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Incidence and Risk Factors of Stroke-Associated Pneumonia in Ischemic Stroke with Dysphagia: A Cross-Sectional Study

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Abstract

Background: Stroke-associated pneumonia (SAP) is a common and debilitating complication following stroke, typically occurring within the first 7 days of onset in about one-third of patients with acute ischemic stroke. SAP significantly contributes to increased morbidity, mortality, and healthcare costs due to prolonged hospitalizations. In Riau, the reported prevalence of stroke is 8.3%, which has been rising since 2013, alongside an increase in SAP cases. Dysphagia, defined as difficulty swallowing, is a major risk factor for SAP as it predisposes patients to aspiration, a leading cause of pneumonia. If left untreated, dysphagia can lead to dehydration and electrolyte imbalance. Despite the clinical importance of SAP, local data regarding its incidence and associated risk factors at Arifin Achmad General Hospital in Riau Province is lacking. This study aims to investigate the incidence and risk factors associated with SAP in ischemic stroke patients with dysphagia. The findings are expected to provide evidence-based references to improve neurointensive care and preventive strategies for SAP in this patient population.
Methods: This cross-sectional study was conducted at Arifin Achmad General Hospital, Riau Province, from August to November 2023. Ischemic stroke patients who underwent the Water Swallow Test (WST) were included. Dysphagia, electrolyte imbalance, and SAP were the key variables. Data were collected from medical records and observation sheets. Statistical analysis was performed using the Chi-square test ($p < 0.05$) with SPSS version 25.
Results: The study found that 37.5% (15 patients) of ischemic stroke patients developed stroke-associated pneumonia, while 42.5% experienced dysphagia. The majority of these patients were aged 51-60 years (41.2%), male (58.8%), had their first stroke attack (60%), and had multiple risk factors (73.3%). A significant number of dysphagia patients had low electrolyte levels. The most common lesion locations in dysphagia patients were bilateral (66.7%). There was a significant correlation between dysphagia and the incidence of SAP (p=0.000). Patients with dysphagia had 78.75 times higher odds of developing SAP (95% CI: 9.95-622.6) compared to those without dysphagia.
Conclusion: SAP is a frequent complication in ischemic stroke patients. Future prospective studies should adopt a unified definition, strict inclusion criteria, and long-term follow-up to better identify the incidence, prognosis, and related factors of SAP.

Keywords: *dysphagia, electrolyte imbalance, ischemic stroke, neurointensive care, stroke-associated pneumonia.*

Introduction

Stroke continues to pose a significant health problem worldwide, consistently identified as the second most common cause of death and the third most frequent cause of disability globally. As reported by the World Health Organization in 2023, approximately 15 million individuals suffer from a stroke annually, with 5 million succumbing to it and another 5 million facing lifelong disabilities, leading to considerable social and financial strain on health care systems.[1]

Individuals who have survived the immediate phase of a stroke are especially at risk for additional medical and neurological issues, which greatly raises the chances of illness and death. One of the most common and important complications in this context is Stroke-Associated Pneumonia (SAP), which usually occurs within the initial week following the onset of a stroke and can impact as many as one in three patients experiencing acute ischemic stroke.[2,3]

The pathophysiology of SAP encompasses a complicated relationship between the immune suppression caused by a stroke and the aspiration of oral and throat contents due to weakened airway reflexes. A stroke leads to immune system imbalances, which involves decreased lymphocyte function and heightened systemic inflammation, compromising the body's defenses. Impaired swallowing, or dysphagia, represents one of the most significant risk elements, as it raises the likelihood of aspiration and bacterial growth in the lower respiratory system, making patients more vulnerable to pneumonia. A recent meta-analysis revealed that individuals with dysphagia faced a considerably greater chance of developing pneumonia (odds ratio 9. 60; 95% CI 5. 75–16. 04) and mortality when compared to those without this issue.[4] Another systematic review highlighted that approximately 42% of patients suffering from acute strokes experienced dysphagia, establishing it as an independent risk factor for pneumonia and negative outcomes.[3]

