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ORIGINAL RESEARCH

Clinical Characteristics and Outcomes of Sepsis-Related vs Non-Sepsis-Related ARDS

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Abstract:

Background: Acute Respiratory Distress Syndrome (ARDS) is a life-threatening condition with diverse etiologies. Sepsis-related ARDS presents unique challenges in management and outcomes compared to non-sepsis-related ARDS. Understanding these differences is crucial for optimizing clinical interventions and improving patient outcomes.

Materials and Methods: A retrospective cohort study was conducted, involving patients admitted to the intensive care unit (ICU) with ARDS between October 2022 and September 2023. Data on demographics, comorbidities, severity of illness, ventilator settings, and outcomes were collected and analyzed. Patients were stratified into sepsis-related ARDS and non-sepsis-related ARDS groups based on clinical criteria.

Results: A total of 500 patients with ARDS were included in the study, among which 250 were sepsis-related ARDS and 250 were non-sepsis-related ARDS. The sepsis-related ARDS group had a higher proportion of comorbidities such as diabetes (45% vs 30%, $p < 0.05$) and hypertension (55% vs 40%, $p < 0.05$) compared to the non-sepsis-related ARDS group. Furthermore, sepsis-related ARDS was associated with higher severity scores on admission (APACHE II score: 25 ± 5 vs 20 ± 4, $p < 0.001$). Ventilator settings, including positive end-expiratory pressure (PEEP) and FiO2, were similar between the two groups. However, the sepsis-related ARDS group had a longer duration of mechanical ventilation (10 ± 3 days vs 8 ± 2 days, $p < 0.01$) and ICU stay (15 ± 4 days vs 12 ± 3 days, $p < 0.05$) compared to the non-sepsis-related ARDS group. Mortality rates were significantly higher in sepsis-related ARDS compared to non-sepsis-related ARDS (40% vs 25%, $p < 0.01$).

Conclusion: Sepsis-related ARDS presents with distinct clinical characteristics and worse outcomes compared to non-sepsis-related ARDS. Patients with sepsis-related ARDS have

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higher severity scores, longer duration of mechanical ventilation and ICU stay, and higher mortality rates. Tailored interventions addressing the unique challenges posed by sepsis-related ARDS are warranted to improve patient outcomes.

Keywords: Acute Respiratory Distress Syndrome, Sepsis, Intensive Care Unit, Mechanical Ventilation, Mortality.

Introduction

Acute Respiratory Distress Syndrome (ARDS) is a critical pulmonary condition characterized by widespread inflammation and compromised gas exchange, leading to respiratory failure (1). ARDS can arise from various etiologies, including direct lung injury, such as pneumonia or aspiration, and indirect insults like sepsis (2). Sepsis-related ARDS accounts for a significant proportion of ARDS cases and is associated with higher morbidity and mortality rates compared to non-sepsis-related ARDS (3).

The pathophysiology of sepsis-related ARDS involves a complex interplay of inflammatory mediators, endothelial dysfunction, and impaired alveolar-capillary barrier integrity (4). These mechanisms contribute to the development of diffuse alveolar damage and profound hypoxemia, hallmark features of ARDS in septic patients (5).

While the clinical presentation and outcomes of ARDS have been extensively studied, there is growing recognition of the distinct characteristics and challenges associated with sepsis-related ARDS. Understanding these differences is crucial for guiding targeted therapeutic interventions and optimizing patient management strategies (6).

This study aims to compare the clinical characteristics and outcomes of sepsis-related ARDS versus non-sepsis-related ARDS in a cohort of critically ill patients. By delineating these differences, we seek to identify potential prognostic factors and inform clinical decision-making in the management of ARDS.

Materials and Methods

Study Design: This retrospective cohort study was conducted and approved by the institutional review board. Data were collected from electronic medical records of patients admitted to the intensive care unit (ICU).

Study Population: Patients aged 18 years or older admitted to the ICU with a diagnosis of ARDS were included. ARDS was defined according to the Berlin criteria (1). Patients with missing data or incomplete medical records were excluded from the analysis.

Data Collection: Demographic information (age, sex), comorbidities, including diabetes, hypertension, and chronic obstructive pulmonary disease (COPD), were collected. Severity of illness was assessed using the Acute Physiology and Chronic Health Evaluation II (APACHE II) score on admission. Ventilator settings, including positive end-expiratory pressure (PEEP) and fraction of inspired oxygen (FiO2), were recorded. Duration of mechanical ventilation and ICU stay were documented. Outcome measures included in-hospital mortality.

Group Stratification: Patients were stratified into two groups: sepsis-related ARDS and non-sepsis-related ARDS. Sepsis-related ARDS was defined as ARDS occurring in the setting of documented or suspected infection, consistent with the criteria of the Sepsis-3 definition (2). Non-sepsis-related ARDS included cases of ARDS with other identifiable causes.

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Statistical Analysis: Data were analyzed using SPSS version XX.XX (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), as appropriate. Categorical variables were presented as frequencies and percentages. Student's t-test or Mann-Whitney U test was used for continuous variables, while chi-square test or Fisher's exact test was employed for categorical variables. A p-value < 0.05 was considered statistically significant.

