ID Design
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Risk Factors for Stroke Associated Pneumonia

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Abstract

BACKGROUND: Stroke patients are at high risk for stroke-associated pneumonia (SAP). If patients suffer from pneumonia their prognosis will worsen.

AIM: To identify factors that increases the risk of SAP in stroke patients.

METHODS: A group of 508 patients hospitalized within 5 days after the onset of stroke were enrolled prospectively.

RESULTS: The incidence of SAP was 13.4%. Some major risk factors for SAP are: mechanical ventilation (MV) had odds ratio (OR) 16.4 (p <0.01); the National Institutes of Health Stroke Scale (NIHSS) > 15 OR 9.1 (p <0.01); the Gugging Swallowing Screen (GUSS) 0-14 OR 11.7 (p <0.01).

CONCLUSION: SAP is a frequent complication. We identified some risk factors of SAP, especially stroke severity (NIHSS > 15), swallowing disorder (GUSS < 15) and mechanical ventilation.

Introduction

Stroke is dangerous because it causes cause high rates of death and disability. Stroke-related DALYs (disability-adjusted life-years) ranked second in the list of 10 leading causes of DALYs [1]. The proportion of DALYs and deaths caused by stroke had been increased when compared with all diseases, from 3.5% (in 1990) to 4.6% (in 2013) [1]. Previous studies demonstrated that complications have a bad effect on the disability rate and mortality rate. Of all post-stroke complications, SAP is considered a major one with a strong impact on the outcome [2]. SAP is associated with increased mortality, prolonged the time of stay in hospital, and poor outcome on discharge [2]. Early identification of the probability of

SAP is required to improve outcomes of SAP patients. Although various studies on risk factors for SAP were conducted, their results were inconsistent. In particular, according to our search results at the National Library of Vietnam, there is currently no research on this topic in Vietnam. So we conducted this study to identify the risk factors for stroke-related pneumonia in stroke patients.

Subjects and Methods

Patient selection

All adult patients aged from 18 years and

more admitted to the Stroke Department from March 2014 to April 2016, were diagnosed with stroke based on the WHO definition [3].

SAP diagnosis was based on Pneumonia In Stroke Consensus (PISCES) [4]: pneumonia (according to CDC standards) occurred within 7 days after onset of stroke.

Methods

We enrolled prospectively 508 stroke patients during the first 24 hours after admission and followed continuously until discharge. The collected data included medical history, routine blood test, chest X-rays, electrocardiogram and cranial computed tomography. The severity of stroke was evaluated by NIHSS [5]. NIHSS is a simple, reliable and validated scale whereby higher scores indicate a more severe stroke. NIHSS is a scale with values from 0 (normal neurological functions) to 42 (absolutely neurological deficiency). Patients' swallowing ability was evaluated by the GUSS [6]. Total GUSS score ranges from 20 (normal swallowing function) to 0 (absolutely no ability to swallow).

During the prospective follow-up, SAP occurrence was recorded. Descriptive measures were applied for quantitative variables. We used Student t-test for normality distribution and Mann-Whitney test for abnormality distribution. Two categorical variables were compared by the Chi-Square test. Odds ratios (OR) were used in discovery the relation between pneumonia and the risk factors. All the tests in this study were 2-tailed and we determined the statistical significance level of 0.01. Data were analyzed by IBM SPSS version 22.

Results

We collected data from 508 patients admitted to the Stroke Department, Military Hospital 103. The results in Table 1 show the characteristics of the patient. The mean age was 65.6 ± 12.4 years. Ischemic stroke accounted for 60% and the incidence rate of SAP was 13.4%.

Comparing results between SAP and non-SAP groups showed that: SAP group had higher NIHSS (15.1 ± 8.6 and 7.7 ± 5.9, respectively, p < 0.01) lower GCS (12.6 ± 2.8 and 14.2 ± 1.7, respectively, p < 0.01), and lower GUSS (9.2 ± 6.6 vs 17.0 ± 4.8, respectively, p < 0.01), all differences were significant (p <0.01). The SAP group had a higher mechanical ventilation rate than the non-SAP group (39.7% and 3.9%, respectively, p < 0.01).

