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Sepsis-Related Mortality Among Patients with Pulmonary Disorders

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Abstract

Background: Background: Sepsis is a one cause of increased morbidity and mortality in intensive care units (ICUs). Most studies on sepsis are performed on patients admitted in general or surgical ICU, with limited evaluation on patients admitted at the Respiratory Intensive care unit (RICU) with underlying pulmonary illness. The objective was to determine the mortality rate and the possible risk factors of sepsis in patients admitted at RICU. **Methods:** A cross-section observational study was performed on 100 patients admitted at RICU during a six months duration from December 2022 to May 2023. Patients were divided into two groups: Sepsis and non-sepsis groups. Baseline demographics, clinical and laboratory data were collected upon admission. **Results:** Fifty patients had sepsis based on systemic inflammatory response (SIRS) score ≥ 2 with the mean age of 60.5 years. Twenty- seven patients out of 50 cases of sepsis (54%) died. Univariate regression analysis identified that detection of micro-organisms in sputum and or blood culture, low oxygen saturation< 90% upon admission and elevated serum lactate > 2 mmol/L were associated with mortality. In addition, variables significantly associated with mortality on multivariate regression analysis were age > 60 years, increase length of ICU stay, onset of symptoms of sepsis more than 1 week, presence of microbes on laboratory assay and elevated serum lactate .**Conclusion:** The prevalence of death in sepsis is high. Old age, presence of Gram-negative bacteria, elevated serum lactate, oxygen desaturation, use of vasopressor agents, use of invasive mechanical ventilation and renal failure were possible risk factors of mortality.

Key words: Sepsis, risk factors, pulmonary disorders, mortality

Introduction:

Sepsis is known as a life-threatening organ dysfunction as a result of dysregulation of host response to infection. Septic shock is considered a subtype of sepsis which is characterized by underlying circulatory, cellular, and metabolic abnormalities that increase the risk of mortality over sepsis alone [(1).] Sepsis and septic shock have been more prevalent since the first consensus definition (Sepsis-1) was developed in 1991. In 2017, there were over 49 million cases of sepsis and 11 million deaths due to sepsis worldwide. [(2,3).]

The common sites of infection linked to sepsis are the respiratory tract (43%); the urinary system (16%); the abdomen (14%); the head (that is linked to a fever of unknown origin (FUO)) (14%); and other sites (13%) [(4).]

The 2021 guidelines advise against using quick Sequential Organ Failure Assessment (qSOFA) as the only screening tool and instead suggest using the systemic inflammatory response syndrome (SIRS) in predicting the course of a patient's condition [(5).]

Patients with sepsis are more likely to experience in-hospital mortality (IHM), which, in spite of significant improvements in therapeutic management, continues to be responsible for 20% of all deaths globally. Because of this, the combined illness is among those that have the highest death rate recorded in the emergency department (ED) [6].

Limited data on patients who develop sepsis with underlying pulmonary disorders admitted at respiratory intensive care unit (RICU) is available which encourage us to undertake this study for proper assessment of the outcome.

The aim of this study was to detect case fatality rate among patients with sepsis admitted in Respiratory Intensive Care Unit as well as the predictors of sepsis related mortality were determined.

Patients and methods:

The present research is a cross-section observational study that was held at RICU, Cardiothoracic Minia University Hospital, during the period from December 2022 to May 2023. One hundred and five cases were admitted at RICU during this period.

Inclusion criteria: All cases > 18 years with clinical suspicion of sepsis

Exclusion criteria: Patients arrested within 48 hours of admission , those with post cardiac arrest and patients admitted at hospitals in the previous 90 days.

All the patients had been subjected to:

- Complete medical history including (age, sex, comorbidities).
- Full clinical examination
- Systemic inflammatory response syndrome (SIRS) score was assessed within half an hour from admission. Four SIRS criteria were established, which included leukocytosis, leukopenia, or bandemia (white blood cells >1,200/mm3, <4,000/mm3, or bandemia ≥10%), fever or hypothermia (temperature >38 or <36 °C), tachypnea (respiratory rate >20 breaths/min), and tachycardia (heart rate >90 beats/min). [7]
- Laboratory examination (complete blood count, liver function tests, renal function tests, C-reactive protein, and serum lactate) were collected from all patients
- Blood and Sputum examination were collected under aseptic technique before antibiotic use.
- Evaluation of (1)Length of hospital stay, (2)ventilator support for patients with respiratory acidosis pH less than 7.2 , confusion, sever shock, respiratory rate more than 30 breath/minute, (3)organ dysfunction and (4)vasopressor need when mean arterial pressure less than 60 mmHg.

