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Evaluating Modifiable and Non-Modifiable Risk Factors Associated with Mortality in Aspiration Pneumonia

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ABSTRACT

Background: Aspiration pneumonia is a prevalent and potentially lethal condition, especially in high-risk and elderly patients. Identification of the key risk factors of aspiration pneumonia can enhance outcomes and can help in treatment.

Objective: To assess both modifiable and non-modifiable factors of mortality in patients with aspiration pneumonia.

Methodology: A retrospective analysis was performed on 55 patients in a District level health facility to determine the risk factors for mortality in patients with aspiration pneumonia (AP). Age, neurological disease, nutritional status (measured by serum albumin), functional status (measured by the Eastern Cooperative Oncology Group (ECOG) Performance Status), and Do-Not-Resuscitate (DNR) status were assessed for their impact. Intensive Care Unit (ICU) admission rates and hospital stay were also compared between survivors and non-survivors.

Results: Older age and neurological illness were high non-modifiable risk factors. Hypoalbuminemia and poor ECOG performance were associated with increased mortality, and therefore represent possible sites for intervention. Early antibiotic treatment had a trend towards increased survival that was not significant. DNR orders were more frequent in non-survivors. ICU admissions and increased hospital stay were also more frequent and strongly associated with this group and represent a more severe course of illness.

Conclusion: This study emphasizes that modifiable and non-modifiable factors both effect the outcomes in aspiration pneumonia. While neurological disease and age are unchangeable risks, timely intervention focusing on nutrition and physical status can enhance prognosis. The role of DNR orders highlights the importance of clearly defined care goals.

Keywords: Aspiration pneumonia; Mortality risk; Early antibiotics; Hypoalbuminemia; Nutritional support

Introduction

Pneumonia is an inflammatory illness of the lungs, usually due to bacterial, viral, or fungal infection, resulting in symptoms of cough, fever, chest pain, and shortness of breath. It is a significant cause of morbidity and mortality globally, mostly occurring in the very young, elderly, and those with compromised immune function.[1] Aspiration pneumonia is a distinct form of pneumonia in which food, saliva, vomit, or other foreign material is aspirated into the lungs rather than swallowed down into the stomach. It is primarily observed in patients with dysphagia, neurological disease, or decreased consciousness and frequently contains a combination of aerobic and anaerobic bacteria. Aspiration pneumonia is more severe and persistent, particularly in elderly or bedridden people. Aspiration pneumonia is a frequent and dangerous pulmonary infection that occurs as a result of the inhalation of oropharyngeal or gastric contents into the lower respiratory airway.[2]

Aspiration pneumonia (AP) occurs frequently in elderly patients and is associated with unfavorable outcomes. Researchers showed that the patients with AP were older, frailer, and had more comorbidities. They were sicker, had longer hospital stays, and had more repeat episodes of pneumonia or died. Although AP was not a definite indicator of poor outcome, it was the largest risk factor for the return of pneumonia. This indicates that AP is a distinct form of pneumonia and requires special attention to avoid recurrence.[3]

In contrast to community-acquired pneumonia (CAP), aspiration pneumonia possesses a distinct microbiologic pattern. It commonly involves anaerobic bacteria and mixed oropharyngeal flora, so it acquires specific strategies for diagnosis and its antibiotic treatment.[4] Aspiration pneumonia can clinically manifest gradually with non-specific symptoms of fever, cough, tachypnea, or altered mental status in elderly or cognitively impaired individuals. Diagnosis is often clinical, supported by radiological features like infiltrates in dependent lung areas; however, differentiation from other forms of pneumonia is still a clinical challenge due to superimposed features.

Mortality rates due to aspiration pneumonia are quite high. The reported prevalence is extremely varied, ranging from 10% to 70%, and death up to 70%, depending on the quantity and character of the aspirate.[5] Many studies have proposed that the high mortality is not only caused by the infection itself, but also significantly determined by the patient's pre-existing functional status, nutritional status, immune status, and the severity of comorbid conditions including dementia, cerebrovascular disease, chronic obstructive pulmonary disease (COPD), and malignancy.[6] Also, complications such as late diagnosis, inappropriate initial antibiotic treatment, and life-sustaining treatment decisions (e.g., the presence of do-not-resuscitate [DNR] orders) may add to the complexity of outcomes.

