



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

Characteristics of Adult Sepsis Patients Admitted to Department of Internal Medicine, Dr. M. Djamil General Hospital, Padang, Indonesia

Elvia Fataya¹, Fadrian^{2*}, Mustafa Noer³, Dwitya Elvira², Yuliarni Syafrita⁴, Netti Suharti⁵

¹Undergraduate Program, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

²Department of Internal Medicine, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

³Department of Medical Education, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

⁴Department of Neurology, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

⁵Department of Microbiology, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

ARTICLE INFO

Keywords:

Cefepime
Comorbid disease
Escherichia coli
Sepsis
Septic shock

*Corresponding author:

Fadrian

E-mail address:

fadrian@med.unand.ac.id

All authors have reviewed and approved the final version of the manuscript.

<https://doi.org/10.37275/bsm.v7i3.791>

ABSTRACT

Background: Sepsis is a life-threatening organ dysfunction resulting from a dysregulated host response to infection. Septic shock is the most dangerous complication of sepsis, characterized by abnormalities in the circulatory and metabolic systems. This study aimed to determine the characteristics of adult sepsis patients admitted to the department of internal medicine of Dr. M. Djamil General Hospital, Padang, Indonesia. **Methods:** This research was a descriptive study and used secondary data from medical records. Samples in this study were medical record data from the medical record installation of Dr. M. Djamil General Hospital, Padang, Indonesia. The inclusion criteria were adult patients aged more than 18 years old, diagnosed with sepsis, and hospitalized in the department of internal medicine for the period of January 2020 to December 2021. **Results:** Most of the sepsis patients were mostly aged more than 60 years old (51.7%), female (57.2%), and had normal BMI scores (59.3%). The infections mainly originated from the lungs (80%), the most common comorbid disease was chronic kidney disease (26.4%), the most frequent causing microorganism was *Escherichia coli* (15.9%), the frequent degree of severity was a septic shock (60%), and cefepime was used as the initial empirical antibiotic (44.8%). **Conclusion:** Most sepsis patients were adults aged more than 60 years old and females, with the focus on infection originating from the lungs, degree of severity in the form of septic shock, and the most used initial empirical antibiotic, namely cefepime.

1. Introduction

Sepsis is a syndrome that is significantly affected by both pathogen and host factors.¹ Sepsis is initiated by the presence of infection, which is defined as the entry of a causative organism into human tissue along with its reaction to the organism. Bacteria, viruses, and fungi are all known microorganisms that can cause infection.² Septic shock is the most serious complication of sepsis, characterized by profound circulatory and metabolic impairments that can enhance mortality.^{1,3}

Sepsis remains a serious health issue with varying incidence in different regions. A total of 48.9 million

people suffered from sepsis in 2017, of which 11 million were reported dead from their sepsis.⁴ The occurrence of sepsis is affected by several factors. Older age is associated with an increased risk of sepsis. This can occur as the body's immune system decreases with age.⁵ Male gender has also been reported to be more likely to suffer from sepsis rather than female. This may be due to the influence of female sex hormones that are reported to affect the immune system, which may cause a protective effect in females.⁶ The next factor associated with sepsis is nutritional status. Obese individuals are reported to be more susceptible to sepsis.⁷ However, sepsis

patients with a lean nutritional status are said to have a lower survival rate compared to obese patients.⁸ This is influenced by the lack of nutritional reserves that the patient has, which affects the patient's ability to overcome infection.⁹

The majority of sepsis is caused by bacterial infections. Viral and fungal infections can also be a cause of sepsis, but less frequently. The sepsis occurrence in acutely ill patients (SOAP) study showed *Staphylococcus aureus* as the most commonly identified gram-positive bacteria while *Pseudomonas sp* and *Escherichia coli* as the most commonly identified gram-negative bacteria in sepsis patients.¹⁰ Infection in sepsis can originate from various locations in the host's body. Common primary sites of infection are the respiratory system, digestive system, and genitourinary system. Sepsis can be community-acquired and can also be acquired as a result of hospitalization (hospital-acquired). Cases of sepsis resulting from hospitalization can occur up to about 80% in the community.¹⁰

