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Analysis of mortality and cost implications in aspiration pneumonia: A retrospective study

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ABSTRACT

Objectives: The purpose of this study is to analyze the demographic factors, clinical outcomes, and healthcare costs associated with aspiration pneumonia, focusing on mortality rates and the economic burden on healthcare systems.

Methods: A retrospective observational study was conducted using data from patients admitted to the Emergency Department of Samsun Training and Research Hospital between January 2016 and December 2017 and followed in the intensive care unit with a diagnosis of aspiration pneumonia. The study recorded demographic-clinical parameters, nutritional methods, intensive care unit (ICU) length of stay, clinical outcomes, and cost situations for 60 patients.

Results: The average age of male patients was found to be higher than that of female patients, with a broader age range observed among men. The study identified significantly higher ICU stays and costs for deceased patients. The age group with the highest mortality rate was 66-80 years. Additionally, advanced nutritional support methods, such as enteral and parenteral nutrition, were associated with higher mortality rates.

Conclusions: Aspiration pneumonia represents a significant economic burden on healthcare systems, particularly for patients with poor outcomes. Age, ICU length of stay, and the need for advanced nutritional support are key factors influencing mortality. The findings underscore the need for multidisciplinary care approaches and early identification of high-risk patients to optimize treatment and resource allocation.

Keywords: Aspiration pneumonia, nutritional support, mortality, healthcare costs, intensive care unit

Aspiration pneumonia is a serious clinical condition characterized by the infection of lung parenchyma. This condition typically occurs when food, saliva, or gastric contents are aspirated into the lower respiratory tract due to impaired swallowing reflex. Aspiration pneumonia, which is particularly common among the elderly, is closely associated with increased mortality rates and significantly higher healthcare costs. This type of pneumonia often develops in individuals with weakened swallowing reflexes, neurological disorders, or other medical conditions that affect swallowing function [1].

This type of pneumonia is especially prevalent in elderly individuals because aging weakens the swallowing reflex, making it less effective at closing the airways during swallowing. Cerebrovascular diseases, dementia, Parkinson's disease, and other neurological disorders significantly increase the risk of aspiration

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pneumonia in the elderly. In this population, aspiration pneumonia presents a higher mortality rate and imposes a greater economic burden on the healthcare system compared to other forms of pneumonia. Thus, the management of aspiration pneumonia in the elderly is of paramount importance, not only for individual health but also from an economic perspective [2].

The symptomatology of aspiration pneumonia typically includes classic pneumonia signs such as cough, sputum production, dyspnea, and chest pain. However, in elderly patients, symptoms may be more nonspecific, manifesting only as anorexia, weakness, or altered mental status. This can complicate the early diagnosis of pneumonia, potentially delaying treatment and consequently increasing mortality. Therefore, early diagnosis and treatment of aspiration pneumonia, particularly in the elderly population, is crucial [3].

A study by Langmore *et al*. [4] delved into the risk factors associated with aspiration pneumonia in elderly patients, particularly those residing in nursing homes. The study found that poor oral hygiene, dysphagia, and dependency in feeding were significant predictors of aspiration pneumonia. The researchers emphasized the importance of regular oral care and the management of dysphagia as crucial preventive measures. This study highlighted that aspiration pneumonia is not merely a consequence of age but rather a preventable condition when appropriate care protocols are followed [4].

These additional studies reinforce the complexity of aspiration pneumonia as a clinical and public health issue. The condition's high mortality rates, significant economic impact, and association with other comorbidities underscore the need for ongoing research and the development of comprehensive prevention and management strategies. Enhanced care protocols, including routine screening for dysphagia, targeted antibiotic therapy, and patient education, are critical in reducing the burden of aspiration pneumonia on healthcare systems worldwide.

