

ORIGINAL ARTICLE

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The effects of comorbidity factors on the prognosis in geriatric sepsis patients in the intensive care unit**Özkan Gorgulu¹, Mehmet Nuri Kosar²**¹*Antalya Training and Research Hospital, Department of Anesthesiology and Reanimation, Antalya, Turkey*²*Antalya Training and Research Hospital, Department of General Surgery, Antalya, Turkey*

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**Abstract**

Mortality rates in geriatric sepsis patients are very high in the intensive care unit. The aim of our study is to evaluate the prognosis of geriatric patients diagnosed with sepsis according to age groups in the intensive care unit. The data of 189 geriatric patients were reviewed retrospectively. Elixhauser Comorbidity index was calculated. The patients were divided into three different age groups young-old (65-74 years), middle-old (75-84 years) and oldest-old (85 years and above). The prognosis was evaluated in patients with Elixhauser Comorbidity index score ≥ 10 . The mean length of ICU stays of those aged over 85 years (21.10 ± 23.75) and 75-84 years (17.45 ± 20.59) was compared with that of 65-74-year-old patients (10.23 ± 12.19). Young elderly patients had shorter length of ICU stay than other groups (95% confidence interval) ($p=0,01$ $p<0,05$). It was found that in terms of length of ICU stay and age did not affect prognosis in the sepsis patients in 3 different geriatric age groups ($p>0.05$). Oldest-old and middle-old patients' length of stay in the intensive care unit for a longer period than young-old patients. Mortality rate in geriatric sepsis patients with Elixhauser Comorbidity Index greater than 10 is over 70%, but ICU stay did not affect 30-day mortality.

Keywords: Geriatrics, sepsis, Intensive care units, mortality, comorbidity**Introduction**

The World Health Organization defined patients aged ≥ 65 years as geriatric patients. Aging brings many functional and physiological deterioration, while a weakened immune system becomes susceptible to infections, such as bacteremia and sepsis [1,2], a major cause of morbidity and mortality in the geriatric age group [2]. Although a consensus on the definition of sepsis with regard to the host response to infection is available, the complexity of this response and the affected patient groups means that establishing accepted definitions of sepsis is difficult [3]. The prevalence of sepsis in geriatric patients admitted to intensive care units (ICUs) is quite high, and its prognosis varies depending on the underlying pathogen and severity of organ failure [4]. As the length of ICU stay of geriatric patients increases, they become susceptible to nosocomial infections [5]. The most common causes of nosocomial infections are urinary, nasogastric, and central venous catheters [5]. The most common tissue sources for bacteremia are the urogenital system and lungs [6,7].

In geriatric age groups, the most common cause of sepsis in ICUs appears to be gram-negative bacteria [8]. Geriatric patients admitted in the ICU commonly had sepsis, which has an effect on mortality [9]. Severe sepsis increases the morbidity and mortality by creating a global tissue hypoperfusion and oxidative damage [10]. The key to preventing sepsis in geriatric patients is rapid diagnosis and aggressive resuscitation [2]. This study aimed to analyze the length of ICU stay and investigate the 30-day mortality rate in geriatric patients diagnosed with sepsis in the ICU.

Material and Methods**Study Population**

This study was conducted from 2008 to 2018 in accordance with the Helsinki Declaration after obtaining approval from the Ethics Committee of the Institution (Approval Date/ Protocol No: 07.11.2019-24/6). This is a single-center retrospective descriptive study conducted by scanning the electronic patient data system (SARUS) data of 6501 geriatric patients treated in the ICU of our Level 3 hospital. During the study period, among the 273 patients with sepsis followed up in the ICU, 189 (69.2%) were diagnosed with geriatric sepsis, aged ≥ 65 years (mean $\pm$ SD: 76.68 ± 7.09) (65-95), 50.8% (96) of them were women, and the mean length of ICU

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stay was 14.87 ± 18.44 (1-81) days.

Assessments

Patients included in the study (n=189) were divided into three geriatric age groups: young-old (65-74), middle-old (75-84), and oldest-old (≥ 85 years). Diagnostic criteria for sepsis; 1-Fever > 38.3 degrees C or Hypothermia < 36 degrees C core temperature 2-Change in mental status 3-White blood cell count $> 12,000$ or less than $4,000$ 4-Arterial hypoxemias ($paO_2 / FiO_2 < 300$). 5-Acute drop in urine output (< 0.5 ml/kg/hr for at least 2 hours despite fluid resuscitation, or about 35ml/hour for a 70kg person) 6-Creatinine increase > 0.5 mg/dL 7-INR > 1.5 9-Platelet count $< 100,000$ 8-Hypotension (systolic blood pressure < 90 mm Hg or fallen by > 40 from baseline, mean arterial pressure < 70 mm Hg). 9-High bilirubin values (total bilirubin > 4 mg/dL) 10-Glasgow coma score (GCS) < 10 . In the presence of infection, patients with two or more of these criteria were diagnosed as sepsis. The Elixhauser Comorbidity Index criteria include the following diseases (range -19 [less likely for in-hospital death] to 89 [more likely for in-hospital death]).