Clinical criteria for diagnosing sepsis are obtained from the sequential organ failure assessment (SOFA) score, which allows the identification of organ dysfunction. The occurrence of two or more criteria on the SOFA score, along with the presence of infection, is a diagnostic feature of sepsis in adult patients.¹¹ Screening for signs and symptoms of sepsis is crucial for early identification. Appropriate intervention can significantly reduce patient mortality. The focus of treatment in sepsis patients involves prompt intervention, eradicating the source of infection, restoring tissue perfusion, and repairing damaged organs. Eradicating the cause of infection is carried out by providing adequate antimicrobial therapy early on.¹⁰ This study aimed to determine the characteristics of adult sepsis patients admitted to the department of internal medicine, Dr. M. Djamil General Hospital, Padang, Indonesia.

2. Methods

This research was a descriptive study and used secondary data from medical records. The medical

records were collected from November to December 2022. Samples in this study were medical record data from the medical record installation of Dr. M. Djamil General Hospital, Padang, Indonesia. Data were collected using total sampling, where the sample included the entire population that met inclusion criteria. The inclusion criteria were adult patients aged more than 18 years old, diagnosed with sepsis, and hospitalized in the department of internal medicine for the period of January 2020 to December 2021. This study has received approval from the ethical committee, Faculty of Medicine, Universitas Andalas. Obtained data were analyzed using the Microsoft Excel program, then presented in narrative paragraphs and tables.

3. Results

A total of 145 samples were included in this study, with details of 113 cases found in 2020 and as many as 32 cases found in 2021. The characteristics of adult sepsis patients admitted to the department of internal medicine of Dr. M. Djamil General Hospital, Padang, Indonesia, in 2020-2021 are shown in Table 1. Table 1 shows that most of the patients were aged more than 60 years old (51.7%), female (57.2%), and had BMI scores around 18.5-25.0 (59.3%). Based on the focus of infection, 80% of patients had a focus of infection originating from the lungs, and based on the degree of severity, 60% of patients had septic shock.

Table 2 shows that chronic kidney disease (CKD) and diabetes mellitus are the two most common comorbid diseases. This study also found that CKD and diabetes mellitus had the highest mortality rate, with 50 cases (22%) and 49 cases (21.6%), respectively.

The causative microorganisms based on culture examinations of patients are presented in Figure 1 and Table 3. From 145 culture examinations, most of them were gram-negative bacteria, and the rests were gram-positive bacteria, fungi, and no growth (Figure 1). Table 3 shows the most common type of bacteria found in adult sepsis patients was *Escherichia coli* (15.9%).

Table 1. Characteristics of adult sepsis patients.

Characteristics	Frequency	Percentage %
Age group		
18 – 40 years	17	11.7
>40 – 60 years	53	36.6
>60 years	75	51.7
Gender		
Male	62	42.8
Female	83	57.2
BMI score		
<18.5	11	7.6
18.5 – 25.0	86	59.3
>25.0	48	33.1
Focus of infection		
Lungs	116	80
Skin/soft tissue	17	11.7
Urinary tract	10	6.9
Digestive	1	0.7
Other	1	0.7
Severity		
Sepsis	58	40
Septic shock	87	60

Table 2. Comorbid diseases among patients along with the outcomes.

Comorbid diseases	Outcome		Total
	Survived;n (%)	Died; n(%)	
AIDS	0 (0)	1 (0.4)	1 (0.4)
Autoimmune	0 (0)	4 (1.8)	4 (1.8)
CKD	10 (4.4)	50 (22)	60 (26.4)
Diabetes mellitus	9 (4)	49 (21.6)	58 (25.6)
Hypertension	8 (3.5)	11 (4.8)	19 (8.4)
Malignancy	6 (2.6)	9 (4)	15 (6.6)
COPD	0 (0)	3 (1.3)	3 (1.3)
Cirrhosis hepatis	1 (0.4)	7 (3.1)	8 (3.5)
Stroke	6 (2.6)	12 (5.3)	18 (7.9)
Tuberculosis	1 (0.4)	22 (9.7)	23 (10.1)
No comorbid diseases	4 (1.8)	14 (6.2)	18 (7.9)
Total	45 (19.8)*	182 (80.2)*	227 (100)*

*Notes: One patient may have more than one comorbid disease.

