all inpatient rooms were diagnosed with pneumonia; 52.8% of them had confirmed pneumonia, while the rest were still suspected of pneumonia. Most pneumonia occurs in ischemic stroke patients (93.9%), first-time stroke patients (87.1%), experienced dysphagia (55.2%), length of stay less than 7 days (55.2%), hypertension (55.2%), diabetes mellitus (57.1%), and discharged home (84%). We also found as much as 12.9% inpatient mortality due to SAP. Dysphagia, DM, and COVID-19 were significantly correlated with the incidence of stroke-associated pneumonia (p=0.000).
Conclusion: Stroke-associated pneumonia is a substantial medical complication among stroke patients affected by dysphagia, DM, and COVID-19. Screening for dysphagia is necessary for nurses to prevent SAP in stroke patients.

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1. Introduction

Stroke-associated pneumonia (SAP) refers to a pulmonary infection that is the most common complication of stroke in the first 7 days after stroke onset, with an estimated incidence of 5.6% - 32% of acute stroke cases (Cugy & Sibon, 2017; Ritonga et al., 2019). SAP increases the risk of mortality (49%) and poor functional outcome (92%), contributes to as much as 10% of causes of death from stroke, and extends the patient's stay in the hospital by two times (Wandira et al., 2018). The prevalence and severity of post-stroke complications heavily influence how a stroke will turn out. Of all stroke subtypes, pneumonia associated with stroke (SAP) complicates 5–44% of cases (Assefa et al., 2022). The incidence of complications of pneumonia among stroke patients in Indonesia is relatively high. A study showed that out of 106 acute stroke patients, 28.3% had pneumonia, of which 53.33% had hospital-acquired pneumonia (HAP) (Muhafidzah et al., 2021). Additionally, ventilated stroke patients are at high risk of developing ventilator-associated pneumonia (Alreshidi et al., 2024; Theresia, 2016).

The prevention of complications of pneumonia in stroke patients is also a concern of the Indonesian government, as stated in the Decree of the Minister of Health concerning the National Guidelines for Medical Services for Stroke Management (Indonesian Ministry of Health Decree, 2019). Nurses have an important role in preventing pneumonia by identifying risk factors in stroke patients, including screening for dysphagia, feeding management, body position management, oral care, and respiratory tract management (Guo et al., 2022; Palli et al., 2017). In addition, some previous histories of diseases, such as diabetes mellitus and hypertension, are also indicated as risk factors for SAP (Kembuan et al., 2021; Liu et al., 2022; Szylińska et al., 2022; Tashima et al., 2023). Fasting hyperglycemia patients, whether they have diabetes with poor glycemic control or newly onset diabetes, are more likely to develop SAP (Li et al., 2019). Severe hypertension, defined as 200/120 mmHg or higher, is one of the most important risk factors for developing stroke-associated pneumonia (Grossmann et al., 2021). So, it is necessary to identify the factors that influence the incidence of SAP in stroke patients and their discharge status.

Early recognition of patients with a high risk of developing pneumonia is essential in critical care unit and every hospital ward admitting high-risk patients (Szylińska et al., 2022). Previous studies reported that several factors influence the occurrence of SAP, including age, gender, stroke type, stroke onset, comorbidities, length of stay (LOS), and dysphagia (Almeida et al., 2015; Assefa et al., 2022; Muhafidzah et al., 2021; Widyantara et al., 2020). However, those studies were conducted in emergency and intensive care settings, and were rarely performed in inpatient ward settings, even though the majority of pneumonia that occurs in stroke patients are caused by HAP (Muhafidzah et al., 2021). Previous studies have proven that the incidence of pneumonia in stroke patients often occurs in inpatient rooms, which is frequently caused by Klebsiella pneumonia (40.0%) (Ekayana et al., 2020). SAP is associated with significantly worse clinical outcomes, including more significant inpatient mortality (Ho et al., 2018; Widyantara et al., 2020), a lower likelihood of discharge home, and a lower likelihood of good functional recovery at discharge from the stroke services (Ali et al., 2018). Stroke patients diagnosed with pneumonia have higher short-term mortality than those without pneumonia (Teh et al., 2018). Most of the research on SAP cases in Indonesia is outdated (Ritonga et al., 2019; Sari et al., 2017), so updated research is needed regarding this phenomenon and the impact of SAP on inpatient mortality.

