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Association Between Pneumonia Incidence and 30-Day Mortality in Patients with Acute Coronary Syndrome

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Abstract

Background: Acute Coronary Syndrome (ACS) and pneumonia are significant contributors to global morbidity and mortality. This study aims to investigate the relationship between pneumonia incidence and 30-day mortality in ACS patients.

Methods: This retrospective cohort study analyzed data from 439 ACS patients admitted to Dr. Wahidin Sudirohusodo Hospital, Makassar, from August 2021 to July 2022. Patients were categorized based on pneumonia diagnosis and followed up for 30 days post-ACS. The primary outcome was 30-day mortality.

Results: Of 439 ACS patients, 94 (21.4%) had pneumonia. The 30-day mortality rate was significantly higher in ACS patients with pneumonia (39.1%) compared to those without (19.3%) (RR: 2.681, 95% CI: 1.41-5.1, p=0.002). Patients with pneumonia, diabetes mellitus, and chronic kidney disease had the highest risk of 30-day mortality (RR: 58.8, 95% CI: 6.9- 500.69, p<0.001).

Conclusion: Pneumonia significantly increases the risk of 30-day mortality in ACS patients, especially when combined with other comorbidities. These findings emphasize the importance of pneumonia prevention and management in ACS patients to improve outcomes.

Keywords: Acute Coronary Syndrome, Pneumonia, 30-day mortality, Comorbidity

1. Introduction

Acute Coronary Syndrome (ACS) encompasses a spectrum of conditions including unstable angina, non-ST-elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI). Despite advancements in management strategies, ACS remains a significant cause of morbidity and mortality worldwide (1). In recent years, there has been growing recognition of the impact of non-cardiovascular complications on ACS outcomes, with pneumonia emerging as a particularly important factor (2).

Pneumonia is a common complication in ACS patients, with reported incidence rates ranging from 5% to 20% (3). The relationship between pneumonia and adverse cardiovascular events is bidirectional and complex. On one hand, the systemic inflammation and hypoxemia associated with pneumonia can exacerbate myocardial ischemia and promote plaque instability (4). On the other hand, ACS itself can predispose patients to pneumonia through various mechanisms, including increased aspiration risk, pulmonary oedema, and immune dysregulation (5).

While previous studies have demonstrated an association between pneumonia and poor outcomes in ACS patients, the magnitude of this effect and its interaction with other comorbidities remain poorly understood, particularly in the context of short-term mortality (6). Furthermore, most existing research has focused on Western populations, leaving a gap in knowledge regarding the impact of pneumonia on ACS outcomes in Southeast Asian settings, where healthcare resources and patient characteristics may differ significantly (7).

The primary objective of this study was to investigate the association between pneumonia and 30-day mortality in patients hospitalized with ACS. Additionally, we sought to examine the interaction between pneumonia and other comorbidities, particularly diabetes mellitus and chronic kidney disease, in influencing short-term mortality risk. By elucidating these relationships, we aim to inform risk stratification strategies and guide targeted interventions to improve outcomes in this high-risk patient population

2. Materials and Methods

Study Design and Sample

This retrospective cohort study was conducted at the Integrated Heart Center of Dr. Wahidin Sudirohusodo Hospital, Makassar, Indonesia. Data were collected from the Acute Coronary Syndrome (ACS) Registry for patients admitted between August 2021 and July 2022. Inclusion criteria were: 1) Patients diagnosed with ACS as recorded in the medical records, 2) Age ≥18 years, and 3) Willingness to participate in the study by signing informed consent. Exclusion criteria were: 1) Patients with infections other than pneumonia, 2) Patients with other lung diseases (asthma, COPD, lung tumors). All ACS patients meeting the inclusion criteria during the study period were included until the required sample size was reached. This method was chosen to minimize selection bias and ensure a representative sample of the ACS patient population. Patient data were extracted from the Acute Coronary Syndrome (ACS) Registry maintained by the hospital. This registry contains comprehensive clinical information for all ACS patients admitted to the facility. The study initially registered 472 potential participants.

After applying the exclusion criteria, the final sample size was 439 patients. The breakdown of exclusions was as follows:

