Original Article
Eurasian Journal of Critical Care

A Comparison of Opera and MEWS Scores in Patients Applying to the Emergency Department with Dyspnea During the Covid-19 Pandemic Period

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Abstract

Introduction: During the COVID-19 pandemic, there were difficulties in diagnostic applications in patients who applied to the emergency department with dyspnea. We aimed to compare the Oxygen, Predisposing factors, Effusion, Radiology, Age (OPERA) scoring that we determined to be fast in diagnosis and treatment, with the Modified Early Warning Score (MEWS) scoring and imaging findings. We investigated the effectiveness of scoring in predicting prognosis and mortality.

Methods: Our retrospective cross-sectional study included 271 patients who presented to a university emergency department between 07 April and 31 July 2020 with dyspnea. MEWS and OPERA scores, demographic characteristics, vital signs, serological tests and detailed findings of computed tomography (CT) of the patients included in the study were scanned. Patients were analyzed in terms of diagnosis, need for intensive care, and two-month mortality.

Result: A total of 271 patients (149 (55%) women, mean age 60.6 ± 18.1 years old) who presented to the emergency department with dyspnea were included in our study. While 43 (15.9%) patients died in the last two months, 69 (25.5%) patients needed intensive care. When the value of 4 was determined as the limit for the MEWS score, 21 (14.1%) patients admitted to the intensive care unit were found to be <4, while 48 (39.3%) patients were ≥4. While 9 (6.0%) of the patients with MEWS score <4 were mortal, 34 (27.9%) patients with MEWS score ≥4 were found to be mortal. OPERA score cutoff value of 6 was calculated. While 27 patients (12.8%) were admitted to the intensive care unit with a score of <6, 52 patients (37.7%) were hospitalized with a score of ≥6. While 4 (3.0%) patients with OPERA score <6 were mortal, 39 (28.3%) patients with ≥6 scores. While the sensitivity of the MEWS score was 69.6% and specificity 63.4% in the need for intensive care, the sensitivity was 79.1% and the specificity was 61.4% in mortality. In the OPERA scoring, the sensitivity for the need for intensive care was 75.4%, the specificity was 57.4%, while the sensitivity for mortality was 90.7% and the specificity was 56.6%. All results are similar between both scores and there is no statistically significant difference (p<0.001).

Conclusion: While OPERA scoring is based on the patient's history and imaging, MEWS is calculated based on vital signs. However, no statistically significant difference was found in all results in terms of predicting both mortality and intensive care hospitalization in both scorings (p<0.00).

Keywords: COVID-19, dyspnea, mortality, MEWS, OPERA

Introduction

Diagnosis and treatment of dyspnea is sometimes difficult with the presence of concurrent underlying disease, age, and morbid disease. Of the patients who applied to the emergency department with dyspnea; 16.5% had Chronic Obstructive Pulmonary Disease (COPD), 16.1% had heart failure, 8.8% had pneumonia, 5.3% had myocardial infarction, 4% had Nine of them were diagnosed with atrial fibrillation and flutter, 3.3% with malignancy, and 3.3% with pulmonary embolism (1).

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, which is a common cause of atypical pneumonia recently, was declared a pandemic by the World Health Organization (WHO) on March 11, 2020 (2). Although the case fatality rate of Coronavirus Disease 2019 (COVID-19) was lower than that of SARS (about 10%) and MERS (about 40%), the pandemic associated with COVID-19 was much more severe worldwide. Although the disease has been defined as severe lung damage in all age groups, the virus is more likely to cause serious illness in the elderly or some high-risk people with a morbid disease. These conditions are severe pneumonia, acute respiratory distress syndrome (ARDS), and multiple organ failure. Typically, individuals affected by COVID-19 present with varying degrees of dyspnea and radiological manifestations (3,4). The time from the onset of COVID-19 to death varies between 6 and 41 days, with a median value of 14 days. The most common symptoms at the onset of COVID-19 disease are shortness of breath, malaise, fever, cough, loss of appetite, myalgia, and fatigue. Other symptoms are sputum, vomiting, headache, diarrhea, hemoptysis and lymphopenia (5,6,7). Extensive laboratory tests are helpful for patients with suspected infection. (8). The definitive diagnosis is

