Dysphagia
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ORIGINAL ARTICLE

Prevalence of Stroke-Associated Pneumonia and Associated Factors Among Acute Ischemic Stroke Patients with Dysphagia

Tran Huu Thong[1,2,3] · Nguyen Thi Thu Hien[4,5] · Tran Huu Trung[6] · Thang Phan[7] · Tran Huu Lam[8]

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Abstract

Stroke-associated pneumonia is a common complication in acute ischemic stroke patients, particularly those with dysphagia. Although some studies have addressed stroke-associated pneumonia, research remains limited on this issue among acute ischemic stroke patients with dysphagia, especially in Vietnam. This study used data from a prior cross-sectional study conducted at Bach Mai Hospital in Hanoi, Vietnam. A total of 681 acute ischemic stroke patients with dysphagia were included in the study. The outcome variable was the occurrence of stroke-associated pneumonia within seven days of post-stroke. Univariate and multivariate logistic regression analyses were performed to assess associations with stroke-associated pneumonia. The prevalence of stroke-associated pneumonia among acute ischemic stroke patients with dysphagia was 10.3%. Stroke-associated pneumonia was significantly associated with age > 70 years (AOR: 2.0, 95% CI: 1.1–3.7, P = 0.02), combined or other stroke locations (AOR: 2.6, 95% CI: 1.03–6.3, P = 0.04), National Institute of Health Stroke Scale (NIHSS) score > 14 (AOR: 2.8, 95% CI: 1.4–5.6, P < 0.01), tube feeding (AOR: 3.9, 95% CI: 1.7–8.9, P < 0.01), and hospital stays longer than 14 days (AOR: 3.7, 95% CI: 1.6–8.5, P < 0.01). We found that stroke-associated pneumonia accounts for a significant proportion of stroke patients with dysphagia. The status of stroke-associated pneumonia is associated with older age, specific stroke locations, higher stroke severity, tube feeding, and prolonged hospitalization. We suggest prioritizing respiratory care and physiotherapy, particularly for elderly patients, individuals with severe strokes, those undergoing tube feeding, and those experiencing prolonged hospitalization.

Keywords Stroke-associated pneumonia · Dysphagia · Acute ischemic stroke · Risk factors · Vietnam · Respiratory complications

✉ Nguyen Thi Thu Hien
hienntbmh2017@gmail.com

Tran Huu Thong
thongccbm@gmail.com

Tran Huu Trung
tranhuutrung1915@gmail.com

Thang Phan
phanthang@hueuni.edu.vn

Tran Huu Lam
tranhuulam2425@gmail.com

[1] Center for Emergency Medicine, Bach Mai Hospital, Hanoi, Vietnam

[2] Department of Emergency and Critical Care Medicine, Hanoi Medical University, Hanoi, Vietnam

[3] Faculty of Medicine, University of Medicine and Pharmacy, Vietnam National University, Hanoi, Vietnam

[4] Dermatology and Burn Department, Bach Mai Hospital, Hanoi, Vietnam

[5] Nam Dinh University of Nursing, Ninh Binh, Vietnam

[6] Hanoi Medical University, Hanoi, Vietnam

[7] Department of Anesthesiology, Critical Care and Emergency Medicine, University of Medicine and Pharmacy, Hue University, Hue City, Vietnam

[8] University of Medicine and Pharmacy, Hue University, Hue City, Vietnam

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Introduction

Stroke-associated pneumonia is considered one of the common complications in patients with acute ischemic stroke, especially in patients with dysphagia [1]. This condition is characterized by lower respiratory tract infections that manifest within the initial 7 days following the onset of a stroke [2]. Furthermore, dysphagia frequently manifests in the early stages of stroke patients, impacting pharyngeal secretions and airway circulation, hence raising the risk of stroke-associated pneumonia [3]. Patients with stroke-associated pneumonia will have higher medical expenses, a longer hospital stay, and a higher chance of dying [4–7].

