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ARAŞTIRMA / RESEARCH

The role of scoring systems in evaluation of the geriatric patients in emergency department

Acil serviste geriatrik hastaların değerlendirilmesinde skorlama sistemlerinin rolü

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Abstract

Purpose: The aim of this study was to compare the reliability of scoring methods in determining critical geriatric patients in the emergency department.
Materials and Methods: This prospective study included patients aged over 65 who presented to the emergency department between 15 October 2014 and 15 November 2014. APACHE II (Acute Physiology and Chronic Health Evaluation II), REMS (Rapid Emergency Medicine Score), HOTEL (Hypotension, Oxygen saturation, low Temperature, ECG changes, and Loss of independence), VIEWS (Vital PAC Early Warning Score) and VIEWS-L (Vital PAC Early Warning Score with Lactate Level) were evaluated.
Results: Of the 244 patients included in the study, the mean age of survivors was 75.69 ± 6.96 years, and the mean age of the mortal cases was 80.47 ± 6.63 years, 139 (57%) women. It was found that 30 (12.3%) of the patients included in the study died. The risk scores of the patients hospitalized in the intensive care unit were higher than those who were discharged or hospitalized. All risk scores in the mortality group were found to be significantly higher than the other patient groups.
Conclusion: The study showed that risk scoring systems can be used safely in the evaluation of geriatric patients in the emergency department, to predict mortality and to select critically ill patients.
Keywords:. Scoring methods, geriatric, mortality, emergency department

Öz

Amaç: Bu çalışmada acil serviste kritik geriatrik hastaları belirlemede skorlama sistemlerinin güvenilirliğini karşılaştırmayı amaçlanmıştır.
Gereç ve Yöntem: Bu prospektif çalışmaya 15 Ekim 2014-15 Kasım 2014 tarihleri arasında acil servise başvuran 65 yaş üstü hastalar dahil edildi. Çalışmada APACHE II (Akut Fizyoloji ve Kronik Sağlık Değerlendirmesi II) , REMS (Hızlı Acil Tıp Skoru), HOTEL (hipotansiyon, oksijen satürasyonu, düşük vücut sıcaklığı, EKG değişiklikleri ve bağımsız yaşam kaybı), VIEWS (Vital PAC Erken Uyarı Skoru) ve VIEWS-L (Vital PAC Laktat Seviyesi ile Erken Uyarı Skoru) değerlendirildi.
Bulgular: Çalışmaya dahil edilen 244 hastadan sağ kalanların yaş ortalaması 75.69 ± 6.96 yıl, ölen vakaların yaş ortalaması 80.47 ± 6.63 yıl, 139'u (%57) kadındı. Çalışmaya alınan hastaların 30'u (%12,3) mortal sonuçlandı. Yoğun bakımda yatan hastaların risk puanları, servisten taburcu olan veya hospitalize edilenlere göre daha yüksekti. Mortalite grubundaki tüm risk skorları diğer hasta gruplarına göre anlamlı derecede yüksek bulundu.
Sonuç: Çalışma, acil serviste geriatrik hastaların değerlendirilmesinde, mortaliteyi ön görebilmek ve kritik hastaları seçebilmek için risk skorlama sistemlerinin güvenle kullanılabileceğini göstermiştir.

Anahtar kelimeler: Skorlama yöntemleri, geriatri, mortalite, acil servis

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INTRODUCTION

Aging can be described as normal, predictable, and irreversible physiological changes in various organ systems that will ultimately lead to death[1]. Worldwide life expectancy is increasing at birth, thus increasing the average life span and increasing the elderly population[2]. The average life expectancy of the American people has increased by about 30 years, with an average lifespan of 47 years in 1900 to 76 years in 2000[1].

As the life expectancy continues to increase, the number of geriatric patients will increase and these numbers will also be reflected in the percentage of patients seen in the emergency department. It is estimated that the elderly population, which is between 7-10% today, will be over 20% by 2050 and that this increase will be reflected in the percentage of patients who need to be evaluated in the emergency department[3]. Emergency physicians are responsible for quick diagnosis and quick treatment[2]. Physiological changes resulting from aging make this responsibility more difficult for emergency physicians due to the lack of knowledge and experience in the management of elderly patients, the underlying diseases of the elderly, the use of multiple medications[4]. For this reason, geriatric patients should be treated as a special population like pediatric patients.

