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RESEARCH

COMBINATION OF LACTATE WITH MODIFIED EARLY WARNING SCORE AND RAPID EMERGENCY MEDICINE SCORE IN GERIATRIC PATIENTS ADMITTED TO EMERGENCY DEPARTMENT TO PREDICT 28-DAY MORTALITY

Abstract

Introduction: Aim was to compare the efficacy of Rapid Emergency Medicine Score, Rapid Emergency Medicine Score-Lactate, Modified Early Warning Score and Modified Early Warning Score-Lactate scores in predicting 28-day mortality after emergency department visit and hospitalization from emergency department for patients with age ≥65 years.

Materials and Method: The prospective observational study that carried out between February 29 to April 30, 2016 included patients with age ≥65 years who were referred to emergency department and did not have any trauma history.

Results: The mean age of 1106 patients included was 77.23±7.41 years and 52.3% (n=578) were female. In the prediction of hospital admission, AUC for Rapid Emergency Medicine Score, Rapid Emergency Medicine Score-Lactate, Modified Early Warning Score and Modified Early Warning Score-Lactate were 0.837, 0.918, 0.817, 0.927 (p=0.001, p<0.001, p=0.002, p<0.001) respectively. In the prediction of 28-day mortality AUC for Rapid Emergency Medicine Score, Rapid Emergency Medicine Score-Lactate, Modified Early Warning Score and Modified Early Warning Score-Lactate were 0.659, 0.695, 0.647, 0.681 (p<0.001, p<0.001, p<0.001, p<0.001) respectively.

Conclusion: Rapid Emergency Medicine Score and Modified Early Warning Score were powerful in predicting hospital admission from emergency department and had moderate force in predicting 28-day mortality. Rapid Emergency Medicine Score-Lactate and Modified Early Warning Score-Lactate scoring systems are more powerful than isolated Rapid Emergency Medicine Score and Modified Early Warning Score in predicting both for hospitalization and 28-day mortality.

Keywords: Aged; Geriatrics; Hospitalization; Latic acid; Mortality

ARAŞTIRMA

ACİL SERVİSE BAŞVURAN GERİATRİK HASTALARDA 28 GÜNLÜK MORTALİTE TAHMİNİNDE "MODIFIED EARLY WARNING SCORE" VE "RAPID EMERGENCY MEDICINE SCORE"UN LAKTAT İLE KOMBİNASYONUNUN KARŞILAŞTIRILMASI

Öz

Giriş: Acil servise başvuran 65 yaş üstü hastalarda mortalite tahmininde kullanılan Rapid Emergency Medicine Score, Rapid Emergency Medicine Score-Laktat, Modified Early Warning Score ve Modified Early Warning Score-Laktat skorlarının 28 günlük mortalite tahmini ve hastane yatışı tahmini açısından güvenilirliği ve kullanılabilirliğini araştırmak ve etkinliğini karşılaştırmaktır.

Gereç ve Yöntem: Bu çalışma 29 Şubat-30 Nisan 2016 tarihleri arasında hastanemiz acil servisine başvuran 65 yaş ve üstü olan 1106 hasta dahil edildi.

Bulgular: Çalışmaya alınan hastaların yaş ortalaması 77.23±7.41 yıl ve %52.3'ü (n=578) kadındı. Hastane yatışı tahmininde ROC eğrisinin altında kalan alan Rapid Emergency Medicine Score, Rapid Emergency Medicine Score-Laktat, Modified Early Warning Score ve Modified Early Warning Score-Laktat için sırası ile 0.837, 0.918, 0.817, 0.927 (sırası ile p=0.001, p<0.001, p=0.002, p<0.001); 28 günlük mortalite açısından ROC eğrisinin altında kalan alan Rapid Emergency Medicine Score, Rapid Emergency Medicine Score-Laktat, Modified Early Warning Score ve Modified Early Warning Score-Laktat için sırası ile 0.659, 0.695, 0.647, 0.681 olarak hesaplandı (sırası ile p<0.001, p<0.001, p<0.001, p<0.001).