Ethical consideration:

The study protocol was approved by the Research Ethics Committee of Faculty of Medicine, Minia University, Approval number (565/ 2022**).** An informed written consent was obtained from patients before enrollment while maintaining patient confidentiality.

Statistical Analysis:

Data were analyzed via SPSS version 22 for Windows (IBM Corp., Armonk, NY, USA). The quantitative and categorical variables were described using mean SE and numbers (percentages), respectively. Every statistical difference between groups was examined using the independent t test. Utilizing the Chi square test, categorical data was compared. P-value less than 0.05 was used as the threshold for significance. Both univariate and multivariate logistic regression models were used to estimate the predictors of mortality, odds ratio (OR), and 95% confidence interval (CI). A p value of less than 0.05 was deemed statistically significant.

Results:

In the present study, 100 out of 105 patients who were admitted to the RICU throughout the study duration were included. Fifty patients had sepsis as their SIRS score ≥ 2. Patients with sepsis mean age was 60.56±1.15, while non- sepsis patients had mean age of-63.64±1.27-(P=0.42).

Pneumonia was the most significant pulmonary disease associated with sepsis (42% vs 12%) (P= 0.000) (**Table 1**).

In the present study all sepsis patients presented by cough and most of them presented with dyspnea, wheezes, fever, fatigue, and muscle aches as shown in **Table 2**.

Figure 1 illustrates underlying diseases associated with sepsis; the most frequent disease was Obstructive airway diseases (46 %) Followed by pneumonia (42 %) then suppurative lung diseases (10 %), interstitial lung disease (ILD) (10 %) and the least frequent was pulmonary embolism (2 %).

Table (3) shows that 23 patients out of 50 patients with sepsis were survived. There was a statistically significant differences between survivor and non-survivor patients as regard age (P<0.001), Serum Lactate (*P<0.001*), length of stay "LOS" (*P<0.001*), Need of vasopressor (*P<0.01*), Need for ventilatory support (*P<0.001*) and renal dysfunction (*P<0.001*). Regarding the bacteriological load, Gram negative bacteria were the most predominant organism in non survivors (P= 0.04).

Considering the risk factors of in-hospital mortality among patients with sepsis, it was found that serum lactate > 2 mmol/ L had an odd ratio of 2.26, and 1.25 on univariate and multivariate analysis respectively , while age > 60 years, length of ICU stay more than 10 days, , duration of sepsis symptoms > seven days and presence of organism were a significant risk factor on multivariate analysis **(Table 4).**

Table (1): Demographic data of studied patients.

	Sepsis patients (n=50)	Non-Sepsis patients (n=50)	P-value
Age (Years) Range Mean±SE	 45 -72 60.56±1.15	 46 -80 63.64±1.27	 0.424[b]
Gender, no. (%) Male Female	 25(50%) 25(50%)	 25(50%) 25(50%)	0.786[a]
SIRS score - < 2 - ≥ 2	 --- 50 (100 %)	 50(100%) ---	0.001[a]
Underlying disease			
-Obstructive airway diseases	23 (46%)	26 (52%)	
-Suppurative lung diseases	5 (10%)	4 (8%)	
-Pneumonia	21 (42 %)	6 (12 %)	
-Interstitial lung diseases (ILD)	5 (10%)	9 (18%)	0.002[a]
-Pulmonary embolism	1 (2%)	1 (2%)	
Comorbidity			
-None	13 (26%)	12 (24%)	
-Hypertension	22 (44%)	29 (58%)	
-Diabetes mellitus	12 (24%)	18 (36%)	0.328[a]
-Cardiac diseases	8 (16%)	10 (20%)	
-Cancer	3 (6%)	2 (4 %)	
-Cerebrovascular diseases	-----	1 (2%)	
-others	4 (8%)	6 (12%)	