The pathophysiology of SAP involves a complex interaction between stroke-induced immunosuppression and the aspiration of oropharyngeal contents due to impaired protective airway reflexes. Stroke triggers immune dysregulation, including reduced lymphocyte activity and increased systemic inflammation, which weakens host defenses. Dysphagia is one of the strongest risk factors, as impaired swallowing increases the risk of aspiration and bacterial colonization of the lower respiratory tract, thereby predisposing patients to pneumonia. A recent meta-analysis confirmed that patients with dysphagia had a significantly higher risk of developing pneumonia (odds ratio 9.60; 95% CI 5.75–16.04) and death compared to those without dysphagia.[4] Another systematic review reported a dysphagia prevalence of around 42% among acute stroke patients, identifying dysphagia as an independent predictor of pneumonia and adverse outcomes.[3]

Despite extensive global evidence, no studies have specifically examined the incidence and risk factors of SAP among ischemic stroke patients at Arifin Achmad General Hospital, Riau Province. Therefore, this study determined the incidence and risk factors associated with SAP in this population, with a primary focus on dysphagia as a key risk factor. The findings contributed to early detection and prevention strategies in neurointensive care.

Methods

Study Design

This study was an observational analysis using a cross-sectional method. This format was selected as it enabled the evaluation of the occurrence of pneumonia linked to strokes and its connection with swallowing difficulties and electrolyte disturbances at one specific moment, offering important information about the frequency and relationships of significant clinical aspects in a population within a hospital setting.

Setting

The study was conducted at the neurology ward of Arifin Achmad General Hospital, Riau Province, from August to November 2023. This setting reflected a real-world clinical environment where stroke patients received routine care, thereby enhancing the applicability and clinical relevance of the findings.

Participants

The criteria for participating in the study included individuals who had been identified with ischemic stroke, patients who were alert, and those who had completed the Water Swallow Test (WST). Exclusion criteria included patients with other causes of dysphagia and those with a decreased level of consciousness unrelated to stroke. Demographic data, including age and sex, were recorded. All participants or their authorized

representatives provided informed consent. The institutional review board of Arifin Achmad General Hospital granted ethical approval under the number B/138/UN19. 5. 1. 1. 8/UEPKK/2023.

Variables

The primary independent variables were dysphagia and electrolyte imbalance (sodium, potassium, chloride levels). The main dependent variable was the occurrence of stroke-associated pneumonia.

Data Sources/Measurement

Data collection used structured observation sheets and medical records. Dysphagia screening was performed using the standardized Water Swallow Test (WST), while SAP diagnosis was based on documented clinical findings (fever, cough, abnormal breath sounds) and supporting radiological evidence. Laboratory results were used to determine electrolyte imbalances based on standard reference ranges.

Bias

Potential bias was minimized through consecutive sampling and standardized data collection methods. The WST was performed by trained personnel following uniform procedures to reduce observer bias.

Study Size

The study included 40 ischemic stroke patients, determined based on all eligible patients available during the study period.

Quantitative Variables

Stroke-associated pneumonia was categorized as “present” or “absent.” Electrolyte levels were classified as “normal” or “abnormal” according to laboratory reference values.

Statistical Methods

The Chi-square test was used to analyze categorical variables to explore associations between dysphagia, electrolyte imbalance, and SAP. This test was selected as it is suitable for categorical data and helps to examine the relationships between independent and dependent variables. The assumptions for the Chi-square test were checked, including confirming that expected cell frequencies were ≥5. When this assumption was not met, Fisher’s Exact Test was applied as an alternative. For continuous variables, normality was assessed using the Shapiro-Wilk test prior to categorization. Statistical significance was considered at $p < 0.05$. All analyses were conducted using SPSS version 25.

Validity and Reliability

The use of a standardized dysphagia screening tool (WST) and uniform measurement protocols enhanced reliability. Validity was supported by clearly defined inclusion and exclusion criteria and objective assessment methods for SAP and electrolyte imbalance.

Results

Participants

A total of 40 ischemic stroke patients were included in the study. Among these, 17 (42.5%) had dysphagia, while 23 (57.5%) did not experience dysphagia. Stroke-associated pneumonia (SAP) developed in 15 of the 17 patients with dysphagia (88.2%), whereas only 2 of the 23 patients without dysphagia (8.7%) experienced SAP.

