The relationship between pneumonia and Glasgow coma scale assessment on acute stroke patients

K Ritarwan*, C A Batubara and R Dhanu

Department of Neurology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia
*Corresponding author: kikingritarwan@gmail.com

Abstract. Pneumonia is one of the most frequent medical complications of a stroke. Despite the well-documented association of a stroke associated infections with increased mortality and worse long-term outcome, on the other hand, the limited data available on independent predictors of pneumonia in acute stroke patients in an emergency unit. To determine the independent relationship between pneumonia and Glasgow Coma Scale assessment on acute stroke patients. The cohort retrospective study observed 55 acute stroke patients who stayed in intensive care unit Adam Malik General Hospital from January until August 2017. Pneumonia was more frequent in patients with Ischemic stroke (OR 5.40; 95% CI: 1.28 – 6.40, p=0.003), higher National Institute of Health Stroke Scale (NIHSS) (p= 0.014) and lower Glasgow Coma Scale (p=0.0001). Analysis multivariate logistic regression identified NIHSS as an independent predictors of pneumonia (95% CI : 1.047 – 1.326, p =0.001). Pneumonia was associated with severity and type of stroke and length of hospital stay. The severity of the deficits evaluated by the NIHSS was shown to be the only independent risk factor for pneumonia in acute stroke patients.

1. Introduction
Acute stroke is one of the leading factors of morbidity and mortality worldwide. After cardiovascular disease, stroke ranks as either the second or third most common cause of death in industrial countries.[1] Pneumonia is closely associated with a high risk of mortality in acute stroke, whether the immediate identification of patients at high risk of acquiring pneumonia may determine stroke patients who require close monitoring and prophylactic treatment.[2,3] Pneumonia has been associated with a relative risk of 3.0 for mortality in a study including 14,293 patients with stroke.[4]

Despite the well-documented association of stroke-associated infections with increased mortality and worse long-term outcome, as yet there are only limited data available on independent predictors of pneumonia in acute stroke patients, treated in the emergency unit. The identification of early predictors is of paramount importance for clinicians so that specific therapies and management strategies can be applied to patients at high risk of dying.[5,6,7]

In the present study, the objective was to determine the independent’s relationship between pneumonia and Glasgow Coma Scale assessment on acute stroke patients.

2. Materials and Methods
This is an exploratory, retrospective cohort study. All patients admitted from January to August 2017 with a diagnosis of stroke in an Intensive Unit of Adam Malik General Hospital were included. Some
patients were transferred to the intensive care unit or neurology ward. The diagnosis of stroke was based on clinical characteristics and imaging result. Patients with symptoms, if admitted with pneumonia or others of pulmonary infections and were using antibiotics, were excluded. The study was approved by the Committee on Ethics of the Medical Faculty, Universitas Sumatera Utara. We reviewed all the medical charts and extracted information using a structured questionnaire. The questionnaire included demographics and vascular risk factors. Stroke degree of severity was assessed using the National Institute of Health Stroke Scale (NIHSS), and level of consciousness was assessed using the Glasgow Coma Score (GCS) scale, type (ischemic vs. hemorrhagic); and time use of mechanical ventilation was also collected. Pneumonia was diagnosed based on clinical, laboratory and radiological data by the treating physician and registered on the medical records.

Categorical variables are expressed as proportions, while continuous variables as the mean ± standard deviation (SD) and median (IQR). A univariable analysis was performed. Proportions were analyzed with the Fisher’s exact test. Continuous variables were analyzed with the Man-Whitney U test. Variables selected a priori (age, sex, NIHSS, type of stroke) and those with p-value <0.01 in the bivariate analysis were included in a logistic regression model. All statistical analyses were performed with SPSS for Windows.

3. Results

The sum of patients as a subject in this study was very peculiar 55 patients. Consequently, all the data in this study were distrust. The patients who suffered from pneumonia were 37 patients. Hypertension, diabetic’s, dyslipidemia’s and previous vascular disease’s patients who suffered pneumonia were 21 patients.