Table (2): Symptoms & Signs of Sepsis patients

-Symptoms		No. (%)
Pulmonary		
Cough	-Yes -No	50(100%) --
Dyspnea	-Yes -No	48(96%) 2(4%)

Chest-pain	-Yes -No	2(4%) 48(96%)
Wheezing	-Yes -No	21(42%) 29(58%)
Extrapulmonary		
Fever	-Yes -No	41(82%) 9(18%)
Fatigue	-Yes -No	45(90%) 5(10%)
Muscles-aches	-Yes -No	28(56%) 22(44%)
Sore-throat	-Yes -No	8(16%) 42(84 %)
Vital-signs		
Glass cow coma scale	score =15 score <15	40(80%) 10(20%)
pulse	- 90 - 100 - 110 - 120 - 130 - 150	18(36%) 24(48%) 8(16%)
Blood pressure (Systolic)	-<90 - ≥90	19(38%) 31(62%)
Temperature	- < 38.0 - >38.0	9 (18%) 41(82%)
Respiratory rate	- < 22 - > 22	0(0%) 50(100%)
Oxygen saturation on room air	- < 92 - >92	49(8%) 1(8%)

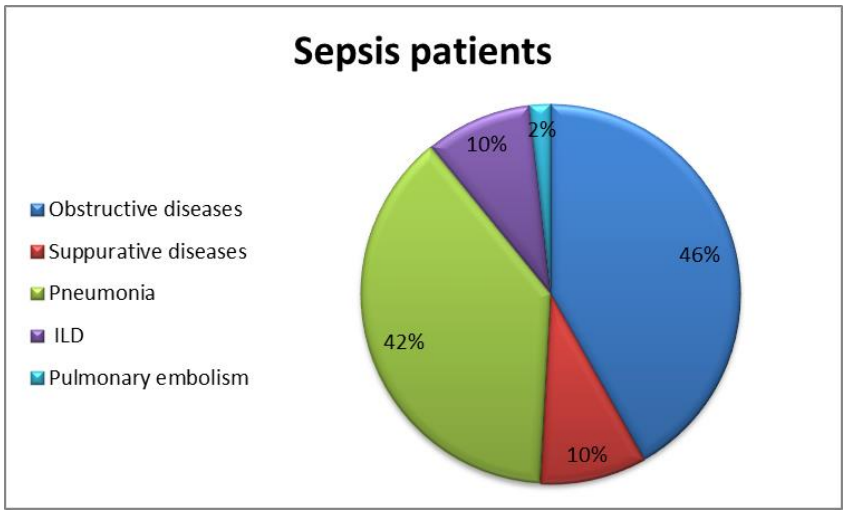

Figure 1: Underlying disease of Sepsis groups were presented as percentages

Table (3): Clinical variables of Sepsis patients according to outcome.

	Sepsis patients (n=50)		P-value
	Survivors (n=23)	Non- Survivors (n=27)	
Age (Years) - < 60 - >60	 10(43%) 13(57%)	 7(26%) 20(74%)	0.001[a]
Sex, no. (%) -Male -Female	 12(52%) 11(48%)	 13(48%) 14(52%)	0.79[a]
- SIRS score	3.65±0.12	3.85±0.07	0.191[b]
- Serum Lactate	1.52±0.17	6.50±1.78	0.001[b]
-LOS (days)	16.04 ±2.46	12.93 ±1.28	0.007[b]
-Need of vasopressor	3 (13%)	23 (85%)	0.009[a]
Ventilatory support			0.002[a]
-None	5 (22%)	1 (3.7%)	
-NIV	18 (78%)	1 (3.7%)	
-MV	---	25 (92%)	
Comorbidity			0.487[a]
-None	8 (35%)	5 (18.5%)	
-Hypertension	10 (43%)	12 (44.4%)	
-Diabetes mellitus	6 (26%)	6 (22.2%)	
-Cancer	1 (4%)	2 (7%)	
-Others	3 (12%)	9 (33.3%)	
Organism			
-No growth	10 (43.5%)	3 (11.1%)	
-Gram positive bacteria	2 (8.7%)	4 (14.8%)	0.048[a]
-Gram negative bacteria	8 (34.8%)	19 (70.4 %)	
-candida non albicans	3 (13%)	1(3.7 %)	
Organ dysfunction			0.001[a]
-None	19 (83%)	6 (22.2%)	
-Renal failure	4 (17%)	16 (59.3%)	
-Cardiac failure	----	4 (14.8%)	
-Hepatic failure	----	1 (3.7%)	