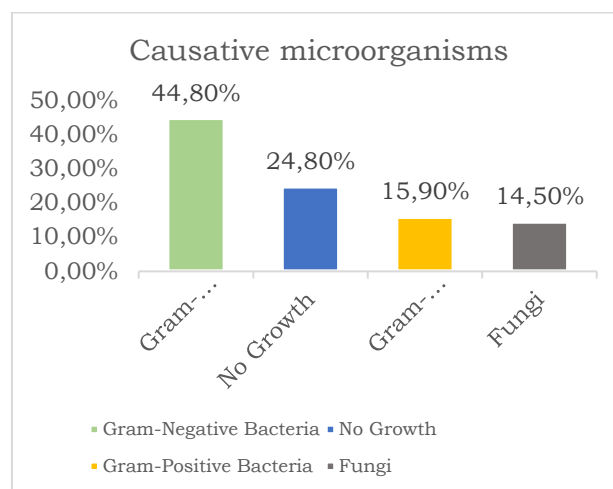


Figure 1. Causative microorganisms.

Table 3. Types of causative microorganisms found in patient culture.

Causative microorganisms	n (145)	Percentage %
<i>Acinetobacter baumannii</i>	14	9.7
<i>Candida sp</i>	21	14.5
<i>Citrobacter freundii</i>	2	1.4
<i>Enterobacter cloacae</i>	2	1.4
<i>Enterococcus faecalis</i>	2	15.9
<i>Escherichia coli</i>	23	11.7
<i>Klebsiella pneumoniae</i>	17	3.4
<i>Pseudomonas aeruginosa</i>	5	0.7
<i>Salmonella sp</i>	1	1.4
<i>Staphylococcus aureus</i>	2	3.4
<i>Staphylococcus epidermidis</i>	5	9
<i>Staphylococcus haemolyticus</i>	13	0.7
<i>Staphylococcus pseudintermedius</i>	1	0.7
<i>Stenotrophomonas maltophilia</i>	1	24.8
No growth	36	

Table 4 shows that cefepime was the most frequent initial empirical antibiotic used in adult sepsis patients, followed by ceftriaxone and meropenem.

Cefepime also had the highest mortality rate, while meropenem was the antibiotic with the lowest survival rate.

Table 4. Initial empirical antibiotics used in patients, along with the outcomes.

Initial empirical antibiotics	Outcome		Total
	Survived n (%)	Died n (%)	
Amikacin	0 (0)	1 (0.7)	1(0.7)
Azithromycin	1 (0.7)	0 (0)	1 (0.7)
Cefepime	11 (7.6)	54 (37.2)	65 (44.8)
Cefoperazone	1 (0.7)	0 (0)	1 (0.7)
Ceftazidime	1 (0.7)	1 (0.7)	2 (1.4)
Ceftriaxone	11 (7.6)	40 (27.6)	51 (35.2)
Ciprofloxacin	1 (0.7)	0 (0)	1 (0.7)
Gentamicin	0 (0)	1 (0.7)	1 (0.7)
Levofloxacin	1 (0.7)	5 (3.4)	6 (4.1)
Meropenem	0 (0)	13 (9)	13 (9)
Metronidazole	1 (0.7)	1 (0.7)	2 (1.4)
Moxifloxacin	1 (0.7)	0 (0)	1 (0.7)
Total	29 (20)	116 (80)	14500

4. Discussion

The results showed that based on their age, most adult sepsis patients were aged more than 60 years old. Another study revealed that sepsis patients were mostly suffered by the age group more than 65 years compared to other age groups.⁵ In older age, there is a decrease in immune system function known as immunosenescence. Immunosenescence affects the capacity of both the innate and adaptive immune

systems.¹² There is a decline in the function of migration, proliferation, differentiation, and activation of immune cells. Aging is also associated with various physiological changes and a progressive decline in body homeostasis. This leads to a decline in various organ functions that affect one's ability to cope with external stressors.¹³