Elixhauser Comorbidity Index Score

Comorbidity Values and percentage rate

1. Congestive heart failure 7 points or 75.9%
2. Cardiac arrhythmias 5 points or 77.8%
3. Valvular disease -1 points or 83.3%
4. Pulmonary circulation disorders 4 points or 78.7%
5. Peripheral vascular disorders 2 points or 80.6%
6. Hypertension 0 points or 82.4%
7. Paralysis 7 points or 75.9%
8. Neurodegenerative disorders 6 points or 76.9%
9. Chronic pulmonary disease 3 points or 79.6%
10. Diabetes 0 points or 82.4%
11. Hypothyroidism 0 points or 82.4%
12. Renal failure 5 points or 77.8%
13. Liver disease 11 points or 72.2%
14. Peptic ulcer disease, no bleeding 0 points or 82.4%
15. AIDS/HIV 0 points or 82.4%
16. Lymphoma 9 points or 74.1%
17. Metastatic cancer 12 points or 71.3%
18. Solid tumor without metastasis 4 points or 78.7%
19. Rheumatoid arthritis/collagen vascular diseases 0 points or 82.4%
20. Coagulopathy 3 points or 79.6%
21. Obesity -4 points or 86.1%
22. Weight loss 6 points or 76.9%
23. Fluid and electrolyte disorders 5 points or 77.8%
24. Blood loss anemia -2 points or 84.3%

25. Deficiency anemia -2 points or 84.3%

26. Alcohol abuse 0 points or 82.4%

27. Drug abuse -7 points or 88.9%

28. Psychosis 0 points or 82.4%

29. Depression -3 points or 85.2%

The Elixhauser Comorbidity Index score was calculated to adjust the effects of comorbidities on clinical outcomes. Mortality and length of ICU stay were analyzed. The study included geriatric patients diagnosed with sepsis and with an Elixhauser Comorbidity Index of > 10 point. Geriatric patients without sepsis and non-geriatric patients aged < 65 years were excluded from the study.

Statistical analysis

Frequency and percentage values were calculated to analyze data related to the descriptive statistics of the groups. Chi-square analysis (Fisher's exact test) was performed to analyze the diagnoses received according to patient characteristics. The Bonferroni method was used to identify the group with differences among the three groups. In this study, the correlation analysis was performed to analyze the correlation between age and length of stay (days) according to age groups. Analysis of variance test was performed to analyze whether the mean length of stay differs according to age groups, and the Sidak binary comparison test was performed to determine differences among groups. In this study, an independent sample t-test was performed to analyze the difference in the length of hospital stay according to mortality rate. Bar charts were drawn to present data. In the study, p-values of < 0.05 were considered statistically significant. Analyses were performed using the SPSS 22.0 software package.

Power analysis

The study consisted of patients aged > 65 years diagnosed with sepsis and hospitalized in the ICU between 01/01/2008 and 31/12/2018 in a tertiary care hospital. The group of patients included in this study would provide 0.90 sampling power at an effect size of 0.40 (in studies, 0.70 sampling power and an effect size of < 0.10 is expressed as small, 0.25 as medium, and 0.40 as large effect size). In summary, this study has sufficient power and level of effect size. The power level and effect size calculated in this study were determined using the G* Power Version 3.1.7.

Results

Rates in the geriatric sepsis groups were different from that of other geriatric diagnostic groups. The incidence of sepsis in geriatric patients hospitalized in the intensive care unit: 84(3.2%) young-old, 72(2.7%) middle-aged, and 33(3.0%) elderly ($p=0.01$ $p<0.05$). Among the 189 patients admitted in the ICU, 93(49.2%) were men and 96(50.8%) were women. The number of patients in three study groups was as follows: 84(44.5%) young-old (69.92 ± 2.48), 72(38.0%) middle-aged (79.62 ± 2.28), and 33 (17.5%) elderly (87.57 ± 2.57). Among them, 144(76.2%) died, whereas 45(23.8%) were discharged from the ICU (Table 1). The length of hospital stays (days) of patients hospitalized in the ICU diagnosed with sepsis varied according to age groups. In the study, the mean length of hospital stay of patients aged > 85 (21.10 ± 23.75)

