

WHAT FACTORS ON ADMISSION INFLUENCE ICU MORTALITY IN ADULT PATIENTS ADMITTED TO THE INTENSIVE CARE UNIT WITH SEVERE PNEUMONIA?

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ABSTRACT

Objective: To identify the risk factors on intensive care unit (ICU) admission that are linked with ICU mortality in patients with severe pneumonia.

Study Design: A retrospective observational study.

Place and Duration of Study: Patients admitted to the medical ICU in Shifa International Hospital, Islamabad, between October 2013 and March 2014.

Material and Methods: Adult patients admitted to the ICU with the suspected diagnosis of severe pneumonia were studied. In addition to the co-morbidities, presence or absence of septic shock and acute kidney injury, PaO₂/FiO₂ ratio and type of mechanical ventilation were recorded on ICU admission. This data was initially recorded on paper forms and latter entered in the SPSS. Bivariate analysis was performed to study the relationship between these risk factors and their effect on the ICU mortality.

Results: We evaluated a total number of 82 patients with severe pneumonia. ICU mortality was 14.8% (12 patients). Statistical analysis showed that patients with severe acute respiratory distress syndrome (ARDS), septic shock, history of chronic liver disease and human immunodeficiency virus (HIV) neutropenic sepsis and those who received invasive mechanical ventilation were at higher risk of mortality. We did not find any direct correlation between age, presence of acute kidney injury, history of diabetes mellitus and risk of death in the ICU.

Conclusion: In adult patients, septic shock, severe ARDS, history of chronic liver disease, neutropenic sepsis and presence of HIV, and invasive mechanical ventilation are associated with a higher risk of ICU mortality in patients admitted with severe pneumonia.

Keywords: Risk factors and mortality, Severe community acquired pneumonia.

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INTRODUCTION

A small number of patients with severe pneumonia require admission to the intensive care unit (ICU). Unfortunately, mortality remains high in these patients¹. It is unclear whether pneumonia severity scoring systems can predict the outcome or not². We have tried to evaluate the link between the co-morbidities and some commonly seen physiological disturbances on admission and the ICU mortality.

This was carried out by conducting a retrospective observational study of patients who were admitted with severe pneumonia in our ICU. By identifying and managing the reversible

factors, the intensive care physicians can improve the outcome in these patients.

MATERIAL & METHODS

This study was carried out between October 2013 and March 2014. The inclusion criteria were the presence of symptoms of lower respiratory tract infection including dyspnoea, cough, fever, sputum, and new infiltrates on chest radiography. Children and patients with non-infectious etiology, and ventilator associated pneumonia were excluded.

Study sample size included the patients who fulfilled the inclusion criteria from October 2013 to March 2014.

Four main categories of data were collected: (1) Demographics (2) Co-morbid illnesses (3) Clinical data on admission and (4) ICU mortality.

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Patients' age and gender were recorded. Co-morbidities included Chronic Obstructive Pulmonary Disease (COPD), diabetes, chronic renal failure, congestive heart failure, chronic liver disease, pregnancy, neutropenia and human immunodeficiency virus (HIV) infection. The clinical data recorded on ICU admission included: shock, severity of acute respiratory distress syndrome (ARDS), acute kidney injury, and the need for non-invasive, and invasive mechanical ventilation. ICU mortality was recorded during the admission.

This data was collected on paper forms by reviewing the patients' charts in the medical record section after approval from the institutional review board and the local ethics committee. Informed consent of the patients was not required as this was a simple retrospective observational study. This collected data was later entered in SPSS (version 22; SPSS®, Inc, Chicago, IL) for statistical analysis.

Septic shock was defined as sepsis related hypotension persisting despite adequate fluid resuscitation³.

ARDS was defined using the Berlin definition with acute onset of lung injury, within one week, bilateral opacities on chest imaging not explained by other pulmonary pathology, respiratory failure not explained by heart failure or volume overload and decreased PaO₂/FiO₂ ratio (mild 20-300mmHg, moderate 101-200mmHg and severe <100mmHg)⁴.

Acute kidney injury was defined as the presence of increase in SCr by >0.3 mg/dl within 48 hours or increase in SCr to >1.5 times baseline, which is known or presumed to have occurred within the previous 7 days or urine volume <0.5 ml/kg/h for 6 hours⁵.

Neutropenia was defined as the cell count <1.0 × 10⁹ cells/l.

Descriptive statistics included means, percentages and standard deviation depending upon the type of the variables. Spearman correlation coefficient was used during initial

Bivariate analysis. Binary logistic regression was used to assess the correlation between risk factors and ICU mortality. Hosmer-Lameshow goodness-of-fit test was applied during binary logistic regression analysis because of the small sample size. Data are presented as odds ratios (OR) with 95% confidence intervals (CI). A *p*-value of <0.05 was considered statistically significant.

RESULTS

In this study period from October 2013 to March 2014, 82 patients were admitted to our critical care services who met the inclusion criteria. Fifty-six (58.3%) patients were male and twenty-six (37.7%) female. Average age was 55.76 years ± 15. In terms of the co-morbidities, 19 (23.2%) patients had previous diabetes diagnosis, 21 (25.6%) patients had COPD, and 28 (34.1%) had history of congestive heart failure. Pre-existing chronic renal disease was found in 10 (12.2%) individuals. A small number of patients, 4 (4.9%) were infected with HIV. Neutropenia was seen in 3 (3.7%) cases. Chronic liver disease was present in 3 (3.7%) patients. Only 2 (2.4%) female patients were pregnant. Non-invasive mechanical ventilation was employed in 47 (57.3%) patients whereas 35 (42.7%) required invasive form of the ventilator support. Mild to moderate degree of ARDS was present in 74 (90.2%) of cases and 8 (9.8%) patients had severe form of ARDS as defined by the Berlin definition. The number of patients who suffered from septic shock was 13 (15.9 %). Acute kidney injury was observed in 31 (37.8%). The ICU mortality was 14.8%.