Previous studies addressed stroke-associated pneumonia, but only a few studies focused on stroke-associated pneumonia among acute ischemic stroke patients with dysphagia [1]. Accordingly, these studies reported that the prevalence of stroke-associated pneumonia among patients with dysphagia ranges from 20.4 to 28.0% [8, 9]. Meanwhile, some other studies showed that stroke patients with dysphagia significantly increase the risk of developing pneumonia post-stroke [3, 10, 11].

Previous studies have reported the association of stroke-associated pneumonia with several factors, including older age, diabetes, chronic obstructive pulmonary disease, and the severity of the stroke [1, 6, 12]. Moreover, immunological responses and respiratory regulatory mechanisms may elevate the susceptibility to infections, particularly pneumonia, in stroke patients [13, 14]. Furthermore, several factors related to the process and duration of hospitalization, such as intubation, feeding method, and feeding route, may also be associated with the risk of stroke-associated pneumonia [15, 16].

Although some studies examined stroke-associated pneumonia in stroke patients with dysphagia worldwide [8, 9], there was no research specifically addressing this issue in Vietnam. Therefore, we conducted this study to determine the prevalence of stroke-associated pneumonia and the factors associated with it among acute ischemic stroke patients with dysphagia in Vietnam. This fills in a major gap in the research and will help us make future prevention and treatment plans that work better in the Vietnamese healthcare system. We hypothesize that among patients with acute ischemic stroke and dysphagia in Vietnam, the prevalence of stroke-associated pneumonia is high and is significantly associated with patient-related factors (such as age and comorbidities), stroke severity, and hospitalization-related factors (including intubation and length of hospital stay).

Methods

Study Data and Patients

This study utilized data from a previous research project conducted at Bach Mai Hospital, Hanoi, Vietnam. The research protocol was approved by the Research Ethics Committee of Nam Dinh University of Nursing under Decision No. 1603/GCN-HDDD. Additionally, the study was registered on the Research Registry website (https://www.researchregistry.com/) with the unique identification number (UIN) researchregistry8203. The study was conducted at Bach Mai Hospital, a tertiary care facility that provides healthcare services to residents of Hanoi and the northern provinces of Vietnam. Data collection took place at the hospital's Neurology Center, which specializes in diagnosing and treating neurological conditions, including acute ischemic stroke. Diagnosis of acute ischemic stroke at this center was confirmed through computed tomography (CT) or magnetic resonance imaging (MRI).

In the previous study, the inclusion criteria were patients aged 18 years or older who had been diagnosed with acute ischemic stroke. Additionally, these patients had a Glasgow Coma Scale (GCS) score greater than 13 and could communicate. Conversely, the exclusion criteria included patients with indications for oxygen therapy or intubation, myocardial infarction, Wernicke's aphasia, dementia, edentulism, and other medical histories of dysphagia. The sample size was determined to be 951 cases using a formula for estimating a population proportion with a specified absolute precision. Details of the previous study have been described elsewhere [17]. In the current study, we specifically selected acute ischemic stroke patients with dysphagia. Patients were screened using the Gugging Swallowing Screen (GUSS) within 4 h of admission to determine the presence of dysphagia [18, 19]. A total of 681 acute ischemic stroke patients with dysphagia were ultimately included in the study.

Variables

The outcome variable in this study was stroke-associated pneumonia, defined as a spectrum of lower respiratory tract infections occurring within the first 7 days after stroke onset [2]. Stroke-associated pneumonia was confirmed using the modified diagnostic criteria recommended by the Pneumonia in Stroke Consensus Group, requiring that all clinical criteria from the Centers for Disease Control and Prevention (CDC) be met and that typical pneumonia findings be present on at least one chest radiograph [2]. The independent variables included sex (male or female), age groups ($\leq$70 years and $>$70 years), education level (primary school or lower, secondary school, and high school or above), obesity (yes

or no), stroke site (hemispheric, brainstem, combined, or other), National Institute of Health Stroke Scale (NIHSS) categories (Mild/Moderate (≤14) and Moderately Severe/Severe (>14)), facial paralysis (yes or no), history of previous stroke (yes or no), hypertension (yes or no), and diabetes mellitus (yes or no). Communication disorder (yes or no) was defined as "an impairment in the ability to receive, send, process, and comprehend concepts or verbal, nonverbal, and graphic symbol systems" and was assessed by a speech-language therapist [20]. Additionally, tube feeding (yes or no) and length of hospital stay (≤14 days or >14 days) were included as variables in this study.

