

Risk Factors for Pneumonia in Patients with Acute Ischaemic Stroke- A Retrospective Study

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ABSTRACT

Introduction: The most common non-neurological complication of stroke is infection. Stroke, associated with pneumonia is one among them. A few studies have identified prognostic predictors of pneumonia in stroke.

Aim: To identify the risk factors of pneumonia in acute ischaemic stroke patients.

Materials and Methods: This retrospective cohort study included medical records of 470 adult patients with acute ischaemic stroke between June 2015 to June 2020 (five years) in a Tertiary Care Medical College and Hospital. Among them, 173 had stroke associated with pneumonia. The clinical parameters-age, gender, lesion location, stroke severity (Glasgow Coma Scale (GCS)), National Institute of Health Stroke Scale (NIHSS), Modified Barthel Activities of Daily Living (ADL) index, water

swallow test, vascular risk factors and co-existing conditions (pre-existent Chronic Obstructive Pulmonary Disease (COPD), atrial fibrillation, renal electrolyte dysfunction, hypoproteinaemia) were compared. Chi-square test and logistic regression analysis were used for statistical analysis.

Results: In this study, the following factors were associated with increased risk of developing pneumonia-age >70 years, bed ridden status, GCS \leq 13, NIHSS \geq 5, water swallow test score \leq 2. Among them, multivariate analysis identified bed ridden status and water swallow test as independent predictors.

Conclusion: Bed ridden status and water swallow test score were significant risk factors of ischaemic stroke associated with pneumonia. Hence, an early identification of these factors and a better knowledge of them may help in better care and prevention of pneumonia in acute ischaemic stroke.

Keywords: Bed ridden status, Cerebrovascular disease, Infection, Prognosis, Water swallow test

INTRODUCTION

Although neurologic complications are the major causes of mortality in acute stroke, upto one-half of all patients with acute stroke may die of other medical complications. The most common non-neurological complication of stroke is infection. Pneumonia and urinary tract infection are the most frequent of them [1]. Pneumonia was found to be the most common cause of mortality in the first month after acute stroke. The incidence of this infective complication ranged between 9.5-56.6% [2]. This contributes to a major cause for stroke deterioration and in turn affecting neuro rehabilitation. Once stroke-related pneumonia develops, the patients will usually have poor clinical outcome including increased long-term disability or mortality [3]. A large cohort study reported that stroke patients complicated with pneumonia had a three-fold greater risk of 30-day mortality compared with those without pneumonia, and the population-attributable risk was 10% [4].

Finding out the risk factors of ischaemic stroke associated pneumonia it could improvise the preventive and therapeutic interventions. This would help in a better patient outcome and quality of life. The better understanding of these factors will help to implement and organise strategies for the management of stroke [5].

Some studies identified the following risk factors that could predispose to early stroke associated pneumonia-elderly population, severe neurological deficits, dysphagia, and diabetes mellitus [6,7]. With regard to the high level of importance of this complication (pneumonia), other predictors that contribute to stroke associated pneumonia need to be identified [8].

The aim of this study was to identify the risk factors of pneumonia in patients with acute stroke. Various factors include sex, age, bedridden status, lesion location, scores of consciousness, neurological function and coexisting conditions. Determining and analysing such predictors would help to identify acute stroke patients with risk. Measures to lower the recurrence of infection in such high risk groups thus could be implemented. This would indeed help for faster and better neuro rehabilitation.

MATERIALS AND METHODS

In the present retrospective cohort study, the medical records of 470 adult patients with acute ischaemic stroke at Travancore Medical College Kollam, Kerala, India, between June 2015 to June 2020 were reviewed. This study was approved by Institutional Research and Ethics committee review board (TMC-IEC:-070/20).

Acute stroke is brain cell death attributable to ischaemia based on pathological, imaging or other objective evidence of cerebral ischaemic injury in a defined vascular distribution. The exclusion criteria: (a) diagnosis other than ischaemic stroke, (b) treatment for >24 hour in a referring hospital after the onset of ischaemic stroke (c) inpatient stay less than 72 hour, (d) management was restricted to palliative care, (e) pulmonary infections were present before the onset of stroke, and (f) antibiotics were administered before the onset of stroke, (g) transient ischaemic attack.

The patients were divided into two groups- stroke patients with and without pneumonia. The following study variables were studied and compared between the two groups-age, gender, lesion location (supratentorial, infratentorial, and supra- and infratentorial), stroke severity-GCS, NIHSS scale, ADL score using Modified Barthel ADL index, water swallow test score, vascular risk factors (hypertension, diabetes, dyslipidaemia, atrial fibrillation, angina/Myocardial Infarction (MI), history of previous vascular events) and co-existing conditions (pre-existent COPD, renal dysfunction, hypoproteinaemia). When infarct was confined to cortical, subcortical or lobar regions, it was considered as supra tentorial. When infarct was confined to mid brain, pons, medulla or cerebellum it was considered as infra tentorial.