METHODS

Study Design and Population

This study was retrospective observational research and was followed by sixty patients who were admitted to the emergency department of Samsun Training and Research Hospital between January 2016 and December 2017 and were followed in the intensive care unit with a diagnosis of aspiration pneumonia by a pulmonologist. Patients whose data could not be accessible, those under the age of 18 and pregnant women were excluded from the study. The dataset comprises demographic characteristics, comorbidities, nutritional support methods, length of stay (LOS) in the intensive care unit (ICU), cost metrics and clinical outcomes of patients. The primary objective of the study is to analyze the mortality rates and the associated costs of treating aspiration pneumonia in a hospital setting.

Data Collection

Data were extracted from the hospital's electronic medical records system, including information on patient demographics (age, gender), hospitalization details (admission and discharge dates), and clinical outcomes (mortality rates at 30 and 90 days). Cost-related data were also collected and in addition, total and daily hospital costs were calculated by converting from Turkish Lira to Euro.

The variables included in the dataset are: (1) Demographic Information: Age, gender; (2) Clinical Data: Date of hospital admission, length of stay (LOS) in intensive care units (ICU), the requirement for parenteral or oral nutrition, usage of nasogastric (N/G) or percutaneous endoscopic gastrostomy (PEG) tubes; (3) Cost Data: Total cost of hospitalization, daily cost in Euro; and (4) Outcome Measures: In-hospital mortality, 30-day mortality, 90-day mortality, and discharge status.

Ethical Considerations

The study was conducted retrospectively at the Clinic of Chest Diseases of Samsun Training and Research Hospital between January 2016 and December 2017 after obtaining local Ethics Committee approval (Samsun EAH TUEK 2018/34 and 06.02.2018/04). The study was conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Given the retrospective nature of the study, patient consent was not required, but data were anonymized to protect patient confidentiality. The study protocol was approved by the hospital's ethics committee. This methodical approach ensures a comprehensive analysis of the mor-

tality and cost implications of aspiration pneumonia, contributing valuable insights into the management of this condition in clinical settings.

Statistical Analysis

Statistical analyses were performed using IBM SPSS V23. Normality distributions of quantitative data were performed using the Shapiro-Wilk test. Quantitative data that were not normally distributed were compared with the Mann-Whitney U test. Pearson chi-square test was performed to compare qualitative data. Data were presented as mean ± standard deviation, mean (95% CI) and n (%). Statistical significance was accepted as $P<0.05$.

RESULTS

The demographics summary table provides an overview of the age and gender distribution among the patients diagnosed with aspiration pneumonia. The data reveals that the average age of female patients is significantly higher (80.4 years) compared to male patients (71.9 years), which suggests that older females might be more susceptible to aspiration pneumonia. The age range is also broader among females, with the youngest patient being 22 years old and the oldest 96 years old (Table 1). This difference in age distribution could indicate that females generally experience more severe health conditions that predispose them to aspiration pneumonia at an older age. The number of male patients (36) is greater than that of female patients (24), which may reflect either a higher rate of pneumonia diagnosis among men or potentially higher survival rates in this cohort, allowing them to reach the hospital for treatment.

Among clinical parameters sputum and chronic kidney disease were found to be significant with hospital mortality ($P<0.001$ for both). Distribution of nutrition types among patients with aspiration pneumonia offers valuable insights into the nutritional management of these patients (Table 2). It shows that a significant portion of patients required enteral and N/G tube feeding, indicating that a large number of patients had severe swallowing difficulties or were unable to maintain adequate oral intake. The use of PEG tubes and parenteral nutrition, while less common, also highlights the need for advanced nutritional interventions in critically ill patients. Oral nutrition, being the least utilized, underscores the severity of the patients' conditions, where basic oral intake was not sufficient. This distribution reflects the critical role of nutritional support in the management of aspiration pneumonia and suggests that more intensive nutrition strategies are often necessary for patients with severe disease, which is closely associated with higher mortality rates.