In recent years, scoring systems have been proposed in critical patient selection and emergency patient prioritization due to increased intensity in emergency departments. Over the past decade, various scoring systems have been developed to determine the severity of patients. These systems have an important place in the evaluation and care of emergency patients in emergency services[5,6]. The aim of scoring systems is to calculate risk with the physiological and/or laboratory values of the patient. According to this risk calculation, we can predict the hospital stay, intensive care/service admission, and mortality. The ideal scoring system has to cover the physical and laboratory values that can be obtained as quickly and easily as possible from the time of admission to the emergency service and also it should be clinically accurate[6,7].

It is important to identify critical patients in the emergency department and to initiate effective and rapid treatment for this patient group. However, the increasing number of emergency patients and the difficulties in evaluating geriatric patients come to the fore. In this study, we aimed to investigate the value of scoring systems in a critical patient selection of patients over 65 years of age admitted to the emergency department, and to predict hospital stay and mortality.

MATERIALS AND METHODS

Sample

Non-traumatic patients over 65 years of age who applied to the emergency department and accepted to participate in the study within 30 days were included in the study. The study was carried out in the emergency department of Ankara Training and Research Hospital. The planning and questioning of the patients were done by the assistants and specialists of the emergency medicine clinic. Patients who were admitted to the hospital after cardiac arrest and those with incomplete data were excluded from the study.

Informed consent was signed by patients who agreed to participate in the study or by first-degree relatives of those who could not consent. Risk scores of the patients were calculated. Four weeks after the date of referral to the emergency department, patients were called by phone, or hospital records were checked to learn the prognosis. Patients who could not access information at this stage were excluded from the study. After all these stages, 244 patients were statistically analyzed. Inclusion and exclusion criteria, the total number of patients and how the patients were selected are clearly stated in Fig. (Fig 1).

Study design

The main aim of the study was to investigate the value of APACHE II (Acute Physiology and Chronic Health Evaluation II)[8], REMS (Rapid Emergency Medicine Score)[9], HOTEL (Hypotension, Oxygen saturation, low Temperature, electrocardiography changes and Loss of independence)[10], VIEWS (Vital PAC Early Warning Score)[11], VIEWS-L (Vital PAC Early Warning Score with Lactate Level)[12] risk assessment scores of the patients aged 65 years and older in the prediction of hospital stay time and mortality.

The first part of the study form includes the vital signs, comorbid diseases, oxygen support, electrocardiography result, loss of independence, and laboratory results. In the second part, the patient is being investigated for the length of stay in service or

intensive care, mortality, and the last diagnosis. The third and final section consists of questions about the outcome, the scores, and the prognosis after 4 weeks (whether the patient is alive or not, whether the patient has been referred to the same complaint again, whether the patient has been hospitalized.) Clinical research ethics committee approval was received from the local committee for the study. Consent was also obtained from all participants.

