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Original Article

Clinical Profile and Outcomes of Patients with Sepsis Admitted to the Intensive Care Unit: A Prospective Observational Study

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Abstract-

Background: Sepsis remains one of the leading causes of morbidity and mortality among critically ill patients worldwide, with case fatality continuing to exceed that of most other causes of intensive care unit (ICU) admission. This study describes the clinical profile, microbiological pattern, and outcomes of patients with sepsis admitted to a tertiary care ICU and identifies factors associated with mortality.***Methods*:** This prospective observational study was conducted over 12 months in a mixed medical-surgical ICU. Adult patients meeting Sepsis-3 criteria within 24 hours of ICU admission were enrolled. Demographic profile, comorbidities, source of infection, microbiological isolates, severity scores (APACHE II and SOFA), organ support requirements, ICU and hospital length of stay, and outcome (survival or death) were recorded and analysed.***Results*:** Of 240 patients enrolled, the mean age was 58.4 ± 14.6 years with a male predominance (61.7%). The respiratory tract was the commonest source of sepsis (38.3%), followed by the urinary tract (21.3%) and intra-abdominal sources (17.1%). Gram-negative organisms predominated among culture-positive cases (61.4%), with Klebsiella pneumoniae and Escherichia coli the most frequent isolates. Septic shock was present in 35.4% of patients. The mean APACHE II score was 21.6 ± 7.8 and mean SOFA score was 8.2 ± 3.6. Mechanical ventilation was required in 52.5% and vasopressor support in 41.7% of patients. Overall ICU mortality was 34.2%, rising to 58.8% among patients with septic shock compared with 21.2% in sepsis without shock ($p<0.001$). On multivariate analysis, septic shock, SOFA score ≥ 8, need for mechanical ventilation, and age above 65 years were independent predictors of mortality.***Conclusion*:** Sepsis continues to carry substantial mortality in the ICU setting, particularly when complicated by septic shock and multi-organ dysfunction. Early recognition, prompt source identification, and severity-based triage using validated scoring systems may help improve outcomes in this high-risk population.

Keywords: *Sepsis; Septic shock; Intensive care unit; APACHE II; SOFA score; Mortality; Critical care*

INTRODUCTION

Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection, a definition formalised in 2016 by the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)[1]. This definition replaced the earlier systemic inflammatory response syndrome (SIRS)-based criteria, recognising that the clinical syndrome of sepsis arises from a complex interplay of pathogen virulence factors and an exaggerated, poorly regulated host inflammatory and immune response that ultimately produces tissue hypoperfusion and multi-organ dysfunction[1,2]. Septic shock, the most severe subset, is identified by the requirement for vasopressors to maintain a mean arterial pressure of 65 mmHg or greater together with a serum lactate level above 2 mmol/L despite adequate fluid resuscitation, and is associated with the highest mortality among ICU syndromes[1,3].

Globally, sepsis remains a major and largely under-recognised public health problem. The Global Burden of Disease Study estimated that in 2017 there were 48.9 million incident cases of sepsis worldwide, resulting in 11.0 million sepsis-related deaths, accounting for nearly one in five deaths globally[4]. Although age-standardised incidence and mortality have declined substantially since 1990, the burden remains disproportionately concentrated in low- and middle-income countries, particularly in sub-Saharan Africa and South Asia[4,5]. This recognition prompted the World Health Assembly in 2017 to adopt a resolution calling on member states to improve the prevention, diagnosis, and clinical management of sepsis as a global health priority[5].

Within the ICU specifically, sepsis and septic shock are among the most frequent reasons for admission and are associated with mortality rates that, despite decades of research, remain considerably higher than most other critical illnesses. Large

multinational audits and national cohort studies have repeatedly demonstrated that a substantial proportion of all ICU admissions meet criteria for severe sepsis or septic shock within the first 24 hours of admission, with cardiovascular and respiratory dysfunction being the most commonly affected organ systems[6]. Single-centre studies from India and other resource-limited settings have similarly reported high in-ICU mortality, frequently exceeding 30% overall and approaching or exceeding 60% among patients who progress to septic shock, with gram-negative bacilli emerging as the predominant causative organisms[7].

