

The Effect of The Diagnostic Criteria on the Prognosis of Patients Diagnosed With Sepsis at the Intensive Care Unit

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Abstract

Sepsis is a hard clinical condition to diagnose and treat; but it occasionally happens and it is an important life threatening health condition. New diagnostic criteriae has been released in 2016. The aim of this study was to show the efficiency of Surviving Sepsis Campaign diagnostic parameters and prognostic factors. 100 patients in intensive care unit of Izmir Ataturk Education and Research Hospital II. Anesthesiology and Reanimation ICU were included. The data of the patients were recorded according to the 2001 Surviving Sepsis Campaign Criteria during the time interval of the study. Each parameter was assessed separately in both the survived (Group I) and deceased (Group II) patients. The specificity and sensitivity was calculated for each parameter with statistical significance. A total of 100 patients were evaluated. The mortality of sepsis patients was 46%. Among the SSC diagnostic criteria; respiratory rate, mental status, elevation of CRP and procalcitonin, presence of arterial hypoxemia, presence of acute oliguria, thrombocytopenia, aPTT elevation, hypotension and lactate elevation were determined as prognostic factors. Only the specificity and sensitivities of CRP (82% and 95%, respectively) and of procalcitonin (53% and 82%, respectively) were high. The 2001 SSC diagnostic criteria are useful in determining mortality in patients with sepsis in intensive care unit. Nevertheless, pre-screening of high-risk patients, avoidance of unnecessary admissions, and creating guidelines for approaching the patients with this disease will reduce mortality and morbidity rates.

Research Article

INTRODUCTION

Sepsis is an important cause of morbidity and mortality in intensive care patients. Sepsis is a life threatening condition and defined as a response to infection due to unregulated/impaired host defence¹⁻⁴.

The sepsis findings are nonspecific and because of that consensus meetings were held about diagnostic criteria and treatment guidelines and their possible revisions. The new guideline was released in 2016¹.

According to the new sepsis criteria in 2016; inflammatory markers did not have a place; but in 2017 criteria they still have the importance.

Recently treatment protocols have been required due to an increment in hospitalizations due to sepsis and high morbidity and mortality rates.

Close monitoring in intensive care units enables early recognition of problems that may develop in these cases, and

contributes to the recovery process in patients. Early hemodynamic evaluation, assessment of physical findings, and abnormalities in parameters such as central venous pressure and urinary output help identification of persistent tissue hypoxia. In order to perform the targeted treatment immediately, the diagnostic criteria determined by the Surviving Sepsis Campaign should be carefully followed and treatment should be initiated^{5,6}.

There are a large number of diagnostic criteria, which are recognized to determine sepsis, but these diagnostic criteria are not specific to the disease. In addition, there have not been a sufficient number of studies defining the superiority of any of these diagnostic criteria in terms of diagnosis, treatment and prognosis. The purpose of this study was to compare the roles of the 2001 diagnostic parameters in predicting mortality and to establish prognostic factors for a poor prognosis in patients admitted to our intensive care unit.

MATERIALS and METHODS

Ethical approval

The data in this study was obtained retrospectively from the hospital automation system and because of that no ethical approval was taken

In our study, following the approval by the local ethic committee of Izmir Ataturk Training and Research Hospital, the data of 100 patients, who were monitored between 01.September.2009 and 01.October.2010 with the diagnosis of sepsis at the 2nd anesthesiology and reanimation intensive care unit of Izmir Ataturk Research and Training Hospital, were recorded according to the diagnostic criteria developed by the 2001 Surviving Sepsis Campaign (SSC) and were evaluated retrospectively.