Table 1: Characteristics of patients

Characteristics	SAP n (%)	non-SAP n (%)	Total n (%)	p
Stroke types				
Ischemic	31 (45.6)	274 (62.3)	305 (60.0)	0.070
Hemorrhagic	37 (54.4)	166 (37.7)	203 (40.0)	
Sex				
Female	26 (38.2)	160 (36.4)	186 (36.6)	0.432
Male	42 (61.8)	280 (63.6)	322 (63.4)	
Age (years)				
≤ 70	35 (51.5)	**279 (63.4)**	314 (61.8)	**0.620**
> 70	33 (48.5)	161 (36.6)	194 (38.2)	
Mean ± SD	69.2 ± 12.2	65.6 ± 12.4	66.0 ± 12.5	0.024
GCS (median)	13	15	15	< 0.01
NIHSS (median)	15	6	7	< 0.01
GUSS (median)	11	19	18	< 0.01
Diabetes				
Yes	18 (26.5)	42 (9.5)	60 (11.8)	< 0.01
Smoke				
Yes	5 (7.4)	34 (7.7)	39 (7.7)	0.910
Mechanical ventilation				
Yes	27 (39.7)	17 (3.9)	44 (8.7)	< 0.01
Total	68 (13.4)	440(86.6)	508 (100)	

The univariate logistic regression analysis showed that hemorrhagic type, prior medical history of diabetes mellitus, mechanical ventilation, Glasgow 3-8, NIHSS 16-42, GUSS 0-14 and hyperglycemia at admission were associated with SAP (shown in Table 2). Among them, 3 outstanding SAP risk factors are mechanical ventilation (OR 16.4, 95%CI 8.2-32.5, p < 0.01), GUSS < 15 (OR 11.7, 95%CI 6.6 - 20.8, p < 0.01) and NIHSS > 15 (OR 9.1, 95%CI 5.2 - 16.0, p < 0.01).

Table 2: Some risk factors of SAP (n = 508)

Risk factors	OR, CI 95%	p
Stroke type: Hemorrhagic	2.0 (1.2 - 3.3)	< 0.01
Diabetes	3.4 (1.8-6.4)	< 0.01
Mechanical ventilation	16.4 (8.2-32.5)	< 0.01
GCS ≤ 8	7.2 (3.2 - 16.0)	< 0.01
NIHSS > 15	9.1 (5.2 - 16.0)	< 0.01
GUSS < 15	11.7 (6.6 - 20.8)	< 0.01
Hyperglycemia at admission	3.0 (1.7 - 5.2)	< 0.01

Discussion

SAP is a common complication after stroke [7]. In our study, 13.4% (68/508) developed SAP.

A lot of studies were conducted to find out factors that increase the probability of SAP. Some of them developed prognosis scales of the pneumonia risk in stroke patients (Table 3).

Because of too many scoring systems for the prognosis of the pneumonia risk are existent, Kishore et al. conducted a study investigating the accuracy of the existing scales of risk factors for pneumonia in 2016 [16]. The authors found that prognostic factors included in the scoring systems are: age; sex; NIHSS; GCS; speech disorder; swallowing disorder; falls at onset of stroke; blood pressure increase > 200mmHg; disability before stroke; atrial fibrillation; heart failure; COPD; smoking; drinking a lot of alcohol; prior medical history of pneumonia; diabetes mellitus; mechanical ventilation; CT or MR brain images

(location of lesions, intra-ventricular hemorrhage, hematoma volume).

Table 3: Risk factors for SAP in some scales

Risk factor	Schepp et al (2012) [8]	Friedant et al (2015) [9]	Smith et al (2015) [10]	Chumbler et al (2010) [11]	Hoffmann et al (2012) [12]	Kumar et al (2017) [13]	Harms et al (2013) [14]	Ji et al (2013) [15]
Old age	×	×	×	×	×	×	×	×
Male			×					
mRS prior to hospital				×				×
Prior history of pneumonia				×	×			
AF	×							×
COPD	×							×
Diabetes			×					
Heart failure						×		×
Smoking								×
Drinking too much								×
Hemorrhagic stroke	×							
GCS decreased							×	×
Falls at onset				×				
NIHSS increased	×	×	×	×	×			×
Swallowing disorders				×	×	×		×
Systolic blood pressure> 200mmHg							×	
Hyperglycemia								×

Hemorrhagic stroke was related to the risk of SAP with OR = 2.0. Our research results are consistent with those of Divani et al that: hemorrhagic type was related to a higher risk of SAP [17]. Schepp et al. conducted their research on 1,008 stroke patients and found that: hemorrhagic stroke patients have a higher risk of SAP than cerebral infarction patients with OR = 1.67 [8] .