Furthermore, this study also examines COVID-19 as a possible factor contributing to pneumonia in stroke patients, as it was conducted after the COVID-19 pandemic. Between 2020 and 2022, individuals with ischemic stroke who had COVID-19 had a death rate exceeding 50% in Indonesia (Sari et al., 2022). Previous research reported that 43% of stroke patients who were treated were found to have SARS-CoV-2 infection, presenting with moderate to severe pneumonia with increased $\log_{10}$ CRP and $\log_{10}$ D-dimer (Nishiyama et al., 2024; Zhai et al., 2020). Although most strokes occur within days of the onset of COVID-19 symptoms, neurological symptoms are the reason for hospitalization in more than a third of people with COVID-19 and stroke (Nannoni et al., 2021). Accordingly, this study aimed to determine the factors influencing the incidence of stroke-associated pneumonia in hospital settings and the discharge status of patients.

2. Methods

2.1. Research design

This study used a case-control design to determine the relationship between age, gender, stroke type, stroke onset, comorbidities (hypertension, diabetes mellitus, COVID-19), LOS, dysphagia, and the incidence of stroke-associated pneumonia. Before the study began, both exposure and illness had occurred in the past; therefore, the variables were measured using the patients' medical records.

2.2. Setting and samples

This study was conducted at a private hospital in Surabaya, Indonesia. Researchers collected data using patients' medical records from January 2021 to December 2022 to identity stroke patients with a medical diagnosis of suspected or confirmed pneumonia. The diagnosis of ischemic stroke was identified using ICD-10 codes (The International Statistical Classification of Diseases and Related Health Problems, 10th Revision) including ischemic stroke (I63), hemorrhagic stroke (I60-I62) (Hsieh et al., 2020; McCormick et al., 2015).

A total of 725 medical records of patients with a stroke diagnosis were examined, and we obtained 163 medical record data showing stroke patients being treated in the inpatient room

with a diagnosis of suspected and confirmed pneumonia. In this study, we used data from stroke patients diagnosed with suspected pneumonia based on the criteria by Grossmann et al. (2021) given that there is no agreed-upon terminology or gold-standard diagnostic criteria for the spectrum of lower respiratory tract infections that complicate stroke. Furthermore, Smith et al. (2015) presented operational consensus criteria for diagnosing and treating SAP in the UK. These criteria require progressively infiltrating lesions in post-stroke chest imaging and more than two clinical signs of infection to diagnose stroke-associated pneumonia. These are: (1) a temperature of ≥38 °C; (2) a new cough, a productive cough, or an aggravation of the symptoms of an existing respiratory disease with or without chest pain; (3) indications of pulmonary consolidation and/or moist rales; and (4) peripheral WBC above 10 x 10^9/L or below 4 x 10^9/L with or without a nuclear shift to the left (Smith et al., 2015). Most patients with suspected pneumonia in this study showed the above signs, but chest X-rays results were not included; therefore, the doctor could not confirm the diagnosis of pneumonia. All data were filtered by age, gender, type of stroke, stroke onset, and comorbidities, including history of hypertension, diabetes mellitus, and COVID-19. The inclusion criteria for the medical records used in this study were: patients aged over 18 years and those diagnosed during treatment in one of three inpatient wards. The exclusion criteria included conditions with clinical manifestations similar to pneumonia, such as tuberculosis, lung tumors, pulmonary edema, pulmonary embolism, and pulmonary atelectasis, as well as incomplete or missing medical record data.

2.3. Measurement and data collection

Data collection was divided into four stages. The first stage was perception equation, which involved three assembling personnel (RYS, EMW, NA), two coding personnel (YS, IF), and two medical recording teams responsible for the data collection process. In the second stage, the assembling staff grouped patient data based on ICD-10 codes, including ischemic stroke (I63) and hemorrhagic stroke (I60-I62). The categorized data were then reviewed for completeness, and incomplete data were excluded. In the third stage, we categorized the data based on the additional diagnosis of pneumonia (J18), after which the examiner classified the data as either confirmed pneumonia (1) or suspected pneumonia (0). Furthermore, the coding personnel coded the collected data according to the predetermined research variables. In the last stage, the data were filtered based on stroke type, onset, length of stay, dysphagia, comorbidities (hypertension, diabetes mellitus, COVID-19), and discharge status. Data were recorded in a Microsoft Excel master table and then confirmed with the medical records team to prevent errors and bias. This study was conducted after the COVID-19 outbreak, and we found that COVID-19 correlated with complications among acute ischemic stroke patients. According to prior studies, stroke patients with severe clinical symptoms of COVID-19 infection had considerably worse outcomes than those with moderate COVID-19 infection (Hidayat et al., 2022; Nannoni et al., 2021). We also examined the prognosis of SAP based on patients' discharge status, as previous studies have shown that SAP can prolong LOS and increase inpatient mortality in stroke patients (Hannawi et al., 2013).