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Received: 27.12.2024 • **Accepted:** 30.12.2024
DOI: 10.55994/ejcc.1608271

Cite this article as: Ugur Y. Sonmez E, Taslidere B, Gulen B. A Comparison of Opera and MEWS Scores in Patients Applying to the Emergency Department with Dyspnea During the Covid-19 Pandemic Period. Eurasian Journal of Critical Care. 2024;6(3): 126-132

Table 1: Modified Early Warning Score

Parameter	3	2	1	0	1	2	3
Respiratory Rate (/min)	<8		9-11	12-20		21-24	³25
Oxygen saturation (%)	£91	92-93	94-95	³96			
Body Temperature (°C)	£35.0		35.1-36.0	36.1-38.0	38.1-39	³39.1	
Systolic Blood Pressure (mmHg)	£90	91-100	101-110	111-219			³220
Pulse (/min)	£40		41-50	51-90	91-110	111-130	³131
Consciousness Level	-	-	-	Alert	-	-	VPU**

**VPU: Verbal Response (V) , Pain Response (P), Unresponsive (U) (*Each parameter is evaluated over 3 points. Value range is 0-18)

complete genome sequencing and phylogenetic analysis on bronchoalveolar lavage fluid or combined nasal and pharyngeal swab to diagnose COVID-19 infection (9). It is difficult to distinguish COVID-19 from other common respiratory diseases. With COVID- 19, our approach to all dyspnea has changed. This study investigates OPERA, MEWS scores and imaging findings in terms of diagnosis, need for intensive care, and mortality estimation in patients admitted to the emergency department with dyspnea during the COVID-19 pandemic.

Method

Data Collection and Measurement

The study was carried out between 07.04.2020 and 31.07.2020, during the period when the COVID-19 disease was first seen in Istanbul, with the approval of the ethics committee with the decision of the Non-Interventional Clinical Research Ethics Committee of our university, dated 16.02.2021 and numbered 03/67. Patients who applied to the emergency medicine clinic of our university and complained of dyspnea R06.0 in the International Diagnostic Coding (ICD) of shortness of breath were retrospectively researched. The study was conducted with 271 patients with appropriate data from 603 patients admitted to the emergency department. The data were obtained from the hospital information management system "Nucleus" database. Included were all individuals over the age of 18. Patients under the age of 18 who did not have shortness of breath, had incomplete information in the database, did not have imaging, and were under the age of 18 were not included in the study. Demographic characteristics of all patients such as age and gender, known chronic diseases, onset time of the complaint, vital signs (fever, respiratory rate, systolic and diastolic blood pressure, oxygen saturation), hemogram parameters, biochemical parameters, serological tests, coagulation parameters, and thorax CTs was taken were analyzed. Imaging studies were reviewed by two radiologists. The Modified Early Warning Score (MEWS), which evaluates the systolic blood pressure, pulse, respiratory rate, fever and consciousness status of the patients, was calculated (Table 1). As a result of the Receiver Operating Characteristic (ROC) analysis applied for MEWS, the cut off value was accepted as 4. We also analyzed a separate scoring system in which the patient's oxygen saturation, predisposing factors (co-morbidities), presence of effusion, radiological findings and age were taken into account (Table 2). We named our scoring system OPERA (Oxygen, Predisposing factors, Effusion, Radiology, Age) by taking the initials of the factors in it. In this scoring, two parameters were demographic data, two parameters were radiological findings and one parameter

Table 2: Oxygen, Predisposing factors, Effusion, Radiology, Age (OPERA) score

Age		**Predisposing Factors**	
18-39	0	Any Predisposing Factor	0
40-64	1	Diabetes Mellitus (DM), Coronary Artery Disease (CAD), Chronic Renal Failure (1)	1
≥65	2	Concomitant Lung Disease * (2)	2
		Presence of Both Disease Groups (1 and 2)	3
Oxygen	**Saturation (%)**	**Radiological Signs of Lung**	
≥93	0	No Involvement	0
92-81	1	Single Lobe Involvement	1
≤80	2		
Pleural Effusion			
Yok	0	Single Lung involvement	2
Var	1	Bilateral Involvement	3