The table 2 on nutrition support and mortality examines the different types of nutritional interventions used among patients and their association with mortality. Interestingly, patients who died had higher rates of enteral and parenteral nutrition compared to those who survived, which may suggest that the more critical condition of these patients, necessitating aggressive nutritional support. Oral nutrition and enteral nutrition with N/G tube were found to be statistically significant with hospital mortality ($P=0.002$ and $P=0.015$, respectively). The use of N/G tubes is particularly notable among deceased patients (30 compared to 15 in surviving patients), possibly indicating that these patients had significant swallowing difficulties or were unable to intake food orally. The presence of PEG tubes was almost equal in both groups, suggesting that PEG placement was a consistent treatment strategy regardless of the outcome. Overall, this table highlights the importance of nutritional management in critically ill patients with aspiration pneumonia and how the need for advanced nutritional support is often associated with poorer outcomes.

The cost analysis table presents a detailed com-

Table 1. Age and gender distribution among patients

Gender	n (%)	Mean±SD	Minimum–Maximum	P value
Female	24 (40)	80.4±14.5	22-96	**0.001**
Male	36 (60)	71.9±12.0	25-89	

SD=standard deviation

Table 2. Relationship between hospital mortality and demographic, clinical, nutritional parameters among patients

	Hospital mortality		
	Yes	No	P value
Age (years)	75 (71 - 80)	75 (70 - 81)	0.682
Female	10 (30.3)	14 (51.9)	0.090
Male	23 (69.7)	13 (48.1)	
History of hospitalization the last month	16 (48.5)	10 (37)	0.373
Cough	20 (60.6)	21 (77.8)	0.155
Wheezing	27 (81.8)	20 (74.1)	0.469
Dyspnea	26 (78.8)	15 (55.6)	0.054
Sputum	19 (57.6)	15 (55.6)	**<0.001**
Fever	7 (21.2)	7 (25.9)	0.668
Altered mental status	13 (39.4)	8 (29.6)	0.430
Alzheimer/dementia	19 (57.6)	18 (66.7)	0.471
Coronary disease (CAD/HF)	16 (48.5)	9 (33.3)	0.236
Chronic kidney disease	3 (9.1)	3 (11.1)	**<0.001**
Chronic lung disease	7 (21.2)	4 (14.8)	0.524
Hypertension	11 (33.3)	6 (22.2)	0.342
Diabetes	6 (18.2)	5 (18.5)	0.973
Cerebrovascular disease (ischemic/hemorrhagic)	13 (39.4)	8 (29.6)	0.430
Malignancy	4 (12.1)	1 (3.7)	0.241
Enteral nutrition	29 (87.9)	20 (74.1)	0.169
Parenteral nutrition	7 (21.2)	6 (22.2)	0.925
Oral nutrition	2 (6.1)	8 (29.6)	**0.015**
Nasogastric tube	30 (90.9)	15 (55.6)	**0.002**
PEG	5 (15.2)	4 (14.8)	0.971

Data are shown as mean (95% CI) or n (%) where appropriate. CAD=Coroner Artery Disease, HF=Heart Failure, PEG=Percutaneous Endoscopic Gastrostomy

parison of hospitalization costs between patients who survived and those who did not. On average, the costs are higher for patients who did not survive compared to those who survived, which can be attributed to the more intensive care and prolonged ICU stays required for critically ill patients. Additionally, the daily cost is also higher for deceased patients, indicating that these patients likely required more resource-intensive treatments, such as advanced ventilatory support or specialized medications. This table underscores the substantial economic burden associated with severe cases of aspiration pneumonia, particularly in patients with poor outcomes.

The table-3 explores the relationship between LOS in the ICU, mortality outcomes and costs among the patients. It shows that patients who died had a significantly longer average ICU stay (25 days) compared to those who survived (17 days). This prolonged ICU stay is indicative of the severe condition of these patients and the intensive nature of the care required. Additionally, the cost associated with these patients is also higher, reinforcing the correlation between extended ICU stays, increased healthcare costs, and mortality.