This study also shows that females suffer from sepsis more often than males. The immune response

in overcoming infection in males is different from females. This is because the hormone testosterone in men suppresses the immune system, while the hormone estrogen in women increases the activity of the immune response, which contributes to the natural protective effect.⁶ However, the hormone estrogen in women can decrease with age. Levels of this hormone decline progressively, especially in women who have undergone menopause. This decrease in estrogen levels causes women to lose their protective function, which can disrupt the body's immune balance and make women, especially in older age, more susceptible to infection.

Based on BMI scores, adult sepsis patients most often have a normal BMI (18.5 - 25.0), as much as 59.3%. These results are in line with research conducted by Fuchs et al., which found that as many as 64.1% of sepsis patients had nutritional status in the normal category.¹⁴ Previous studies have explained the hypothesis regarding the mechanism of the relationship between obesity and a person's susceptibility to sepsis. In obese individuals, there is an increase in adiposity that can lead to chronic inflammation. Adipose tissue can secrete inflammatory cytokines that are associated with sepsis.⁷ This study showed a different result, where the majority of sepsis patients had normal BMI scores. Chronic inflammation is not only caused by adipose accumulation. Other factors, such as comorbidities that patients have, also have a major influence. Diabetes mellitus, hypertension, and other chronic diseases are examples of risk factors that influence the development of sepsis. In addition, there is also the possibility that the patients in this study had experienced weight loss, causing the patients who were previously in the obese category to turn into the normal category at the time of the examination. This weight loss can occur unintentionally due to other diseases and comorbidities suffered by the patient.¹⁵

Furthermore, the focus of infection of sepsis patients in the study was mostly from the lungs (80%). A previous study stated that the lungs are the most frequent initial site of infection in sepsis patients.¹⁶

The lungs play a role as a portal between the external and internal environment. A number of factors can influence the occurrence of pulmonary infection, including abnormalities in the anatomical shape of the lungs, a decrease in mucociliary clearance ability, and abnormalities in the immune response.¹⁷ Some conditions that increase the risk of aspiration, such as stroke, seizures, anesthesia, and drug poisoning, also predispose a person to lung infection. In addition, smoking, alcoholism, malnutrition, and bronchial obstruction due to tumors are also common predisposes to infection.

The most common severity of sepsis in this study was septic shock amounting to 87 individuals (60%). This is in accordance with a study by Abe et al., which showed that of 1184 patients with sepsis, septic shock occurred in 745 patients (62.9%).¹⁶ Septic shock is the most severe complication of sepsis. Septic shock occurs in response to a triggering factor that causes activation of both pro-inflammatory and anti-inflammatory immune systems. This activation involves various cytokines that can ultimately lead to capillary leakage. This series of events leads to clinical signs and symptoms of sepsis as well as its progression to septic shock.³ Clinically, sepsis shock is characterized by persistent hypotension requiring vasopressors to maintain MAP \geq 65 mmHg and lactate concentration greater than 2 mmol/L despite adequate fluid resuscitation.¹⁰

The results showed that most adult sepsis patients had comorbid diseases such as chronic kidney disease (CKD), followed by diabetes mellitus. A study by Nasir et al. also showed similar results, with hypertension, diabetes mellitus, and chronic kidney disease being the three most common comorbidities found in sepsis patients.¹⁸ Patients with CKD are reported to be at higher risk of infection. In addition, CKD patients require hemodialysis therapy. Each hemodialysis procedure requires access to the patient's vascular bed. This also increases the risk of infection in patients with CKD.¹⁹ In addition, due to the disruption of renal clearance function, CKD patients tend to accumulate inflammatory cytokines. This can lead to persistent

inflammation and impaired immune function.²⁰

Patients with diabetes mellitus (DM) also have a higher risk of infection and sepsis.²¹ Elevated blood glucose levels in DM patients tend to inhibit the function of polymorphonuclear leucocytes (PMN).²² This can disrupt immune system mechanisms and result in the body's failure to control the growth of microorganisms during infection. Hyperglycaemia can affect the function of neutrophils and macrophages, making patients more susceptible to sepsis. Hyperglycaemia also leads to increased production of pro-inflammatory cytokines, such as TNF- α , which results in persistent inflammation and tissue damage.²³

