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## Aspiration pneumonia in patients with cerebral infarction

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## A B S T R A C T

**Background:** Aspiration pneumonia is a major complication and cause of death in patients admitted to intensive care units. Numerous features about this condition still remain imprecise. One of its causes could be cerebral infarction. So it is needed to study its prevalence in the population presenting with cerebral infarction. The present study was conducted to determine the frequency of aspiration pneumonia in patients with cerebral infarction.

**Methodology:** This cross sectional study was conducted at Department of Medicine Ayub Teaching Hospital Abbottabad Pakistan from July 2020 to April 2021. Both male and female patients of age 40-70 years with cerebral infarct who developed neurological deficit within 48 hours of stroke onset were included in the study. Each patient underwent thorough history and clinical examination. Data was recorded on a proforma and the collected data was entered and analyzed using SPSS 24. Quantitative data like age, temperature, blood pressure (BP), Glasgow coma scale (GCS) score, fasting blood sugar (FBS) and body mass index (BMI) were presented as mean and standard deviation. Qualitative data like gender, impaired gag reflex and presence of aspiration pneumonia were presented as frequencies and percentages. Data was stratified for BP, FBS, age, gender and BMI.

**Results:** A total of 217 patients were enrolled for study. Mean age of the study participants was  $54.79 \pm 7.45$  years. Males were 124 (57.1%) and remaining 93 (42.9%) patients were females. Mean body temperature of the study participants was  $103.05 \pm 1.21^\circ\text{F}$ , Mean score on GCS was  $9.04 \pm 1.76$ , Gag reflex was impaired in 68 (31.3%) patients, mean systolic BP was  $143.02 \pm 10.19\text{mmHg}$ , Mean BMI was  $32.04 \pm 3.91\text{kg/m}^2$ . Mean FBS was  $129.02 \pm 10.86\text{mg/dl}$ . Aspiration pneumonia was noted in 46 (21.2%) cases while 171 (78.8%) patients had no aspiration pneumonia. There was no impact of age, gender, BMI, FBS and BP on cerebral infarction-associated aspiration pneumonia.

**Conclusion:** Aspiration pneumonia has been observed in around one fifth of the patients with cerebral infarction.

**Key words:** Cerebral infarction; aspiration pneumonia; stroke

## Introduction

Cerebral infarction is a major risk factor for aspiration pneumonia.<sup>1</sup> Historically stroke or cerebrovascular accident has been classified as hemorrhagic or embolic.<sup>1</sup> The embolic stroke is also known as cerebral infarction. A Cerebral infarction usually manifests as a sudden loss of neurological function due to interrupted blood supply itself.<sup>1</sup> Stroke is the fifth leading cause of death in United States.<sup>2,3</sup> Fifteen million strokes occur globally each year. About two-thirds of these patients develop permanent disability or die.<sup>4</sup> Up to one-third of stroke patients suffer from pneumonia hence enhancing the morbidity and mortality associated with this condition.<sup>5</sup> Pneumonia is considered the highest attributable factor for mortality among all medical complications following stroke.<sup>6</sup> Although there is no published data available regarding its incidence and prevalence in our country but in our neighboring country India the estimated incidence is around 116-163 per 100,000 population.<sup>7</sup> The incidence of death from aspiration pneumonia or choking in patients who died with stroke is approximately 5%.<sup>8</sup> It is difficult to differentiate ischemic stroke from hemorrhagic stroke on the basis of history and clinical examination findings alone.<sup>9</sup> Brain imaging with computed tomography (CT) scanning or magnetic resonance imaging (MRI) is required for accurate diagnosis.<sup>9</sup> Globally, in majority of cases the stroke burden is attributable to the potentially treatable risk factors including hypertension, hyperlipidemia, diabetes mellitus and smoking.<sup>10</sup> A review of recent literature regarding frequency of aspiration pneumonia suggests its occurrence in about 17.8% and 17.0 % in patients with ischemic stroke having dysphagia, impaired Glasgow Coma Scale and significantly impaired mobility.<sup>11,12</sup> Attempts at reducing the occurrence of aspiration pneumonia in these patients have good prognostic implications and can lead to gross reduction in morbidity and mortality associated with this condition. No study has been conducted on this issue during recent years in our region. The purpose of our study was to find out the frequency of aspiration pneumonia in patients with cerebral infarction in our region. The results of our study may be utilized as local evidence and will guide the health

care individuals in instituting meaningful interventions.