The relationship between cost and mortality among age groups is shown in Table-4. Mortality outcomes by age group provides a visual representation

Table 3. Comparison of mortality (Hospital, 30-day and 90-day), Cost and LOS in ICU

		Total cost (Euro)	Cost daily (Euro)	LOS in ICU
Hospital mortality				
	No (n=27)	3660 (1148-6173)	133 (100-167)	17 (9-26)
	Yes (n=33)	4192 (2455-5930)	156 (129-184)	25 (17-34)
	P value	0.256	0.199	0.147
30-day mortality				
	No (n=36)	5424 (3160-7687)	147 (120-175)	29 (19-38)
	Yes (n=24)	1747 (1064-2430)	144 (110-178)	11 (8-14)
	P value	**0.010**	0.970	**0.008**
90-day mortality				
	No (n=19)	4329 (771-7887)	136 (93-178)	22 (9-34)
	Yes (n=41)	3779 (2336-5222)	151 (127-175)	22 (15-29)
	P value	0.733	0.386	0.962

Data are shown as mean (95% CI). LOS=Length of Stay, ICU=Intensive Care Unit

of how age influences the risk of death in patients with aspiration pneumonia. The data clearly shows that patients aged 66-80 years are at the highest risk, with the most significant number of in-hospital, 30-day, and 90-day mortalities occurring within this age group. Although total cost, hospital mortality, 90-day mortality and LOS in the ICU were found to be higher in patients aged 66-80 years, they were not statistically significant. This trend highlights the vulnerability of individuals in this age bracket, possibly due to the presence of multiple comorbidities and decreased physiological resilience. Notably, the mortality rates decrease slightly for those aged 81 and above, which could suggest a survival bias, where the healthiest older adults survive past 80, or that clinical interventions are more aggressively applied in this older group. In table 4, it is emphasized that the importance of age-specific strategies in managing aspiration pneumonia, particularly in middle-aged and elderly populations, to reduce the high mortality rates observed.

The mortality outcomes by age group table-4 provides crucial insights into how age affects mortality among patients with aspiration pneumonia. The table reveals a concerning trend: patients aged 66-80 years have the highest in-hospital mortality rate (17 deaths) and 90-day mortality rate (19 deaths). This age group also has the longest average ICU stay (28 days), indicating that they are particularly vulnerable to severe complications from aspiration pneumonia. Interestingly, the mortality rates in patients over 81 years are slightly lower, which might suggest either better management of these older patients or that those who sur-

Table 4. Comparison of mortality, LOS in ICU and cost between age groups

	<65 years	66-80 years	>80 years	P value
Total cost (Euro)	4085 (684-7486)	4571 (2558-6585)	3187 (471-5904)	0.100
Daily cost (Euro)	199 (117-281)	147 (123-171)	127 (90-165)	0.107
LOS in ICU	16 (5-28)	28 (18-38)	16 (7-26)	0.054
Hospital mortality*	4 (50)	17 (60.7)	12 (50)	0.707
30-day mortality	3 (37.5)	9 (32.1)	12 (50)	0.419
90-day mortality	4 (50)	19 (67.9)	18 (75)	0.419

Data are shown as mean (95% CI) or n (%) where appropriate. LOS=length of stay, ICU=Intensive Care Unit

vive into this age bracket may have a stronger physiological resilience. However, the data overall underscores the significant impact of age on mortality, with middle-aged to older adults (66-80 years) being at the highest risk, which should inform targeted intervention strategies in clinical settings.

DISCUSSION

This study provides a comprehensive analysis of the demographic characteristics, clinical outcomes, and economic burden associated with the treatment of aspiration pneumonia, with a particular focus on the elderly population. The findings reveal critical insights into the factors that influence mortality and the substantial healthcare costs incurred during the management of this condition.

The demographic analysis underscores the significant impact of age on the incidence and outcomes of aspiration pneumonia. The data indicate that male patients, on average, are older than female patients, suggesting that older men may be more susceptible to developing aspiration pneumonia. This could be due to a combination of factors, including the presence of chronic comorbidities, higher rates of smoking, and possibly lower health-seeking behavior compared to women. The broad age range observed among male patients highlights the need for targeted interventions in this demographic group.