Gram-negative bacteria *Escherichia coli* was found to be the most common microorganism that caused sepsis in this study. Another study stated that gram-negative *Escherichia coli* were the most often found bacteria in the culture results of sepsis patients.¹⁶ Gram-negative bacteria produce large molecules consisting of lipids and polysaccharides (LPS) that can increase the ability of bacteria to cause disease.²⁴ Several conditions such as kidney failure, cancer, catheterization, and urinary incontinence are risk factors for the development of *Escherichia coli* in the bloodstream.²⁴

This study also found 24.8% of culture samples with no growth results. In line with research by Phua et al., which reported that the distribution of positive blood cultures in sepsis patients was 58.5%, while the remaining 41.5% did not find the causative microorganisms.²⁵ There are several things that can cause negative blood culture results in patients, such as the condition of patients who are already on antibiotics before culture examination, inappropriate sampling techniques, lack of sample volume being taken, poor sample transportation process, and the nature of bacteria that grow slowly or require more specific culture media.²⁵

Based on the initial empirical antibiotic, cefepime was found to be the most commonly used antibiotic, along with the highest mortality rate in adult sepsis patients. Cefepime is a common antibiotic given in

hospitals. It is often given empirically to sepsis patients whose pathogen causing the infection is unknown. Cefepime is an antibiotic from the fourth-generation cephalosporin group that works by inhibiting bacterial cell wall synthesis. Cefepime has a broad spectrum of coverage and is more stable against beta-lactamase enzymes.²⁶

The results of this study also showed that based on the outcome, cefepime had the highest death outcome, at 37.2%. Cefepime has a narrow therapeutic index that may lead to neurological disorders in patients.²⁷ This antibiotic has neurotoxic effects due to its ability to cross the blood-brain barrier. Patients who receive cefepime therapy are likely to experience these side effects, especially in patients who have risk factors such as renal dysfunction, dose discrepancies, obesity, and older age.

5. Conclusion

Most sepsis patients were adults aged more than 60 years old and females, with the focus on infection originating from the lungs, degree of severity in the form of septic shock, and the most used initial empirical antibiotic, namely cefepime.

6. 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. Zachary JF. Mechanisms of microbial infections. *Pathologic basis of veterinary disease*. 2017: 132.
3. Mahapatra S, Heffner AC. Septic shock (sepsis). *StatPearls Internet*. 2017.
4. Rudd KE, Johnson SC, Agesa KM, Shackelford KA, Tsoi D, Kievlan DR, et al. Global, regional, and national sepsis incidence and mortality, 1990–2017: analysis for the Global Burden of Disease Study. *The Lancet*. 2020; 395(10219): 200-11.