Definition of Ischaemic Stroke Associated Pneumonia

Pneumonia was diagnosed by the physician if the following were present-respiratory tract infection symptoms or signs (cough, fever, crackles upon lung auscultation, and purulent tracheal secretion), laboratory test results (increased inflammatory markers and reduced oxygen saturation), microbiologic evidence (tracheal specimens and

blood cultures), and radiological evidence (chest X-ray or Computed Tomography (CT)). The radiological findings of pneumonia include airspace opacity, lobar consolidation, interstitial infiltrates and or cavitation.

Stroke associated pneumonia was considered if it presented during the patients' hospitalisation for stroke.

Bedside Swallowing Assessment

Bedside swallowing function was assessed by the modified water swallow test. Pour 3 mL of water into the oral vestibule and instruct to swallow, if possible; then, the patient was given more water and was asked to swallow again. It was scored as follows-1-Failed to swallow with choking and/or changes in breathing, 2-Swallowed successfully but with choking or wet hoarseness, 3-Swallowed successfully without choking, but with changes in breathing or wet hoarseness, 4-Swallowed successfully with no choking or wet hoarseness, 5-Criteria (4) plus two successful swallowing within 30 seconds. Worst attempt was taken into consideration for evaluation. Score ≤ 2 was abnormal [9].

Activities of Daily Living

Modified Barthel ADL index was used. This included 10 items which was sub-categorised to four functional grades depending on whether the patients needed help or not. The total score of ADL was 20. Score of <10 signifies severe disability [10].

Bed Ridden Status

This is a form of immobility that can present as the inability to move or even sit upright by self. Zero score of mobility in the Modified Barthel ADL index would be considered as bed ridden status.

STATISTICAL ANALYSIS

Data was entered in Microsoft excel and analysed using Statistical Package for the Social Sciences (SPSS) statistical software. (SPSS, version 20.0, Chicago, IL, USA). The results were shown as the mean \pm Standard Deviation (SD) for the number of assays indicated and as the count (percentage) for categorical variables. For univariate analysis, Chi-square test was performed. For multivariate analysis, binary logistic regression analysis was used. The p-value <0.05 was considered to be statistically significant.

RESULTS

Clinical Characteristics of Acute Ischaemic Stroke Patients

Among 470 patients with acute ischaemic stroke, 173 (36.8%) patients had pneumonia. 308 patients (65.5%) were males and 162 (34.5%) were females. The mean age was 68.31 years. The baseline characteristics of the patients are shown in [Table/Fig-1]. A total of 95 patients (20.2%) were bed ridden, 299 (63.6%) had supra tentorial lesions. The most common risk factors for stroke were hypertension (83.8%) and diabetes mellitus (67.9%).

Risk Factors for Ischaemic Stroke Associated Pneumonia

Various variables were compared and analysed to determine the risk factors associated with pneumonia between the two groups. In univariate analysis, age >70 years, bed ridden status, GCS ≤ 13 , NIHSS ≥ 5 , water swallow test score ≤ 2 were associated with development of ischaemic stroke associated with pneumonia. [Table/Fig-2]. Logistic regression analysis was performed to assess the independent predictors. In multivariate analysis, bed ridden status and water swallow test score ≤ 2 were independent risk factors of developing pneumonia in patients with acute ischaemic stroke [Table/Fig-3].

DISCUSSION

Stroke is a major cause of morbidity and mortality in clinical practise. Secondary infections will add to the burden and disability

Clinical data	Value, n (%) or (Mean \pm SD)
Demographics	
Male	308 (65.5%)
Female	162 (34.5%)
Age (Years)	68.31 \pm 6.359
Clinical characteristics	
Bed ridden status	95 (20.2%)
Scores at admission	
GCS (Glasgow Coma Scale)	13.28 \pm 2.458
NIHSS score (National Institute of Health Stroke Scale)	7.41 \pm 6.769
Water swallow test score	1.91 \pm 1.456
Modified Barthel ADL score (Activities of daily Living)	12.29 \pm 3.961
Lesions	
Supratentorial	299 (63.6%)
Infratentorial	107 (22.8%)
Supra+Infra tentorial	64 (13.6%)
Coexisting conditions	
Ischaemic heart disease	129 (27.4%)
Hypertension	394 (83.8%)
Dyslipidemia	226 (48.1%)
Diabetes	319 (67.9%)
Atrial fibrillation	88 (18.7%)
Chronic Obstructive Pulmonary Disease (COPD)	59 (12.6%)
Hypoproteinemia	53 (11.3%)
Renal dysfunction	75 (16.0%)
Hyponatremia	92 (19.6%)
Hypokalemia	38 (8.1%)

[Table/Fig-1]: Baseline characteristics of all patients.

in patients. Respiratory tract infection is considered to be a common complication associated with stroke. This will indirectly influence the quality of life, thus imposing a social financial burden to the family. This can also have other adverse outcomes [8].

In the present study, 36.8% of patients with acute ischaemic stroke developed pneumonia during hospitalisation. The mean age was 68.31 years and 65.5% were males. In the study by Mlinac ME and Feng MC, 41.6% acquired infection by lungs, 59.9% were males and the mean age was 72 years [10]. In the study by Finlayson O et al., pneumonia was found in 7.1% of patients with stroke, with a mean age of 72.2 years and 51.7% were males [11].