Several factors are believed to influence outcome in septic patients admitted to the ICU. These include the source and site of infection, the causative organism and its antimicrobial susceptibility, the time to initiation of appropriate antibiotics and source control, the severity of organ dysfunction at presentation as quantified by validated scoring systems such as the Acute Physiology and Chronic Health Evaluation (APACHE) II score and the Sequential Organ Failure Assessment (SOFA) score, and underlying patient comorbidities such as chronic kidney disease, diabetes mellitus, and cirrhosis[8,9]. Notably, patients with underlying cirrhosis admitted with sepsis have been shown to have more than twice the odds of in-hospital death compared with non-cirrhotic septic patients, independent of organ dysfunction or haemodynamic status, underscoring the importance of host factors in determining prognosis[9].

In response to the persistently high burden of sepsis-related mortality, the Surviving Sepsis Campaign has periodically updated international evidence-based guidelines for the early management of sepsis and septic shock, with the most recent 2021 iteration emphasising early fluid resuscitation, timely administration of broad-spectrum antimicrobials, judicious use of vasopressors, and structured post-ICU follow-up for survivors[10]. Despite these advances, considerable variability in clinical profile, microbial epidemiology, and outcome persists across regions and even across individual ICUs, reflecting differences in case-mix, resource availability, and adherence to bundled care[6,10].

Given this background, there remains a continued need for context-specific data describing the clinical characteristics, microbiological spectrum, and outcomes of patients with sepsis admitted to the ICU, particularly to identify locally relevant predictors of mortality that can inform triage, resource allocation, and quality-improvement initiatives. The present study was therefore undertaken to describe the clinical profile and outcomes of patients with sepsis admitted to a tertiary care intensive care unit, and to identify the factors independently associated with mortality in this population.

MATERIALS AND METHODS

Study design and setting

This was a prospective, observational, single-centre study conducted in the multidisciplinary medical-surgical intensive care unit of a tertiary care teaching hospital over a period of 12 months. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from each patient or their legally authorised representative prior to enrolment, in accordance with the Declaration of Helsinki.

Study population

All adult patients aged 18 years and above who were admitted to the ICU and who fulfilled the Sepsis-3 consensus criteria for sepsis — defined as a suspected or confirmed infection accompanied by an acute increase of 2 points or more in the Sequential Organ Failure Assessment (SOFA) score — within the first 24 hours of ICU admission were consecutively enrolled[1]. Septic shock was defined according to the same consensus criteria as sepsis with persisting hypotension requiring vasopressors to maintain a mean arterial pressure of 65 mmHg or greater and a serum lactate level exceeding 2 mmol/L despite adequate fluid resuscitation[1].

Patients younger than 18 years, those with a documented do-not-resuscitate order at the time of admission, pregnant women, and patients with an ICU stay of less than 24 hours due to early transfer or discharge were excluded from the study. Patients in whom informed consent could not be obtained were also excluded.

Data collection

Data were collected using a structured proforma by trained investigators at the time of ICU admission and during the course of the ICU stay. Recorded variables included age, sex, presenting comorbidities (diabetes mellitus, hypertension, chronic kidney disease, chronic liver disease, chronic obstructive pulmonary disease, malignancy, and coronary artery disease), suspected and confirmed source of infection, and results of microbiological cultures obtained from blood, urine, respiratory secretions, and other relevant sites prior to initiation of antimicrobial therapy.

Severity of illness was quantified using the Acute Physiology and Chronic Health Evaluation (APACHE) II score and the Sequential Organ Failure Assessment (SOFA) score, both calculated using the worst physiological and laboratory parameters recorded within the first 24 hours of ICU admission. Organ support requirements, including invasive mechanical ventilation, vasopressor or inotropic support, and renal replacement therapy, were recorded prospectively

throughout the ICU stay. The primary outcome was ICU mortality, defined as death occurring during the ICU stay; secondary outcomes included hospital mortality, ICU length of stay, hospital length of stay, and duration of mechanical ventilation.

Statistical analysis

Data were entered into a structured spreadsheet and analysed using standard statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, as appropriate to their distribution, and were compared between survivors and non-survivors using the independent samples t-test or Mann-Whitney U test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher's exact test, as applicable. Variables found to be significant on univariate analysis ($p<0.05$) were entered into a multivariate binary logistic regression model to identify independent predictors of ICU mortality, with results expressed as adjusted odds ratios (AOR) with 95% confidence intervals (CI). A p-value of less than 0.05 was considered statistically significant throughout.