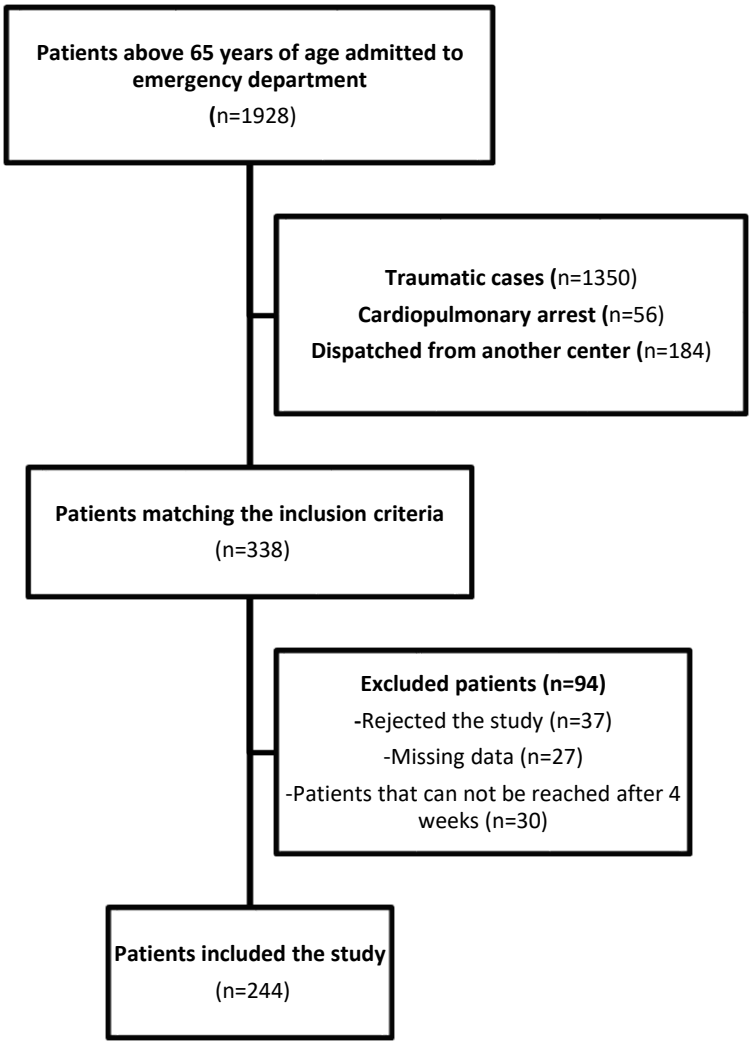

Figure 1. Patient selection

Statistical analysis

The required sample size was based on the scores obtained from similar studies that were previously done. In this context, Jo et al.[12] reported that the HOTEL score was 1.6±1.0 for survivors and 2.3±1.2 for those who died. These values were used as the mean and standard deviation to calculate the sample size required in the study with 5% type 1 error (α) and 20% type 2 error (β). As a result, the calculated sample size was calculated as 31 for each group. After the survey was applied, the power of the study was

calculated as %100 [The lowest mean difference of the HOTEL score was 0.84±0.9 (n=214) for the patients who were survivors and 2.35±1.3 (n=30) for dies.]

The data of the study were analyzed using the statistical package program SPSS 18.0 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics [Percentage, mean, median, quartile 1 (Q1) and quartile 3 (Q3)] were used in the analyses, chi-square test was used to compare grouped variables, and Fisher's exact test was used where necessary. Student's t-test was used to compare independent two-group continuous variables with normal distribution, Mann Whitney U test for comparisons of independent two-group continuous variables that did not fit normally, ANOVA for comparison of more than two independent variables with normal distribution, and Kruskal Wallis test for comparison of more than two variables that did not fit normally. Tukey test was used for Post-Hoc analysis of more than two continuous variables with normal distribution, and Bonferroni-corrected p values were used for comparison of more than two continuous variables that were not normally distributed. The conformity of the variables to the normal distribution was checked with Kolmogorov Smirnov and Shapiro Wilk tests. Finally, we added the age and gender variables into the model. Logistic regression analysis was performed for the last time with the variables that constitute the latest model. The "interaction" situations were also investigated while the logistic regression model was developed. The diagnostic decision-making features of the scales were analyzed by Receiver Operating Characteristics (ROC) curve analysis. Sensitivity and selectivity values of these cut-off values are calculated in the presence of significant cut-off points. The method proposed by De Long et al.[13] was used to compare areas under the ROC curves. Values less than 0.05 for type 1 error (alpha) were considered statistically significant for the evaluation of the area under the curve and for other statistics

RESULTS

The mean age of the 244 patients included in the study was 76.9 ± 7.2 years and 105 (43%) were male and 139 (57%) were female. The mean age of the survivors was 75.69 ± 6.96 years, the mean age at death was 80.47 ± 6.63 years. Death was detected in 30 (12.3%) patients.