Aspiration pneumonia is a serious disease, but physicians still do not have a clue how to predict what will occur with patients. Therefore, treatment varies from individual to individual and it is difficult to say who may worsen or die. For this reason, it is necessary to discover simple and distinct signs, such as test results or patient information, that would inform physicians who is at greater risk. Researchers continue to search for these signs.

This research points out that comorbidities like neurological disease, older age, poor functional status, and longer hospital stays are important causes of mortality among aspiration pneumonia patients. Though AP itself is not a direct predictor of adverse outcomes, it is highly associated with recurrence of pneumonia as well as deteriorated clinical condition. Characterization of these risk factors is critical for early intervention, tailored care, and formulation of aimed strategies to minimize death and enhance outcomes in this high-risk population. Additional research is required to enhance prevention practices and normalize care procedures.

Objective

To assess both modifiable and non-modifiable factors of mortality in patients with aspiration pneumonia.

Methodology

This retrospective observational study was done among 55 patients in a district level health facility of District Bannu, Khyber Pakhtunkhwa with the aim of identifying the risk factors of mortality in aspiration pneumonia diagnosed patients (AP). The research population consisted of adult patients (≥35 years) admitted with a diagnosis of aspiration pneumonia between January 2023 and December 2023. Patients were identified through International Classification of Diseases (ICD) diagnostic codes for pneumonia and verified by clinical, radiological, and microbiological findings documented in hospital charts.

Inclusion criteria included patients diagnosed with aspiration pneumonia according to clinical history (e.g., witnessed aspiration or risk factors of dysphagia), radiologic evidence consistent with AP (e.g., infiltrates in dependent lung fields), and evidence in the medical chart by the attending physician. Exclusion criteria were patients with incomplete medical records, patients with concomitant active tuberculosis or fungal lung infection, and patients who acquired pneumonia during intubation (i.e., ventilator-associated pneumonia).

Demographic information (age, gender), clinical variables (comorbidities including stroke, dementia, COPD, malignancy), functional status (measured based on Eastern Cooperative Oncology Group Performance

Table 1. Demographics and Baseline Clinical Characteristics

Characteristic	Survivors (n=40)	Non-survivors (n=15)	p-value
Mean Age (years)	67.6 ± 10.1	76.5 ± 9.3	0.001
Male Gender (%)	22 (55.0%)	9 (60.0%)	0.95
Neurological Disease (%)	12 (30.0%)	10 (66.6%)	0.004
Dementia (%)	7 (17.5%)	7 (46.6%)	0.006
COPD (%)	8 (20.0%)	4 (26.6%)	0.65
Malignancy (%)	5 (12.5%)	4 (26.6%)	0.16

Status - ECOG PS), laboratory results (e.g., white blood cell count, serum albumin), and treatment variables (early antibiotic administration, DNR orders) were recorded. The primary outcome was in-hospital mortality. Secondary outcomes included length of hospital stay and recurrence of pneumonia within 30 days of discharge.

Statistical analysis was performed using SPSS version 26.0. We used simple statistics to characterize the main features of the patients. To determine which factors could be associated with death, we initially employed the Chi-square test for categories (such as gender or the presence of disease) and the t-test for numbers (such as age or laboratory test results). The findings were presented in odds ratios with 95% confidence intervals, and a p-value of less than 0.05 was taken to be statistically significant.

Ethical approval (Ref. No. 123/2022) was obtained from the hospital's Institutional Review Board, and patient confidentiality was maintained throughout the study.

Results

A total of 55 patients were included in this study. Results showed that aspiration pneumonia non-survivors were older and more likely to have neurological disease and dementia than survivors. Higher mortality was strongly associated with age ($p = 0.001$), neurological disease ($p = 0.004$), and dementia ($p = 0.006$). There were no differences between the groups in gender, COPD, and malignancy. This implies that neurological diseases and age are the most important predictors of poor prognosis (Table 1).