Sonuç: Çalışmamıza göre Rapid Emergency Medicine Score ve Modified Early Warning Score skorlama sistemleri geriatrik hastaların acil servisten hastane yatışı tahmini açısından güçlü; 28 günlük mortalite tahmininde orta kuvvette puanlama skorlarıdır. Rapid Emergency Medicine Score-Laktat ve Modified Early Warning Score-Laktat skorlarını skorlama sistemleri ise geriatrik hastaların hem acil servisten hastane yatışı hem 28 günlük mortalite tahmini açısından izole Rapid Emergency Medicine Score ve Modified Early Warning Score'dan daha güçlüdür.

Anahtar sözcükler: Geriatri; Hospitalizasyon; Laktat; Mortalite; Yaşlı

INTRODUCTION

Emergency departments are facilities where rapid triage and stabilisation of patients are performed simultaneously and where people from different age groups present with medical and trauma associated complaints as well as different provisional diagnosis. The rate of elderly patients presenting to emergency departments (EDs) is increasing both in Turkey and abroad (1-4). Therefore, EDs have an important role and responsibility with respect to the initial assessment and treatment of this patient group.

Elderly patients might become clinically unstable in a short time and this could result in increased mortality. ED physicians should be more attentive and vigilant with respect to this patient group. There is no globally acknowledged and common scoring system for elderly patients presenting to EDs. Therefore, it is crucial to investigate the extent to which early warning systems are effective in assessing mortality and morbidity in elderly patients who presented to EDs (5).

Modified Early Warning Score (MEWS) comprises five physiological parameters: systolic blood pressure (SBP), heart rate (HR), respiratory rate (RR), temperature and mental status (6). Rapid Emergency Medicine Score (REMS) comprises six physiological parameters: mean arterial pressure (MAP), HR, RR, mental status, oxygen saturation and age (7).

An increase in lactate levels was demonstrated to be associated with shock, perfusion and poor prognosis. Studies on EDs found that a lactate level of>4 mmol/L was associated with the severity of critical illness (8).

The aim was to investigate the prognostic value of REMS, MEWS and the combination of REMS and MEWS with lactate levels on hospitalisation and estimation of 28-day mortality in elderly patients.

MATERIALS AND METHOD

Research population

This prospective, monocentric study was conducted in the Ankara Yıldırım Beyazıt University Atatürk Training and Research Hospital ED between 29.02.2016 and 30.04.2016. We obtained ethical approval from the Ethics Committee of Clinical Studies (Date 17.02.2016; No. 46).

Patient inclusion criteria

1. Patients aged ≥ 65 years

2. Patients tagged with yellow or red colour codes during a triage

3. Voluntary participation in the study

Patient exclusion criteria

1. Presentation to ED because of trauma

2. Patients who underwent cardiopulmonary resuscitation before admission to ED

3. Inability to reach the patient or patient's relative by phone

Research method

In our ED, patients were classified as green (less acute), yellow (urgent) and red (emergency) during admission at triage site by the emergency resident physician in charge and referred to relevant fields in ED. The patients were then assessed by the emergency resident and specialist physician. Patient admission date, age, sex, HR, SBP, diastolic blood pressure, body temperature, RR, oxygen saturation, mental status, comorbidities, complaints, diagnosis and outcomes in the emergency department were recorded. We recorded findings obtained by the clinician on the study form to calculate REMS and MEWS values. We never interfered with the decision process about patients. When arterial blood gas sampling was obtained, lactate levels were also recorded to measure the REMS-Lactate (REMS-L) and MEWS-Lactate (MEWS-L) values.

'REMS-L=REMS + lactate levels (mmol/L)'

'MEWS-L=MEWS + lactate levels (mmol/L)'

Patients' demographic data and contact details were obtained. The 28-day mortality status of all was recorded.

Statistical analysis

The analyses of the study were conducted using Statistical Package for the Social Sciences (SPSS) software (version 19.0, SPSS Inc., Chicago, IL) package programme. Descriptive measures of variables were calculated. Categorical variables were presented as frequency and percentage, whereas ratio scale variables were presented as mean±SD in tables. The normal distribution of continuous variables was analysed via Kolmogorov–Smirnov test. It was found that the variables were not normally distributed. Therefore, during comparison of independent groups, Mann–Whitney U Test was used for data with two groups and Kruskal–Wallis Test was used for data with multiple groups. In statistically significant multiple comparisons, paired comparisons were implemented. Groups that had significant differences were shown as exponential letters in tables. Results of mortality in ED and 28-day mortality estimation were visualised via figures. Throughout the study, the type-1 error was set at 5%, and a p-value of <0.05 was considered to be statistically significant.