RESULTS

A total of 240 patients meeting Sepsis-3 criteria were enrolled over the study period. The baseline demographic and clinical characteristics of the study population are summarised in Table 1.

Table 1. *Baseline demographic and clinical characteristics of the study population (n = 240)*

Variable	n	% / Mean ± SD
Age, years (mean ± SD)	240	58.4 ± 14.6
Male sex	148	61.7%
Female sex	92	38.3%
Diabetes mellitus	92	38.3%
Hypertension	84	35.0%
Chronic kidney disease	40	16.7%
Chronic liver disease	22	9.2%
COPD	26	10.8%
Coronary artery disease	31	12.9%
Malignancy	18	7.5%
Source: Respiratory tract	92	38.3%
Source: Urinary tract	51	21.3%
Source: Intra-abdominal	41	17.1%
Source: Skin / soft tissue	24	10.0%
Source: Bloodstream (unknown focus)	20	8.3%
Source: Other / CNS	12	5.0%
Septic shock at admission or during ICU stay	85	35.4%

The mean age of the study population was 58.4 ± 14.6 years, with a male predominance of 61.7%. Diabetes mellitus (38.3%) and hypertension (35.0%) were the most common pre-existing comorbidities, followed by chronic kidney disease (16.7%) and chronic liver disease (9.2%). The respiratory tract was the most frequent primary source of infection (38.3%), followed by the urinary tract (21.3%), intra-abdominal sources (17.1%), skin and soft tissue infections (10.0%), and bloodstream infections of unidentified primary focus (8.3%). Septic shock at the time of ICU admission or during the ICU stay was documented in 35.4% of the cohort.

Table 2. *Microbiological profile of culture-positive patients (n = 158)*

Organism	n	% of culture-positive (n=158)
Gram-negative organisms (total)	97	61.4%
Klebsiella pneumoniae	36	22.8%
Escherichia coli	28	17.7%
Pseudomonas aeruginosa	19	12.0%
Acinetobacter baumannii	14	8.9%
Gram-positive organisms (total)	42	26.6%
Staphylococcus aureus (MRSA: 60%)	21	13.3%
Enterococcus species	13	8.2%
Streptococcus pneumoniae	8	5.1%
Fungal isolates (total)	19	12.0%
Candida tropicalis	11	7.0%
Candida albicans	8	5.0%

Microbiological cultures were positive in 158 of 240 patients (65.8%). Among culture-positive cases, gram-negative organisms predominated, accounting for 61.4% of isolates, while gram-positive organisms accounted for 26.6% and fungal isolates for 12.0%. Klebsiella pneumoniae (22.8%) and Escherichia coli (17.7%) were the most frequently isolated gram-negative organisms, followed by Pseudomonas aeruginosa (12.0%) and Acinetobacter baumannii (8.9%). Among gram-positive isolates, Staphylococcus aureus (13.3%, of which 60% were methicillin-resistant) and Enterococcus species (8.2%) were most common. Candida species, predominantly Candida tropicalis and Candida albicans, accounted for the fungal isolates, identified largely in patients with prolonged ICU stay and prior broad-spectrum antibiotic exposure.

Table 3. *Severity scores, organ support, and ICU course in the study population*

Parameter	Value
APACHE II score (mean ± SD)	21.6 ± 7.8
SOFA score (mean ± SD)	8.2 ± 3.6
Mechanical ventilation, n (%)	126 (52.5%)
Vasopressor / inotropic support, n (%)	100 (41.7%)
Renal replacement therapy, n (%)	44 (18.3%)
ICU length of stay, days (median, IQR)	7 (4–12)
Hospital length of stay, days (median, IQR)	14 (9–21)
Duration of mechanical ventilation, days (median, IQR)	6 (3–10)
ICU mortality, n (%)	82 (34.2%)
Hospital mortality, n (%)	90 (37.5%)

The mean APACHE II score at admission was 21.6 ± 7.8 and the mean SOFA score was 8.2 ± 3.6, reflecting a moderately to severely ill cohort. Mechanical ventilation was required in 52.5% of patients, vasopressor or inotropic support in 41.7%, and renal replacement therapy in 18.3%. The median ICU length of stay was 7 days (interquartile range 4–12 days) and the median hospital length of stay was 14 days (interquartile range 9–21 days). Among patients requiring mechanical ventilation, the median duration of ventilation was 6 days (interquartile range 3–10 days).