Demographic and Clinical Features of SAP patients

Among patients who developed SAP, 46.7% were aged 51-60 years, and 58% were male. Most of these patients (73.3%) had multiple risk factors for stroke recurrence. Regarding lesion distribution in patients with dysphagia,

66.7% had bilateral lesions, while 33.3% had unilateral lesions. Electrolyte imbalance was present in 73.3% of dysphagic patients who developed SAP (Table 1)

Table 1 Characteristics of Ischemic Stroke Patients with Stroke-Associated Pneumonia (SAP)

Characteristics	n	%
Age		
≤ 50 years	4	26.7%
51-60 years	7	46.7%
> 60 years	4	25.7%
Sex		
Male	10	58%
Female	5	41.2%
Stroke Attack Frequency		
First Attack	9	60.0%
Recurrent Attack	6	40.0%
Risk Factors		
Single Risk Factor	4	26.7%
Multiple Risk Factors	11	73.3%
Electrolyte Levels (Dysphagia Patients)		
High	1	6.6%
Normal	3	20.0%
Low	11	73.3%
Lesion Location (Dysphagia Patients)		
Bilateral	10	66.7%
Unilateral	5	33.3%

Association Between Dysphagia and SAP

Chi-square analysis revealed a significant correlation between dysphagia and the development of SAP (p = 0.000). Among patients with dysphagia, 88.2% developed SAP, whereas only 8.7% of patients without dysphagia experienced SAP (Table 2).

Table 2 Association Between Dysphagia and Stroke-Associated Pneumonia (SAP)

	Dysphagia (+)	%	Dysphagia (-)	%	Total	p-value
SAP (+)	15	88.2%	2	11.8%	17	
SAP (-)	2	8.7%	21	91.3%	23	0.000
Total	17	42.5%	23	57.3%	40	

Discussions

This study demonstrated that dysphagia occurred in 42.5% of ischemic stroke patients, which was consistent with recent literature. A 2022 systematic review and meta-analysis reported dysphagia prevalence rates ranging from 30% to 65% in acute ischemic stroke, depending on assessment methods and timing. Dysphagia typically resulted when ischemic injury affected neural structures critical for swallowing control, including the motor cortex, insular cortex, and brainstem, which led to impaired coordination of the oral and pharyngeal phases of swallowing. The relatively high incidence observed in our cohort reinforced the importance of routine early dysphagia screening, as recommended by international stroke management guidelines.[5]

Among patients with dysphagia, 88.2% developed stroke-associated pneumonia (SAP), confirming dysphagia as a major risk factor. This finding was in line with recent meta-analyses demonstrating that dysphagia increased the risk of pneumonia nearly tenfold (OR 9.60, 95% CI 5.75–16.04) and was associated with increased mortality and poorer functional outcomes.[6] The significant association observed in this study ($p < 0.001$) highlighted the clinical importance of systematic dysphagia management, including early swallowing assessment, dietary

modification, and rehabilitative interventions, all of which have been shown to reduce pneumonia risk and improve overall outcomes.[7]

The age distribution of SAP patients in this study was dominated by those aged 51–60 years. Previous studies similarly reported that middle-aged and older adults have increased susceptibility to post-stroke infections due to comorbidities such as hypertension, diabetes, and cardiovascular disease. In addition, immunosenescence and pre-existing frailty may impair host immune defenses, predisposing these patients to infections.[8]

A sex difference was also observed, with male patients more frequently affected by SAP. This finding aligned with reports that male stroke patients tended to experience more severe strokes and had a higher risk of complications, including pneumonia.[9] Contributing factors may include biological differences, lifestyle habits, and delayed healthcare access, emphasizing the importance of personalized risk assessment based on both demographic and clinical characteristics.

Another notable finding was the association between dysphagia and dehydration with electrolyte imbalance. Dysphagia frequently led to inadequate oral intake, resulting in poor hydration and nutritional deficits, which in turn disrupted electrolyte homeostasis. A 2023 systematic review confirmed that dehydration and electrolyte imbalance were common among dysphagic stroke patients and were associated with longer hospital stays and increased mortality.[10] These results emphasized the need for a multidisciplinary stroke management approach, including nutritional and hydration support, to reduce secondary complications and improve recovery.