RESULTS

In total, 21685 patients presented to ED between the study period. Of these patients, 3079 patients were aged ≥65 years and 1106 patients who fulfilled the inclusion and exclusion criteria were included in the study.

The mean age was 77.23±7.41 years, and the median was 77 years. The number of female patients was 52% (n=578). The most frequent complaints of the patients who admitted to the ED were dyspnea (18.4%; n=204), abdominal pain (7.2%; n=80) and fever (6%; n=66), whereas the most frequent comorbidities were hypertension (58.1%; n=643), diabetes mellitus (32.8%; n=363) and atherosclerotic cardiovascular disease (32.5%; n=360) (Table 1).

In total, 56.2% (n=622) of the elderly patients who presented to the ED were discharged. Twenty-five percent of the cases (n=276) were referred to wards, whereas 15.2% (n=168) were referred to the intensive care unit (ICU); 2.9% (n=32) of the patients were discharged on their own accord and 1% (n=8) were exitus patients. At the end of 28 days, 15.6% (n=173) of the cases resulted in exitus (Table 1).

Elderly patients who presented to ED were divided into three groups with respect to age: 65–74, 75–84 and ≥85 years. Among the age groups, there was a statistically significant difference with respect to gender distribution, Glasgow Coma Scale (GCS) and mean saturation levels (p=0.017, p=0.012 and p<0.001, respectively). There was no statistically significant difference between the age groups with respect to mortality in ED; however, there was a statistically significant difference between the age groups with respect to 28-day mortality (p=0.066 and p=0.001, respectively) (Table 1).

A statistically significant difference between the age groups existed only with respect to REMS and REMS-L values (p<0.001 and p<0.001, respectively). The mean REMS in the 65–75 age group was significantly lower than that in the other groups. In addition, REMS-L values increased with age. The mean MEWS and MEWS-L increased with age; however, the difference was not statistically significant (Table 1).

Elderly patients who presented to ED were divided into survival and non-survival groups with

respect to their 28-day mortality scores. There was a statistically significant difference between the groups with respect to age, SBP, diastolic blood pressure (DBP), MAP, RR, GCS, lactate levels, MEWS, REMS, MEWS-L and REMS-L ($p=0.003$, $p<0.001$, $p<0.001$, $p<0.001$, $p=0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$ and $p<0.001$, respectively) (Table 2). There was also a statistically significant difference between the mortality in ED categories with respect to 28-day mortality scores ($p=0.001$). The exitus rate was very high in patients who were referred to the ICU, whereas the survival rate was statistically higher in those who were discharged from ED (Table 2).

Excluding 'those who were discharged on their own wish', the results were reassessed with respect to mortality in ED via a sub-analysis. The patients were divided into four groups: group I (admitted to a hospital ward bed), group II (admitted to an ICU bed), group III (discharged from ED) and group IV (exitus at ED). There was a statistically significant difference between the groups with respect to SBP, MAP, RR, GCS and lactate levels ($p=0.004$, $p=0.021$, $p<0.001$, $p<0.001$ and $p<0.001$, respectively). In addition, there was a statistically significant difference between the groups with respect to scoring systems: MEWS, REMS, MEWS-L and REMS-L ($p<0.001$, $p<0.001$, $p<0.001$ and $p<0.001$, respectively). All scores were significantly higher in group IV, whereas group III had the lowest scores (Table 3).

Analysis of ROC was conducted to assess the efficiency of scoring systems in estimating the mortality in ED and 28-day mortality. Among the four scoring systems, MEWS-L yielded the highest score for estimating hospitalisation (AUC=0.921; $p<0.001$), whereas REMS-L yielded the highest score for estimating the 28-day mortality (AUC=0.695; $p<0.001$; Table 4).