These diagnostic criteria are listed below (5-9):

1. General criteria: a) Fever > 38 or <36 degrees Centigrade, b) Heart rate $> 90/\text{min}$, c) Tachypnea, respiratory rate $> 22/\text{dk}$, d) Altered mental status (GCS < 11), e) The presence of Edema or positive fluid balance ($> 20 \text{ mL/kg}$ over 24 hours), f) Hyperglycemia (glucose level > 120)

2. Inflammatory variables: a) Leukocytosis (WBC $> 12,000$), b) Leukopenia (WBC < 4000), c) elevation of CRP, d) Elevation of Procalcitonin

3. Hemodynamic variables: a) Hypotension (systolic blood pressure 90 mmHg , MAP $< 70 \text{ mmHg}$ or normal values less than 2 SD below normal for age)

4. Organ dysfunction: a) Arterial hypoxia (PaO₂ / FiO₂ > 300), b) The presence of acute oliguria (urine output $< 0.5 \text{ ml/kg/hour}$), c) Creatinine increase, d)Coagulation abnormalities (INR > 1.5 or aPTT > 60), e)İleus, f) Thrombocytopenia ($< 100,000/\text{mm}^3$), g)Hyperbilirubinemia (total bilirubin $> 4\text{mg/dl}$)

5. Tissue perfusion: a) Hyperlactatemia ($> 1\text{mmol/L}$)

After the evaluation of demographic data, After the evaluation of demographic data, all parameters on the record were separated into 2 groups; one group consisting of discharged patients (Group I), the other group consisting of decedents (Group II). The statistical significance of each parameter was evaluated and the specificity and sensitivity of each parameter with a statistical significance were calculated.

Exclusion criteria: Patients below 18 years of age, pregnant patients with sepsis, patients with a previous established diagnosis of chronic renal failure and of diabetes were excluded from the study.

SPSS for Windows 17.0 program was used for statistical analysis. Besides the descriptive statistical methods, Chi Square test for the qualitative data, and Independent Samples T-Test for the quantitative data were used in comparisons. The parameters demonstrating statistical significance between the groups were evaluated by logistic regression analysis. The results within the 95% confidence interval and a value of $p < 0.05$ were considered statistically significant.

RESULTS

The study data demonstrated that 54 patients were discharged from the intensive care unit while 46 patients died. The mortality rate was calculated as 46%. In Group II patients, the age, the APACHE II and SOFA scores at the time of diagnosis were statistically significant compared to those in Group I patients (Table 1). When the diagnostic criteria for sepsis according to the Surviving Sepsis Campaign 2001 recommendations were compared, it was determined that among the global variables, the respiratory rate and GCS values (Table 2); among the inflammatory variables, procalcitonin and CRP values (Table 3); among the organ dysfunction variables, arterial hypoxemia; acute oliguria, and the platelet count (Table 4); in coagulation abnormalities, aPTT (Table 5); and hemodynamic and tissue perfusion variables (Table 6) were detected as the criteria with a prognostic value in Group II patients.

The specificity and the sensitivity of the 11 diagnostic criteria, which were reported by the Surviving Sepsis Campaign in 2001, and which would have a potential to demonstrate a prognostic quality are demonstrated in Table 7. Of the diagnostic criteria, only two of them, namely procalcitonin and CRP levels were determined to have high sensitivity and specificity.

Table 1. Demographic data, APACHE II and SOFA scores

	Grup 1,(n=54)	Grup 2,(n=46)	P
Gender (Female/Male)	18/36	25/21	>0.05
Age	64.95±13.33	55.94±18.09	$=0.007^*$
APACHE II	22.86±8.78	27.25±5.75	$=0.01^*$
SOFA	6.19±2.02	8.82±3.05	$=0.05^*$

* , $p < 0.05$

Table 2. General variables of the diagnostic criteria for sepsis

Pathology	Group 1, n (%)	Group 2, n (%)	P
Fever	29 (53.7)	25 (52.1)	<0.05
Heart rate	40 (74.1)	40 (86.9)	>0.05
Respiratory rate	24 (44.4)	30 (65.2)	$=0.04^*$
Glasgow Coma Scale	7 (13)	18 (39.1)	$=0.004^*$
Positive fluid balance	8 (14.8)	10 (21.7)	>0.05
Hyperglycemia	10 (18.5)	10 (21.7)	>0.05

* , $p < 0.05$

Table 3. Inflammatory variables of the diagnostic criteria for sepsis

Pathology	Group 1,n (%)	Group 2,n (%)	P
Leukocyte count	46 (85.2)	35 (76.1)	>0.05
Procalcitonin	29 (53.7)	38 (82.6)	=0.002*
CRP	44 (81.5)	44 (95.6)	=0.025*