The most common complaints of the patients were abdominal pain 53 (21.7%), shortness of breath 51 (20.9%), nausea and vomiting 39 (16%), chest pain 28 (11.5%), and unconsciousness 28 (11.5%) was detected. In the mortality group, loss of consciousness 19 (30.6%), shortness of breath 17 (27.4%), nausea and vomiting 8 (12.9%), abdominal pain 7 (11.3%), and fever 6 (9.7%) was detected.

Hypertension was the most frequently seen co-morbidity 184 (75.4%) following with coronary artery disease 102 (41.8%), diabetes mellitus 98 (40.2%), and congestive heart failure 58 (23.8%). There was no co-morbidity in 12 (4.9%) of patients. The most common diagnosis was pneumonia 35 (14.3%), followed by cerebrovascular disease 32(13.1%) and acute renal failure 23 (9.4%) respectively.

The risk scores according to emergency department stay times of the patients are given in Table 1. All of the risk scores were significantly longer in patients with longer than 12 hours of stay in the emergency department (Table 1). All of the risk scores were positively correlated with hospital stay time (APACHE II r=0.336; REMS r=0.291; HOTEL r=0.295; VIEWS r=0.287; VIEWS-L, r=0.294, In all, p = 0.001).

Table 1. The risk scores according to emergency department stay time

Scores	≤4 hour median (IQR)	4-8 hour median (IQR)	8-12 hour median (IQR)	≥12 hour median (IQR)	p*
APACHE II	9 (6-13)	10 (8-18)	10 (10-15.3)	15.5 (11-24.3)	0.001
REMS	8 (6-9)	8 (6.25-10)	8 (8-11)	10 (9-12)	0.001
HOTEL	1 (0-2)	1 (0-2)	1 (1-2)	2 (1-3)	0.001
VIEWS	5 (2-9)	5.5 (2-1075)	6.5 (6.5-10.5)	10 (5.75-16)	0.001
VIEWS-L	7.3 (3.6-11.3)	8.2 (4-13)	9.05 (9-14.8)	12.4 (8.65-19.8)	0.001

IQR: Interquartile Range; APACHE II: Acute Physiology And Chronic Health Evaluation II, REMS: Rapid Emergency Medicine Score, HOTEL: Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of independence, VIEWS: Vital PAC Early Warning Score, VIEWS-L: Vital PAC Early Warning Score with Lactate Level; *Kruskall-Wallis test, p<0,017 (0,05/3) is accepted as significant because we compared three groups.

Table 2. The demographic properties and vital signs according to the end result of the patients

	Discharged (n=112)	Hospitalized in service (n=61)	ICU (n=58)	p*
Age**	76 (70.2-81)	77 (70.5-82.5)	79.5 (71.7-85.2)	0.080
Gender**				0.662
Male, n (%)	47 (42)	29 (47,5)	23 (39,7)	
Female, n (%)	65 (58)	32 (52,5)	35 (60,3)	
SBP, mmHg**	140 (120-167.5)	134 (120-155.5)	118.5 (90-140)	0.001
DBP, mmHg**	80 (70-90)	80 (70-90)	70 (60-84)	0.001
Heart rate, beats/min**	88.5 (76.3-104.8)	95 (80-105)	106 (88-120)	0.001
Respiratory rate, breaths/min**	20 (16.3-24)	21 (18-24)	24 (21.8-26.3)	0,001
Fever, °C**	36.7 (36.2-37.0)	36.6 (36.2-37.2)	36.2 (36-36.7)	0.018
SpO_2, %**	93 (89-96)	94 (89.5-96)	88 (80-94)	0.001
GCS**	15 (15-15)	15 (15-15)	13.5 (11-15)	0.001
Loss of independence; n (%)	7 (6.3)	13 (21.3)	35 (60.3)	0.001

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, min: minute, SpO_2: Peripheral Oxygen Saturation, GCS: Glasgow Coma Scale, O_2: Oxygen, ECG: Electrocardiography; *p<0,017 (0,05/3) is accepted as significant because we compared three groups.
** median (Interquartile range)