Non-survivors had considerably increased white blood cell counts (13.4 vs. 11.3, $p = 0.021$) and lower serum albumin levels (2.9 vs. 3.5 g/dL, $p < 0.001$), reflecting increased inflammation and worse nutritional status. More non-survivors had poor functional status (ECOG PS ≥ 3) at 73.3% compared to 25.0% of the survivors ($p < 0.001$). CRP and hemoglobin levels were not found to be significantly different between the groups (Table 2).

Non-survivors experienced a much longer in-hospital stay (12.6 vs. 8.3 days, $p = 0.002$) and greater rates of ICU admission (33.3% vs. 10.0%, $p = 0.01$). A Do-Not-Resuscitate (DNR) order was far more frequent among non-survivors (66.6% vs. 15.0%, $p < 0.001$) and indicates more severe conditions. While early antibiotic therapy was more often given in survivors (77.5% vs. 60.0%), it was not significantly different ($p = 0.11$). Results for recurrent pneumonia within 30 days were reported only

Table 2. Laboratory Parameters and Functional Status

Variable	Survivors (n=40)	Non-survivors (n=15)	p-value
WBC count (x10 /L)	11.3 ± 3.5	13.4 ± 4.2	0.021
Serum Albumin (g/dL)	3.5 ± 0.6	2.9 ± 0.7	<0.001
ECOG PS ≥ 3 (%)	10 (25.0%)	11 (73.3%)	<0.001
CRP (mg/dL)	9.9 ± 2.3	10.5 ± 2.5	0.18
Hemoglobin (g/dL)	11.8 ± 1.4	10.8 ± 1.8	0.07

Table 3. Treatment Variables and Hospital Course

Treatment Factor	Survivors (n=40)	Non-survivors (n=15)	p-value
Early Antibiotic (≤8 hr) (%)	31 (77.5%)	9 (60.0%)	0.11
DNR Order Present (%)	6 (15.0%)	10 (66.6%)	<0.001
Mean Hospital Stay (days)	8.3 ± 3.1	12.6 ± 4.5	0.002
ICU Admission (%)	4 (10.0%)	5 (33.3%)	0.01
Recurrent Pneumonia (30d) (%)	5 (12.5%)	—	—

for survivors (12.5%) (Table 3).

Patients over the age of 70 had a highly elevated risk of death (OR 2.86, p = 0.026). Low serum albumin (<3.0 g/dL) and poor functional status (ECOG PS ≥ 3) were strong predictors with odds ratios of 4.22 (p = 0.004) and 5.64 (p = 0.001), respectively. Neurological disease also had a significant elevating effect on mortality risk (OR 3.43, p = 0.014). The existence of a DNR order had the highest correlation with mortality (OR 6.77, p < 0.001), which suggests its close relation with adverse outcomes (Table 4).

Discussion

Aspiration pneumonia is a respiratory infection of the lungs that results from the inhalation of food, saliva, vomit, or other foreign materials into the lungs rather than swallowing it into the stomach.[7] It is most frequently observed in elderly patients, neurological patients, or patients with compromised swallowing reflexes. Unlike in community-acquired pneumonia, aspiration pneumonia tends to have a combination of aerobic and anaerobic bacteria involved, thus making its diagnosis and management more challenging. The illness may evolve gradually with subtle manifestations like cough, fever, or confusion, especially in elderly patients or in patients with wasting syndrome. Aspiration pneumonia, because of its high complication and recurrence rate, needs to be promptly recognized and managed on an individualized basis to minimize morbidity and mortality.