Table 1 Characteristics of acute ischemic stroke patients with dysphagia in the study

Variable	N (%)
Sex	
Male	425 (62.4)
Female	256 (37.6)
Age group (year)	
≤70	419 (61.5)
>70	262 (38.5)
Education	
Primary school or lower	195 (28.6)
Secondary school	219 (32.2)
High school or above	267 (39.2)
Obesity	
No	570 (83.7)
Yes	111 (16.3)
Site of stroke	
Hemispheric	510 (74.9)
Brainstem	130 (19.1)
Combined and other	41 (6.0)
NIHSS score	
Mild/Moderate (≤14)	597 (87.7)
Moderately Severe/Severe (>14)	84 (12.3)
Communication disorder	
No	350 (51.4)
Yes	331 (48.6)
Facial paralysis	
No	64 (9.4)
Yes	617 (90.6)
Previous stroke	
No	535 (78,6)
Yes	146 (21.4)
Hypertension	
No	213 (31.3)
Yes	468 (68.7)
Diabetes Melitus	
No	524 (77.0)
Yes	157 (23.0)
Tube feeding	
No	377 (55.4)
Yes	304 (44.6)
Length of hospital stay	
≤14 days	334 (49.1)
>14 days	347 (50.9)

NIHSS: National Institute of Health Stroke Scale

Statistical Analysis

Qualitative data were presented as frequencies and percentages. Additionally, Chi-square tests were employed to compare differences between groups for qualitative variables. Furthermore, univariate and multivariate logistic regression analyses were conducted to examine factors associated with stroke-associated pneumonia among acute ischemic stroke patients with dysphagia. All statistical analyses were performed using STATA® 14, and the level of statistical significance was set at a P-value of less than 0.05.

Results

Table 1 presents the demographic and clinical characteristics of acute ischemic stroke patients with dysphagia. The majority of patients were male (62.4%), and most were aged 70 years or younger (61.5%). Regarding educational attainment, 39.2% completed high school or higher, while 28.6% had only primary education or lower. Obesity was present in 16.3% of patients. The most common site of stroke was hemispheric (74.9%), followed by brainstem (19.1%) and combined or other locations (6.0%). Most patients had mild to moderate stroke severity based on NIHSS scores (≤14 points) (87.7%). Nearly half (48.6%) experienced communication disorders, and a large proportion exhibited facial paralysis (90.6%). A previous history of stroke was noted in 21.4% of patients. Hypertension was the most common comorbidity, affecting 68.7% of the patients, and diabetes mellitus was present in 23.0%. Additionally, 44.6% of patients required tube feeding. The length of hospital stay was relatively balanced, with 50.9% hospitalized for more than 14 days and 49.1% for 14 days or less.

Table 2 shows the prevalence of stroke-associated pneumonia among acute ischemic stroke patients with dysphagia, stratified by various demographic and clinical factors. The overall prevalence of stroke-associated pneumonia was 10.3%. The prevalence of stroke-associated pneumonia was significantly higher among patients aged over 70 years (14.1%) compared to those aged 70 years or younger (7.9%) (P<0.01). When stratified by stroke location, the highest prevalence was observed in the "combined and other" group (22.0%), followed by the hemispheric group (10.6%), and the lowest in the brainstem group (5.4%), with the differences reaching statistical significance (P<0.01). Stroke severity, as measured by the National Institutes of Health Stroke Scale, was also significantly associated with stroke-associated pneumonia. Patients with moderately severe to

Table 2 Prevalence of stroke-associated pneumonia among acute ischemic stroke patients with dysphagia by various factors