Table 3. The relationship between hospitalization rate in ICU with risk scores

	Discharged (n=112)	Hospitalized in service (n=61)	ICU (n=58)	p**
APACHE II*	9 (7-11)	10 (6.5-13.5)	17 (10-24)	0.001
REMS*	8 (6-9)	7 (6-10)	10 (8-13)	0.001
HOTEL*	1 (0-1)	1 (0-2)	2 (1-3)	0.001
VIEWS*	4 (2-7.8)	4 (1.5-7.5)	10.5 (6.8-15)	0.001
VIEWS-L*	5.9 (3.3-9.7)	6 (3.5-9.4)	14.45 (9.3-20.5)	0.001

*Median (Interquartile range); APACHE II: Acute Physiology And Chronic Health Evaluation II, REMS: Rapid Emergency Medicine Score, HOTEL: Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of independence, VIEWS: VitalPAC Early Warning Score, VIEWS-L: VitalPAC Early Warning Score with Lactate Level; **Kruskall-Wallis test, p<0,017 (0,05/3) is accepted as significant because we compared three groups.

Table 4. Multivariate Logistic Regression analysis for determination of the independent effects of the factors that can predict the hospitalization in ICU

	p	OR	%95 CI
Age	0.502	0.978	0.916-1.044
Gender*	0.755	1.150	0.478-2.766
SBP	0.011	0.982	0.969-0.996
SpO_2	0.042	0.942	0.889-0.998
ECG*	0.001	0.237	0.097-0.575
Loss of independence*	0.001	6.724	2.615-17.287
Lactate	0.001	1.650	1.238-2.198

SBP: Systolic blood pressure, SpO_2: Peripheral Oxygen Saturation, ECG: Electrocardiography, OR: Odds Ratio, CI: Confidence Interval; *Females in gender, normal ECG and independence are accepted as reference group.

Patients; 112 (45.9%) were discharged from the emergency department, 58 (23.7%) were admitted to the intensive care unit, and 61 (25%) to the services. Only two patients died in the emergency department. 214 of the patients (87.7%) were alive at the end of four weeks, 30 (12.3%) died, 10 were still receiving treatment at the hospital. Patients hospitalized in the intensive care unit had lower systolic blood pressure, diastolic blood pressure and Glasgow Coma Score, but heart and respiration rates were higher than others (Table 2). The risk scores of the patients who were hospitalized in the intensive care unit were greater than patients who was discharged or hospitalized in service department (Table 3). The relative risk values (odds ratio=OR) of age, gender, systolic blood pressure, oxygen saturation, electrocardiogram, lactate and loss of independence of the patients that were hospitalized in the intensive

care unit were expressed in (Table 4). High systolic blood pressure, oxygen saturation, and lactate levels, abnormal electrocardiogram and loss of independence were independent factors in predicting the hospitalization in the intensive care unit.OC analysis of risk scores in predicting hospitalization in the intensive care unit is given in Fig 2.

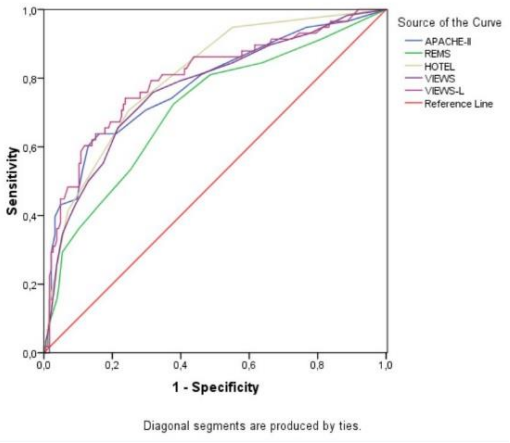

Figure 2. ROC curve for critical care

Accordingly, the results of APACHE II, REMS, HOTEL, VIEWS and VIEWS-L ROC curve analysis were as follows, respectively. Area under curve: 0.777, 0.710, 0.803, 0.768, 0.799; Cut-off value: 14.5, 8.5, 1.5, 7.5, 10.25; Sensitivity: 63.8%, 72.4%, 70.7%, 72.4%, 74.1%; Specificity: 83.8%, 62.2%, 75.1%, 71.4%, 76.2%, In all, p=0.001. All risk scores have good predictive values in predicting hospitalization in the intensive care unit. The best cut-off point was determined as the point with the highest sum of sensitivity and specificity. Patients in the death group consisted of deaths that occurred in the emergency department or within the first 28 days of hospitalization. Ten patients hospitalized for more than 28 days were not included in the comparison. All risk scores of the patients in the mortality group were significantly higher (Table 5).

