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Original Article

Efficiency of Hematocrit, Lymphocyte, C-Reactive Protein and Transferrin Levels in Predicting Mortality in Intensive Care Unit Patients

Onur Palabiyik[1], Yasemin Isik[2], Muhammed Bilal Cegin[3], Ugur Goktas[3], Ismail Kati[4]

ABSTRACT

The effectiveness of many physiological parameters and laboratory tests was investigated in predicting mortality. In this study, we investigated hematocrit, C-reactive protein, transferrin and total lymphocyte count along with Acute Physiology and Chronic Health Evaluation II and Glasgow Coma Scores of patients who were hospitalized in the intensive care unit. The data were retrospectively analyzed from hospital information management system, doctors' records and nurse observing forms. The mortality rate was 42.6%. The Acute Physiology and Chronic Health Evaluation II scores were significantly higher in cases with mortality compared to those without mortality. The admission and discharge Glasgow Coma Scores were significantly lower in patients who showed mortality compared with patients without mortality. Admission and discharge hematocrit and transferrin values were significantly lower in cases with mortality compared to those without mortality. Discharge C-reactive protein values were significantly higher in cases with mortality compared to those without mortality. Discharge total lymphocyte count values were significantly lower in cases with mortality compared to those without mortality. Consequently, we believe that hematocrit and transferrin values at the time of admission to the intensive care unit and total lymphocyte count and C-reactive protein at the time of discharge from the intensive care unit can be effective in predicting mortality.

Key words: *C-reactive protein, hematocrit, predicting mortality, total lymphocyte count, transferrin.*

Yoğun Bakım Hastalarında Hematokrit, Lenfosit, C-Reaktif Protein ve Transferrin Düzeylerinin Mortalite Tahmininde Etkinliği

ÖZET

Mortalite tahmininde birçok fizyolojik parametre ve laboratuvar testinin etkinliği araştırılmıştır. Bu çalışmada, yoğun bakım ünitesinde yatan hastaların Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi II ve Glasgow Koma Skalası skorları ile hematokrit, C-reaktif protein, transferrin ve total lenfosit sayısı değerleri incelendi. Veriler retrospektif olarak hastane bilgi yönetim sistemi, doktor notları ve hemşire gözlem formlarından elde edildi. Mortalite oranı % 42,6 olarak bulundu. Mortalite görülen olguların Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi II değerleri, mortalite görülmeyen olgulardan anlamlı şekilde yüksek bulundu. Mortalite görülen olguların giriş ve çıkış Glasgow Koma Skalası değerleri, mortalite görülmeyen olgulardan anlamlı şekilde düşük bulundu. Mortalite görülen olguların giriş ve çıkış hematokrit ve transferrin değerleri, mortalite görülmeyen olgulardan anlamlı şekilde düşük bulundu. Mortalite görülen olguların çıkış C-reaktif protein değerleri, mortalite görülmeyen olgulardan anlamlı şekilde yüksek bulundu. Mortalite görülen olguların çıkış total lenfosit değerleri, mortalite görülmeyen olgulardan anlamlı şekilde düşük bulundu. Sonuç olarak, hematokrit ve transferrinin yoğun bakım ünitesine giriş değerlerinin; total lenfosit sayısı ve C-reaktif proteinin yoğun bakım ünitesinden çıkış değerlerinin mortalite tahmininde efektif olabileceği kanısındayız.

Anahtar kelimeler: *C-reaktif protein, hematokrit, mortalite tahmini, total lenfosit sayısı, transferrin.*

[1]Sakarya University Training and Research Hospital, Department of Anesthesiology and Reanimation, Sakarya, [2]Izmir Katip Celebi University, Medical Faculty, Department of Anesthesiology and Reanimation, Izmir, [3]Yuzuncu Yil University, Medical Faculty, Department of Anesthesiology and Reanimation, Van, [4]Gazi University, Medical Faculty, Department of Anesthesiology and Reanimation, Ankara, Turkey

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Correspondence: *Dr. Onur Palabıyık*
Sakarya Üniversitesi Eğitim ve Araştırma Hastanesi Merkez Kampüsü Anesteziyoloji ve Reanimasyon Kliniği 54100 Sakarya-Türkiye
Tel: +90 264 4445400 Fax: +90 264 2751254
e-mail: mdpalabiyikonur@yahoo.com

INTRODUCTION

Intensive care units (ICUs) are the units in hospitals in which severely ill patients are followed up, many invasive interventions are applied, nosocomial infections are frequently observed, and mortality rates and hospital stays are the highest. Several scoring systems have been developed for predicting mortality rates and the prognosis of patients using different physiologic parameters. Measurements of hematocrit, which is an indicator of the oxygen-carrying capacity of blood in ICU patients, are important in terms of prognosis. C-reactive protein (CRP) is used for detecting the presence or recurrence of an infection and treatment effectiveness; therefore, it is a marker of prognosis. The measurement of circulating visceral proteins is used as a method for assessing and following up on the nutritional status of ICU patients. The serum level of transferrin, a visceral protein, may also be used to assess prognosis. The total lymphocyte count (TLC) is a good indicator of nutritional status in ICU patients, and it is also a clinical indicator of immune function.