Variable	Stroke-associated pneumonia N (%)	P value
All	70 (10.3)	NA
Sex		
Male	47 (11.1)	0.39
Female	23 (9.0)	
Age group		
≤70	33 (7.9)	<0.01
>70	37 (14.1)	
Education		
Primary school or lower	19 (9.7)	0.80
Secondary school	25 (11.4)	
High school or above	26 (9.7)	
Obesity		
No	61 (10.7)	0.41
Yes	9 (8.1)	
Stroke location		
Hemispheric	54 (10.6)	<0.01[a]
Brainstem	7 (5.4)	
Combined and other	9 (22.0)	
NIHSS score		
Mild/Moderate (≤14)	41 (6.9)	<0.01
Moderately Severe/Severe (>14)	29 (34.5)	
Communication disorder		
No	27 (7.7)	0.02
Yes	43 (13.0)	
Facial paralysis		
No	4 (6.3)	0.27
Yes	66 (10.7)	
Previous stroke		
No	45 (8.4)	<0.01
Yes	25 (17.1)	
Hypertension		
No	25 (11.7)	0.40
Yes	45 (9.6)	
Diabetes Mellitus		
No	53 (10.1)	0.80
Yes	17 (10.8)	
Tube feeding		
No	9 (2.4)	<0.01
Yes	61 (20.1)	
Length of hospital stay		
≤14 days	8 (2.4)	<0.01
>14 days	62 (17.9)	

NA: Not Applicable, NIHSS: National Institute of Health Stroke Scale

[a]: Fisher's exact test

severe strokes (NIHSS > 14) had a notably higher prevalence (34.5%) compared to those with mild to moderate strokes (NIHSS ≤ 14), who had a prevalence of 6.9% (P < 0.01). Furthermore, patients with communication disorders exhibited a higher prevalence of stroke-associated pneumonia (13.0%) than those without such disorders (7.7%) (P = 0.02). Regarding stroke history, the prevalence of stroke-associated pneumonia was higher among patients with a previous stroke (17.1%) compared to those without a prior stroke (8.4%), and this difference was statistically significant (P < 0.01). In terms of feeding status, patients who required tube feeding had a substantially higher prevalence of stroke-associated pneumonia (20.1%) compared to those who did not require tube feeding (2.4%) (P < 0.01). Additionally, a longer hospital stay was associated with a higher prevalence of stroke-associated pneumonia, with 17.9% in patients hospitalized for more than 14 days compared to only 2.4% in those hospitalized for 14 days or less (P < 0.01). No statistically significant differences in the prevalence of stroke-associated pneumonia were found in relation to educational level, obesity, facial paralysis, hypertension, or diabetes mellitus (all P > 0.05).

As shown in Table 3, factors associated with stroke-associated pneumonia among acute ischemic stroke patients with dysphagia were analyzed using multivariate logistic regression. Stroke-associated pneumonia was found to be significantly associated with several factors: patients older than 70 years (adjusted odds ratio [OR]: 2.0; 95% confidence interval [CI]: 1.1–3.7; P = 0.02), those with combined or other stroke locations (adjusted OR: 2.6; 95% CI: 1.03–6.3; P = 0.04), a NIHSS score greater than 14 (adjusted OR: 2.8; 95% CI: 1.4–5.6; P < 0.01), patients receiving tube feeding (adjusted OR: 3.9; 95% CI: 1.7–8.9; P < 0.01), and those with hospital stays longer than 14 days (adjusted OR: 3.7; 95% CI: 1.6–8.5; P < 0.01).

Discussion

In this study, we found a significant proportion of patients with stroke-associated pneumonia also had dysphagia. Additionally, we identified associations between stroke-associated pneumonia and several other factors, including age, stroke location, stroke severity, the need for tube feeding, and prolonged hospital stays. This is the first hospital-based study conducted in Vietnam on stroke-associated pneumonia in patients with dysphagia at a tertiary hospital where most stroke cases are admitted and treated for Hanoi and neighboring provinces. The results provide an overview of the issue, which may help doctors and policymakers implement appropriate interventions for these patients and serve as a foundation for further research in this field.