Demographic and co-morbidities are shown in table-1. Clinical data and outcome is shown in table-2.

After applying bivariate correlation analysis, we identified a positive correlation between severe ARDS, septic shock, history of chronic liver disease (CLD), presence of neutropenia, and HIV infection, and invasive mechanical ventilation, with the outcome in the ICU. Binary logistic regression analysis showed that these

variables were independent predictors of mortality in patients who were admitted with the diagnosis of severe pneumonia. This is shown in table-3.

Surprisingly, we did not observe any direct

immunosuppression and invasive mechanical ventilation were independent risk factors of mortality. While most of these factors are irreversible, authors believe that by addressing the reversible factors, we can decrease the mortality in some patients. Surprisingly, we did

Table-1: Demographics and co-morbidities

Characteristics	All(N=82)
Age, years	55.7 (15.0)
Gender, male	56 (68.3%)
Congestive heart failure	28 (34.1%)
COPD	21 (25.6%)
HIV	4 (4.9%)
DM	19 (23.2%)
CRF	10 (12.2%)
Neutropenia	3 (3.7%)
Pregnancy	2 (3.1%)
Chronic liver disease	3 (3.7%)

Data are expressed as no. or (%).

Table-2: Clinical data and outcome

Invasive mechanical ventilation	35 (42.7%)
Acute kidney injury	31 (37.8%)
Septic shock	13 (15.9%)
Non-invasive ventilation	47 (57.3%)
Severe ARDS	8 (9.8%)
ICU mortality	12 (14.8%)

Data are expressed as no. or (%).

Table-3: Risk factors in non-survivors

Variable	Non-survivors	Odds Ratio
Severe ARDS	8 (9.8%)	2.1(1.58-3.7)
Chronic Liver Disease	3 (3.7%)	3.0 (1.7-7.8)
Neutropenic sepsis	3 (3.7%)	3.6 (2.2-6.7)
Invasive mechanical ventilation	35 (42.7%)	3.1 (1.2-4.8)
HIV infection	4 (4.9%)	1.8 (1.5-5.2)
Septic shock	13(15.9%)	1.6 (1.2---2.6)

Data are expressed as no or (%). Odds ratio are reported for ICU mortality.

correlation between age, presence of acute kidney injury (AKI) and pregnancy with the ICU mortality

DISCUSSION

This retrospective observational study looked at the risk factors on admission to the ICU which could result in high mortality. In our bivariate analysis, it was observed that history of chronic liver disease, severe ARDS,

not observe any independent link between the patients' age, AKI and pregnancy with the mortality.

Some of these findings; ARDS and presence of immunosuppression, were also reported by Sirvent et al⁶. While they did not specify the degree of severity of hypoxemia, the ARDS Definition Task Force clearly observed a 45%

mortality in severe form of ARDS⁴. Although we did not study the effect of proning and the use of neuromuscular blockers, there is some evidence that the use of these interventions in ARDS result in a better outcome⁷⁻⁹.

Neutropenic sepsis secondary to pneumonia results in a very poor outcome as noted in this study which is consistent with the findings observed elsewhere¹⁰. Some studies have shown more than 50% of mortality in neutropenic patients who develop severe pneumonia, despite the use of antibiotics^{11,12}. Neutropenic sepsis due to severe pneumonia is a leading cause of death. We believe that early use of non-invasive ventilation might improve the outcome in those neutropenic patients who are not in shock, are awake, and cooperative^{13,14}. Moreover, HIV infection status is also seen to be independently influencing the ICU outcome which was also reported by Simpson¹⁵.

In addition to the above findings, invasive ventilation, history of CLD and septic shock were found to be linked with poor outcome. A higher mortality seen with invasive form of ventilator support was probably due to more severe nature of disease and the requirement of sedation¹⁶. Viasus et al has also reported a high mortality in patients with CLD¹⁷. Septic shock in patients with pneumonia is also directly associated with high mortality^{3,6}. These findings of our study are not new to the medical literature.

Surprisingly, age was not associated with high mortality in our study which is consistent with the findings of Lim¹⁸. Similarly, after the introduction of new definition of acute kidney injury which replaced the older term of acute renal failure, we observed that this new criteria was probably more sensitive to identify the cases of AKI but this did not correlate with the ICU mortality in our patients. In other words, AKI is not an independent risk factor of ICU mortality in patients with severe pneumonia¹⁹.

What are the limitations of this study? This is a single center study with a small sample size that included patients treated in a single discipline intensive care unit. In addition, we did not collect the data on delayed transfers and the timing of antibiotic which are well known factors influencing mortality in sick patients. Microbiological results were also excluded because they are usually unavailable on admission and moreover they are not seen to influence the patients' outcome⁶.

CONCLUSION

To sum up, this study has identified some independent predictors of ICU mortality. We believe that early use of non-invasive ventilation might be helpful in neutropenic sepsis. Neuromuscular blockers and prone positioning could be instituted in severe ARDS. Unfortunately, the choice of sedative drugs is often overlooked in those cases that require invasive form of ventilator support. There are certainly some risk factors which are not amenable to any intervention.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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