(*Decompensated Heart Failure, COPD, Lung Malignancy, Lung Involvement of Malignancies, Pulmonary Embolism
** In this scoring, two parameters are demographic data, two parameters are radiological findings and one parameter is vital signs. Value range is 0-11)

was vital signs. Again, as a result of the ROC analysis applied for this scoring table, the cut-off value was accepted as 6. We analyzed imaging findings and scoring systems in terms of their effectiveness in predicting morbidity and mortality in patients presenting to the emergency department with dyspnea. In addition, the patients' discharge status after diagnosis, service or intensive care follow-up, and mortality within two months were also evaluated. Mortality information of the patients was obtained from the Death Notification System (OBS) of the Ministry of Health of the Republic of Turkey.

Statistical Analysis: For the power analysis, the ministry of health is based on the number of suspected COVID-19 patients in the last 7 days. The calculated formula for the study: n= N. t^2. P. q / d^2(N-1)+ t^2. P. q P:0.50, q:0.50, t:1.96 (for alpha 0.05), d:0.05 n:761238/1982 n:383. The number of patients in our study was also determined according to this analysis. aROC curve analysis was used to estimate the performance of the assessed scores in predicting study outcomes. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for each score cutoff. The Youden index was used to estimate optimal thresholds for sensitivity and specificity. Comparison between areas under the ROC curve (AUROCs) was made according to the DeLong method. All statistical calculations were done using R software (version 4.0.5) (R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, Available online: http/www.r-project.org/). The conformity of the variables to the normal distribution was evaluated with Kolmogorov Smirnov and Shapiro Wilk tests and Q-Q plot and histogram graphs. Normally distributed continuous data were shown as mean±standard deviation, and non-normally distributed continuous data as median (interquartile range). Categorical data were presented with frequency (percentage). For categorical data, it was compared with Pearson Chi-square test when the number of observations was sufficient, and with Fisher's exact test when the number of observations was insufficient. Sensitivity, specificity, positive predictive value and negative predictive values were calculated using the 'DT ComPair' package. Sensitivity and specificity comparisons were calculated with McNemar test, while positive predictive value and negative predictive value were calculated with generalized score statistics. $p<0.05$ was considered significant.

Our study was conducted in accordance with the World Medical Association (WMA) Declaration of Helsinki 1964 (including versions 1975, 1983, 1989, 1996, 2000, 2002, 2004, 2008, 2013) and/or the World Medical Association Declaration of Hawaii.

Result

603 of the patients applied to the emergency department with the complaint of shortness of breath. 332 of them were not included in the study due to lack of data. 271 patients who met the criteria were included in the study. (Figure 1). When the demographic characteristics of the 271 patients included in the study were examined, 149 (55%) were female and 122 (45%) were male. The mean age was determined as 60.6 ± 18.1 (Table 3). Chronic disease information of the patients, duration of complaints, and accompanying symptoms are given in Table 3, and laboratory findings are given in Table 4. CT findings of the patients were compared in our study. When the lesion distributions of 221 patients with only CT imaging were evaluated; bilateral involvement was observed in 149 (67.4%) patients, single lung involvement in 12 (5.4%) and single lobe involvement in 10 (4.5%) patients. When compared according to the types of involvement, 86 (38.9%) patients had patchy involvement, 100 (45.2%) nodular involvement, 10 (4.5%) spider web involvement. According

Table 3: Clinical History, Admission Symptoms and Vital Findings of All Patients

Parameter	Total (n=271)
Age	60.6 ± 18.1
Gender	
Female	149 (55.0%)
Male	122 (45.0%)
Chronic Diseases	
Diabetes Mellitus	75 (27.7%)
Chronic Renal Failure	32 (11.8%)
Coronary Artery Disease	72 (26.6%)
Decompensated Heart Failure	44 (16.2%)
COPD	51 (18.8%)
Lung Cancer	17 (6.3%)
Metastatic Involvement in the Lung	17 (6.3%)
Other Lung Diseases	9 (3.3%)
Number of Complaint Days	
Last 2 days	188 (69.4%)
2-7 days	40 (14.8%)
>7 days	43 (15.9%)
Associated Symptoms	
Fever	21 (7.7%)
Cough	48 (17.7%)
Myalgia	26 (9.6%)
Throat Ache	7 (2.6%)
Other Symptoms	73 (26.9%)
Vital Signs	
Temperature, °C	36.3 ± 0.8
Pulse, /min	97.6 ± 21.0
Systolic Blood Pressure , mmHg	144.4 ± 31.5
Diastolic Blood Pressure, mmHg	78.5 ± 16.9
Respiratory Rate, /min	20.8 ± 4.1
Oxygen Saturation, %	93.0 ± 7.2