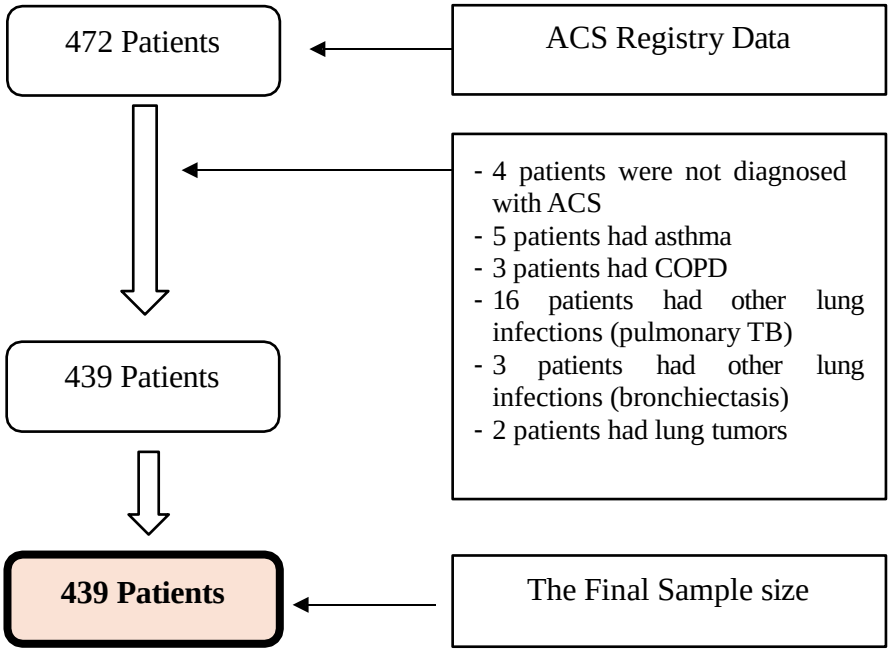

Figure 1. Patients' recruitment flow chart

Data Collection

Data were collected from medical records, patient interviews, and follow-up assessments. Information gathered included demographics, clinical characteristics, laboratory results, and 30-day mortality outcomes. All included patients were followed up for 30 days post-ACS diagnosis to assess mortality outcomes. Follow-up data were collected through medical records, telephone interviews with patients or family members, and review of the ACS Registry data. Patients were classified into two groups based on the presence or absence of pneumonia. The diagnosis of pneumonia was based on clinical assessment, chest radiographs, and laboratory findings as recorded in the patients' medical records.

Statistical Analysis

Data were analyzed using SPSS Statistics version 29.0. Categorical data were presented as percentages, while numerical data were presented as mean ± SD for normally distributed data or median (min-max) for non-normally distributed data. The Kolmogorov-Smirnov test was used to assess data normality. Bivariate analysis used Chi-square tests for categorical variables and Independent T-test or Mann-Whitney U test for numerical variables. Relative risk

(RR) with 95% confidence intervals was calculated. A p-value <0.05 was considered statistically significant.

Ethical Considerations

This study was approved by the Ethics Committee of the Faculty of Medicine, Hasanuddin University (No. 781/UN4.6.4.5.31/PP36/2023) and Dr. Wahidin Sudirohusodo Hospital (No. DP.04.03/D.XIX.2/6651/2024).

3. Results

Baseline Characteristics

A total of 439 patients met the inclusion criteria and were included in the final analysis. The mean age was 58.1 ± 10.9 years, and 80.9% were male. STEMI was the most common type of ACS (55.1%), followed by NSTEMI (30.1%) and unstable angina (14.8%). Ninety-four patients (21.4%) developed pneumonia during hospitalization. Table 1 presents the baseline characteristics of patients with and without pneumonia. Patients who developed pneumonia were older (61.4 ± 9.8 vs. 57.7 ± 11.0 years, p = 0.014) and more likely to have STEMI (71.7% vs. 53.2%, p = 0.046).

Table 1. Baseline characteristics of study participants based on 30-day mortality outcome

Characteristic	Mortality (n=46)	Survival (n=393)	Total (n=439)	p-value
Age (years)	61.43 ± 9.79	57.73 ± 11.0	58.11 ± 10.93	0.014*
≥45 years, n(%)	43 (93.5)	354 (90.1)	397 (90.4)	0.458
BMI (kg/m²)	24.15 ± 3.26	24.9 ± 3.39	24.83±3.38	0.214
Male, n(%)	32 (69.6)	323 (82.2)	355 (80.9)	0.039*
Length of stay (days)	9.34 ± 6.46	8.15 ± 4.18	8.27±4.48	0.57
ACS type, n(%)				
STEMI	33 (71.7)	209 (53.2)	242 (55.1)	0.046*
NSTEMI	10 (21.7)	122 (62)	132 (30.1)	
Unstable Angina	3 (6.5)	62 (15.8)	65 (14.8)	

Pneumonia and 30-Day Mortality

Table 2 shows the association between pneumonia and other risk factors with 30-day mortality. Of the 439 patients, 94 (21.4%) had pneumonia. The 30-day mortality rate was significantly higher in ACS patients with pneumonia (39.1%) compared to those without pneumonia (19.3%) (RR: 2.681, 95% CI: 1.41-5.1, p=0.002). Diabetes mellitus (DM) and chronic kidney disease (CKD) were also associated with increased 30-day mortality. Patients with DM had a 2.843 times higher risk of death (95% CI: 1.53-5.281, p<0.001), while those with CKD had a 6.042 times higher risk (95% CI: 3.09-11.8, p<0.001).

Table 2. Risk factors associated with 30-day mortality in ACS patients.