2.4. Data analysis

The data obtained were analyzed descriptively and presented as frequencies and percentages. Multivariate analysis (binary logistic regression) was used to predict the probability of a binary outcome based on one or more independent variables with a significance level of 0.005. We used binary logistic regression based on Yuan et al. (2021) to examine the correlation of all factors associated with pneumonia incidence and predict the most dominant factor.

2.5. Ethical consideration

This study used secondary data obtained from patient medical records. The data collection received permission from the medical records section and the education coordinating committee at the hospital where the study took place. The study was declared ethically feasible by the Health Research Ethics Committee with certificate number 023/KEPK-RSISJS/III/2023. We took the data to the medical record room to maintain its security and confidentiality as mandated by Law No. 29 of 2004, which requires medical records to be kept confidential by doctors or dentists and leaders of health service facilities (Izza & Lailiyah, 2024). Electronic medical record data were accessed through the Hospital Management Information System (HMIS) by involving the medical

record team, who were the only ones authorized to access to the data through a password-protected system.

3. Results

3.1 Characteristics of the samples and factors related to SAP

The characteristics of SAP patients in this study are summarized in Table 1. A total of 163 stroke patients were included in the study. The mean age of the participants was 63.51±12.11 years in the confirmed group and 64.29±11.32 in the suspected group. Most of them were men (58.3% vs. 25.2%), had an ischemic stroke (50.9% vs. 42.9%), experienced first-time stroke (47.2% vs. 39.9%), had LOS less than 7 days (26.4% vs. 28.8%), experienced no hypertension (29.5% vs. 27.6%), and had confirmed COVID-19 (41.7% vs. 47.2%). Most of the confirmed respondents did not have dysphagia (44.2%) and did not have diabetes mellitus (DM) (29.5%), while the suspected respondents mostly had dysphagia (46.6%) and DM (35%). Half of the pneumonia cases were confirmed (52.8%), and the rest were still suspected. The results of the correlation test between risk factors and the incidence of SAP are also described in Table 1.

Table 1. The characteristics of the samples and factors related to SAP

Variables	The incidence of pneumonia (n=163)				*p*-value
	Confirmed n (%)		Suspects n (%)		
Age (Mean±SD)	63.51±12.11		64.29±11.32		
Gender					
Male	54	33.1	41	25.2	0.217[a]
Female	32	19.6	36	22.1	
Stroke type					
Ischemic stroke	83	50.9	70	42.9	0.193[b]
Hemorrhagic stroke	3	1.9	7	4.3	
Length of Stay					
Less than 7 days	43	26.4	47	28.8	0.157[a]
Equal to or more than 7 days	43	26.4	30	18.4	
Stroke frequency					
First time	77	47.2	65	39.9	0.33[a]
Secondary time	9	5.5	12	7.4	
Dysphagia					
Yes	14	8.6	76	46.6	0.000[a]*
No	72	44.2	1	0.6	
Diabetes Mellitus					
Yes	33	20.2	57	35	0.000[a]*
No	53	32.5	20	12.3	
Hypertension					
Yes	38	23.3	32	19.6	0.735
No	48	29.5	45	27.6	
COVID-19					
Yes	68	41.7	77	47.2	0.000[a]*
No	18	11.1	0	0	
Discharge status					
Home	74	45.4	63	38.7	
Referred	1	0.6	4	2.4	0.326[a]
Death	11	6.8	10	6.1	

Notes. [a]= Chi-square test; [b]= Fisher's exact test, *p-values are statistically significant

Table 1 also summarizes the correlation test results between factors affecting SAP, including stroke type, stroke onset, length of stay, dysphagia, hypertension, diabetes mellitus, COVID-19, and discharge status. The Chi-square test results showed a correlation between dysphagia, DM, and COVID-19 and the incidence of SAP (p=0.000).