The prevalence of stroke-associated pneumonia in patients with dysphagia is a significant concern in clinical practice, as dysphagia is a common complication following a stroke. Studies indicate that dysphagia occurs in approximately 37–78% of stroke patients, which markedly increases

Table 3 Factors associated with stroke-associated pneumonia among acute ischemic stroke patients with dysphagia: multivariate logistic regression analysis

Variable	Stroke-associated pneumonia Adjusted OR (95% CI)	P value
Sex		
Male	1.5 (0.8–2.7)	0.23
Female	1	
Age group		
≤70	1	
>70	2.0 (1.1–3.7)	0.02
Education		
Primary school or lower	1	
Secondary school	1.4 (0.7–3.1)	0.34
High school or above	0.9 (0.4–1.9)	0.76
Obesity		
No	1	
Yes	1.1 (0.5–2.5)	0.83
Stroke location		
Hemispheric	1	
Brainstem	0.6 (0.3–1.5)	0.28
Combined and other	2.6 (1.03–6.3)	0.04
NIHSS score		
Mild/Moderate (≤14)		
Moderately Severe/Severe (>14)	2.8 (1.4–5.6)	<0.01
Communication disorder		
No	1	
Yes	0.8 (0.4–1.4)	0.41
Facial paralysis		
No	1	
Yes	1.4 (0.4–4.4)	0.58
Previous stroke		
No	1	
Yes	1.6 (0.9–3.0)	0.13
Hypertension		
No	1	
Yes	0.7 (0.4–1.3)	0.26
Diabetes Mellitus		
No	1	
Yes	1.2 (0.6–2.4)	0.58
Tube feeding		
No	1	
Yes	3.9 (1.7–8.9)	<0.01
Length of hospital stay		
≤14 days	1	
>14 days	3.7 (1.6–8.5)	<0.01

OR: Odds Ratio; CI: Confidence Interval, NIHSS: National Institute of Health Stroke Scale

the risk of pneumonia, particularly aspiration pneumonia, due to the inhalation of oropharyngeal contents into the lungs [3, 21]. The incidence of pneumonia in patients with dysphagia can range from 20 to 47%, with severe dysphagia leading to an 11-fold increase in risk for aspiration pneumonia [21–23]. Dysphagia can lead to poor nutritional intake and aspiration, which are critical factors contributing to pneumonia [10, 22]. Furthermore, patients with dysphagia often exhibit altered consciousness and more severe strokes, which can exacerbate the risk of pneumonia [21, 22, 24]. In this study, we included only acute ischemic stroke patients with dysphagia and found that 10.3% of these patients developed stroke-associated pneumonia. This finding was consistent with previous studies, which noted that patients with dysphagia following a stroke were at higher risk of developing pneumonia [24, 25]. A systematic review also reported that pneumonia was a prevalent complication, affecting a significant proportion of dysphagic patients [1].

We observed an association between stroke-associated pneumonia in dysphagic patients and older age, consistent with previous findings [12, 26, 27]. Advanced age is a contributing factor for developing pneumonia following a stroke, with patients over 70 years being especially vulnerable. One study specifically demonstrated that patients who developed stroke-associated pneumonia had a median age of 79.5 years, significantly higher than those without pneumonia [26]. This elevated risk may be attributed to immune senescence and an increased susceptibility to aspiration in older adults [28]. Immune senescence, the gradual decline in immune function with age, may render older individuals more susceptible to infections, including respiratory infections such as pneumonia [29, 30]. Additionally, older patients often experience diminished protective airway reflexes, which increases the likelihood of aspiration, particularly in the context of post-stroke dysphagia.

Our findings suggested that stroke-associated pneumonia was primarily associated with combined and certain specific stroke locations. Previous studies on this connection produced mixed results, with some establishing a link and others finding no significant relationship [31–33]. Addington et al. found that brainstem and cerebral strokes significantly impacted the laryngeal cough reflex, thereby increasing pneumonia risk, as an impaired laryngeal cough reflex affected airway protection [31]. Similarly, Kemmling et al. highlighted a notable association between pneumonia and right hemispheric peri-insular strokes, suggesting that this specific location might suppress immune responses via autonomic pathways [32]. Another study by Víchová et al. investigated whether the side of paresis influenced pneumonia location but found no significant relationship, indicating that the side of stroke-related hemiparesis alone was not predictive of pneumonia location [33]. The variability in findings across studies may have reflected differences in study populations, methodologies, or classification of stroke locations, underscoring the need for further research to clarify the role of stroke location in the risk of stroke-associated pneumonia.