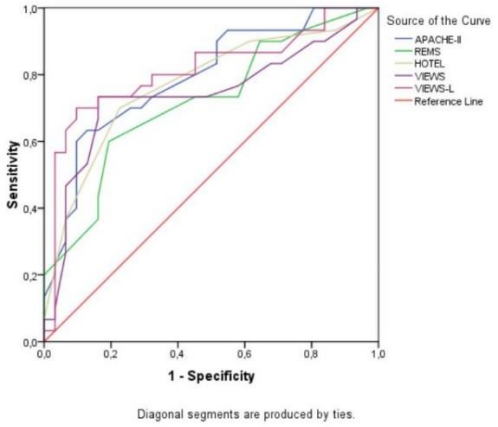

Figure 3. ROC curve for mortality

ROC analysis of risk scores in predicting mortality is given in Fig 3. Accordingly, the results of APACHE II, REMS, HOTEL, VIEWS and VIEWS-L ROC curve analysis were as follows, respectively. Area under curve: 0.794, 0.718, 0.771, 0.741, 0.812; Cut-off value: 20.5, 12.5, 2.5, 12.5, 18.3; Sensitivity: 63.3%, 60%, 70%, 73.3%, 70%; Specificity: 87.1%, 80.6%, 77.4%, 83.9%, 90.3%, In all, p=0.001. All risk scores have good predictive values in predicting mortality. The best cut-off point was determined as the point with the highest sum of sensitivity and specificity.

The age, gender, systolic blood pressure, albumin and lactate relative risk values (odds ratio = OR) of the patients hospitalized in the intensive care unit are presented in (Table 6). High albumin and lactate levels are independent factors in predicting mortality.

Table 5. The relationship of risk scores with mortality rate

	Death (n=30)	**Discharged (n=204**)**	**p*****
APACHE II*	24 (15.8-29,3)	9 (7-13)	0.001
REMS*	13 (9-16)	7.5 (6-10)	0.001
HOTEL*	3 (2-4)	1 (0-2)	0.001
VIEWS*	15 (8.8-17)	4 (2-8.8)	0.001
VIEWS-L*	20.6 (14-22.5)	6.1 (3.4-11.2)	0.001

*Median (Interquartile range); APACHE II: Acute Physiology and Chronic Health Evaluation II, REMS: Rapid Emergency Medicine Score, HOTEL: Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of independence, VIEWS: VitalPAC Early Warning Score, VIEWS-L: VitalPAC Early Warning Score with Lactate Level; ** 10 patients were excluded in this calculation because their hospitalization were longer than 4 weeks; ***Mann-Whitney-U Test

Table 6. Multivariate logistic regression analysis for determination of the independent effects of the factors that can predict the mortality

	p	OR	%95 CI
Gender*	0.735	1.250	0.343-4.558
Age	0.120	1.076	0.981-1.181
SBP	0.056	0.980	0.961-1.000
Albumin	0.001	0.119	0.038-0.371
Lactate	0.001	2.753	1.879-4.033

SBP: Systolic blood pressure, OR: Odds Ratio, CI: Confidence Interval; *Females is accepted as reference group.

DISCUSSION

Emergency departments are the units where patients should be assessed in a short time and correct and effective treatment should be started. The increasing intensity of the emergency department, complex, critical unstable, and weak patients force the emergency physicians to start correct and effective treatment in a short time[2,14]. It is stated that the scoring systems are more valuable than the physician's experience in predicting mortality and systematically providing the physician's assessment of the current state of the patient, thereby providing concrete data[15-16].

The average age of geriatric patients in emergency services varied between 73.2 and 77.6 years in various patients[17-20]. The female sex ratio varies between 42% and 46%, and the male gender between 54% and 58%[17,20-23]. In our study, the mean age was 77.6 years and 57% of the patients were women. We think that the reason for this difference in gender is the coincidence of patients coming to the emergency department.

