RESEARCH ARTICLE

Risk factors for pneumonia in acute stroke patients admitted to the Emergency Department of a Tertiary Government Hospital

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ABSTRACT

Background: Knowledge on the risk factors of developing pneumonia, one of the top causes of mortality in acute stroke patients admitted to a tertiary government hospital, is lacking. **Aim and Objective:** This study aimed to determine the factors associated with the risk of developing pneumonia in acute stroke patients admitted to the emergency department of a tertiary government hospital. **Materials and Methods:** A retrospective matched case–control study involving acute stroke patients admitted to the emergency department of a tertiary government hospital with 168 pneumonia patients matched with 168 controls by sex was employed. Age, sex, vascular risk factors, previous hospitalization within the past 3 months, type and location of stroke, need for intubation, length of hospital emergency room stay, National Institute of Health Stroke Scale (NIHSS) score on admission, pre-morbid Modified Rankin Scale (mRS) score, and outcome (mortality, NIHSS score and mRS score at discharge) were obtained from the medical charts. Odds ratios were calculated using a multivariate logistic regression analysis. Among stroke patients developing pneumonia, the type of pneumonia and microorganisms were identified. **Results:** Smoking, alcohol intake, dysphagia, hemorrhagic stroke, need for intubation, and age were associated with pneumonia. Pneumonia increases the odds of mortality and disability by 14 and 7 times, respectively. Hospital-acquired pneumonia is the most common type with *Acinetobacter baumanii* and *Klebsiella pneumonia* as the most common microorganisms identified. **Conclusion:** Age, alcohol intake, dysphagia, hemorrhagic stroke, and need for intubation increase the risk for post-stroke pneumonia with organisms isolated consistent with nosocomial pneumonia.

KEY WORDS: Stroke; Pneumonia; Risk Factors; Case-control Study; Logistic Regression

INTRODUCTION

Philippine General Hospital is a tertiary hospital catering to the country's indigenous patients. A lot of patients are received and managed at the adult emergency department every day, often exceeding the maximum allowable admissions. Acute stroke patients coming straight from their homes or from other hospitals are initially admitted to the hospital emergency department and subsequently transferred either to a 15-bed capacity Adult Neurology Ward or to a six-bed capacity Neurology Intensive Care Unit. Based on the monthly census of the Department of Neurosciences, the average length of stay of stroke patients at the Emergency Department is 3.6 days.

Pneumonia is one of the most common complications of stroke, occurring in around 32% of acute stroke patients,

with a relative risk of 3.0 for mortality.[1] Pneumonia can be classified as (a) community-acquired pneumonia (CAP), (b) nosocomial pneumonia (hospital-acquired pneumonia or ventilator-associated pneumonia), and (c) healthcare-associated pneumonia.[2] Pneumonia that is acquired out of the hospitals is termed as CAP while nosocomial pneumonia is classified further into hospital-acquired and ventilator-associated pneumonia. Hospital-acquired pneumonia is a pneumonia occurring in the hospital after more than 48 h of admission. Ventilator-associated pneumonia is defined as pneumonia developing 48 h after intubation. Healthcare-associated pneumonia refers to pneumonia occurring before hospital admission in patients closely associated with the health-care system, such as those with recent hospitalization in the past 3 months, residing in a nursing facility, and frequenting the dialysis units.

Several factors predispose stroke patients to develop pneumonia such as prolonged immobility, aspiration due to depressed level of consciousness, dysphagia, and bulbar symptoms.[3] Other risk factors include older age, diabetes, cognitive impairment, stroke severity,[4] and modified Rankin scale (mRS) score ≥4.[5] Stroke severity as measured using the National Institute of Health Stroke Scale (NIHSS) score is the only factor associated with pneumonia,[1] and is a predictor of poor outcome.[6] The increasing length of stay (>5 h) at the emergency department was found to worsen the neurologic outcome but not mortality.[7]

Pneumonia has been one of the top causes of mortality in acute stroke patients in our institution over the years. The knowledge about the risk factors of developing pneumonia in acute stroke patients admitted in our institution is lacking. Hence, this study aimed to determine the factors associated with the risk of developing pneumonia in acute stroke patients admitted to the emergency department of the Philippine General Hospital. It has also determined the most common type of pneumonia and identified the most common microorganisms isolated among patients with pneumonia. Moreover, once these risk factors have been identified, further improvement in the health-care system of the hospital might be possibly done.