and 75-84(17.45±20.59) years was statistically higher than that of patients aged 65-74 (10.23±12.19) (95% confidence interval) ($p=0.01$, $p<0.05$) (Table 2). Mortality rates of patients did not vary according to age groups: 77.0%(65) aged 65-74 years, 76.8%(56) aged 75-84 years, and 69.6%(23) aged ≥ 85 years died ($p=0.67$, $p>0.05$) (Figure 1). In the age group 65-74, 75-84, ≥ 85 years, age and length of hospital stay were not correlated with the prognosis ($r=-0.06$, $p=0.59$, $p>0.05$; $r=-0.09$, $p=0.45$, $p>0.05$; and $r=-0.05$, $p=0.78$, $p>0.05$, respectively). In the age group 65-74, 75-84, and ≥ 85 years who were discharged, age and length of hospital stay were not correlated with prognosis ($r=-0.03$, $p=0.91$, $p>0.05$; $r=-0.02$, $p=0.96$, $p>0.05$; and $r=-0.01$, $p=0.99$, $p>0.05$, respectively). In the age group 65-74, 75-84, and ≥ 85 years who died, age and length of hospital stay were not correlated with prognosis ($r=-0.04$, $p=0.74$, $p>0.05$; $r=-0.05$, $p=0.72$, $p>0.05$; and $r=0.05$, $p=0.73$, $p>0.05$, respectively) (Figure 2). The difference between the prognosis and length of hospital stay was not significant in the geriatric group aged 65-74 ($p=0.29$, $p>0.05$), 75-84 ($p=0.06$, $p>0.05$), and >85 (at 95% confidence interval) ($p=0.09$, $p>0.05$) years (Figure 3).

Table 1. Demographic characteristics of patients

Gender	n	%
Male	93	49.2
Female	96	50.8
Age	n	%
65-74 years of age	84	44.4
75-84 years of age	72	38.1
85 years of age and above	33	17.5
Mean Age by Age Group	Mean age	s.d.
65-74 years of age	69.92	2.48
75-84 years of age	79.62	2.28
Above 85 years of age	87.57	2.57
Survival	n	%
Exitus	144	76.2
Survived	45	23.8

Table 2. Length of stay by age groups

Measurement	Group	n	x	s.d.	Confidence Interval 95%		p
					Below	Above	
Length of stay	65-74 years of age	84	10.23	12.19	7.47	13.00	%
	75-84 years of age	72	17.45	20.59	12.39	22.52	44.4
	Above 85 years of age	33	21.10	23.75	12.23	29.97	38.1