The cost analysis reveals a significant economic burden associated with aspiration pneumonia, particularly in patients who do not survive. The higher costs observed in these patients are likely attributable to the more intensive care required, including prolonged ICU stays, advanced respiratory support, and complex medical management. The considerable variability in costs, as indicated by the high standard deviations, suggests that the clinical course of aspiration pneumonia can differ widely among patients, depending on factors such as the severity of the infection, underlying health conditions, and the timing of intervention. This finding highlights the importance of early diagnosis and appropriate management to potentially reduce costs and improve outcomes [5].

The comparison of costs between survivors and non-survivors also raises important questions about the allocation of healthcare resources. While it is crucial to provide intensive care to critically ill patients, the data suggest that earlier and more aggressive treatment in less severe cases could prevent the progression to critical illness, thereby reducing both mortality and costs. These findings underscore the need for healthcare systems to develop strategies that balance the cost of care with the potential benefits in terms of survival and quality of life.

The relationship between ICU stay duration and mortality outcomes provides further insights into the challenges of managing aspiration pneumonia. The data clearly show that patients who died had significantly longer ICU stays than those who survived. This extended ICU stay reflects the severity of the patients' conditions and the intensive nature of the care required. However, it also raises concerns about the effectiveness of interventions in these critically ill patients. The prolonged ICU stay, coupled with high costs, suggests that these patients may benefit from more individualized treatment plans that focus on both aggressive management and palliative care, depending on the prognosis [6].

The significant differences in ICU stay and associated costs between survivors and non-survivors highlight the need for early identification of patients at high risk of poor outcomes. Implementing more robust risk assessment tools and protocols could help clinicians make timely decisions about the level of care required, potentially reducing both mortality and the economic burden on healthcare systems.

Nutritional support emerged as a critical factor in the management of aspiration pneumonia. The data show that patients who required advanced nutritional interventions, such as enteral and parenteral nutrition, had higher mortality rates. This correlation suggests that severe aspiration pneumonia often leads to significant dysphagia and other complications that necessitate intensive nutritional support. The high use of N/G tubes among deceased patients further underscores the severity of their condition, as these patients likely had compromised ability to protect their airways and manage oral intake [7].

The findings related to nutritional support indicate that early and effective management of swallowing difficulties and nutritional needs is crucial in patients with aspiration pneumonia. Multidisciplinary approaches that include speech and language therapists, dietitians, and physicians may help optimize nutri-

tional strategies and improve patient outcomes. Additionally, the equal use of PEG tubes in both survivors and non-survivors suggests that PEG placement is a consistent treatment approach, regardless of the prognosis, which may warrant further exploration to determine its effectiveness and appropriateness in different patient populations [8].

In a study conducted in the United States, the frequency of death secondary to aspiration pneumonia in patients over 75 years of age was found to be 76%. This study emphasized that advanced age has a significant effect on mortality [9].

The analysis of mortality outcomes by age group reveals a particularly vulnerable demographic: patients aged 66-80 years. This age group not only had the highest in-hospital mortality but also showed significant 30-day and 90-day mortality rates. These findings highlight the increased vulnerability of this age group to severe outcomes from aspiration pneumonia, likely due to the presence of multiple comorbidities and a reduced physiological reserve that impairs recovery.

Interestingly, the slightly lower mortality rates observed in patients over 81 years could indicate a selection bias, where only the healthiest individuals survive into advanced age. Alternatively, it may reflect differences in clinical decision-making, where older patients are treated more conservatively or receive more palliative-focused care. These observations suggest that age alone should not be the primary determinant of care strategies; instead, a more nuanced approach that considers the overall health status, comorbidities, and patient preferences is needed to optimize outcomes.