*, p<0.05

Table 4. Organ dysfunction variables of the diagnostic criteria for sepsis

Pathology	Group 1,n (%)	Group 2,n (%)	P
Arterial hypoxia	25 (46.3)	32 (71.1)	=0.02*
Acute oliguria	6 (11.1)	14 (31.1)	=0.02*
Kreatinin	15 (27.8)	21 (46.7)	>0.05
Ileus	12 (22.2)	26 (35.6)	>0.05
Thrombocyte count	5 (9.3)	12 (26.7)	=0.04*
Bilirubin level	14 (25.9)	19 (42.2)	<0.05

*, p<0.05

Table 5. Coagulation abnormalities of the diagnostic criteria for sepsis

Pathology	Group 1,n (%)	Group 2,n (%)	P
INR	12 (22.2)	18 (39.1)	<0.05
aPTT	3 (5.6)	11 (23.9)	=0.01*

*, p<0.05

Table 6. Hemodynamic and tissue perfusion variables of the diagnostic criteria for sepsis

Pathology	Group 1,n (%)	Group 2,n (%)	P
SAB	14 (25.9)	28 (62.2)	=0.001*
OAB	13 (24.1)	27 (58.6)	=0.001*
Lactate level	8 (14.8)	27 (58.6)	<0.000*

*, p<0.05

Table 7. The sensitivity and specificity rates of the diagnostic criteria with statistical significance

	Sensitivity (%)	Specificity (%)
Respiratory rate	65	55
Glasgow coma scale	39	12
Procalcitonin	82	53
CRP	95	81
Arterial hypoxia	69	46
Acute oliguria	45	11
Thrombocyte count	26	1
aPTT	24	0.05
SAB	60	24
OAB	58	17
Lactate level	58	17

DISCUSSION

Sepsis is a hard clinical condition to diagnose and treat; but it occasionally happens and an important life threatening health condition ^{6,10,11,12}. According to the new sepsis criteria in 2016; inflammatory markers did not have a place; but in 2017 criteria they still have the importance ¹⁻⁴. The annual rate of sepsis is 50-95 cases per 100,000, and this figure shows an increase by 9% every year ⁶. In the international literature, the mortality of severe sepsis has been reported as 30-50%. The mortality risk in sepsis patients is affected by disease severity, age, and underlying diseases ⁶. Poeze et al. ¹³ conducted a study by addressing questions on a phone call to randomly selected 10058 physicians from Europe and U.S. The interviewed

physicians were either intensive care unit physicians or physicians, who spent 50% of their duration of working time in treating intensive care unit patients. The authors reported that 67% of the physicians thought that there are deficiencies in applying a common definition of sepsis, and 83% of them thought that sepsis cases were often missed as they could be confounded by symptoms of many diseases. Indicating factors of poor prognosis of sepsis especially will be more helpful in terms of treatment and monitoring ^{14,15}. The performance of these criteria, namely biomarkers, are measured by sensitivity, which is the ability to detect the patients with the correct diagnosis; and by specificity, which is the ability to recognize the patients without a correct diagnosis ¹⁶. But there are some problems in the biomarkers and in the criteria for sepsis in terms of sensitivity and specificity ^{17,18}. Therefore, we aimed to compare the effects of diagnostic parameters published in 2001 on the mortality estimates of the sepsis patients admitted to our intensive care unit; and to identify the poor prognostic factors in order to contribute to diminish the problems of making an initial diagnosis and to the decline of mortality rates.

In our study, 100 patients admitted to the reanimation clinic of the anesthesiology and reanimation department with the diagnosis of sepsis were evaluated. Of these 100 patients, 54 of them were discharged from the intensive care unit, while the 46 of them died, demonstrating a mortality rate of 46% in accordance with the literature.

Sepsis, is common in advanced ages, especially above the age of 50 ¹⁰⁻¹². It is more common in men than women. The reason for this difference is unknown, however, it is suggested that men are more prone to trauma, and to undergo surgery. In our study too, sepsis was detected in male patients at an advanced age.