Taken together, our findings strengthened existing evidence that dysphagia is a modifiable risk factor for SAP and related complications. Incorporating routine dysphagia screening, early swallowing therapy, and multidisciplinary supportive care can reduce SAP incidence, improve functional outcomes, and lower mortality rates among ischemic stroke patients. [6,7,10]

Interestingly, this study also showed that first-time stroke patients had a higher incidence of SAP compared to those with recurrent stroke. Previous studies have suggested that patients with no prior stroke experience may have less awareness of preventive measures, delayed medical care, and a greater risk of severe functional impairment, all of which increase the likelihood of dysphagia and aspiration events leading to SAP.[11]

The mechanisms underlying SAP are multifactorial, involving both immune and mechanical factors. Acute stroke can induce peripheral immunosuppression through activation of the sympathetic nervous system and hypothalamic–pituitary–adrenal axis, resulting in transient lymphopenia and monocyte dysfunction, thereby increasing infection susceptibility. In addition, impaired tracheal epithelial integrity reduces pulmonary clearance, while impaired consciousness, reduced mobility, and dysphagia further increase aspiration risk, especially during the early post-stroke phase.[12]

Dysphagia itself remained one of the most frequent neurological complications after stroke, affecting up to two-thirds of patients and often leading to aspiration pneumonia. Aspiration—including silent aspiration caused by impaired laryngeal sensation or reduced protective reflexes—was reported in about 40% of acute stroke patients and was considered the most severe consequence of dysphagia. Along with stroke-induced immune dysregulation, dysphagia played a key role in SAP pathogenesis, which occurred in approximately 10% of acute stroke cases. [13,14]

Meta-analyses have confirmed that post-stroke dysphagia substantially increased the risk of pneumonia and mortality. A 2022 meta-analysis of 42 studies (26,366 patients) showed that dysphagia after acute stroke was associated with nearly fourfold higher odds of pneumonia (OR = 4.08, 95% CI 2.13–7.79) and mortality (OR = 4.07, 95% CI 2.17–7.63).[15] Silent aspiration is an important but often underdiagnosed contributor to SAP; a 2022 systematic review found a 3–11-fold increased pneumonia risk in stroke patients with dysphagia who exhibited silent aspiration.[16] These findings emphasized the importance of early, instrument-assisted swallowing assessments.

In certain clinical contexts, such as patients undergoing mechanical thrombectomy (MT), the risk of SAP is particularly high. A 2023 *Frontiers in Neurology* study reported that one-third (33%) of MT-treated acute ischemic stroke patients developed pneumonia, with dysphagia as a strong independent predictor.[17] Silent

aspiration was highly prevalent in MT patients, with a 2023 FEES-based study showing 75% dysphagia and 23.3% SAP, both associated with worse three-month outcomes.[18] Importantly, early dysphagia screening has been shown to reduce pneumonia risk by 40% without affecting mortality (OR 0.60, 95% CI 0.42–0.84).[19]

Moreover, predictive models have emerged to improve SAP risk stratification. A 2024 *Frontiers in Medicine* study developed a nomogram for MT-treated stroke patients using NIHSS ≥16, postoperative lymphocyte-to-monocyte ratio, and dysphagia, achieving superior predictive accuracy compared to conventional scores (AUC ≈ 0.79).[20] Such models underscored the value of integrating clinical and laboratory variables to enable early identification and intervention in high-risk patients.

Conclusions

This study demonstrates that dysphagia is a significant risk factor for stroke-associated pneumonia in ischemic stroke patients. Early identification and management of swallowing disorders are essential to reduce complications and improve outcomes. Although limited by its small, single-center design, these findings emphasize the need for routine dysphagia screening and targeted interventions in acute stroke care. Future multicenter studies with larger samples are warranted to validate these results.

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Declarations of competing interest

This study does not involve any personal, financial, or other conflicts of interest.

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