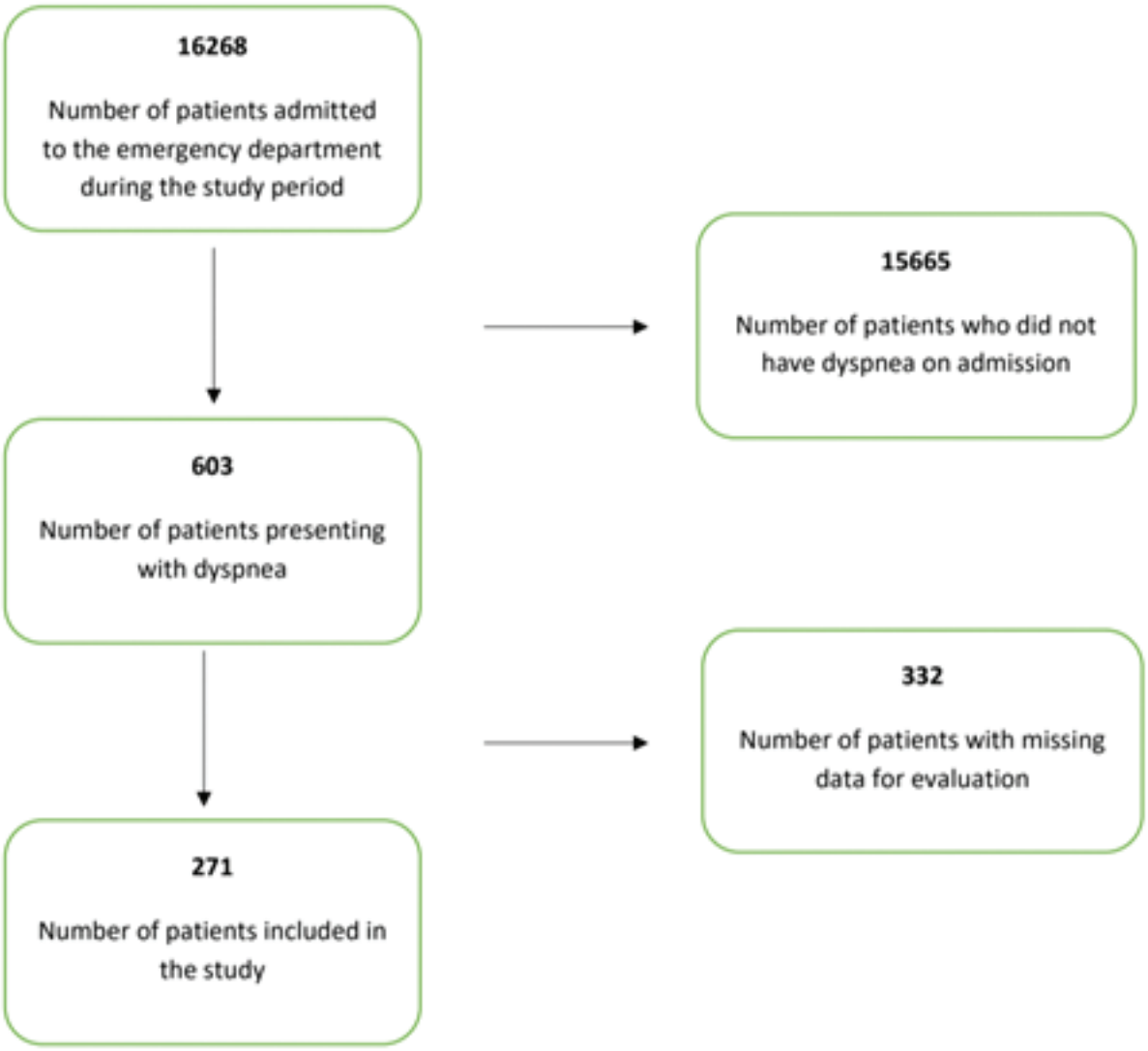

Figure 1: Patient Admission Chart

to their density, 123 (55.7%) of the patients had ground glass, 32 (14.5%) air bronchograms, 37 (16.7%) consolidation. In addition, 19 (8.6%) patients had pleural thickening, 78 (35.3%) pleural effusion, and 95 (43.0%) mediastinal/hilar lymphadenopathy. The tomography findings of 50 (22.6%) patients were evaluated as normal (Table 5). MEWS and OPERA scores used in our study were compared in terms of intensive care need and mortality. The median value of the MEWS score was 4, and the median value of the OPERA score was 6. 4 was accepted for the cut-off MEWS score and 6 was accepted for the OPERA score. The vital signs of the patients at the time of admission to the emergency department were evaluated with the Modified Early Warning Score (MEWS). When the value of 4 for the MEWS score was determined as cut-off, we found a statistically significant difference between intensive care unit admissions and mortality ($p<0.001$) (Table 6). When the OPERA score was determined as 6 as cut-off, there was a significant difference in terms of ICU admission and mortality. ($p<0.001$) (Tablo 7). When the MEWS and OPERA scoring systems are compared in terms of hospitalization in the intensive care unit, the sensitivity of MEWS is 69.6%, specificity 