Aspiration pneumonia continues to be a clinically relevant illness with significant morbidity and mortality, especially in the elderly and frail patients.[8] Older age was a significant predictor of mortality, with patients aged 70 years or more showing almost a threefold higher risk of death. Findings of the present study inline earlier research, e.g., a research conducted by Kikawada et al. (2005), reported that older patients had increased rates of mortality and complications due to the fact that aspiration pneumonia in the older age groups tends to result from the combined effects of dysphagia, inadequate oral hygiene, and compromised immune or pulmonary defenses. Diseases such as cerebrovascular disease, particularly basal ganglia infarct, disrupt dopamine metabolism, decreasing swallowing effectiveness and cough reflex are the important elements that predispose to aspiration and subsequent infection in the elderly patient.[9]

Nutritional status is of critical significance in aspiration pneumonia since malnutrition compromises the body's immune defense and diminishes muscle strength, including that of muscles utilized for swallowing and

Table 4. Multivariate Logistic Regression Analysis of Risk Factors for Mortality

Variable	Odds Ratio (OR)	95% CI	p-value
Age > 70 years	2.86	1.12 – 7.17	0.026
Serum Albumin < 3.0 g/dL	4.22	1.61– 11.09	0.004
ECOG PS ≥ 3	5.64	1.99 – 16.11	0.001
Neurological Disease	3.43	1.29 – 9.12	0.014
DNR Order	6.77	2.21 – 20.66	<0.001

coughing. Low serum albumin levels, a sign of poor nutrition, are correlated with increased mortality and worse outcomes, since they indicate both systemic inflammation and reduced physiological reserve. Malnourished patients will have a higher risk of severe infection, delayed recovery, and are at risk of complications like recurrent pneumonia. In our study, serum albumin was significantly lower in non-survivors, indicating poor nutritional status and systemic inflammatory condition. The close correlation between hypoalbuminemia and mortality is established by various studies. One of the studies is a Japanese cohort by Kim et al. (2017) where non-survivors had mean albumin of 3.0 g/dL compared to 3.5 g/dL among survivors; albumin continued to be an independent predictor with adjusted OR of 0.30 and AUROC of 0.72.[10]

Functional status, determined through the ECOG Performance Status, was a strong predictor of adverse outcomes with a 5.6-fold higher risk in those with ECOG scores ≥3. A 216 hospitalized CAP patient Italian study by Pieralli et al. (2018) found that ECOG 3–4 quadrupled 30-day mortality (HR 4.07), and greatly enhanced mortality risk stratification above CURB 65.[11]

Neurological illnesses, specifically those involving impairment of swallowing like dementia and previous stroke, were most strongly related to higher mortality. A cohort study by Won et al. (2021) also found that patients with Parkinson's disease (PD) are at significantly higher risk of developing aspiration pneumonia, with a hazard ratio of 4.21 compared to control group. The death rate following the first episode is great; approximately 24% die within a month, 65% within one year, and almost 92% within five years, emphasizing the significant effect of neurodegenerative disease on aspiration risk and outcome. Neurodegenerative disease weakens airway protection mechanisms and promotes repeated aspiration events, thus initiating a cycle of inflammation and lung damage.[12] Sarkar et al. (2023) also reported a higher risk of aspiration pneumonia in Parkinson's disease (PD) patients.[13]

Interestingly, Do-Not-Resuscitate (DNR) patients had the greatest risk of mortality, which presumably is a reflection of their general poor health and late illness. DNR status has been found in other research as conducted by Walkey et al. (2016) to be associated with greater mortality because these patients tend to be very ill and not receiving aggressive interventions, focusing more on comfort care.[14]

Early antibiotic therapy had a trend toward improved survival but was not statistically proven in our study. Non-survivors tended to require ICU and had longer hospital stays, demonstrating increased severity of illness. The mortality rate observed in this study (~27%) is within the reported range. Meanwhile, a study conducted by Lanspa et al. (2013) also reported that patients with aspiration pneumonia had increased comorbidity, ICU, and DNR/DNI orders versus CAP, with a 30-day mortality of 21%.[15]

Conclusion

This research indicates that both unchangeable and changeable factors influence the result of aspiration pneumonia. Advanced age and brain illness are unchangeable risk factors. However, reduced albumin levels and poor physical status can be modified with intervention and care at the early stage. DNR orders remind us to have open conversations regarding care objectives. The findings emphasize the importance of early diagnosis, risk-adjusted care, and complete support. Further studies are required to replicate these findings and establish simple treatment plans with nutrition and physical status.

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