In our study, we aimed to investigate whether hematocrit, CRP, transferrin and TLC levels, which we routinely analyze in the ICU, are important in the evaluation of mortality.

MATERIALS AND METHODS

Study Design and Patient Selection

In this study, the records of patients, who were hospitalized between November 2009 and October 2011 in an eight-bed Anaesthesiology and Reanimation ICU of 320 bed-university hospital, were retrospectively analyzed after Local Ethics Committee approval had been obtained. Our ICU is closed unit that included mixed medical and surgical patients, but not cardiologic and cardiac surgical patients. Patients who were hospitalized in the ICU for less than 24 hours or were younger than 18 years were not included in the study. The initial values of patients who were admitted to the ICU more than once were considered.

Data Collection

The Acute Physiology and Chronic Health Evaluation (APACHE) II score on ICU admission; admission and discharge Glasgow Coma Score (GCS); hematocrit, CRP, transferrin and TLC values; age; gender; the mean reason for ICU admission; duration of ICU stay and status of the patient on discharge were all analyzed from hospital information management system, doctors' records and nurse observing forms.

Statistical Analysis

The Number Cruncher Statistical System (NCSS) 2007 & Power Analysis and Sample Size (PASS) 2008 Statistical Software program were used for statistical analysis. Student's t-test was used for inter-group comparisons of parameters that showed a normal distribution, and the Mann-Whitney U test was used for inter-group comparisons of parameters that did not show a normal distribution. The chi-square test was used for the comparison of qualitative values. A p level <0.05 was considered statistically significant.

RESULTS

In this study, the records of patients, who were hospitalized in an eight bed ICU, were retrospectively analyzed. Estimations were performed using the data of 502 patients, as 47 out of 581 cases who were under 18 years old and 32 cases who stayed in the ICU for less than 24 hours were excluded from the study. The demographic data of the cases are shown in Table 1. While a positive correlation was detected between mortality and the mean age of cases and duration of ICU stay ($p<0.01$), no correlation was detected between mortality and gender ($p>0.05$) (Table 2). The distribution of the diagnoses of patients is shown in Table 3. The APACHE II values were significantly higher in cases with mortality (29.87±5.59) compared to those without mortality (19.51±7.26). The mean admission GCS score was 5.15±2.26 in cases with mortality and 9.72±2.30 in cases without mortality, while the mean GCS score on discharge was 3.14±1.21 in cases with mortality and 13.64±2.50 in cases without mortality ($p<0.001$). Hematocrit values on admission and discharge

Table 1. *Demographic data (mean±SD, %)*

		Min-Max	Mean±SD
Age (year)		*18 - 88*	*48.95±21.32*
Length of ICU stay (day)		*2-79*	*10.11±12.35*
		n	*%*
Gender	*Female*	*239*	*47.6*
	Male	*263*	*52.4*

(SD: standard deviation, n: number of cases, %: percent, Min: minimum, Max: maximum)

Table 2. Assessment of demographic data according to mortality (mean±SD)

	Mortality (+) (n:214)	Mortality (-) (n:288)	p value
Age (year)	53.61±20.24	38.67±20.09	0.001*
• Length of ICU stay (day)	10.31±11.08	9.68±14.83	0.006*
+Gender			
Female	97 (45.3%)	142 (49.3%)	0.519
Male	117 (54.7%)	146 (50.7%)	

(SD: standard deviation; n: number of cases; p:significance value; %: percent)

were significantly lower in cases with mortality compared to those without mortality (p<0.05) (Table 4).

While no significant difference was detected between admission CRP values according to mortality (p>0.05), CRP values on discharge were significantly higher in cases with mortality compared to those without mortality (p<0.01) (Table 4). Transferrin values on admission and discharge were significantly lower in cases with mortality compared to those without mortality (p<0.01) (Table 4). While no significant difference was shown between admission TLC values according to mortality (p>0.05), TLC values on discharge were significantly lower in cases with mortality compared to those without mortality (p<0.01) (Table 4).

DISCUSSION

Estimating mortality is important for assessing clinical performance in ICUs, patient classification and clinical studies. We aimed to investigate the efficacy of routinely used physiologic parameters in predicting mortality. Different mortality rates have been determined in many studies conducted in ICUs. In two studies of Meynaar et al. (1) and Silvestre et al. (2), the ICU mortality rates were 13.3% and 40%, respectively. In our study, the mortality rate was 42.6%. The APACHE II score is one of the most commonly used scoring systems for predicting mortality in the ICU. A strong relationship between the APACHE II score and ICU mortality rates has been shown in most of the studies in the literature (1-3). The APACHE II score was also significantly higher in cases with mortality compared to those without mortality in our study.