Table 1. Demographic and clinical data in 55 patients stroke with pneumonia and non-pneumonia that have been treated in an Intensive Care Unit Adam Malik General Hospital.

| Patient characteristics | Pneumonia (n=37) | Non-Pneumonia (n=18) | OR   | 95% CI        | p-value |
|------------------------|------------------|----------------------|------|---------------|---------|
| Age                    |                  |                      |      |               |         |
| <50 years old          | 10 (18.2%)       | 8 (10.9%)            | 0.741| 0.219–0.251   | 0.012   |
| >50 years old          | 27 (49.1%)       | 12 (21.8%)           |      |               |         |
| Sex                    |                  |                      |      |               |         |
| Male                   | 21 (38.2%)       | 12 (21.8%)           | 0.656| 0.202–2.128   | 0.138   |
| Female                 | 16 (29.1%)       | 6 (10.9%)            |      |               |         |
| Onset                  |                  |                      |      |               |         |
| >6 hours               | 8 (14.5%)        | 13 (23.6%)           | 9.425| 2.582–34.403  | 0.001   |
| <6 hours               | 29 (52.7%)       | 5 (9.1%)             |      |               |         |
| Length of Stay         |                  |                      |      |               |         |
| < 10 days              | 26 (47.3%)       | 5 (9.1%)             |      | Reference     | 0.010   |
| 10 – 15 days           | 7 (12.7%)        | 7 (12.7%)            |      |               |         |
| >15 days               | 4 (7.3%)         | 6 (10.9%)            |      |               |         |
| Hypertension           |                  |                      |      |               |         |
| Yes                    | 21 (38.2%)       | 13 (23.6%)           | 0.505| 0.149–1.709   | 0.268   |
| No                     | 16 (29.1%)       | 5 (9.1%)             |      |               |         |
| Diabetes Mellitus      |                  |                      |      |               |         |
| Yes                    | 21 (38.2%)       | 13 (23.6%)           | 0.505| 0.149–1.709   | 0.268   |
| No                     | 16 (29.1%)       | 5 (9.1%)             |      |               |         |
| Dyslipidemia           |                  |                      |      |               |         |
| Yes                    | 21 (38.2%)       | 13 (23.6%)           | 0.505| 0.149–1.709   | 0.268   |
| No                     | 16 (29.1%)       | 5 (9.1%)             |      |               |         |
| Smoking                |                  |                      |      |               |         |
| Non-smoker             | 28 (50.9%)       | 7 (12.7%)            |      | Reference     | 0.001   |
| Current                | 8 (14.5%)        | 4 (7.3%)             |      |               |         |
| Past-smoker            | 1 (1.8%)         | 7 (12.7%)            |      |               |         |
| Previous vascular disease |              |                      |      |               |         |
| Yes                    | 21 (38.2%)       | 13 (23.6%)           | 0.505| 0.149–1.709   | 0.268   |
| No                     | 16 (29.1%)       | 5 (9.1%)             |      |               |         |
Table 2. Variables associated with pneumonia in stroke patients.

|                | Pneumonia | Non Pneumonia | p-value |
|----------------|-----------|---------------|---------|
|                | Median    | IQR           | Median  | IQR   |         |
| Age            | 62        | 51 – 74       | 50.5    | 49.25 – 70.01 | 0.716 |
| NIH Stroke Scale| 15.5     | 8 – 19        | 8       | 3 – 14    | 0.033 |
| GCS Scale      | 12        | 10 – 14       | 15      | 14 – 15   | 0.538 |
| Length of stay in hospital | 7        | 4 – 18        | 3       | 1 – 6   | 0.003 |
| Onset          | 7         | 4 – 9         | 4       | 2 – 8   | 0.001 |

Table 2 shows the patients with longer hospital stay more frequently developed pneumonia; the median hospital stay length was 7 days compared with 4 days in the group without pneumonia (p<0.0001).