MATERIALS AND METHODS

A retrospective matched case–control study involving acute stroke patients admitted to the Emergency Department of the Philippine General Hospital was conducted with an approval from the University of the Philippines Manila Review Ethics Board. Acute stroke patients in the monthly census (strata) of the Department of Neurosciences from January 2015 to December 2015 were screened for pneumonia. Patients with pneumonia in the census were considered as cases while those without pneumonia were the corresponding controls. Pneumonia is diagnosed in adherence to the Philippine clinical practice guidelines on the diagnosis, empiric management,

and prevention of CAP in immunocompetent adults. Both clinical symptoms (fever, cough, sputum production, tachypnea, tachycardia, and egophony) and chest X-ray findings of new lung infiltrates were used in the diagnosis. Aspiration pneumonia, on the other hand, is diagnosed based on clinical symptoms of pneumonia together with the presence of dysphagia.[8]

Only adult patients aged at least 19-year-old who were admitted initially at the Emergency Department within 72 h from onset of stroke were included in the study. Patients who had in-hospital acute stroke, as well as those with incomplete charts were excluded from the study. The diagnosis of stroke was based on clinical manifestations and imaging studies.

The minimum sample size was calculated using the formula obtained from http://www.surveysystem.com/sample-size-formula.htm, and the study required a minimum sample size of 334, at 5% level of significance, with 5% margin of error, and 32% proportion of pneumonia cases.[1] However, sample size was increased to 336 with equal allocation of patients in the case and control groups. Simple random sampling was employed in obtaining the 168 cases and 168 controls. From the monthly census, a list of acute stroke patients was generated and further sorted as to whether they had pneumonia or not. If the cases identified in the census turned out to be controls in the chart and vice versa, they were reclassified based on what was written in the chart. Each patient included in the list was given a corresponding number. Cases were matched with controls using the variable sex. Samples were obtained using a random number generator (http://stattrek.com/statistics/random-number-generator.aspx).

Charts of the patients were obtained from the Medical Records Section, Philippine General Hospital. The age, sex, vascular risk factors (hypertension, diabetes, previous stroke, smoking, alcohol intake, coronary artery disease, and atrial fibrillation), previous hospitalization within the past 3 months, type of stroke (infarct or hemorrhage), localization of stroke if it is an infarct (anterior or posterior circulation), need for intubation, length of emergency room stay, NIHSS score on admission, pre-morbid mRS score, and outcome (mortality, NIHSS score and mRS score at discharge) of the patients were retrieved and recorded. Among stroke patients developing pneumonia, the type of pneumonia and microorganisms identified were also noted.

Descriptive measures including means and standard deviations were reported for quantitative variables included in the study, while frequency count was used for qualitative categorical variables. Crude odds ratios (OR) with 95% confidence interval were calculated in establishing the association between pneumonia and various risk factors using a multivariate logistic regression analysis. All statistical analyses were carried out at 5% level of significance using SAS® statistical software.

RESULTS

Multivariate logistic regression analysis showed that smoking (OR = 0.43), alcohol intake (OR = 2.78), dysphagia (OR = 5.20), hemorrhagic stroke (OR = 2.40), need for intubation (OR = 3.62), and age (OR = 1.03) were factors independently associated with pneumonia (Table 1). Pneumonia in acute stroke patients increased the odds of mortality and disability (measured as mRS of 4-6) by 14 and 7 times, respectively (Table 2). Among the pneumonia cases, the most common type of pneumonia was hospital-acquired pneumonia (44%), followed by aspiration pneumonia (41%). Of these 168 cases, 24 were culture positive, 8 had no growth, 7 had normal respiratory flora, and 129 cases had no results indicated in the charts. All the cultures were taken as endotracheal tube aspirates with *Acinetobacter baumanii* and *Klebsiella pneumonia* as the most common microorganisms identified (Table 3).