Risk Factor	Mortality (n=46)	Survival (n=393)	Total (n=439)	RR	95% CI	*p-value*
Pneumonia, n (%)	18 (39.1)	76 (19.3)	94 (21.4)	2.681	1.41 – 5.1	0.002*
Diabetes, n (%)	25 (54.3)	116 (29.5)	141 (32.1)	2.843	1.53 – 5.281	<0.001*
Hypertension, n (%)	28 (60.9)	224 (57)	252 (57.4)	1.174	0.628 – 2.192	0.615
Obesity, n (%)	21 (45.7)	178 (45.3)	199 (45.3)	1.015	0.550 – 1.873	0.963
CKD, n (%)	19 (41.3)	41 (10.4)	60 (13.7)	6.042	3.09 – 11.8	<0.001*

Combined Effect of Pneumonia and Comorbidities

The combination of pneumonia, DM, and CKD dramatically increased the risk of 30-day mortality (RR: 58.8, 95% CI: 6.9-500.69, p<0.001). Table 3 presents the subgroup analysis of pneumonia with various comorbidities.

Table 3. Subgroup analysis of pneumonia and comorbidities on 30-day mortality in ACS patients.

Characteristic	Mortality (n=18)	Survival (n=76)	Total (n=94)	RR	95% CI	*p-value*
Pneumonia without comorbidities, n (%)	2 (4.3)	30 (7.6)	32 (7.3)	0.55	0.13 – 2.38	*0.559*
Pneumonia with comorbidities, n (%)	16 (34.8)	46 (11.7)	62 (14.1)	4.02	2.04 – 7.94	<0.001
Pneumonia + DM	2 (4.3)	11 (2.8)	13 (3)	1.58	0.34 – 7.35	0.636
Pneumonia + CKD	3 (6.5)	6 (1.5)	9 (2.1)	4.5	1.09 – 18.64	0.058
Pneumonia + DM + CKD	6 (13)	1 (0.3)	7 (1.6)	58.8	6.9 – 500.69	<0.001

4. Discussion

This study demonstrates a strong and independent association between pneumonia and 30-day mortality in patients hospitalized with ACS. Our findings indicate that the development of pneumonia more than doubles the risk of short-term mortality in this population, even after adjusting for traditional risk factors and comorbidities. Furthermore, we observed a striking synergistic effect between pneumonia, diabetes mellitus, and chronic kidney disease, with the combination of these conditions conferring a particularly high mortality risk.

The association between pneumonia and adverse cardiovascular outcomes has been previously reported in various settings [8],[9]. However, our study adds several important contributions to the existing literature. First, we focused specifically on short-term mortality, providing insights into the immediate impact of pneumonia on ACS outcomes. Second, our analysis of the interaction between pneumonia and other comorbidities highlights the importance of considering the patient's overall risk profile when assessing prognosis. Finally, our study provides valuable data from a Southeast Asian population, addressing the paucity of research in this region.

The mechanisms underlying the increased mortality risk associated with pneumonia in ACS patients are likely multifactorial. Systemic inflammation triggered by pneumonia can exacerbate myocardial ischemia, promote plaque instability, and increase the risk of arrhythmias (10). Hypoxemia and increased myocardial oxygen demand may further compromise cardiac function in the setting of coronary artery disease(9). Additionally, pneumonia may lead to delays in appropriate ACS management, including timely revascularization, potentially contributing to poorer outcomes (11).

The synergistic effect observed between pneumonia, diabetes, and chronic kidney disease underscores the complex interplay between cardiovascular and non-cardiovascular conditions in determining patient outcomes. Diabetes and chronic kidney disease are known to impair immune function and increase susceptibility to infections (12). Moreover, these conditions are associated with a pro-inflammatory state and endothelial dysfunction, which may amplify the deleterious effects of pneumonia on the cardiovascular system (13).

Our findings have important clinical implications. First, they highlight the need for heightened vigilance in preventing and promptly diagnosing pneumonia in ACS patients, particularly those with diabetes or chronic kidney disease. Strategies such as early mobilization, optimal glycemic control, and careful attention to oral hygiene may help reduce the risk of pneumonia in this population (14). Second, our results suggest that the development of pneumonia should prompt reassessment of the patient's overall risk and potentially more

aggressive management. Finally, our study underscores the importance of a multidisciplinary approach in managing ACS patients with complex comorbidities.

The strengths of this study include its relatively large sample size, the use of a comprehensive ACS registry, and the consideration of multiple comorbidities. However, there are several limitations to consider: this may limit the generalizability of our findings to other populations or healthcare settings. Our study was limited to 30-day mortality. Longer-term follow-up could provide additional insights into the long-term impact of pneumonia on ACS outcomes. We relied on clinical diagnosis of pneumonia as recorded in medical records. A standardized diagnostic criteria for pneumonia could enhance the reliability of our findings.

Future research directions could include prospective, multi-center studies to validate these findings in diverse populations. Investigation of the mechanisms underlying the synergistic effects of pneumonia, diabetes, and CKD in ACS patients. Evaluation of targeted interventions to reduce mortality risk in this high-risk group of patients. Exploration of long-term outcomes beyond 30 days in ACS patients with pneumonia and other comorbidities.

5. Conclusion

Pneumonia significantly increases the risk of 30-day mortality in patients with acute coronary syndrome, particularly when combined with comorbidities such as diabetes mellitus and chronic kidney disease. These findings emphasize the importance of pneumonia prevention, early detection, and aggressive management in ACS patients to improve outcomes. Clinicians should be vigilant for pneumonia in ACS patients and consider it an important factor in risk stratification and treatment planning.

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