It was demonstrated that as MEWS increased from 2 to 3, the mortality rate increased from 9.6% to 22.3% and as it increased from 6 to 7, the mortality rate increased from 22.7% to 58.8%. Based on these results, the patients can be divided into the following risk groups: MEWS<3, MEWS between 3 and 6 and MEWS>6. There were 681 patients (61.6%) in the MEWS<3 group, 402 patients (36.4%) in the MEWS between 3 and 6 group and 23 patients (2%) in the MEWS>6 group (Figure 1).

It was found that as REMS increased from 8 to 9, the mortality rate increased from 15.4% to 20.2% and as it increased from 11 to 12, the mortality rate increased 17.1% to 38.1%. According to these results, the patients can be divided into the following risk groups: REMS<9, REMS between 9 and 11 and REMS>11. There were 820 (74.2%) patients in the REMS<9 group, 229 (20.7%) patients in the REMS between 9 and 11 group and 57 (5.1%) patients in the REMS>11 group (Figure 1).

It was demonstrated that as MEWS-L increased from 2 to 3, the mortality rate increased from 8.4% to 17.9% and as it increased from 6 to 7, the mortality rate increased from 30% to 60%. According to these results, the patients can be divided into the following risk groups: MEWS-L<3, MEWS-L between 3 and 6 and MEWS-L>6. There were 388 (49.5%) patients in the MEWS-L<3 group, 378 (48.3%) patients in the MEWS-L between 3 and 6 group and 17 (2.2%) patients in the MEWS-L>6 group (Figure 1).

It was found that as REMS-L increased from 7 to 9, the mortality rate increased from 9.4% to 18.4% and as it increased from 13 to 15, the mortality rate increased from 31.5% to 54.2%. Based on these results, the patients can be divided into the following risk groups: REMS-L<9, REMS-L between 9 and 13 and REMS-L>13. There were 340 (43.5%) patients in the REMS-L<9 group, 386 (49.5%) patients in the REMS-L between 9 and 13 group and 55 (7%) patients in the REMS>13 group (Figure 1).

Table 1. The distrubiton of demographic, vital signs, lactate level, ED visiting results and 28-day mortality in all and according to age groups..

		All patients	Age groups 65-74 years	75-84 years	+85 years	
		n (%) or mean±sd				p
Age	years	77.23±7.41	69.59±2.95	79.52±2.84	88.28±2.71	**<0.001***
Sex	male	528 (47.7)	217 (51.3)[a]	234 (48.1)	76 (39.0)[b]	**0.017***
	female	578 (52.3)	206 (48.7)[a]	252 (51.9)	119 (61.0)[b]	
Comorbidities	yes	1023(92.5)	385 (91.0)	454 (93.4)	182 (93.3)	0.347
	no	83 (7.5)	38 (9.0)	32 (6.6)	13 (6.7)	
Systolic blood pressure	mmHg	138.27±30.81	138.26±31.88	138,25±29.74	138.32±31.22	0.998
Diastolic blood pressure	mmHg	77.80±28.63	77.88±18.56	78.43±37.77	76.05±18.45	0.576
Mean arterial pressure	mmHg	97.42±20.29	97.64±21.17	97.48±19.21	96.81±21.05	0.927
Pulse	per/min	89.25±22.20	90.05±21.42	88.90±22.96	88.40±22.02	0.406
Breathing rate	per/min	22.43±6.39	22.23±6.14	22.27±5.874	23.24±7.93	0.323
Body temperature	°C	36.54±0.81	36.52±0.71	36.55±0.91	36.58±0.75	0.069
GCS	score	14.55±1.36	14.69±1.10[a]	14.49±1.52	14.42±1.4[b]	**0.012***
Peripheral oxygen saturation	%	92.34±26.96	92.26±6.82[a]	92.86±40.05[a]	91.20±5.45[b]	**<0.001***
Lactate	mmol/L	2.20±1.75	2.15±1.67	2.20±1.76	2.29±1.87	0.894
REMS		8.14±2.37	7.41±2.25[a]	8.52±2.42[b]	8.78±2.07[c]	**<0.001***
REMS-L		10.51±3.27	9.63±3.11[a]	10.94±3.33[b]	11.14±3.06[c]	**<0.001***
MEWS		2.47±1.62	2.44±1.59	2.41±1.61	2.66±1.71	0.190
MEWS-L		4.75±2.70	4.73±2.63	4.70±2.62	4.91±3.02	0.957
ED visiting results	Ward admission	276 (25.0)	114 (27.0)	120 (24.7)	42 (21.5)	0.066
	ICU admission	168 (15.2)	72 (17.0)	67 (13.8)	29 (14.9)	
	Discharged from ED	622 (56.2)	224 (52.5)	281 (57.8)	117 (60.0)	
	Left yourself	32 (2.9)	13 (3.1)	14 (2.9)	5 (2.6)	
	Exitus	8 (0.7)	2 (0.5)	4 (0.8)	2 (1.0)	
28-day mortality	Survivor	933	372 (87.5)[a]	412 (84.8)	149 (76.4)[b]	**0.001***
	Non-survivor	173	53 (12.5)[a]	74 (15.2)	46 (23.6)[b]	