DISCUSSION

Despite the advances in acute stroke care, pneumonia has consistently been one of the most common causes of mortality among acute stroke patients in our institution. The main objective of this study was to determine the factors associated with the risk of developing pneumonia in acute stroke patients admitted to the emergency department of a tertiary hospital. Findings of the study showed that smoking, alcohol intake, dysphagia, age, hemorrhagic type of stroke, and need for intubation were factors independently increased the risk for developing pneumonia. Age, dysphagia, hemorrhagic stroke, and need for intubation have all been previously reported as risk factors for stroke-associated pneumonia,[1,4,5,9-13] which is consistent with our findings. However, this study identified another risk factor not yet reported in literature which is alcohol intake, but the data on the amount and duration of alcohol intake were not obtained. Contrary to other studies, smoking is a protective factor for pneumonia in this study. The previous studies only included current smokers, while this study did not qualify if the patients had already stopped smoking and for how long. Smoking is a known risk factor for pneumonia in the general population. The risk increases in proportion to the duration of smoking and number of cigarettes consumed but decreases by as much as 50% after 5 years of quitting.[14]

Table 1: Clinical characteristics of acute stroke patients with pneumonia and matched controls				
Qualitative characteristics	***n*=336**		**OR (95% CI)**	***P* value**
	Pneumonia	**Control**		
Sex				
Female	84	84	1.29 (0.65-2.56)	0.4748
Male	84	84		
Hypertension	118	108	1.07 (0.59-1.94)	0.8236
History of stroke	38	21	1.84 (0.85-3.97)	0.1208
Diabetes	17	18	0.75 (0.31-1.83)	0.5287
Smoking	57	77	0.43 (0.21-0.87)	0.0187
Alcohol intake	75	68	2.78 (1.31-5.89)	0.0075
Coronary artery disease	2	0	>999.9 (<0.001->999.9)	0.9872
Atrial fibrillation	12	11	1.04 (0.36-3.04)	0.9455
Previous hospitalization	105	93	1.03 (0.59-1.82)	0.9061
Dysphagia	144	60	5.20 (2.65-10.24)	<0.0001
Type of stroke				
Hemorrhage	104	62	2.40 (1.31-4.43)	0.0047
Infarct	64	106		
Anterior	55	87	1.335 (0.564-3.160)	0.5116
Posterior	9	19		
Intubation	61	9	3.62 (1.53-8.56)	0.0034
Pre-morbid mRS				
4-6	3	3	0.48 (0.06-3.85)	0.4900
0-3	165	165		
Continuous variables	**Mean±SD**	**Mean±SD**	**OR (95% CI)**	***P* value**
Age	58.92±12.08	55.42±12.59	1.03 (1.001-1.05)	0.0382
NIHSS during admission	19.22±7.84	11.12±9.03	1.02 (0.99-1.06)	0.2215
Length of ER stay	2.34±2.15	2.81±2.09	0.97 (0.86-1.10)	0.9710

mRS: Modified Rankin Scale, NIHSS: National Institute of Health Stroke Scale, ER: Emergency room, CI: Confidence interval, OR: Odds ratio, SD: Standard deviation

Table 2: Outcomes of acute stroke patients with pneumonia and matched controls				
Outcome	*n*=336		OR (95% CI)	*P* value
	Pneumonia	Control		
Mortality	35	3	14.47 (4.36-48.10)	<0.0001
mRS (4-6)	144	75	7.44 (4.39-12.62)	<0.0001

mRS: Modified Rankin Scale; CI: confidence interval, OR: Odds ratio

Table 3: Number of cases based on microorganisms identified among culture positive	
Microorganism	Cases
Acinetobacter baumanii	10
Klebsiella pneumoniae	9
Pseudomonas aeruginosa	2
Candida sp.	1
Enterobacter cloacae	1
Enterobacter aerogenes	1

Thus, this study might have overestimated the number of smokers for each group.