3.2 Risk factor analysis using binary logistic regression

The risk factors related to SAP were further analyzed using binary logistic regression. We observed the following possible risk factors for SAP (Table 2).

Table 2. Risk factor analysis using binary logistic regression

Variables	Coeff. B	Wald	*p*-value	Nagelkerke R^2
Age (Mean±SD)	0.01	0.88	0.767	
Gender				
Male	ref	ref	0.29	
Female	1.07	1.13		
Stroke type				
Ischemic stroke	ref	ref	0.47	
Hemorrhagic stroke	1.19	0.52		
Length of Stay				
Less than 7 days	ref	ref	0.06	
Equal to or more than 7 days	-1.77	3.56		
Stroke frequency				
First time	ref	ref	0.14	
Secondary time	1.94	2.12		
Dysphagia				
Yes	ref	ref	0.995	0.88
No	-32.49	0.00		
Diabetes Mellitus				
Yes	ref	ref	0.216	
No	1.05	1.53		
Hypertension				
Yes	ref	ref	0.853	
No	-0.15	0.03		
COVID-19				
Yes	ref	ref	0.998	
No	-21.7	0.00		
Discharge status				
Home	ref	ref	0.996	
Referred	15.75	0.00		
Death	26.8	0.00		

In the binary logistic regression test, we examined the correlation of all observed risk factors with SAP, presented through the coefficient B, Wald test, *p*-value, and Nagelkerke R^2. The results of the correlation are indicated by the *p*-values, which showed that there was no significant correlation among the observed risk factors, so the most dominant factor causing SAP could not be identified.

4. Discussion

This study included 163 medical records to determine factors influencing the incidence of stroke-related pneumonia (SAP) in the hospital and the discharge status of patients. The findings indicated that dysphagia, DM, and COVID-19 were the risk factors related to SAP. This is in line with the research of Wandira et al. (2018) showing that dysphagia was a neurological deficit found in SAP patients (87.5%), and patients with dysphagia were at increased risk of SAP compared to patients without dysphagia (OR 8.57; 95%CI 5.65–13) (Eltringham et al., 2018). A study from Nor Adina et al. (2012) also showed that clinical dysphagia, a predictor for developing pneumonia, was also one of the independent predictors of 30-day mortality. The pathophysiology of stroke-associated pneumonia (SAP) is multifactorial. In particular, a combination of dysphagia leading to oropharyngeal aspiration and stroke-induced immunosuppression due to acute cerebral ischemia has been postulated as a possible mechanism (Teh et al., 2018). A study has confirmed the deleterious effects of dysphagia, and it found that patients with dysphagia had a higher probability of developing SAP than patients without dysphagia ($p<0.0001$) (Sari et al., 2017). Some of these studies emphasized dysphagia as a factor causing SAP, but not all nurses at the hospital where this study was conducted could screen for dysphagia. So far, neurologists have only

performed dysphagia screening after stroke patients treated in the inpatient ward. Sometimes, patients' families still give them drinks and food (liquid and solid). Solid and hard foods make it difficult for patients to chew and swallow, while drinks or runny foods carry the risk of causing accidental aspiration (Liu et al., 2024). Combined weakening of the swallowing and coughing reflexes appears to be an essential marker of increased risk of pneumonia in post-stroke dysphagia patients (Grossmann et al., 2021). Dysphagia brought on by a stroke may cause aspiration, which can cause pneumonia to develop. Within 3 days following the stroke occurrence, 40% to 70% of stroke patients experience dysphagia, 40% of those who aspirate, and approximately one-third of those who aspirate develop pneumonia (Yuan et al., 2021). Most SAP originates from aspiration pneumonia caused by food aspiration, various body liquids, and chemical forms of gastrointestinal contents (Zewdu & Lidetu, 2022).

Dysphagia is a critical factor that leads to mortality in stroke patients (Ho et al., 2018). SAP had significant clinical implications and the highest attributable rise in mortality of all medical complications following stroke (estimated to be between 10.1 and 37.3%) (Tinker et al., 2021). A study by Teh et al. (2018) showed that SAP was associated with 5.87 times increased odds of in-patient mortality (95%CI 4.97 to 6.93) and had significantly higher odds of in-hospital mortality (odds ratio [OR] 2.90: 2.83-2.96) (Barlas et al., 2019). Poor nutritional status and aspiration pneumonia significantly impact the prognosis and death in stroke patients with dysphagia (Feng et al., 2019). Our finding is in line with previous studies that dysphagia is one of the factors that causes SAP. Stroke patients experience accidental aspiration and malnutrition due to their inability to chew and swallow food and drinks. Aspiration occurs when food enters the respiratory tract and causes inflammation of the lungs, while malnutrition causes the body's immune system to weaken, making it more easily infected by bacteria.