The most common complaints in our study were abdominal pain, shortness of breath, nausea-vomiting, chest pain and altered consciousness. These findings, frequencies may vary depending on the center and population where similar studies are conducted[20,22-25]. The most common comorbidities were hypertension, coronary artery disease and diabetes. It was consistent with similar studies[25-27].

Post-emergency situations of geriatric patients varied according to the center where the study was conducted; While the application rate was reported as 62-69% in some studies, it was 11.5% in some studies; intensive care admission rates can range from 1.5% to 38.1%; Emergency department mortality rates have been reported below 1% (17-19,23). Similarly, in our study, the admission rate was 48.7%, the rate of hospitalization in the intensive care unit was 23.7%, and the death in the emergency department was 0.8%. Farley et al.[28] reported that an increase in respiratory rate and a decrease in diastolic blood pressure within 24 hours after admission to the emergency department were risk factors for hospitalization in the intensive care unit. Considine et al.[29] abnormal heart rate, respiratory rate, and the presence of body temperature were associated with an increased risk of hospitalization in the intensive care unit. In our study, the factors affecting the risk of hospitalization in the intensive care unit were found to be a poor general condition, lactate level, pathological electrocardiography, low oxygen saturation, and increased systolic blood pressure values.

There are very few studies comparing risk scoring systems in predicting the hospitalization in the intensive care unit. Bulut et al.[30] reported that in predicting the hospitalization either in service room or the intensive care unit, REMS core is better than modified early warning score (MEWS). In our study, we found that APACHE II, REMS, HOTEL, VIEWS and VIEWS-L scores were higher in patients hospitalized in the intensive care unit compared to patients who were discharged in the service or hospitalized. The sensitivity and specificity values of the scores on hospitalization in the intensive care unit, respectively; APACHE II, REMS, HOTEL, ViEWS, ViEWS-L: 63.8%-83.8%, 72.4%-62.2%, 70.7%-75.1%, 72.4%-71.4%, 74.1%-76.2%. The VIEWS-L score had the highest sensitivity and specificity for predicting hospitalization in the intensive care unit.

Bulut et al.[30] reported that MEWS and REMS scores were higher in in-hospital mortality but also REMS was better than MEWS scores in predicting the in-hospital mortality. Fan et al.[31] reported that the APACHE II score over 20 was a risk factor for mortality. In the same way, Kua et al.[32] reported that higher REMS scores related to mortality. Wheeler et al.[33] reported that the HOTEL score is higher than

the MEWS score in predicting in-hospital mortality. Jo et al.[12] reported the VIEWS-L score is higher in predicting the in-hospital mortality than APACHE II, HOTEL, VIEWS score. Although individual risk scores were taken into consideration in similar studies, in our study, all risk scores such as APACHE II, REMS, HOTEL, VIEWS and VIEWS-L were evaluated. All scores were higher in predicting mortality. In our study, sensitivity and specificity values were; APACHE II, REMS, HOTEL, VIEWS and VIEWS-L were: 63.3%-87.1%, 60%-80.6%, 70%-77.4%, 73.3%-83.9%, 70%-90.3%. The VIEWS-L score had the highest sensitivity and specificity for predicting mortality.

It is important to differentiate the critical situation in an emergency and to anticipate risks for patient safety. Our study shows that APACHE II, REMS, HOTEL, VIEWS, and VIEWS-L scoring can be used safely in predicting mortality risk in critical geriatric patients or hospitalization in intensive care units.

Yazar Katkıları: Çalışma konsepti/Tasarımı: İB, YK, AC; Veri toplama: İB, BD, SG, MSY; Veri analizi ve yorumlama: AC, YK, İB; Yazı taslağı: BD, İB, MSY, SG; İçeriğin eleştirel incelenmesi: YK, AC; Son onay ve sorumluluk: İB, SG, BD, MSY, AC, YK; Teknik ve malzeme desteği: BD,İB, SG, MSY; Süpervizyon: YK, AC; Fon sağlama (mevcut ise): yok.
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