* Different exponential letters indicate the categories where the results of the paired comparisons are different.
ED: Emergency Department; GCS: Glascow Coma Scale; ICU: Intensive Care Unit

Table 2. The distribution of demographic, vital signs, lactate level, scoring systems and ED visiting results according to 28-day mortality.

		Survival (n=933)	Non-survival (n=173)	
		n (%) or mean±sd		p
Sex	female	495 (53.1)	83 (48)	0.219
	male	438 (46.9)	90 (52)	
Age	years	76.93±7.31	78.87±7.71	**0.003***
Systolic blood pressure	mmHg	140.11±30.34	128.18±31.66	**<0.001***
Diastolic blood pressure	mmHg	78.84±30.08	72.14±17.88	**<0.001***
Mean arterial pressure	mmHg	98.62±19.98	90.95±20.78	**<0.001***
Breathing rate	per/min	22.10±6.21	24.12±7.05	**0.001***
GCS	score	14.68±1.13	13.88±2.09	**<0.001***
Lactate	mmol/L	2.02±1.37	3.08±2.82	**<0.001***
MEWS	score	2.35±1.55	3.11±1.86	**<0.001***
REMS	score	7.98±2.27	9.03±2.65	**<0.001***
MEWS-L	score	4.42±2.27	6,37±3.81	**<0.001***
REMS-L	score	10.08±2.89	12.58±4.08	**<0.001***
ED visiting results	Ward admission	244 (26.2)	32 (18.5)	
	ICU admission	88 (9.4)[a]	80 (46.2)[b]	
	Discharged from ED	574 (61.3)[a]	50 (28.9)[b]	**0.001***
	Left yourself	27 (2.9)	5 (2.9)	

* Different exponential letters indicate categories where the results of the paired comparisons are different.
ED: Emergency Department; GCS: Glascow Coma Scale; MEWS: Modified Early Warning Score; REMS: Rapid Emergency Medicine Score; L: Lactate

Table 3. The distribution of demographic, vital signs, lactate level, scoring systems and according to ED visiting results.

		Group I (N=276)	Group II (N=168)	Group III (N=622)	Group IV (N=8)	
		n (%) or mean±sd				p
Sex (N %)	Female	140 (50.7)	89 (53.0)	328 (52.7)	6 (75.0)	0.546
	Male	136 (49.3)	79 (47.0)	294 (47.3)	2 (25.0)	
Age	years	76.54±7.13	76.70±7.39	77.70±7.46	79.75±8.61	0.157
Systolic blood pressure	mmHg	139.38±29.23[b]	131.80±33.15[a]	139.68±30.58[b]	111.13±42.04[c]	**0.004***
Diastolic blood pressure	mmHg	77.12±16.69	75.80±20.26	78.77±34.64	60.87±21.31	0.118
Mean arterial pressure	mmHg	97.63±18.99	94.36±22.15	98.26±2019	77.60±27.07[a]	**0.021***
Breathing rate	per/min	22.44±5.67	25.16±6.65	21.55±6.30	31.00±9.98[a]	**<0.001***
GCS	score	14.67±1.03	13.43±2.37	14.82±0.79	12.00±3.29[a]	**<0.001***
Lactate	mmol/L	2.05±1.36	3.21±3.03	1.91±0.94	6.37±4.96[a]	**<0.001***
MEWS	score	2.46±1.63	3.46±1.77	2.18±1.46	4.75±1.83[a]	**<0.001***
REMS	score	7.93±2.24	9.56±2.58	7.82±2.20	11.38±2.06[a]	**<0.001***
MEWS-L	score	4.53±2.46	6.85±3.82	4.15±1.80	11.12±5.27[a]	**<0.001***
REMS-L	score	10.05±2.97	13.13±4.12	9.87±2.50	17.75±4.52[a]	**<0.001***