Table (4): Logistic regression analysis of in-hospital mortality

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	**P-value**	**OR (95% CI)**	P-value
Age (Years) < 60 < 60	 1 1.20 (-0.11 – 0.49)	 0.199	 1 1.19 (0.05 – 0.31)	 0.008
Sex Male Female	 1 1.04 (-0.25 – 0.33)	 0.782	 1 0.96 (-0.13 – 0.05)	 0.395
LOS (days) < 10 >10	 1 (0.24 – 0.36-) 0.94	 0.673	 1 0.87 (-0.26 – 0.03)	 0.018
Duration of Symptoms < 7 days >7 days	 1 (0.58 – 0.03-) 1.29	 0.075	 1 1.15 (0.04 – 0.26)	 0.011

- Organism No yes	 1 (0.73 – 0.11) 1.44	 0.009	 1 0.71 (-0.58 – 0.21)	 0.000
SPO_2 >90 % < 90%	 1 (0.08 – 1.09-) 0.73	 0.024	 1 0.97 (-0.24 – 0.14)	 0.579
WBCs count < 11.000 > 11.000	 1 (0.55 – 0.29-) 1.09	 0.533	 1 1.03 (-0.11 – 0.19)	 0.566
- Platelets count > 150.000 < 150.000	 1 (0.10 – 0.77-) 0.81	 0.129	 1 1.02 (-0.13 – 0.19)	 0.746
- CRP (mg/dL) < 6 > 6	 1 (0.25 – 1.20-) 1.21	 0.190	 1 0.97 (-0.33 – 0.19)	 0.597
- Serum Lactate (mmol/L) < 2 > 2	 1 2.26 (0.67 – 1.02)	 0.000	 1 1.25 (0.09 – 0.37)	 0.002

LOS=length of stay, SPO2=saturation of oxygen on pulse oximeter, WBCs=white blood cells, CRP=C-reactive protein

Discussion:

Sepsis is a common and serious illness that lowers quality of life and is linked to high rates of morbidity and mortality [8]. The purpose of this study was to estimate the case fatality rate for adult sepsis patients with underlying pulmonary disorders and to determine the possible risk factors of in-hospital mortality.

We found that the case fatality rate of sepsis was 54%. Previous 2 studies that were performed in India, found a mortality rate of 55.7% and 62.5% respectively [9,10]

Current epidemiologic research indicate that sepsis continues to be a major burden in all economic regions, despite advances in care. In-hospital mortality in the US ranging from 25 to 30 percent [11]. Nevertheless, there is no accepted method for diagnosing sepsis, and inconsistent definitions make it difficult to compare the findings of epidemiological and clinical research.[12]

Low- and middle-income nations have been advised by the World Health Organization to determine the prevalence and results of sepsis. Most authors and societies that contributed to the definitions of septic shock and sepsis were from high income nations[13] .

In this study, 50% of the studied cases with sepsis were males which was consistent with the findings of Ortiz et al. [14] study who found that 53% of sepsis patients were males and 47% were females.

In this study, the mean age of sepsis patients was 60.56±1.15years which was similar to Mohamed et. al. [15] who noticed that the mean age of patients with sepsis was 60.97 years. Furthermore, these findings agreed to the results of the following studies: Martin et al., van Gestel et al., and Finfer et al. [16, 17, 18], which noticed that most epidemiological studies' mean age of sepsis patients was between 55 and 64 years old.

The current study found that pneumonia was the significant respiratory disorders associated with sepsis (42%, P=0.002). In many of the previous studies, sepsis is more frequently caused by community acquired pneumonia [19]. Forty to fifty percent of sepsis patients had respiratory infection origins .

The current study found that increased age more than 60 years old was associated with higher mortality, where there was statistically significant difference in age between survived and non-survived patients. This was similar to that found by Adrie C. et.al., [20]. This may be explained by lower immune system function and weak immune response at old age. This is compounded by poor nutritional status and

altered cytokine response. Also, increase comorbidities with older age patients.[4] .