63.4%, positive predictive value (PPD) 39.3%, negative predictive value (NPD) 85.9%, while OPERA's sensitivity is 75.4%, specificity 57.4%, positive predictive value 37.7% and negative predictive value 87.2%. The difference between them is not statistically significant ($p=0.371$, $p=0.102$, $p=0.585$, $p=0.642$). When the MEWS and OPERA scoring systems are compared in terms of mortality, the sensitivity of MEWS is 79.1%, specificity 61.4%, positive predictive value 27.9% and negative predictive value 93.9%, while OPERA's sensitivity is 90.7%, specificity 56.6% positive predictive value 28.3% and negative predictive value 96.9%. The difference between them is not statistically significant ($p=0.131$, $p=0.166$, $p=0.876$, $p=0.170$) (Table 8).

Table 4: Laboratory Findings of the Patients

Parameter	Total (n=271)
Hemoglobin, g/dL	12.3 ± 2.3
Hematocrit, %	37.4 ± 6.4
MCV, fL	86.4 ± 7.7
WBC, 10^3/µL	9.03 (7.00-11.48)
Lymphocyte, 10^3/µL	1.8 (1.1-2.5)
Platelets, 10^3/µL	259.0 (214.5-335.5)
Glucose, mg/dL	118.0 (99.0-155.5)
BUN, mg/dL	15.9 (12.2-25.7)
Creatinine, mg/dL	0.9 (0.8-1.2)
ALT, IU/L	19.0 (13.0-29.5)
AST, IU/L	19.0 (15.0-28.0)
Na, mEq/L	137.0 ± 9.4
K, mEq/L	4.3 ± 0.6
Troponin, pg/ml	5.5 (2.2-23.7)
D-Dimer, ng/ml	241.5 (145.0-517.8)
Procalcitonin, ng/ml	0.13 (0.06-0.28)
CRP, mg/L	10.3 (2.8-57.0)