## Methodology

This cross sectional study was conducted at Department of Medicine Ayub Teaching Hospital, Abbottabad Pakistan from July 2020 to April 2021. A total of 217 patients were enrolled for study via consecutive non probability sampling technique. Both male and female patients of age 40-70 years with cerebral infarct who developed neurological deficit within 48 hours of stroke onset were included in the study while patients with history of bronchiectasis, pulmonary fibrosis, chronic obstructive pulmonary disease, parkinson's disease, multiple sclerosis, myasthenia gravis, congestive cardiac failure, renal failure, decompensated liver disease and patients with major psychiatric disorder were excluded. Aspiration pneumonia was diagnosed by findings of body temperature of 100°F or above, audible crepitations on lung auscultation, Glasgow coma scale (GCS) of less than 13/15, impaired gag reflex and heterogeneous lung opacities on chest x-ray involving middle or lower zones. Ischemic stroke was defined by onset of neurological function in a patient with CT scan brain findings of hypodense area consistent with cerebral infarction.

After taking approval from the Hospital ethical committee patients were enrolled in the study.

The purpose of the study was explained to each patient and/or his/her near family member and written informed consent was obtained before collecting the data. Each patient underwent thorough history and clinical examination including weight, height, blood pressure (BP), body temperature, GCS score, chest auscultation and gag reflex. Data was recorded on a predesigned proforma along with information regarding stroke and aspiration pneumonia. Body mass index (BMI) was calculated by the formula: weight/height<sup>2</sup>. Chest X-rays and CT scans were reported by a consultant radiologist having at least 5 years experience.

The collected data was entered and analyzed using SPSS 24. Quantitative data like age, temperature, BP, GCS score, FBS and BMI were presented as mean and standard deviation. Qualitative data like gender, gag reflex and aspiration pneumonia were presented as frequencies

Table 1. Stratification with respect to age for the aspiration pneumonia

Age Group		Aspiration pneumonia		P-Value
		Yes	No	
Group of age	40-50 years	23 (20.9%)	87 (79.1%)	0.54
	>50 years	23 (21.5%)	84 (78.5%)	
Total		46 (21.2%)	171 (78.8%)	217 (100.0%)

Table 2. Stratification with respect to gender for the aspiration pneumonia

Gender		Aspiration pneumonia		P-Value
		Yes	No	
Group of patients	Male	26 (21.0%)	98 (79.0%)	0.57
	Female	20 (21.5%)	73 (78.5%)	
Total		46 (21.2%)	171 (78.8%)	217 (100.0%)

and percentages. Data was stratified for BP, FBS, age, gender and BMI. Post stratification chi square test was applied at a p value of <0.05.

## Results

Mean age of the study participants was  $54.79 \pm 7.45$  years. Males patients were 124 (57.1%) and females were 93 (42.9%). Diffuse lung crepitations on auscultation were present on right side in 91 (41.9%), on left side in 83 (38.2%) and on both sides in 43 (19.8%) cases. Mean body temperature of the study participants was  $103.05 \pm 1.21^\circ\text{F}$ . Mean GCS score was  $9.04 \pm 1.76$ . Gag reflex was impaired in 68 (31.3%) patients while it was normal in 149 (68.7%). Mean systolic BP was  $143.02 \pm 10.19$  mm Hg, Mean BMI was  $32.04 \pm 3.91$  kg/m<sup>2</sup> and Mean FBS was  $129.02 \pm 10.86$ . Aspiration pneumonia was noted in 46 (21.2%) cases while the remaining 171 (78.8%) patients didn't have. On stratification it was found that there was no impact of age, gender, BMI, FBS and BP on aspiration pneumonia associated with cerebral infarction (Table 1-5).

## Discussion

This was the first study in our region to explore the frequency of aspiration pneumonia in patients with cerebral infarction. In this study we observed that a significant number of subjects with cerebral infarction suffered from pneumonia. Aspiration pneumonia is a major complication of stroke and is causing considerably high mortality and morbidity in these patients. It is observed that up to 40% of patients with stroke have some degree of swallowing difficulties during early days of disease onset. For those who have dysphagia it is recommended to have no oral intake or small volumes, thickened fluids or food with soft consistency.<sup>13</sup> It is

understood that oral feeding is not permissible for patients having risk of aspiration. There is still ongoing debate about the safety of water by mouth. One point in favour of safety is the fact that as every patient is already aspirating his/her normal saliva of about 1–2 liters per day so oral water intake in small sips may not be that much big issue. Patients also feel thirsty and dryness of mouth despite adequate fluid replacement by nasogastric tube feeding or intravenous infusion.<sup>14</sup> There is also risk of worse oral hygiene in patients denied oral fluids and the resultant infected saliva aspiration can cause pneumonia.<sup>15</sup> Studies have shown that patients with cerebral stroke are at significantly higher risk of developing pneumonia. However, there are no reports of any association between cerebral infarction and pneumonia.<sup>16,17</sup> Some investigators reported that pneumonia was observed more frequently in subjects with deep infarcts, but there was no significant incidence of pneumonia in patients with superficial infarcts.<sup>18</sup> It is also observed that patients with deep strokes e.g; basal ganglia strokes had higher incidence of pneumonia.<sup>19</sup> The obvious reason in these patients may be the more impaired swallowing reflex and frequent aspiration during sleep.<sup>20,21</sup> Studies done on animals show that the neural circuits involving the basal ganglia along with some other brain parts take part in the modulation of swallowing. The reason is that deep infarcts though clinically silent, may predispose these subjects to develop pneumonia more frequently probably due to frequent aspiration during sleep.<sup>22</sup> Pneumonia is considered as the second most common and severe life-threatening complication of stroke following increased intracranial pressure. It is thought that pneumonia in stroke patients develops as a result of aspiration due to swallowing difficulties and immobilization.<sup>23</sup> Dysphagia