The present study showed that significantly higher level of serum lactate in non-survived sepsis patients than in survived patients which was in concordance with Mohamed et. al. [15] who stated that higher serum lactate was associated with higher mortality rates. Also, Hagiwara et al., [21] discovered that the non-survived group of sepsis had significantly higher serum lactate levels. Lactate is widely considered an indicator of severe sepsis and septic shock because it indicates tissue hypoperfusion. Elevated lactate levels are associated with greater probability of organ failure and mortality.[22]

In the present study, mechanical ventilation was required in 44 (88%) of the fifty patients with sepsis. Out of 44 ventilated patients, 26 (59%) patients died despite the interventions. The mechanical ventilation was associated with higher mortality as seen in studies by Vincent et al.[22] and Mohamed et. al. [14]. In the current study, compared to survivors, non-survivors had a significantly higher incidence of needing vasopressor drugs. This was in agreement with Madkour et al., [23] findings.

Gram-negative bacteria were the commonest isolated organism in sepsis patients followed by gram positive bacteria then Candida non albicans. It was noticed to be significantly higher in non-survived sepsis patients (70.4%) versus (34%) in survivors. Which was similar to the study by Zanon et al. [24]. Another Egyptian study [23] found that the most frequent cause of infection was gram-negative bacteria, which were followed in frequency by acid-fast bacilli, fungal infections and gram-positive bacteria ,

In the present study, length of stay at RICU was 12.93 ±1.28 days for non-survivor compared by 16.04 ±2.46 days for survived sepsis patients. This matched with study by Madkour et al., [23] that recorded the mean length of stay at RICU was 12.720 ± 7.553 days.

We found that organ failure was more in sepsis patients who died. A committee determined the cause of death for patients who passed away during the Recombinant Human Activated Protein C Worldwide Evaluation in Severe Sepsis study. They found that multiple organ failure accounted for the majority of deaths (84.2%) among patients with sepsis[25] .

The logistic regression analysis of in-hospital mortality was performed, and the results revealed that age > 60 years old, symptoms > 7 days, higher serum lactate level >2 mmol/L, length of stay in RICU > 10days, and presence of infection were significant independent risk factors for in-hospital mortality. These results resembled what found by other studies, Medam et al., (26) and Whiles et.al.[27]

Conclusion:

Sepsis has a high mortality rate. Old age, prolonged length of hospital stay, identification of micro-organism on samples, and elevated serum lactate are significant predictors for in-hospital mortality in sepsis patients.

References:

1. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third international Consensus Definitions for Sepsis and Septic shock (Sepsis-3). JAMA. 2016;315(8):801-10.

2. Chiu C, Legrand M. Epidemiology of Sepsis and Septic shock. Current Opinion in Anesthesiology. 2021;34(2):71-6.

3. World Health Organization. Global report on the epidemiology and burden of sepsis: current evidence, identifying gaps and future directions. 2020.

4. Angus DC, Poll TV. Severe Sepsis and Septic Shock. New England journal of medicine. 2013;369(9):840-51.

5. Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, et al. Surviving sepsis campaign: International guidelines for Management of Sepsis and Septic shock 2021. Critical care medicine. 2021;49(11):e1063-e143.

6. Yealy DM, Mohr NM, Shapiro NI, Venkatesh A, Jones AE, Self WH. Early care of adults with suspected sepsis in the emergency department and out-of-hospital environment: a consensus-based task force report. Annals of Emergency Medicine 2021, volume 78, No I.

7. Marik, P. E., & Taeb, A. M. (2017). SIRS, qSOFA and new sepsis definition. J Thorac

Dis, 9(4), 943-945. doi: 10.21037/jtd.2017.03.125

8. Machado FR, Cavalcanti AB, Bozza FA, Ferreira EM, Angotti Carrara FS, Sousa JL, et al. The epidemiology of sepsis in Brazilian intensive care units (the Sepsis PREvalence Assessment Database, SPREAD): an observational study. Lancet Infect Dis. 2017;17:1180–9.

9. Shrestha P, Mohan A, Sharma S, Guleria R, Vikram N, Wig N, et al. To determine the predictors of mortality and morbidity of sepsis in medical ICU of All India Institute of Medical Sciences (AIIMS) New Delhi, India.Chest 2012;142(4 Meeting Abstracts):407A.