5. Sanjaya BD, Djuang MH, Muniro FD, Chiuman L. Sepsis risk factors in elderly patients at Royal Prima Medan General Hospital. *Jambura Journal of Health Sciences and Research*. 2022; 4(3): 596-603.
6. Angele MK, Pratschke S, Hubbard WJ, Chaudry IH. Gender differences in sepsis: cardiovascular and immunological aspects. *Virulence*. 2014; 5(1): 12-9.
7. Wang HE, Griffin R, Judd S, Shapiro NI, Safford MM. Obesity and risk of sepsis: A population-based cohort study. *Obesity*. 2013; 21(12): E762-9.
8. Arabi YM, Dara SI, Tamim HM, Rishu AH, Bouchama A, Khedr MK, et al. Clinical characteristics, sepsis interventions and outcomes in the obese patients with septic shock: an international multicenter cohort study. *Critical Care*. 2013; 17: 1-3.
9. Weng L, Fan J, Yu C, Guo Y, Bian Z, Wei Y, et al. Body-mass index and long-term risk of sepsis-related mortality: a population-based cohort study of 0.5 million Chinese adults. *Critical Care*. 2020; 24: 1-9.
10. Cecconi M, Evans L, Levy M, Rhodes A. Sepsis and septic shock. *The Lancet*. 2018; 392(10141): 75-87.
11. Wentowski C, Mewada N, Nielsen ND. Sepsis in 2018: a review. *Anaesthesia & Intensive Care Medicine*. 2019; 20(1): 6-13.
12. Salminen A, Kaarniranta K, Kauppinen A. Immunosenescence: the potential role of myeloid-derived suppressor cells (MDSC) in age-related immune deficiency. *Cellular and Molecular Life Sciences*. 2019; 76: 1901-18.
13. Esme M, Topeli A, Yavuz BB, Akova M. Infections in the elderly critically-ill patients. *Frontiers in Medicine*. 2019; 6: 118.
14. Fuchs A, Tufa TB, Hörner J, Hurissa Z, Nordmann T, Bosselmann M, et al. Clinical and microbiological characterization of sepsis and evaluation of sepsis scores. *PLoS One*. 2021; 16(3): e0247646.
15. Fildes A, Charlton J, Rudisill C, Littlejohns P, Prevost AT, Gulliford MC. Probability of an obese person attaining normal body weight: cohort study using electronic health records. *American Journal of Public Health*. 2015; 105(9): e54-9.
16. Abe T, Ogura H, Kushimoto S, Shiraishi A, Sugiyama T, Deshpande GA, et al. Variations in infection sites and mortality rates among patients in intensive care units with severe sepsis and septic shock in Japan. *Journal of Intensive Care*. 2019; 7(1): 1-9.
17. Pahal P, Rajasurya V, Sharma S. Typical bacterial pneumonia. *StatPearls Publishing*. 2022.
18. Nasir N, Jamil B, Siddiqui S, Talat N, Khan FA, Hussain R. Mortality in sepsis and its relationship with gender. *Pakistan Journal of Medical Sciences*. 2015; 31(5): 1201.
19. James MT, Laupland KB, Tonelli M, Manns BJ, Culleton BF, Hemmelgarn BR, Alberta Kidney Disease Network. Risk of bloodstream infection in patients with chronic kidney disease not treated with dialysis. *Archives of Internal Medicine*. 2008; 168(21): 2333-9.
20. Carrero JJ, Yilmaz MI, Lindholm B, Stenvinkel P. Cytokine dysregulation in chronic kidney disease: how can we treat it?. *Blood Purification*. 2008; 26(3): 291-9.
21. Frydrych LM, Fattahi F, He K, Ward PA, Delano MJ. Diabetes and sepsis: risk, recurrence, and ruination. *Frontiers in Endocrinology*. 2017; 8: 271.
22. Jiang L, Cheng M. Impact of diabetes mellitus on outcomes of patients with sepsis: an updated systematic review and meta-analysis. *Diabetology & Metabolic Syndrome*. 2022; 14(1): 1-7.
23. Pearson-Stuttard J, Blundell S, Harris T, Cook DG, Critchley J. Diabetes and infection: assessing the association with glycaemic control in population-based studies. *The Lancet Diabetes & Endocrinology*. 2016; 4(2):

148-58.

24. Bertani B, Ruiz N. Function and biogenesis of lipopolysaccharides. *EcoSal Plus*. 2018; 8(1).
25. Phua J, Ngerng WJ, See KC, Tay CK, Kiong T, Lim HF, et al. Characteristics and outcomes of culture-negative versus culture-positive severe sepsis. *Critical Care*. 2013; 17(5): 1-2.
26. O'Connor A, Lopez MJ, Eranki AP. Cefepime. StatPearlsPublishing. 2022.
27. Payne LE, Gagnon DJ, Riker RR, Seder DB, Glisic EK, Morris JG, et al. Cefepime-induced neurotoxicity: a systematic review. *Critical Care*. 2017; 21(1): 1-8.