Table 3. Stratification with respect to Blood pressure for the aspiration pneumonia

Blood pressure		Aspiration pneumonia		P-Value
		Yes	No	
Group of blood pressure	Normal	23 (25.3%)	68 (74.7%)	0.14
	High blood pressure	23 (18.3%)	103 (81.7%)	
Total		46 (21.2%)	171 (78.8%)	217 (100.0%)

Table 4. Stratification with respect to fasting blood sugar for the aspiration pneumonia

DM		Aspiration pneumonia		P-Value
		Yes	No	
Group of fasting blood sugar	Non diabetic	14 (15.9%)	74 (84.1%)	0.07
	diabetic	32 (24.8%)	97 (75.2%)	
Total		46 (21.2%)	171 (78.8%)	217 (100.0%)

Table 5. Stratification with respect to BMI for the aspiration pneumonia

BMI		Aspiration pneumonia		P-Value
		Yes	No	
Category of BMI	Normal BMI	21 (23.9%)	67 (76.1%)	0.26
	High BMI	25 (19.4%)	104 (80.6%)	
Total		46 (21.2%)	171 (78.8%)	217 (100.0%)

was noted in around 40 to 70% of patients following stroke. Among those patients aspiration was noted in around 40% cases. It is well known that the risk of pneumonia increases several folds by post stroke aspiration however in acute strokes aspiration alone cannot be held responsible for pneumonia.<sup>24,25</sup> Some data from stroke patients suggest that cell-mediated immunity is suppressed by stress mediators, which may be responsible for the high incidence of infections in stroke patients.<sup>26</sup> Post stroke complications especially infections are preventable and mortality and morbidity can be lowered by more than 30% with early diagnosis and management. Acute injury of the brain including stroke plays important role in disturbing immune system of the patients.<sup>27</sup> These patients remain susceptible to infections beyond the acute phase as well. Infections in the early phase of stroke also render these patients susceptible to infections in later times. Thus, it is noted that impaired defense is responsible for high rate of pneumonia in stroke patients.<sup>28</sup>

It has been noted that in majority of cases there was lobar pneumonia as a result of aspiration of streptococcus pneumonia.<sup>29</sup> Lobar pneumonia is often caused by streptococcus pneumoniae in elderly patients and around half of these patients develop bacteremia or septicemia. Streptococcus pneumoniae is the most common microorganism in patients presenting with community acquired pneumonia with serious complications globally.<sup>30</sup> Stroke-associated pneumonia in the hospitalized patients is often caused by mixed organisms including Gram-positive and Gram-negative bacteria. Studies in mice have shown spontaneous Gram negative (mainly *Escherichia coli*) pneumonia after cerebral ischemia.<sup>31</sup> Stroke is complicated by various medical complications

like pneumonia, urinary tract infections, venous thromboembolism, bed ulcers, muscle contractures and malnutrition. A lot can be done to prevent these complications if stroke care is improved.<sup>32,33</sup>

Pneumonia is one of the leading causes of death in patients sustaining stroke. Though aspiration is the main cause of pneumonia in these patients but other reasons like hypostatic pneumonia due to poor caring and immobilization also play significant role.<sup>34</sup> In order to implement organized stroke care the health care team needs to properly understand the risk factors and comorbid conditions.<sup>35</sup> No sufficient evidence exists which can address the issue of withdrawal or modification of oral intake in the prevention of aspiration pneumonia after stroke. There is still controversy regarding withdrawal or modification of oral intake in order to prevent aspiration pneumonia and this area needs further research recommendation.<sup>34</sup>

Our study has several limitations. The study was of short duration and single centered. We excluded a large variety of patients with various comorbidities as mentioned in the Methodology section above. Inclusion of such patients might have altered the results considerably. Further large scale studies are needed for determining actual frequency of aspiration pneumonia at multiple centers so that results could be used for making future decisions and policies.

## Conclusion

Around one fifth of patients could be diagnosed with aspiration pneumonia after cerebral infarction. Close monitoring of the patients is necessary to control various secondary complications of the cerebral infarct in order to help reduce mortality and morbidity.



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