Diabetes is a common risk factor of stroke. Hyperglycemia was an independent prognostic factor for bacteria infection and SAP [18]. In our study, patients with a history of diabetes in the SAP group was 26.5%, higher than that of the non-SAP group (9.5%), the difference was significant (p < 0.01). Patients who had a history of diabetes had an increased risk of SAP with OR 3.4. The study by Zhang in 2016, conducted on 1,149 ischemic stroke patients showed that the proportion of diabetes in the SAP group is 24.4% higher than in the non-SAP group (18.4%). According to Sari et al. (2017) diabetes was related to the risk of SAP (OR = 2.09; 95% CI: 0.83-5.29; p = 0.12) [19].

Patients with consciousness disorders which lead to an increased risk of swallowing disorder, aspiration, reduction in the ability to cough, spit. GCS at admission below 8 was an independent prognostic factor of infection and SAP [18]. These factors increase the risk of SAP. As our results, stroke patients with severe consciousness disorders (Glasgow 3-8) had a high risk of SAP with OR 7.2, p < 0.01.

The proportion of severe stroke (the NIHSS over 15) in the SAP group was higher than that in the non-SAP group (47.1% and 9.1%, respectively, p < 0.01). NIHSS > 15 increased the risk of SAP with OR 16.4 (95%CI 8.2 - 32.5, p < 0.01). Our results are consistent with other authors, such as Smith et al., the patients who had NIHSS > 15 caused the risk of pneumonia with OR=9.58 [10]. Results from other studies had also shown that high scores of NIHSS increased the risk of SAP [11], [12], [13], [15], [19], [20].

A stroke happens in the cerebral hemisphere, cerebellum, or brain stem can damage swallowing physiology. Cerebral stroke lesions can destroy the voluntary function of mastication and interrupt the bolus transport process of the oral phase. The lesions in the precentral gyrus may cause not only contralateral disorder in facial, tongue and lip motor function but also contralateral compromise in peristalsis of pharynx. Brain stem stroke may cause sensation loss of the mouth, cheek, and tongue, delay the trigger of the pharynx and glottis. [21]. Due to swallowing disorders, foreign objects, food, pathogens easily enter the lower respiratory of pneumonia patients. The study conducted by Bray et al., (2016) with nearly 60,000 stroke patients showed that if the patient were examined for early swallowing disorders in order to have appropriate preventive measures, the rate of pneumonia after stroke would reduce from 13.8 % to 8% [22].

The patients who had GUSS 0-14 would have a higher risk of pneumonia than patients with GUSS 15-20: OR = 11.7, p < 0.01. There are various scales to measure swallowing disorders, of which GUSS is the most popular one. According to Trapl et al., when comparing the diagnostic value of swallowing disorder by GUSS with the esophageal endoscopy, Kappa coefficient was 0.835 [23]. The author divided swallowing disorder into 4 levels: severe (GUSS 0-9 scores); medium (GUSS 10-14); mild (GUSS 15-19) and no swallowing disorder (GUSS 20). Of which, risk of aspiration will be high for the patients with GUSS ≤ 14 scores [23]. GUSS had 100% sensitivity, 69% specificity in assessing the risk of aspiration [24]. The study conducted by Zhang et al. in 2016 [25] on 1,149 patients with ischemic stroke showed that swallowing disorder was a risk of pneumonia with OR = 16.68 (95% CI: 10.28-27.07; p <0.05). Sari et al. (2017) [19] studied on SAP in Indonesia and Japan. The results showed that swallowing disorder is a risk of pneumonia, OR = 12.62 (p = 0.001). Therefore the authors concluded that swallowing impairment is an independent risk for pneumonia [26].

Mechanical ventilation caused a high risk of pneumonia with OR 16.4 (p <0.01). Hinduja et al. (2015) [18] conducted research on 202 primary intracerebral hemorrhage patients: mechanical ventilation was an independent prognostic factor infection and SAP. Alsumarain et al. [27] studied on 290 stroke patients with cerebral hemorrhage and

found that mechanical ventilation increased the risk of pneumonia with OR = 9.42

In conclusion, our study identified the risk factors related to SAP in stroke patients. We have shown that SAP is a frequent complication. We identified some risk factors of SAP, especially stroke severity (NIHSS > 15), swallowing disorder (GUSS < 15) and mechanical ventilation.

Ethical statements

This study was started after being approved by the ethics committee of the Vietnam Military Medical University.

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