Risk Factors Associated with Pneumonia

In this study, out of the five factors (age >70 years, bed ridden status, GCS ≤ 13 , NIHSS ≥ 5 , water swallow test score ≤ 2) that were identified as being associated with increased risk of developing ischaemic stroke associated pneumonia, two were confirmed as independent predictors by multivariate analysis. They were bed ridden status and water swallow test score. Study by Mao L et al., showed that age >72 years, long term bed ridden status and water swallow test score were prognostic predictors for stroke associated pneumonia [8].

In the study by Finlayson O et al., Stroke severity was the most robust association with pneumonia development. Older age >80 years, male sex, coronary artery disease, dysphagia, COPD, pre-existent dependency, and dysphagia were also associated with pneumonia, although with a lower magnitude of effect [11].

In study by Almeida SR et al., after the adjustment for possible confounders, the NIHSS score was only an independent predictor of pneumonia. This predictor helped in the recognition of neurological impairment, including motor, sensory deficit, and aphasia. Furthermore, aspiration was frequently found in patients

Variables	No Pneumonia (n=297) (63.2%)	Pneumonia (n=173) (36.8%)	p-value
Demographics			
Gender (Male)	193 (65.0%)	115 (66.5%)	0.743
Age>70 Years	117 (39.4%)	122 (70.5%)	0.001
Clinical characteristics			
Bed ridden status	30 (10.1%)	65 (37.5%)	0.001
Scores at admission			
GCS ≤13	30 (10.1%)	81 (46.8%)	0.001
NIHSS score ≥5	103 (34.7%)	121 (69.9%)	0.001
Water swallow test score ≤2	15 (5.1%)	130 (75.1%)	0.001
Modified Barthel ADL score <10	112 (37.7%)	72 (41.6%)	0.402
Lesions			
Supratentorial	192 (64.6%)	107 (61.8%)	0.543
Infratentorial	60 (20.2%)	47 (27.2%)	0.082
Supra+Infra tentorial	45 (15.2%)	19 (11.0%)	0.204
Co-existing conditions			
Ischaemic heart disease	77 (25.9%)	52 (30.1%)	0.333
Hypertension	244 (82.2%)	150 (86.7%)	0.196
Dyslipidemia	145 (48.8%)	81 (46.8%)	0.675
Diabetes	199 (67.0%)	120 (69.4%)	0.597
Atrial fibrillation	53 (17.8%)	35 (20.2%)	0.522
Chronic Obstructive Pulmonary Disease (COPD)	36 (12.1%)	23 (13.3%)	0.711
Hypoproteinemia	33 (11.1%)	20 (11.6%)	0.882
Renal dysfunction	44 (14.8%)	31 (17.9%)	0.375
Hyponatremia	55 (18.5%)	37 (21.3%)	0.449
Hypokalemia	21 (7.1%)	17 (9.8%)	0.291

[Table/Fig-2]: Univariate analysis of variables associated with pneumonia after ischaemic stroke.

p-value <0.005 was considered statistically significant

Variables	OR	95% CI		p-value
		Lower	Upper	
Age (>70 years)	2.015	0.963	4.216	0.063
Bed ridden	40.645	15.483	106.700	0.001
GCS (<13)	0.643	0.282	1.465	0.293
NIHSS score (≥5)	0.619	0.272	1.409	0.253
Water swallow test score (≤2)	70.745	27.763	180.270	0.001

[Table/Fig-3]: Logistic regression modelling of risk factors for pneumonia after ischaemic stroke.

OR: Odds ratio; CI: Confidence interval; GCS: Glasgow coma scale; NIHSS: National institute of health stroke scale; p-value <0.005 was considered statistically significant

with reduced consciousness, impaired gag reflexes or swallowing disturbances in their study [12].

Defect in swallowing or dysphagia makes patients prone for aspirations; leading to aspiration pneumonia. This will add to the

morbidity and delay stroke recovery. Often they need invasive procedures, which increases risk of pneumonia. Thus it is necessary to perform tests and evaluation for deglutition for all acute stroke patients. Precautions need to be taken to decrease the incidence of infection. Strictly following aseptic techniques and parenteral nutrition may provide a solution for such patients. [13].

Stroke patients who are bedridden have increased risk of hypostatic pneumonia. Frequent change of position, passive and active movements will aid to decrease the bed ridden time. The need for starting early chest physiotherapy and similar exercises are essential in such patients.

Limitation(s)

The greatest limitation of present study was the retrospective design and the conclusions were based on observation from a single study centre. Also, the sample size was relatively low. Thus, a prospective multicentre study is required to further evaluate the predictors.

CONCLUSION(S)

Bed ridden status and water swallow test score were significant risk factors of ischaemic stroke associated with pneumonia. Hence, an early identification of these factors and a better knowledge of them may help in better care and prevention of pneumonia in acute stroke patients.

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