10. Bale C, Kakrani AL, Dabadghao VS, Sharma ZD. Sequential organ failure assessment score as prognostic marker in critically ill patients in a tertiary care Intensive Care Unit. Int J Med Public Health 2013;3:155 8.

11.Cohen J, Vincent JL, Adhikari NK, Machad o FR, Angus DC, Calandra T, Jaton K, Giulieri S, Delaloye J, Opal S, et al. Sepsis: a roadmap for future research. Lancet Infect Dis 2015;15:581–614

12.Vincent JL, Opal SM, Marshall JC, Tracey KJ. Sepsis definitions: time for change. Lancet 2013;381:774–775.

13.Fleischmann C, Scherag A, Adhikari NKJ ,Hartog CS, Tsaganos T, Schlattmann P, et al. Assessment of Global Incidence and Mortality of Hospital-treated Sepsis. Current Estimates and Limitations. Am J Respir Crit Care Med 2016, Vol 193, Iss 3, pp 259–272.

14. Ortíz G, Dueñas C, Rodríguez F, Barrera L, de La Rosa G, Dennis R, et al. EEpidemiology of sepsis in Colombian intensive care units. Biomedica. 2014;34(1):40-7.

15. Mohamed AKS, Mehta AA, James P. Predictors of mortality of severe sepsis among adult patients in the medical Intensive Care Unit. Lung India. 2017;34(4):330-5.

16.Martin GS, Mannino DM, Eaton S, Moss M. The epidemiology of sepsis in the United States from 1979 through 2000. New England Journal of Medicine. 2003;348(16):1546-54.

17.van Gestel A, Bakker J, Veraart CP, van Hout BA. Prevalence and incidence of severe sepsis in Dutch intensive care units. Critical care. 2004;8:1-10.

18.Finfer S, Bellomo R, Lipman J, French C, Dobb G, Myburgh J. Adult-population incidence of severe sepsis in Australian and New Zealand intensive care units. Intensive care medicine. 2004;30:589-96.

19.Alberti C, Brun-Buisson C, Chevret S, Antonelli M, Goodman SV, Martin C, et al. Systemic inflammatory response and progression to severe sepsis in critically ill infected patients. Am J Respir Crit Care Med 2005;171:461-8.

20.Adrie C, Francais A, Alvarez-Gonzalez A, Mounier R, Azoulay E, Zahar J-R, et al. Model for predicting short-term mortality of severe sepsis. Critical Care. 2009;13:1-14.

21.Abe T, Ogura H, Shiraishi A, Kushimoto S, Saitoh D, Fujishima S, et al. Characteristics, management, and in-hospital mortality among patients with severe sepsis in intensive care units in Japan: the FORECAST study. Critical Care. 2018;22:1-12.

22. Vincent J-L, Dufaye P, Berré J, Leeman M, Degaute J-P, Kahn Rj. Serial Lactate Determinations During Circulatory shock. Critical care medicine. 1983;11(6):449-51.

23.Madkour AM, ELMaraghy AA, Elsayed MM. Prevalence and outcome of sepsis in respiratory intensive care unit. The Egyptian Journal of Bronchology. 2022;16(1):29.

24.Zanon F, Caovilla JJ, Michel RS, Cabeda EV, Ceretta DF, Luckemeyer GD, et al. Sepsis in the intensive care unit: etiologies, prognostic factors and mortality. Revista Brasileira de terapia intensiva. 2008;20:128-34.

25.Vincent JL, Nelson DR, Williams MD. Is worsening multiple organ failure the cause of death in patients with severe sepsis? Crit Care Med. 2011; 39(5):1050–5.

26.Medam S, Zieleskiewicz L, Duclos G, Baumstarck K, Loundou A, Alingrin J, et al. Risk factors for death in septic shock: a retrospective cohort study comparing trauma and non-trauma patients. Medicine. 2017;96(50):e9241.

27.Whiles BB, Deis AS, Simpson SQ. Increased time to initial antimicrobial administration is associated with progression to septic shock in severe sepsis patients. Critical Care Medicine. 2017;45(4):623-9.