Table 3. Predictors of stroke-associated pneumonia.

|                | OR   | 95% CI Lower | 95% CI Upper | p-value |
|----------------|------|--------------|--------------|---------|
| Age            | 0.74 | 0.22         | 2.51         | 0.63    |
| Sex            | 1.65 | 0.20         | 2.13         | 0.48    |
| NIHSS          | 1.12 | 1.05         | 1.15         | 0.01    |
| Type of stroke | 2.10 | 0.59         | 7.41         | 0.24    |

Table 3 shows the patients' predictors of stroke associated pneumonia. In the multivariable analysis, the NIHSS was the only factor associated (p=0.01) with pneumonia (Table 3). Ages, gender, type of stroke were not associated with pneumonia.

4. Discussion

In this study, pneumonia frequency was higher in patients with hemorrhagic stroke, more common in those with higher NIHSS (p=0.033) and higher Glasgow Coma Score (p =0.538). Some studies have demonstrated that complication such as a stroke progression or pneumonia adversely affects clinical outcome. Increase risk of poor outcome in patients with pneumonia, if unadjusted, reflects not only the effect of pneumonia but the effect of other factor predisposing them to pneumonia, such as initial stroke severity or neurological complications.[8,9,10,16] We found a relationship between pneumonia and hospitalization time, as previously shown by Chen et al.[10] Kwan and Hand reported that post-stroke infection could prolong the length of stay of patients, in the acute stroke patients. The length of stay in hospital has been influenced by the hospital's characteristics and the organization of service within the hospital.[11] Batubara et al. reported from 32 acute stroke patients, consist of 40.6% male and 59.4 % female, with the mean of age 62.38 years. In This study, of 55 patients (21 men and 16 women, mean age 53.9±9.9 years) with acute stroke were included.[8]

Almeido et al. showed the length of stay of pneumonia with an average of 13 days in the hospital compares to 5 days in the group without pneumonia. In this study, patients with longer hospital stay more frequently developed pneumonia; the median hospital stay length was 7 days compared with 4 days in the group without pneumonia (p<0.0001). The highest length of stay in hospital will influence the total financial costs. The marginal cost of pneumonia is up to three times higher than the group without pneumonia. Pneumonia and stay in intensive care unit are independent predictors of acute treatment costs in Brazil hospitals.[4] Stroke severity during admission is a predictor of mortality but not as a predictor of pneumonia.[8,12] Ruijun et al. showed that age, atrial fibrillation, congestive heart failure, chronic obstructive pulmonary disease and current smoking, pre-stroke dependence, dysphagia, admission NIHSS and GCS scores, stroke subtype and blood glucose were independent predictors of pneumonia in ischemic stroke.[13] Finlayson et al. indicated that male sex, nonlacunar ischemic stroke, and preadmission dependency were predictors too.[14] In this study, the
multivariable analysis the NIHSS was the only factor associated (p=0.01) with pneumonia. Ages, gender, type of stroke were not associated with pneumonia. Gong et al. also analyzed the independent risk factors of SAP (Stroke Associated Pneumonia) in our cohort to investigate the reasons why these risk models had different predictive performances in this study. Gong found that age (OR=1.035, 95% CI 1.021 to 1.049), atrial fibrillation (OR=2.733, 95% CI 1.837 to 4.067), chronic obstructive pulmonary disease history (OR=5.006, 95% CI 2.143 to 11.693), NIHSS score (OR=1.124, 95% CI 1.092 to 1.157) and the count of first time white cell count during hospitalization (OR=1.169, 95% CI 1.116 to 1.224) were independent risk factors for Stroke Associated Pneumonia.[9]

5. Conclusions
These study results indicate pneumonia was related to the severity and type of stroke and length of stay in the hospital. We should consider the severity of the neurological deficit evaluated by the NIHSS was shown to be the only independent risk factor for pneumonia in acute stroke patients.