* Different exponential letters indicate the categories where the results of the paired comparisons are different.
ED: Emergency Department; GCS: Glascow Coma Scale; MEWS: Modified Early Warning Score; REMS: Rapid Emergency Medicine Score; L: Lactate

Table 4. The results of scoring systems according to end points of study.

	MEWS	REMS	MEWS-L	REMS-L
Hospitalization				
AUC	0.817 (p=0.002)	0.837 (p=0.001)	0.921 (p<0.001)	0.918
(p)				(p<0.001)
Optimal Cut-off	4.50	8.50	7.35	15.85
Sensitivity (%)	19.14	43.46	17.90	11.14
Spesifisity (%)	91.80	67.04	94.47	97.45
LR+ (%)	233.48	131.88	323.71	437.71
LR- (%)	88.07	84.32	86.90	91.17
28-day mortality				
AUC	0.647 (p<0.001)	0.659 (p<0.001)	0.681 (p<0.001)	0.695
(p)				(p<0.001)
Optimal Cut-off	2.50	9.50	5.25	10.05
Sensitivite (%)	58.38	40.46	58.08	70.37
Spesifisite (%)	65.27	76.84	74.35	57.64
LR+ (%)	168.11	174.77	226.47	166.14
LR- (%)	63.77	77.47	56.37	51.39

AUC: Area Under curve; LR: Likelihood Ratio; MEWS: Modified Early Warning Score; REMS: Rapid Emergency Medicine Score; L: Lactate

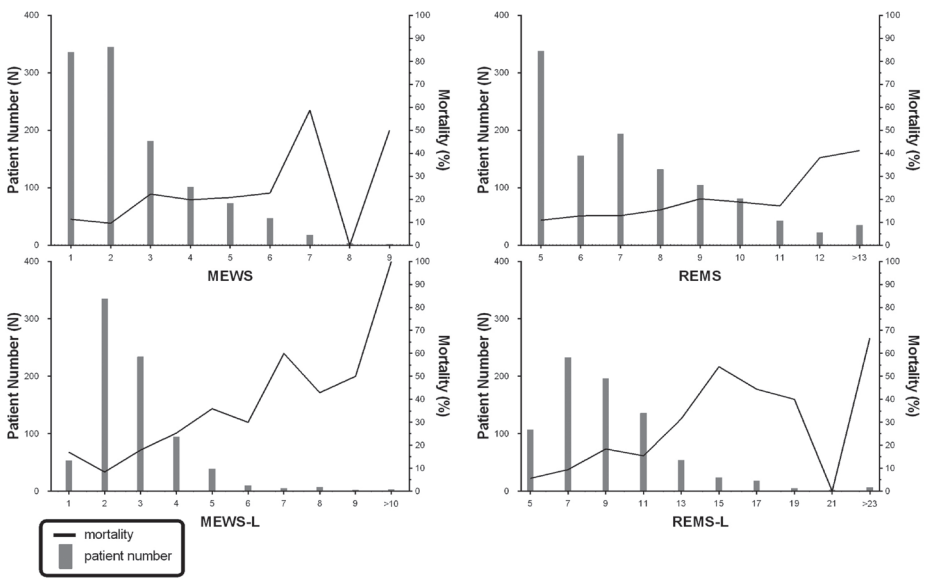

Figure 1. The distribution of patients and rate of mortality according to scores.

DISCUSSION

In the study in which MEWS was first defined, it was reported that AUC for admission to the ICU was 0.62 and that it had an intermediate predictive strength (6). Dundar et al. (4) found that AUC of MEWS for hospitalisation of elderly patients from ED was 0.727 and that it had an intermediate predictive strength. In our study, the predictive strength of MEWS was stronger for estimating the hospitalisation of elderly patients.