Table 3. Distribution of diagnoses

		n	%
	Gunshot Wounds	19	3.8
	Drowning	8	1.6
	Eclampsia	13	2.6
	Intracranial Bleeding	41	8.1
	Cardiac Arrest	32	6.4
Diagnoses	Head Trauma	21	4.2
	Multiple Trauma	77	15.3
	Postoperative RF	91	18.1
	Cerebrovascular Disease	50	10.0
	RF	121	24.1
	Intoxication	29	5.8

(RF: respiratory failure; n: number of cases; %: percent)

The GCS is the most commonly used scale for the neurologic evaluation of patients, particularly those who experience head trauma. In many studies, a low GCS score was correlated with an increase in mortality (4-6). In our study, consistent with the literature, GCS values were significantly lower in cases with mortality compared to those without mortality. In the study of Juncal et al. (7) investigating the clinical effects of sepsis in the ICU, the hematocrit levels were lower in cases with sepsis (23.45% ± 8.62%) compared to those without sepsis (29.84% ± 5.70%), and a low hematocrit level was a significant predictor of increased mortality. In the study of Mudumbai et al. (8) investigating the relationship between 6-month and 1-year mortality rates with hematocrit levels in ICU patients, hematocrit values less than 25% were correlated with increased mortality. Sadamasa et al. (9) and Kellert et al. (10) reported that there was a strong relationship between mortality and low hematocrit levels in patients with subarachnoid haemorrhage and ischemic stroke, respectively. Lam et al. (11) reported that hematocrit was a significant predictor of mortality in trauma cases. Consistent with the literature, we found that hematocrit values on admission and discharge were significantly lower in cases with mortality compared to those without mortality.

CRP is an acute-phase reactant that indicates inflammatory conditions. The effectiveness of the CRP level in estimating mortality in the ICU has been shown in several studies. Meynaar et al. (1) found that the died patients in hospital had the higher CRP levels than the discharged alive patients. Wang et al. (3) found CRP levels of 56.7

Table 4. *Assessment of physiologic parameters according to mortality*

Parameters	*Mortality (+) Mean±SD*	*Mortality (-) Mean±SD*	*p value*
Hematocrit			
Admission	*33.17±8.32*	*35.48±8.12*	*0.023**
Discharge	*30.44±8.12*	*33.23±5.95*	*0.001**
CRP			
Admission	*110.79±72.14*	*92.12±67.99*	*0.086*
Discharge	*136.25±85.05*	*75.63±45.26*	*0.001**
Transferrin			
Admission	*1.44±0.62*	*1.86±0.48*	*0.001**
Discharge	*1.03±0.38*	*1.54±0.55*	*0.001**
TLC			
Admission	*1050±790.38*	*1140.21±695.32*	*0.074*
Discharge	*903.18±732.09*	*1217.53±673.92*	*0.001**

(CRP: C-reactive protein; TLC: total lymphocyte count; SD: standard deviation; p:significance value)

mg/L in surviving cases and 85.9 mg/L in dying cases. While Silvestre et al. (2) found that the CRP levels at ICU discharge were not significantly different between survivors and nonsurvivors patients, Ho et al. (12) and Grander et al. (13) found that the higher CRP levels at ICU discharge were associated with the high post-ICU mortality. In our study, consistent with the literature, at ICU discharge CRP values of cases with mortality were significantly higher than those without mortality. Transferrin is a negative acute-phase reactant. The serum transferrin level, which is used to assess nutritional status, has also been used to assess the prognosis of cases in some studies. Although Guimaraes et al. (14) did not detect a correlation between transferrin level and mortality in ICU cases, they found lower serum transferrin levels in cases with mortality compared to those without mortality in two different studies carried out in the ICU (15,16). In our study, transferrin levels on admission and discharge were significantly lower in cases with mortality compared to those without mortality. In our study, the effect of TLC, which is used in the assessment of the nutritional status of ICU cases, was evaluated in addition to transferrin. A few studies in the literature have evaluated these two parameters together (14-16). In contrast to Guimaraes et al. (14), in different two studies, low transferrin levels and low TLC levels were reported to be associated with mortality (15,16). Jung et al. (17) found that TLC levels were similar in survivors and nonsurvivors haemodialysis patients, and did not suggested that TLC level was used a predictive parameter. However, many studies found that TLC levels of nonsurvivors patients were lower than survivors patients (18,19). In our study, TLC values on discharge were significantly lower in cases with mortality compared to those without mortality.

In conclusion, a positive correlation was detected between mortality and parameters such as hematocrit, CRP, transferrin and TLC, which may easily be used in the ICU. A relationship was found between mortality and hematocrit and transferrin values on admission and discharge, CRP and TLC values only on discharge. We suggest that hematocrit and transferrin values at ICU admission could be used as parameters in predicting ICU mortality, but not CRP and TLC. Otherwise, CRP and TLC could be associated with post-ICU mortality as predictive parameters. These findings are required to supplement by further studies.

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