Table 4. *Comparison of baseline and clinical variables between survivors and non-survivors*

Variable	Survivors (n=158)	Non-survivors (n=82)	p-value
Age, years (mean ± SD)	55.8 ± 14.9	63.7 ± 13.1	<0.001
Male sex, n (%)	96 (60.8%)	52 (63.4%)	0.69
APACHE II score (mean ± SD)	19.1 ± 7.2	26.4 ± 6.9	<0.001
SOFA score (mean ± SD)	6.9 ± 3.0	10.6 ± 3.1	<0.001
Septic shock, n (%)	33 (21.2%)	52 (58.8%)*	<0.001
Mechanical ventilation, n (%)	64 (40.5%)	63 (76.8%)	<0.001
Renal replacement therapy, n (%)	18 (11.4%)	27 (32.9%)	<0.001
Diabetes mellitus, n (%)	57 (36.1%)	35 (42.7%)	0.32
Chronic kidney disease, n (%)	20 (12.7%)	20 (24.4%)	0.02
Mortality by source — Intra-abdominal, n (%)*	—	18/41 (43.9%)	—
Mortality by source — Urinary tract, n (%)*	—	11/51 (21.6%)	—

**Mortality-by-source figures represent in-group death proportions, not column percentages of the survivor/non-survivor totals; SD: standard deviation; IQR: interquartile range; OR: odds ratio; CI: confidence interval.*

Overall ICU mortality in the study cohort was 34.2% (82 of 240 patients), and hospital mortality was 37.5% (90 of 240 patients). On univariate comparison, non-survivors were significantly older (63.7 ± 13.1 years vs. 55.8 ± 14.9 years, p<0.001), had higher APACHE II scores (26.4 ± 6.9 vs. 19.1 ± 7.2, p<0.001) and higher SOFA scores (10.6 ± 3.1 vs. 6.9 ± 3.0, p<0.001) at admission, and were more likely to have septic shock (58.8% vs. 21.2%, p<0.001), to require mechanical ventilation (76.8% vs. 40.5%, p<0.001), and to require renal replacement therapy (32.9% vs. 11.4%, p<0.001) compared with survivors. Mortality also varied significantly with the source of infection, being highest among patients with intra-abdominal sepsis (43.9%) and lowest among those with urinary tract infection (21.6%).

Table 5. *Independent predictors of ICU mortality on multivariate logistic regression analysis*

Predictor	Adjusted OR	95% CI	p-value
Septic shock	4.82	2.41–9.64	<0.001
SOFA score ≥ 8 at admission	3.65	1.87–7.13	<0.001
Requirement for mechanical ventilation	2.94	1.42–6.08	0.004
Age > 65 years	2.21	1.12–4.36	0.022
Chronic kidney disease	1.78	0.89–3.56	0.103

On multivariate logistic regression analysis adjusting for age, comorbidity burden, and source of infection, four variables emerged as independent predictors of ICU mortality: presence of septic shock (adjusted odds ratio [AOR] 4.82, 95% CI 2.41–9.64, p<0.001), SOFA score ≥ 8 at admission (AOR 3.65, 95% CI 1.87–7.13, p<0.001), requirement for mechanical ventilation (AOR 2.94, 95% CI 1.42–6.08, p=0.004), and age greater than 65 years (AOR 2.21, 95% CI 1.12–4.36, p=0.022). Chronic kidney disease showed a trend toward increased mortality risk but did not reach statistical significance after adjustment (AOR 1.78, 95% CI 0.89–3.56, p=0.103).

DISCUSSION

This prospective observational study describes the clinical profile and outcomes of 240 patients with sepsis admitted to a tertiary care ICU, and demonstrates an overall ICU mortality of 34.2%, rising to 58.8% among patients who developed septic shock. These figures are broadly consistent with previously reported mortality rates from comparable ICU cohorts. A large Brazilian single-centre study of 971 ICU admissions reported an overall mortality of 31.1%, with mortality of 22.6% among patients with severe sepsis and 64.8% among those with septic shock[7], figures that closely parallel the shock-

associated mortality observed in the present cohort. Similarly, the landmark Intensive Care National Audit and Research Centre case-mix programme database analysis of over 56,000 adult ICU admissions in England, Wales, and Northern Ireland found that more than one-quarter of all ICU admissions met severe sepsis criteria within the first 24 hours, with cardiovascular and respiratory dysfunction representing the most frequently affected organ systems[6], a pattern mirrored in our cohort where the respiratory tract was the leading source of infection and respiratory and cardiovascular failure were the dominant modes of organ dysfunction necessitating mechanical ventilation and vasopressor support.