Another study calculated AUC of MEWS for estimating the 30-day mortality as 0.754 (9). Çıldır et al. (10) found that the optimal threshold value of MEWS for estimating the 28-day mortality was 6 and determined the sensitivity, specificity and AUC to be 43.24%, 75% and 0.608, respectively. Köksal et al. (11) reported the optimal value of MEWS for estimating the 28-day mortality was 3, sensitivity was 77.97%, specificity was 79.9% and AUC was 0.846. In our study, we obtained lower scores with respect to sensitivity and specificity of MEWS and it yielded an intermediate predictive strength.

Bulut et al. (12) found REMS to be 6 for estimating hospitalisation after ED visit and AUC was calculated as 0.642. Dundar et al. (13) reported AUC of REMS as 0.698. In our study, contrary to the findings of previous studies, REMS had higher AUC values in the prediction of discharge from ED and of hospitalisation in elderly patients.

A study by Cattarmole et al. (9) designated AUC of REMS to be 0.771 for the estimation of 30-day mortality. Hilderink et al. (14) found AUC of REMS to be 0.74 for the estimation of 28-day mortality. In our study, in line with the results of previous studies, we determined similar AUC values of REMS.

Yoo et al. (15) demonstrated that AUC of MEWS was be 0.816, whereas that of MEWS-L was 0.898 for the prediction of hospitalisation after ED visit. In our study, in line with the results of the previous study, AUC of MEWS-L was determined to be high for the estimation of discharge after emergency and hospitalisation. In addition, it was found that AUC and specificity of MEWS-L was higher than those of MEWS.

In our study, AUC and specificity of MEWS-L was significantly higher for the prediction of 28-day mortality than those of MEWS. In line with the findings of our study, Yoo et al. (15) reported that MEWS-L was a stronger predictor of 28-day mortality than MEWS.

In our study, AUC and specificity of REMS-L was higher than that of REMS for predicting discharge after emergency and hospitalisation; however, the sensitivity of REMS-L was found to be lower. In addition, AUC and sensitivity of REMS-L was determined to be higher than that of REMS for estimating the 28-day mortality. We found no study in the literature to compare our findings on REMS-L.

In our study, we found that MEWS of 6 corresponded to a mortality rate of 22.7%, whereas MEWS of 7 corresponded to a mortality rate of 58%. Similarly, Dundar et al. (4) stated that MEWS of 6 corresponded to a mortality rate of 38% and as MEWS increased to 7, the mortality rate increased to 77%. However, Burch et al. (16) determined a mortality rate of 16% for MEWS<5 and a mortality rate of 26% for MEWS ≥5. We determined that REMS of 11 corresponded to a mortality rate of 17.1% and when it increased to 12, the mortality rate increased to 38.1%. A study by Ha et al. (17) designated a mortality rate of 16% for REMS of 10–11 and as REMS increased to 12–13, the mortality rate increased to 39%. However, Dündar et al. (13) found a mortality rate of 3.6% for REMS of 8 and as REMS increased to 9, the mortality rate increased to 14.1%. According to these results, there is a difference among the risk groups with respect to the prediction of mortality.

The main limitations of our study were that it was monocentric, ignored the possible seasonal variations and excluded trauma patients. It is known that in patients aged ≥ 65 years, comorbidity and medications affect the prognosis. These factors were also ignored. Similarly, no detailed evaluations were performed with respect to the cause of death

of patients who died during the study and their final diagnosis.

We approached elderly patients as a whole in our study, and their complaints at admission and final diagnosis were evaluated with respect to their organ systems. However, prognostic values of scoring systems between different sub-groups of patients with different diagnosis were not analysed.

In addition, the study did not evaluate how primary lifesaving interventions and medications provided by the emergency medical system affected MEWS and REMS was not taken into consideration.

In conclusion, the present study supports that MEWS and REMS are effective, reliable and convenient scoring systems for predicting hospitalisation and 28-day mortality in elderly patients who presented to EDs. We found that REMS was a more effective system for predicting hospitalisation and mortality of the patient than MEWS.