CRP levels can be elevated in diseases other than sepsis (trauma, burns, surgery, infarction) ^{19,20}. In spite of this fact, elevations in CRP levels were demonstrated to be a poor prognostic factor by the study by Lobo et al. ¹⁹ and by other studies investigating the effect of this protein ²⁰⁻²². Our study results concluded that increased CRP was a significant criterion for the diagnosis and prognosis. Inflammatory conditions, localized bacterial infections, and viral infections do not trigger the increase of procalcitonin extensively, whereas procalcitonin ratio is elevated in systemic bacterial infections seriously ²³⁻²⁵. As the sensitivity and specificity of Pro-Cal are reported ²³⁻²⁷ to

be 65-97% and 48-94% respectively in the study reports, it is determined that these values are not sufficient to make a diagnosis. Although procalcitonin is recognized as being more specific than CRP in many studies, debate continues²⁸. Simon et al.²⁴ reports that it is a more successful method in defining the severity of sepsis and its prognosis. A statistically significant effect of Pro-Cal on mortality is an indicator that this protein may be effective in the prognosis of sepsis among the specified criteria^{26,27,29}. The results of our study, too, demonstrates that CRP and procalcitonin are the two criteria with high levels of specificity and sensitivity.

Although Jaimes et al.²⁹ determines that high fever ($\geq 37.8^{\circ}\text{C}$) and heart rates of ≥ 90 are significant to diagnose bacteremia, they cannot be established as data influencing the prognosis of sepsis directly. Our study results support this approach as no significant results were obtained for fever and heart rate. Sensitivity and specificity rates of fever were calculated as 53% and 46%, respectively, and did not constitute a confidence level.

Our study results demonstrate that the change in fluid balance, increase in glucose, creatinine, presence of a coagulation disorder (INR), bowel movements, total bilirubin change, and the presence of comorbid diseases are not significant in the prognosis of sepsis. Although the presence of a comorbid disease has been demonstrated as a criterion accelerating or contributing to mortality, it is not an effective data. This is interpreted as the result of excluding the patients with diabetes and chronic renal failure, which might have a negative effect on the prognosis, and as the non-significant effects of comorbidities such as hypertension and chronic obstructive lung disease on the prognosis of sepsis.

The factors demonstrated to trigger sepsis include endothelial activation independent of global tissue hypoxia, impaired balance in the coagulation mechanisms, increased vascular permeability, and impaired vascular tone. Respiratory support to the patients in the intensive care units is a factor in obtaining favorable outcomes in the treatment^{13,30}. Among the criteria investigated by our study, coagulation disorder (aPTT), arterial hypoxemia, and changes in respiratory rate are demonstrated to be the potential significant prognostic indicators.

As the study results of Meyancı et al.⁵ demonstrate that the changes in urinary output are effective in detecting persistent tissue hypoxia, investigation of this data in sepsis is

suggested to have a potential in providing significant information. Oliguria, which is among the criteria investigated in our study revealed significant results thereby supporting this suggestion.

In parallel to the results of the studies by Nguyen et al. and H-Michael et al.^{31,32}, the change of lactate levels has been found to be useful and significant on prognosis.

By the clinical procedures and the studies conducted, it is acknowledged that the thrombocyte count and thrombocyte supply carry the significance with them in the disease prognosis^{5,6,33}. Therefore, the changes in thrombocyte levels as a criterion is determined to be a significant indicator in the prognosis of sepsis.

As a result of our study, it is concluded that, among the diagnostic criteria for sepsis published in 2001 respiratory rate, GCS, CRP, procalcitonin levels, systolic arterial pressure, mean arterial pressure, arterial hypoxemia, oliguria, coagulation disorders (APTT), platelet count, MVS, age, and lactate levels influence the prognosis. It is determined that fever, leukocyte count, heart rate, fluid balance, hyperglycemia, creatinine levels, ileus, hyperbilirubinemia, and INR values have no effect on the prognosis. To be acknowledged of the poor prognostic factors is important in admissions to intensive care unit and during monitoring the patients. It is suggested that future guidelines, to be developed for the treatment management of high risk patients by taking all of these parameters/variables into consideration, will decrease the mortality and morbidity rates. By means of the treatment guidelines, the redundant admissions of the low risk patients to the intensive care unit, or the delayed intensive care monitorization of the critical patients can be prevented.

Conflict of interest

The authors declare that they have no conflict of interest.

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