Based on comorbidities in stroke patients, the present study found that DM and COVID-19 were statistically correlated with the incidence of SAP (p=0.000). Previous research stated that DM is a potential risk factor for SAP (Liao et al., 2015). Moreover, diabetic patients with poor blood glucose control would likely suffer from cerebral infarction (Li et al., 2019). Stroke patients with hyperglycemia (blood glucose level >200 mg/dL) during the first 24 hours after stroke are predicted to experience an expansion of ischemic stroke volume and poor neurological outcomes (Nor Adina et al., 2012). Hyperglycemia can lead to inflammation and oxidative stress responses by damaging the blood-brain barrier, worsening cerebral edema, increasing apoptosis, disrupting coagulation function, and increasing plasma concentrations of free fatty acids, which could have an impact on stroke outcomes after infection (Wei et al., 2022). Apart from DM, another SAP comorbid is COVID-19. An increase in D-dimer in COVID-19 patients promotes the prethrombotic state of patients with venous occlusion, resulting in a large amount of blood clotting. This process risks causing stroke infarction in COVID-19 patients (Chen et al., 2020). SAP incidents related to comorbidities have increased due to low admission rates during the COVID-19 pandemic. Stroke patients are afraid to come to the hospital to check their condition, so when they come to the hospital, stroke complications already occur and potentially increase the rate of in-hospital mortality (Sari et al., 2022). The results of these studies are consistent with the findings in this study. According to Qureshi et al. (2021), 58 out of 103 stroke patients with COVID-19 infection (56.3%) and 51.8% of stroke patients without COVID-19 infection both had diabetes. Patients with a SARS-CoV-2 infection had higher plasma cytokine levels, including IL-2, IL-7, IL-10, GSCF, IP10, MCP1, MIP1A, and TNFα (Huang et al., 2020). The SARS-CoV-2 virus can also be associated with angiotensin-converting enzyme 2 (ACE2) found in brain endothelial and smooth muscle cells. SARS-CoV-2 may deplete ACE2 and favor the ACE1/angiotensin II axis, which can lead to tissue injury, such as stroke (Hess et al., 2020). One pathogenesis of ischemic stroke suggests SARS-CoV-2 uses the cell entry receptor ACE2 to damage the endothelium and activate coagulation factors (increased D-dimer). In addition, the SARS-CoV-2 virus causes lung inflammation, so that the alveoli swell and secrete fluid and pus.

The results of this study also showed that gender was not statistically correlated with SAP, although most stroke patients with confirmed or suspected SAP were male. These findings are in line with a study by Li et al. (2022) and Azeem-ur-rehman et al. (2022) that showed gender was not found to be a risk factor for SAP. Several studies have shown different results regarding the age factor associated with the incidence of SAP. A study from Azzahra et al. (2021) showed that SAP was more common in men because men have Y chromosome genes that are partly involved in increasing blood pressure and hypertension. This is influenced by sex steroid hormones in the

cerebral blood vessels which have the ability to change vascular reactivity and thus modulating blood flow, and male arteries tend to narrow more in response to pressure compared to female arteries (Azzahra et al., 2021; Wang et al., 2019). In addition, women have a lower incidence of stroke because of the protective effect of estrogen on cerebrovascular and peripheral vascular disease. Estrogen can increase blood flow by reducing the vascular reactivity (Azzahra et al., 2021; Haast et al., 2012). The male is one of the predictor factors for the occurrence of pneumonia in acute stroke patients; this is related to the androgen hormone dihydrotestosterone (DHT), which is a potent hormone in males that has the effect of aggravating the condition of immunosuppression after a brain injury due to stroke (Muhafidzah et al., 2021). In contrast, studies from Chaves et al. (2022) and Assefa et al. (2022) show that women are more at risk of experiencing SAP than men. The differences in these findings indicate that gender is not a specific predictive factor for the incidence of SAP.