The microbiological pattern observed in this study, with a clear predominance of gram-negative organisms — particularly Klebsiella pneumoniae and Escherichia coli — accounting for nearly two-thirds of culture-positive isolates, is consistent with patterns reported from other ICU cohorts in similar healthcare settings, where gram-negative bacilli have been repeatedly identified as the most prevalent pathogens in sepsis[7,8]. This finding has direct implications for empirical antimicrobial selection in resource-limited ICU settings, where gram-negative coverage with attention to local antibiograms should remain a cornerstone of initial therapy pending culture results, in line with recommendations of the Surviving Sepsis Campaign for early, broad-spectrum, source-appropriate antimicrobial therapy[10]. The substantial proportion of methicillin-resistant Staphylococcus aureus among gram-positive isolates and the emergence of Candida species in a subset of patients with prolonged ICU stay further underscore the importance of antimicrobial stewardship and judicious de-escalation once culture sensitivities become available.

The independent predictors of mortality identified in this study — septic shock, higher SOFA score, need for mechanical ventilation, and advanced age — are well recognised determinants of outcome in the sepsis literature and reinforce the discriminatory value of validated severity scores at the time of ICU admission[1,8]. The SOFA score, which forms the basis of the Sepsis-3 definition itself, has consistently demonstrated superior predictive validity for in-hospital mortality compared with the older SIRS-based criteria across multiple large cohorts[1], a finding corroborated in the present study by the markedly higher mean SOFA score among non-survivors compared with survivors. Similarly, advancing age has been repeatedly associated with reduced physiological reserve and higher case fatality in sepsis, likely reflecting both diminished organ reserve and a higher prevalence of comorbid disease in older patients[8].

It is notable that although chronic kidney disease showed a trend toward higher mortality in this cohort, it did not retain independent significance after adjustment for shock status and organ dysfunction severity, a pattern that diverges somewhat from data in other high-risk comorbid populations. For example, a large retrospective cohort study of nearly 8,000 ICU patients with sepsis found that the presence of underlying cirrhosis was independently associated with more than double the odds of in-hospital mortality, even after adjustment for comorbidities, organ dysfunction, and haemodynamic status[9], suggesting that certain chronic organ-specific comorbidities may carry prognostic weight that is not fully captured by generic severity scores alone, and that comorbidity-specific risk stratification may have a complementary role alongside SOFA and APACHE II scoring.

From a global health perspective, the mortality observed in this study, while substantial, must be interpreted against the backdrop of the considerable worldwide burden of sepsis. The Global Burden of Disease Study estimated that sepsis was implicated in nearly one-fifth of all deaths worldwide in 2017, with the highest burden concentrated in low- and middle-income regions[4], precisely the settings in which delayed presentation, limited microbiological diagnostic capacity, and constrained critical care resources may compound the inherent lethality of the syndrome. This underscores the continued relevance of the Surviving Sepsis Campaign's emphasis on early bundled care — timely fluid resuscitation, prompt antimicrobial therapy, and judicious haemodynamic support — as a means of mitigating preventable mortality, particularly in resource-constrained ICU environments[10].

This study has certain limitations that merit consideration. As a single-centre study, the findings may not be fully generalisable to ICUs with differing case-mix, resource availability, or microbiological epidemiology. The relatively modest sample size limited the power to detect independent associations for less common comorbidities and infection sources. Additionally, long-term outcomes beyond hospital discharge, including post-ICU functional status and 90-day mortality, were not assessed and represent an important area for future research.

CONCLUSION

Sepsis continues to be associated with substantial mortality among patients admitted to the intensive care unit, with outcomes strongly influenced by the presence of septic shock, severity of organ dysfunction at presentation, requirement for mechanical ventilation, and advanced age. Gram-negative organisms remain the predominant causative pathogens in this setting, reinforcing the need for locally informed empirical antimicrobial protocols. Early recognition of sepsis using validated severity scores such as SOFA, prompt initiation of source-appropriate antimicrobial therapy, and timely escalation of organ support are likely to remain central to improving survival in this high-risk population. Larger

multicentre studies incorporating long-term post-discharge outcomes are warranted to further refine risk stratification and guide resource allocation in critical care settings.