Teramoto *et al*. [10] examined the healthcare costs associated with aspiration pneumonia in patients with neurological disorders. The study demonstrated that aspiration pneumonia significantly increases the cost of care due to prolonged hospital stays, intensive care unit admissions, and the need for extensive rehabilitation services. The authors recommended early intervention strategies, including the use of prophylactic antibiotics and enhanced nursing care, to mitigate these costs [10].

In a review conducted by Marin *et al*. [11], it was stated that oropharyngeal dysphagia secondary to neurological disorders leads to aspiration pneumonia, thereby increasing costs and the economic burden.

In an another review conducted by Attrill *et al*. [12], it is demonstrated that the presence of oropharyngeal dysphagia significantly increases healthcare utilization and cost.

The findings of this study have significant implications for clinical practice and healthcare policy. The high costs and mortality rates associated with aspiration pneumonia highlight the need for improved prevention strategies, particularly in high-risk populations such as the elderly and those with neurological impairments. Early screening for dysphagia, aggressive management of aspiration risks, and timely nutritional support are essential components of care that could reduce the incidence of severe pneumonia and improve survival rates.

Healthcare systems must also consider the economic implications of aspiration pneumonia. Given the substantial costs associated with ICU care and prolonged hospital stays, there is a clear need for cost-effective interventions that can prevent disease progression and reduce the need for intensive care. This may include the development of specialized care pathways for patients with aspiration pneumonia, with an emphasis on early intervention, multidisciplinary care, and appropriate resource allocation.

Limitations

This study has several limitations that should be considered when interpreting the results. Firstly, the retrospective nature of the study introduces potential biases related to data collection and record accuracy. The reliance on existing medical records may have led to incomplete or inconsistent data, particularly in documenting clinical outcomes and cost-related variables. Secondly, the study sample was drawn from a single institution, which may limit the generalizability of the findings to other healthcare settings or populations. The specific practices and protocols of the institution could influence both mortality and cost outcomes, making it challenging to apply these results universally.

Thirdly, the study's focus on hospital-based data means that it does not account for long-term outcomes or costs associated with post-discharge care and follow-up. As a result, the financial burden and mortality associated with aspiration pneumonia may be underestimated.

Additionally, while the study includes a range of age groups and severity levels, it may not fully capture the impact of other confounding factors such as co-

morbidities or socioeconomic status, which could influence both mortality and costs.

Lastly, the analysis of cost data is limited by variations in billing practices and healthcare resource utilization, which can affect the accuracy and comparability of cost estimates.

Data could be supported by more comprehensive and larger sample studies. Addressing these limitations in future research could provide a more comprehensive understanding of the factors influencing mortality and costs in aspiration pneumonia and contribute to more effective management strategies.

CONCLUSION

In conclusion, this study provides valuable insights into the demographic, clinical, and economic factors associated with aspiration pneumonia. The findings underscore the importance of age, nutritional support, and ICU management in determining patient outcomes and healthcare costs. Addressing the challenges posed by aspiration pneumonia requires a multifaceted approach that includes early detection, targeted interventions, and careful consideration of the cost-benefit ratio of various treatment strategies. By focusing on these areas, healthcare providers can improve outcomes for patients with aspiration pneumonia while also mitigating the significant economic burden associated with this condition.

Ethical Statement

The study was approved by Samsun Training and Research Hospital Ethics Committee (Decision no: TUEK 34-2018 BADE/1-7, 2018/04 and date: 06.02.2018). The study was conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Given the retrospective nature of the study, patient consent was not required, but data were anonymized to protect patient confidentiality.

Authors' Contribution

Study Conception: HBA, SG, İA; Study Design: HBA, SG, İA; Supervision: HBA; Funding: HBA; Materials: HBA, SG, İA; Data Collection and/or Processing: HBA, SG, İA; Statistical Analysis and/or Data Interpretation: HBA, SG, İA; Literature Review: HBA, SG, İA; Manuscript Preparation: HBA, SG, İA; and Critical Review: HBA, SG, İA.

Conflict of interest

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