The only non-modifiable risk factors identified in this study are age and type of stroke. Several factors may account for the increased risk for pneumonia in the older age group, such as existing immune senescence and the relatively increased risk for aspiration in the elderly, on top of the immunosuppression brought about by stroke. Hemorrhagic stroke patients are more likely to develop pneumonia than those of ischemic stroke patients.[1] Furthermore, the need for intubation from respiratory failure is greater in hemorrhagic stroke (30% compared to 6% in ischemic stroke).[5]

Dysphagia is a common complication of acute stroke, present in more than 50% of stroke survivors.[15] It can lead to acute malnutrition, dehydration, pneumonia, and airway obstruction, all of which might cause longer hospitalization and poor quality of life.[16] Dysphagia screening and rehabilitation, therefore, is an important component of acute stroke management. Early detection of dysphagia and initiation of swallowing therapy 3 days' post-ictus promote swallowing function, as well as decrease aspiration pneumonia.[17]

Stroke severity has been reported in several studies to be an important risk factor for post-stroke pneumonia.[1,6,9,13] In this study, the mean NIHSS for the cases is 19, while that for the controls is 11 with an overlap in the NIHSS scores between the two groups, suggesting statistically non-significant OR. Clinically, stroke severity can be classified using NIHSS scores as to mild (≤4), moderate (5-15), and severe (more than 15). Based on the mean scores, this study suggests that NIHSS scores differed in both groups clinically but did not attain statistical significance.

Furthermore, findings of the study also showed the impact of pneumonia on the outcomes of acute stroke patients. Pneumonia increases the risk of mortality by 14-fold and of disability by 7-fold (as measured by mRS score more than or equal to 4). Of patients with pneumonia, 44% had hospital-acquired while 41% had aspiration pneumonia. The microorganisms identified in this study were consistent with hospital-acquired pneumonia and CAP with aspiration component. Thus, initial choice of empiric antibiotics must cover for both nosocomial pneumonia and CAP with aspiration component.

Various strategies have been utilized to prevent stroke-associated pneumonia. Placing the patient on nil per os on admission until dysphagia evaluation has been done is the most commonly accepted practice which prevents aspiration, the reported sequela of dysphagia. The use of prophylactic antibiotics is still controversial. The Preventive Antibacterial Therapy in Acute Ischemic Stroke (PANTHERIS) trial reported that the administration of moxifloxacin as prophylaxis reduces infections after severe non-lacunar ischemic stroke compared to placebo but did not improve clinical outcome and survival rate after 6 months of stroke.[3] The Preventive Antibiotics in Stroke Study trial, on the other hand, demonstrated that the use of prophylactic ceftriaxone in a dose of 2 g/day for 4 days did not improve functional outcome (measured by mRS scores) after 3 months of stroke.[18] Thus, the utilization of prophylactic antibiotics is not yet recommended.

Given the retrospective design employed in this study, once the needed variables were not included in the chart, the sample was excluded from the study. The stroke severity scores were based mainly on the chart entries and may therefore have inter-observer variability since the scores were obtained by different physicians. The amount and duration of both smoking and alcohol intake were also not recorded due to the lack of available information from the charts.

CONCLUSION

In this study, there are five easily identifiable factors associated with an increased risk for post-stroke pneumonia: Age, alcohol intake, dysphagia, hemorrhagic stroke, and need for intubation. Pneumonia increases the risk for mortality and neurologic disability among post-stroke patients. The most common type of pneumonia seen in this study is hospital-acquired pneumonia and aspiration pneumonia. Early recognition of dysphagia, prompt swallowing therapy, and proper choice of empiric antibiotics (in those with pneumonia) are essential parts of acute stroke management.

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