** Analysis of variance was carried out. * Indicates a significant difference

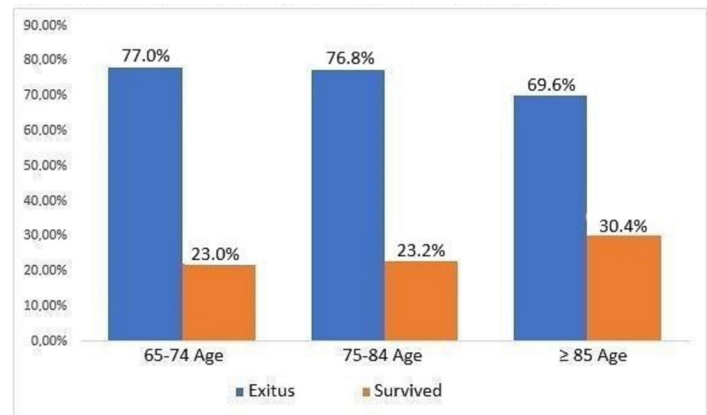


Figure 1. Mortality and survival rates in patients with sepsis



Figure 2. Correlation of age length of hospital stay with prognosis

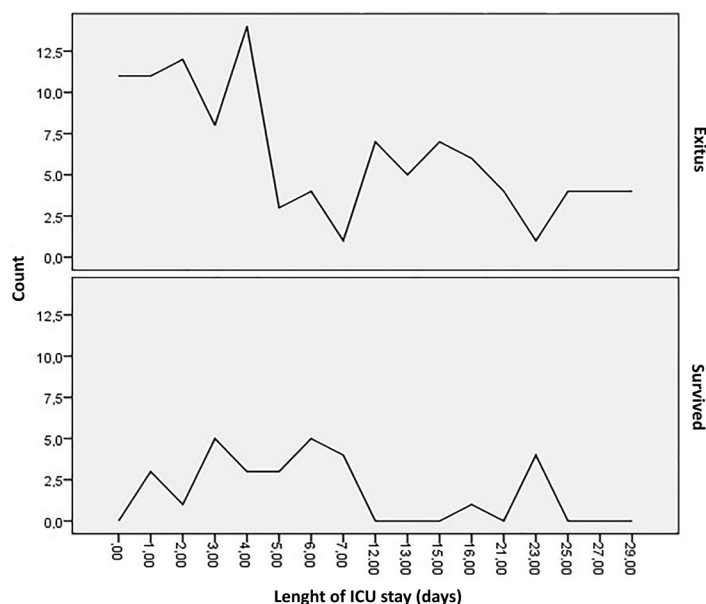


Figure 3. Correlation between length of ICU stay and prognosis

Discussion

The incidence of sepsis in geriatric ICU patients varies between 3.0% and 3.2%. The fact that 189(69.2%) of 273 patients diagnosed with sepsis in the ICU from 2008 to 2018 were in the geriatric age group shows the significance of sepsis in the geriatric age group in ICU patients. There are many scoring systems such as qSOFA, EWS, SIRS [11], APACHE II [12] that evaluate the length of hospital stay and mortality rates of patients diagnosed with sepsis in the intensive care unit. Because the Elixhauser Comorbidity Index is comprehensive, it can make better estimates than other scoring systems in evaluating in the length ICU stay and mortality rate due to the increase in the rate of multimorbidity in geriatric age groups. The mortality rate is very high in three different geriatric age groups diagnosed with sepsis according to the Elixhauser Comorbidity Index of >10 in the ICU. The fact that the 30-day mortality rate of three different geriatric age groups diagnosed with sepsis in the ICU is >70% indicates that sepsis should be diagnosed and treated aggressively in the ICU. In a prospective study evaluating elderly and young adults in the ICU, the 28-day mortality rate was found to be 24.8% [10]. Mortality due to sepsis increases twofold in geriatric patients aged >70 years as compared to patients aged <70 years [13,14]. While aging is associated with weakened immune system [1,2], elderly patients diagnosed with sepsis are thought to increase immune system suppression and mortality by increasing susceptibility to secondary infections [9]. In an international prospective study, hospital-and ICU-acquired infections have been microbiologically documented as the more common cause of sepsis than community-acquired infections [15]. In another study conducted in the geriatric unit, venous catheters, immobilization, swallowing disorders, and nosocomial infections occurring in elderly patients hospitalized due to cancer have been associated with mortality [5]. In another study, three comorbidities were associated with mortality in geriatric patients aged >65 years, indicating coagulopathy, fluid electrolyte disorder, peripheral vascular diseases, and chronic lung diseases [16]. High mortality due to sepsis increases with additional factors, such as winter season, immobilization, chronic heart failure, and respiratory failure [17].

These factors, which lead to increased mortality, are commonly observed in the geriatric age groups. In our study, geriatric patients aged >75 years diagnosed with sepsis were generally considered to have a significantly prolonged length of ICU stay. Although the presence of a significant correlation between advanced age and prolonged length of ICU stay suggested to contribute to increased secondary infections and mortality in geriatric intensive care patients [9], the length of ICU stay does not have an increasing effect on mortality [17]. In our study, the length of ICU stay among three different geriatric age groups diagnosed with sepsis did not have an effect on prognosis, although it increased with age. In a retrospective observational study including male patients aged >50 years, the incidence of sepsis has been found to increase between 2007 and 2016, whereas the in-hospital mortality rate, length of hospital stay, and admission rate to the ICU decreased [18]. In a prospective cohort study on geriatric ICU patients diagnosed with sepsis, the 1-month mortality rate of 60% [19] necessitated early diagnosis, aggressive treatment, and early intensive care support, especially in geriatric age groups.

Conclusion

The incidence of sepsis in geriatric patients hospitalized in the intensive care unit and 30-day mortality rate are extremely high in geriatric patients admitted to the ICU. The mortality rate of geriatric sepsis patients with Elixhauser Comorbidity Index of >10 is >70%. In geriatric patients diagnosed with sepsis, the length of ICU stay increases with age; however, age and length of ICU stay have no effect on the 30-day mortality.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

This study was conducted in accordance with the ethical principles stated in the "Declaration of Helsinki" and permission was obtained from Ethics Committee of Antalya Training and Research Hospital for the use of patient data for publication purposes (07.11.2019-24/6).

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