We also determined that a combination of REMS and MEWS with lactate levels had a stronger estimation value for predicting hospitalisation and 28-day mortality than REMS and MEWS alone. We believe that future studies on MEWS-L and REMS-L in elderly patients who presented to EDs will yield a better understanding on their roles in the definition of critical elderly patients.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Loğoğlu A, Ayrık C, Köse A, et al. Analysis of non-traumatic elderly patient presentations to the emergency department. Tr J Emerg Med 2013;13(4):171-9. doi:10.5505/1304.7361.2013.82474. (in Turkish).
2. Ergin M, Karamercan MA, Ayranci M, et al. Epidemiological characteristics of geriatric patients in emergency departments: results of a multicenter study. Turk J Geriatrics 2015;18(4):259-65. [Internet] Available from: http://geriatri.dergisi.org/pdf/pdf_TJG_906.pdf. Accessed: 12.03.2018.
3. Pines JM, Mullins PM, Cooper JK, et al. National trends in emergency department use, care patterns, and quality of care of older adults in the United States. J Am Geriatr Soc 2013;61(1):12-7. (PMID:23311549).
4. Dundar ZD, Ergin M, Karamercan MA, et al. Modified early warning score and vitalpac early warning score in geriatric patients admitted to emergency department. EJEM 2016;23(6):406-12. (PMID:25919485).
5. Groarke JD, Gallagher J, Stack J, et al. Use of an admission early warning score to predict patient morbidity and mortality and treatment success. Emerg Med J 2008;25:803–6. (PMID:19033494).
6. Subbe C, Kruger M, Rutherford P, et al. Validation of a modified early warning score in medical admissions. Q J Med 2001;94(10):521-6. (PMID:11588210).
7. Olsson T, Lind L. Comparison of the rapid emergency medicine score and APACHE II in nonsurgical emergency department patients. Acad Emerg Med 2003;10(10):1040-8. (PMID:14525735).
8. Shapiro NI, Howell MD, Talmor D, et al. Serum lactate as a predictor of mortality in emergency department patients with infection. Ann Emerg Med 2005;45(5):524-8. (PMID:15855951).
9. Cattermole GN, Mak SP, Liow CE, et al. Derivation of a prognostic score for identifying critically ill patients in an emergency department resuscitation room. Resuscitation 2009;80(9):1000-5. (PMID:19608327).
10. Çıldır E, Bulut M, Akalın H, et al. Evaluation of the modified MEDS, MEWS score and Charlson comorbidity index in patients with community acquired sepsis in the emergency department. Intern Emer Med 2013;8(3):255-60. (PMID:23250543).
11. Köksal Ö, Torun G, Ahun E, et al. The comparison of modified early warning score and Glasgow coma scale-age-systolic blood pressure scores in the assessment of nontraumatic critical patients in emergency department. Niger J Clin Pract 2016;19(6):761-5. (PMID:27811448).
12. Bulut M, Cebicci H, Sigirli D, et al. The comparison of modified early warning score with rapid emergency medicine score: a prospective multicentre observational cohort study on medical and surgical patients

presenting to emergency department. Emerg Med J 2014;31:476-81. (PMID:23562988).

13. Dundar ZD, Karamercan MA, Ergin M, et al. Rapid emergency medicine score and HOTEL score in geriatric patients admitted to the emergency department. Int J Gerontol 2015;9(2):87-92. [Internet] Available from: http://www.ijge-online.com/article/S1873-9598(15)00045-9/pdf. Accessed:12.03.2018.
14. Hilderink MJ, Roest AA, Hermans M, et al. Predictive accuracy and feasibility of risk stratification scores for 28-day mortality of patients with sepsis in an emergency department. EJEM 2015;22(5):331-7. (PMID:25144398).
15. Yoo J-W, Lee JR, Jung YK, et al. A combination of early warning score and lactate to predict intensive care unit transfer of inpatients with severe sepsis/septic shock. Korean J Intern Med 2015;30(4):471-7. (PMID:26161013).
16. Burch V, Tarr G, Morroni C. Modified early warning score predicts the need for hospital admission and inhospital mortality. Emerg Med J 2008;25(10):674-8. (PMID:18843068).
17. Ha DT, Dang TQ, Tran NV, et al. Prognostic performance of the rapid emergency medicine score (REMS) and worthing physiological scoring system (WPS) in emergency department. Int J Emerg Med 2015;8(1):18. (PMID:26069474).