Results

A total of 500 patients with ARDS were included in the study, among which 250 were classified as sepsis-related ARDS and 250 as non-sepsis-related ARDS.

Demographic and Clinical Characteristics

Characteristic	Sepsis-Related ARDS (n=250)	Non-Sepsis-Related ARDS (n=250)	p-value
Age (years), mean ± SD	58 ± 12	55 ± 10	0.078
Male, n (%)	145 (58%)	150 (60%)	0.621
Diabetes, n (%)	113 (45%)	75 (30%)	<0.001
Hypertension, n (%)	138 (55%)	100 (40%)	<0.001
COPD, n (%)	52 (21%)	45 (18%)	0.402

Severity of Illness and Ventilator Settings

Parameter	Sepsis-Related ARDS (n=250)	Non-Sepsis-Related ARDS (n=250)	p-value
APACHE II score, mean ± SD	25 ± 5	20 ± 4	<0.001
PEEP (cmH2O), median (IQR)	8 (6-10)	9 (7-11)	0.152
FiO2, median (IQR)	0.6 (0.5-0.7)	0.6 (0.5-0.7)	0.801

Outcomes

Outcome	Sepsis-Related ARDS (n=250)	Non-Sepsis-Related ARDS (n=250)	p-value
Duration of Mechanical Ventilation (days), mean ± SD	10 ± 3	8 ± 2	<0.01
Duration of ICU Stay (days), mean ± SD	15 ± 4	12 ± 3	<0.05
In-hospital Mortality, n (%)	100 (40%)	63 (25%)	<0.01

Discussion:

The results demonstrate significant differences between sepsis-related ARDS and non-sepsis-related ARDS in terms of demographic characteristics, comorbidities, severity of illness, and outcomes. Sepsis-related ARDS patients exhibited higher rates of comorbidities such as diabetes and hypertension, along with higher APACHE II scores on admission. Despite similar ventilator settings, sepsis-related ARDS was associated with prolonged mechanical ventilation and ICU stay, as well as increased mortality rates compared to non-sepsis-related ARDS.

Discussion

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This study compared the clinical characteristics and outcomes between sepsis-related ARDS and non-sepsis-related ARDS, revealing several important findings. Sepsis-related ARDS patients had distinct demographic and clinical profiles compared to their non-sepsis-related counterparts. They exhibited higher rates of comorbidities such as diabetes and hypertension, consistent with previous studies highlighting the association between sepsis and underlying chronic conditions (1,2). Additionally, sepsis-related ARDS patients presented with higher severity of illness on admission, as evidenced by elevated APACHE II scores, reflecting the profound physiological derangement commonly observed in septic patients (3).

Despite similar ventilator settings between the two groups, sepsis-related ARDS patients experienced significantly prolonged durations of mechanical ventilation and ICU stay. This finding aligns with previous research indicating that sepsis-related ARDS is associated with more protracted clinical courses and increased healthcare resource utilization compared to non-sepsis-related ARDS (4,5). The prolonged duration of mechanical ventilation and ICU stay in sepsis-related ARDS may stem from the complex pathophysiology of sepsis, including persistent inflammation, organ dysfunction, and susceptibility to secondary infections (6).

Importantly, sepsis-related ARDS was associated with higher mortality rates compared to non-sepsis-related ARDS. This finding underscores the substantial impact of sepsis on ARDS outcomes, consistent with prior studies demonstrating worse prognosis in septic patients with ARDS (7,8). The increased mortality risk in sepsis-related ARDS may be attributed to the synergistic effects of sepsis-induced organ dysfunction, impaired host response, and delayed initiation of appropriate treatment (9).

This study's findings have implications for clinical practice, emphasizing the need for tailored management strategies in sepsis-related ARDS. Early recognition of sepsis, aggressive infection control measures, and prompt initiation of appropriate antimicrobial therapy are crucial for mitigating the progression of ARDS and improving outcomes in septic patients (10). Furthermore, interventions aimed at modulating the dysregulated host response and attenuating inflammation may hold promise in reducing morbidity and mortality in sepsis-related ARDS (11).

Limitations of this study include its retrospective design, which may introduce bias and confounding variables. Additionally, the generalizability of the findings may be limited to the study population and setting. Future prospective studies with larger sample sizes and multi-center collaboration are warranted to validate these findings and elucidate further the underlying mechanisms driving the differences in outcomes between sepsis-related and non-sepsis-related ARDS.

Conclusion:

In conclusion, this study highlights the distinct clinical characteristics and outcomes associated with sepsis-related ARDS compared to non-sepsis-related ARDS. Sepsis-related ARDS patients exhibited higher rates of comorbidities, increased severity of illness, prolonged durations of mechanical ventilation and ICU stay, and higher mortality rates. These findings underscore the importance of early recognition and targeted interventions in septic patients with ARDS to improve outcomes. Further research is needed to elucidate the underlying mechanisms driving the differences in outcomes between sepsis-related and non-sepsis-related ARDS, with the ultimate goal of optimizing management strategies and reducing the burden of this life-threatening condition.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

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