References
[1] Caplan L R 2009 Caplan’s stroke: a clinical approach, 4th edition (Philadelphia: Saunders Elsevier)
[2] Carandang R, Seshadri S, Beiser A, Kelly-Haymes M, Kase C S, Kannel W B, et al. 2006 Trends in incidence, lifetime risk, severity, and 30-day mortality of stroke over the past 50 years JAMA 296(24) 2939-46 Available from: http://dx.doi.org/10.1001/jama.296.24.2939
[3] Nedeltchev K, Renz N, Karamesheva A, Haefeli T, Brekenfeld C, Meier N, et al. 2010 Predictors of early mortality after acute ischaemic stroke Swiss Med. Wkly. 140(17-8) 254-9
[4] Almeida S R, Bahia M M, Lima F O, Paschoal I A, Cardoso T A and Li L M 2015 Predictors of pneumonia in acute stroke in patients in an emergency unit Arq. Neuropsiquiatr. 73(5) 415-9
[5] Hinche J A, Shephard T, Furie K, Smith D, Wang D, Tonn S, et al. 2005 Formal dysphagia screening protocols prevent pneumonia Stroke 36(9) 19726 Available from: http://dx.doi.org/10.1161/01.STR.0000177529.86868.8d
[6] Hong K S, Kang D W, Koo J S, Yu K H, Han M K, Cho Y J, et al. 2008 Impact of neurological and medical complications on 3-month outcomes in acute ischaemic stroke Eur. J. Neurol. 15(12) 1324-31 Available from: http://dx.doi.org/10.1111/j.1468-1331.2008.02310.x
[7] Westendorp W F, Nederkoorn P J, Vermeij J D, Dijkgraaf M G and Beek D 2011 Post-stroke infection:a systematic review and meta-analysis BMC Neurol. 11(1) 110 Available from: http://dx.doi.org/10.1186/1471-2377-11-110
[8] Batubara C A 2015 The relationship was clinical score A2DS2 for pneumonia patients on acute stroke [Dissertation]
[9] Gong S, Zhou Z, Zhou M, Guo J, Chen N and He L 2016 Validation of risk scoring models for predicting stroke-associated pneumonia in patients with ischaemic stroke Stroke Vasc. Neurol. 00 e000025
[10] Chen C M, Hsu H C, Tsai W S, Chang C H, Chen K H and Hong C Z 2012 Infections in acute older stroke inpatients undergoing rehabilitation Am. J. Phys. Med. Rehabil. 91(3) 211-9
[11] Kwan J and Hand P 2007 Infection after acute stroke are associated with poor short-term outcome Acta. Neurol. Scand. 115(5) 331-8
[12] Ifejika-Jones N L, Harun N, Peng H, Elizabeth A, Grotta J C and Francisco G E 2012 The interaction of aspiration pneumonia with demographic and cerebrovascular disease risk factors is predictive of discharge level of care in acute stroke patient Am. J. Phys. Med. Rehabil. 91(2) 141-7
[13] Ruijun J, Shen H, Yuensing P, Wang P, Liu G, Wang Y, et al. 2013 Novel risk score to predict pneumonia after acute ischemic stroke Stroke 44(5) 1303-9
[14] Finlayson O, Kapral M, Hall R, Asllani E, Selchen D, Saposnik G, et al. 2011 Risk factors, inpatientcare, and outcomes of pneumonia afterischemic stroke Neurol. 77(14) 1338-45
[15] Rotstein C, Evans G, Born A, Grossman R, Light R B, Magder S, et al. 2008 Clinical practice guidelines for hospital-acquired pneumonia and ventilator-associated pneumonia in adults (AMMI Canada Guidelines) Can. J. Infect. Dis. Med. Microbiol. 19(1) 19-53

[16] Ovbiagele B, Hills N K, Saver J L and Johnston S C 2006 Frequency and determinants of pneumonia and urinary tract infection during stroke hospitalization J. Stroke Cerebrovasc. Dis. 5 209–13