Most of the SAP in this study occurred in patients over 60 years. Old age (especially >65 years) is a risk factor for pneumonia in stroke because it is associated with decreased protective reflexes such as coughing and swallowing (Muhafidzah et al., 2021). Elderly people with SAP are more likely to have it due to comorbidities, immunosuppression, swallowing issues, and frailty (Assefa et al., 2022; Li et al., 2019). Old age is associated with more severe neurological outcomes, impaired swallowing function, reduced immunity, and increased comorbidities (Zewdu & Lidetu, 2022).

Most patients in this study were ischemic stroke patients, but stroke type did not correlate significantly with the incidence of SAP. This finding is similar with a previous study, which showed that the type of stroke did not correlate with the incidence of SAP in the ICU, where most of the patients treated had hemorrhagic strokes (Widyantara et al., 2020). Hemorrhagic stroke patients have a higher risk of infection than those with ischemic stroke (Almeida et al., 2015), and it was seen in around two-thirds of the cases due to decreased consciousness. which is at risk of aspiration (Azeem-ur-rehman et al., 2022). On the contrary, a study from Nor Adina et al. (2012) focusing on the first acute ischemic stroke patient found that the incidence of stroke-associated pneumonia among first-time acute stroke patients in hospitals was 15.8% higher than in other studies conducted locally and globally. Ischemic stroke is also associated with dysphagia due to disturbances in the anterior circulation, such as the middle cerebral vessels (Patmah et al., 2022).

The incidence of SAP is always associated with prolonged LOS, but our findings showed that LOS did not significantly affect the incidence of SAP. This finding is the same as that of Muhafidzah et al. (2021), who found that the length of stay in stroke patients with pneumonia was more with LOS <7 days (36.67%), and was supported by research Widyantara et al. (2020) that showed LOS was not related to the incidence of pneumonia stroke patients in intensive care. On the other hand, previous studies have shown that prolonged LOS was strongly associated with SAP (<0.001), and also had a 3-fold increased risk of inpatient mortality and an 11.5-fold increased risk of long hospital stay (Barlas et al., 2019). The difference in results is linked to the setting in which the data were collected. This study was conducted in an inpatient setting, with two possibilities: stroke patients admitted to the inpatient setting were either stroke patients from the ICU or patients from the emergency room. If the patient was admitted to the ICU, most of the pneumonia occurred due to VAP, while patients from the emergency room had community-acquired pneumonia (CAP). The LOS of the two settings is different, where the LOS of patients from the ICU is more prolonged than that of patients from the emergency room, but both have the same risk of SAP.

5. Implication and limitation

The findings in this study can be used as a basis for efforts to prevent SAP complications through holistic nursing care in stroke patients during hospitalization. A focused and complete nursing assessment, such as dysphagia screening and blood sugar measurement in patients, is important from admission to discharge from the hospital. It is crucial to provide health education to families of stroke patients about dysphagia to ensure they understand the risks of providing food and drink to stroke patients with difficulty swallowing, which could prevent aspiration pneumonia.

The present study has some limitations. This single-center retrospective cohort study was conducted in a private type B hospital, so the sample size was limited. We did not analyze cigarette smoking due to a lack of documentation regarding smoking history, as not all nurses asked about

it. Although laboratory test results, such as blood sugar level and D-dimer, were available in the medical records, including the results of chest X-rays, stroke severity was not included in this study because nurses also did not document it using the NIHSS. Some of these factors are important to explore in future studies to help prevent SAP in stroke patients. Research related to dysphagia screening is also essential as a follow-up to this study.

6. Conclusion

Our findings indicate that dysphagia, diabetes mellitus (DM), and COVID-19 are significant risk factors for stroke-associated pneumonia (SAP) which can contribute to increased inpatient mortality among stroke patients. Dysphagia screening and blood sugar management are needed to prevent SAP in stroke patients. Nurses play a crucial role in this process and are expected to conduct dysphagia screening as part of a comprehensive nursing assessment. In addition, blood sugar level management in stroke patients needs to be implemented to reduce the risk of SAP.

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Author contribution

YS: Writing – original draft, conceptualization, methodology, formal analysis
RYS: Writing – review & editing, conceptualization
EMW: Writing – review & editing, conceptualization, methodology, validation
NA: Writing – review & editing, investigation
IF: Writing – review & editing, project administration
AY: Writing – review & editing, conceptualization, methodology, supervision
IYW: Writing – review & editing, conceptualization, methodology, validation

Conflict of interest

The authors declare that there are no conflicts of interest.

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