A significant association between stroke-associated pneumonia and the use of tube feeding was revealed in our study. Tube feeding, particularly nasogastric feeding, is often necessary for stroke patients with dysphagia to ensure adequate nutrition and hydration. However, evidence indicated that the administration of tube feeding increases the risk of pneumonia [34–36]. Aspiration pneumonia is particularly common, as stroke-induced dysphagia can lead to regurgitation and subsequent aspiration of tube-fed material into the lungs, thus raising the risk of infection [37, 38]. This risk is compounded in cases where there is a delay in initiating oral feeding or a prolonged reliance on tube feeding [39]. In addition, poor oral hygiene and the presence of bacterial biofilm around the tube can exacerbate the risk of SAP, emphasizing the need for stringent oral care protocols for tube-fed stroke patients [40, 41].

Our study identified that prolonged hospital stays, particularly those exceeding 14 days, heighten the risk of pneumonia in post-stroke patients. Following a stroke, patients frequently experience hemiplegia or other motor impairments that limit mobility. This immobility can result in decreased pulmonary ventilation and impaired clearance of respiratory secretions, creating a favorable environment for bacterial growth and subsequent pneumonia. Previous studies emphasize that patients with extended hospital stays are especially vulnerable, as prolonged immobility elevates the risk of stroke-associated pneumonia [6]. Conversely, it is crucial to recognize that stroke-associated pneumonia itself can contribute to longer hospitalizations. The onset of pneumonia often necessitates additional interventions, including antibiotic therapy, respiratory support, and intensive monitoring, which further increase healthcare resource utilization [4].

This study has several limitations that may impact the interpretation and generalizability of the findings. First, the cross-sectional design permitted the identification of associations but precluded conclusions about causation, thus limiting the ability to establish a clear temporal relationship between associated factors and pneumonia onset. Additionally, reliance on patient self-reports or retrospective data introduced recall bias, especially regarding pre-existing conditions contributing to pneumonia risk. Selection bias was also a potential issue, as restricting the sample to a single hospital could limit the generalizability of the findings to all stroke patients with dysphagia. The study may have disproportionately represented patients with more severe strokes, who are inherently more susceptible to complications such as pneumonia. Diagnostic variability in identifying stroke-associated pneumonia introduced further limitations, potentially impacting the reliability of the observed associations. Lastly, unmeasured variables, such as specific dietary practices, intensity of rehabilitation, or environmental exposures, may have influenced pneumonia risk but were not included in the analysis, potentially affecting the robustness of the conclusions.

Conclusion

The findings revealed that the overall prevalence of stroke-associated pneumonia was 10.3%, indicating that it is a common complication among stroke patients with dysphagia. Several factors were significantly associated with an increased probability of stroke-associated pneumonia, including age over 70 years, strokes in combined or other locations, more severe strokes (NIHSS score > 14), the need for tube feeding, and prolonged hospital stays exceeding 14 days. We recommend that elderly patients, especially those over 70 years of age, pay close attention to preventing stroke-associated pneumonia. Additionally, patients with multiple stroke sites or other comorbid conditions should be closely monitored; however, further studies are needed to clarify the relationship between stroke location and the risk of pneumonia. Enhanced respiratory care and rehabilitative physiotherapy are essential for patients with severe strokes (NIHSS > 14) to prevent respiratory complications. Advanced care for patients requiring tube feeding is also critical, including regular assessments of swallowing function, proper feeding posture, and strict hygiene practices to reduce the risk of aspiration pneumonia. Developing appropriate care and rehabilitation plans can help shorten hospital stays and, in turn, reduce the risk of stroke-associated pneumonia.

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Data Availability The datasets are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The dataset for this study was obtained from a previous study, approved by the research ethics committee at Nam Dinh University of Nursing under approval number 1603/GCN-HDDD and registered on the Research Registry website (https://www.researchregistry.com/) with the unique identification number (UIN) researchregistry8203.

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