Discussion

It is challenging for clinicians to distinguish COVID-19 from other common respiratory diseases. With the pandemic, the need to determine different approaches to dyspnea was felt. In our study, we thought that examining the MEWS and OPERA scores according to the vital signs, demographic data, and radiological findings of the patients who presented to the emergency department with dyspnea could contribute to predicting the prognosis and mortality of the patients. We analyzed scores for ICU admissions and 2-month mortality. We found that both scorings were similar and predicted 2-month mortality with a negative predictive value of over 90%. In a study in which CT findings of 58 patients with a diagnosis of COVID-19 and positive PCR uptake were examined, ground glass density in 100% of the patients, involvement of at least 2 lobes in 93%, bilateral involvement in 91%, consolidation in 72%, LAP in %58, air bronchogram in 36%, and pleural effusion in was detected 3% (10). In another study in which 90 patients diagnosed with COVID-19 were investigated, when the CT findings of the patients were compared, ground glass density was found in 72% of the patients, involvement of at least 2 lobes in 59%, bilateral involvement in 59%, consolidation in 13%, air bronchogram in %8, LAP in 1%, and pleural effusion in 4%. (11). In our study, ground glass density was observed in 71% of PCR-positive patients, bilateral involvement in 71%, consolidation in 29%, air bronchogram in 24%, LAP in 18%, and pleural effusion in 5.9%. As with other studies, in our study, in which ground glass density was observed with bilateral involvement in COVID-19 patients, these involvements were found to be high. In our study, it was found that the PCR result was higher in the presence of pleural effusion. It can be thought that this is a finding in favor of pulmonary edema rather than viral pneumonia in

Table 5: Comparison of CT Lesion Distribution, Involvement Type, Density and Other Findings of the Patients

CT Findings	Number of patients (n=221*)
Bilateral Involvement	149 (67.4%)
Single Lung Involvement	12 (5.4%)
Single Lobe Involvement	10 (4.5%)
Involvement Type	
Patch Style Involvement	86 (38.9%)
Nodular Involvement	100 (45.2%)
Spider Web Involvement	10 (4.5%)
Density	
Ground Glass	123 (55.7%)
Air Bronchogram	32 (14.5%)
Consolidation	37 (16.7%)
Other Findings	
Pleural Thickening	19 (8.6%)
Pleural Effusion	78 (35.3%)
Mediastinal/Hilar Lymphadenopathy	95 (43.0%)
Normal	50 (22.6%)

* Only patients with CT imaging are included

Table 6: Comparison of MEWS Score, Intensive Care Unit Admission and Mortality Rates

	<4 n=149 (55%)[1]	³4 n=122 (45%)[1]	p-value
Admission to the Intensive Care Unit			
No	128 (85.9%)	74 (60.7%)	< 0.001[2]
Yes	21 (14.1%)	48 (39.3%)	
Mortality			
Discharge	140 (94.0%)	88 (72.1%)	< 0.001[2]
Exitus	9 (6.0%)	34 (27.9%)	

[1]%$_n$, [2]Pearson Chi-square test

Table 7: Comparison of OPERA Score and Intensive Care Unit Admission and Mortality Rates

	<6 n=133 (49.1%)	³6 n=138 (50.9%)	p-value
Admission to the Intensive Care Unit			
No	116 (87.2%)	86 (62.3%)	<0.001[2]
Yes	17 (12.8%)	52 (37.7%)	
Mortality			
Discharge	129 (97.0%)	99 (71.7%)	<0.001[2]
Exitus	4 (3.0%)	39 (28.3%)	

[1]%$_n$, [2]Pearson Chi-square test

Table 8: Comparison of sensitivity, specificity, positive predictive value and negative predictive value of MEWS and OPERA scores in predicting ICU admission and mortality

	Sensitivity	p-value	Specificity	p-value	PPD	p-value	NPD	p-value
ICU admission								
MEWS	69.6	0.371[1]	63.4	0.102[1]	39.3	0.585[2]	85.9	0.642[2]
OPERA	75.4		57.4		37.7		87.2	
Mortalite								
MEWS	79.1	0.131[1]	61.4	0.166[1]	27.9	0.876[2]	93.9	0.170[2]
OPERA	90.7		56.6		28.3		96.9	

[1]McNemar Test, [2]Generalized Score Statistics

the presence of pleural effusion of ground glass densities in imaging findings. The Modified Early Warning Score (MEWS) is a simple physiological scoring system that includes vital signs. In a study investigating the ability of MEWS to identify patients at risk of poor prognosis in an intense clinical area, when the cutoff value was accepted as 5, it was found that patients with a score of 5 and above had a higher need for intensive care and mortality (12). In another study investigating the relationship between the National Early Warning Score (NEWS) and MEWS scores in the prehospital and emergency departments of the geriatric age group with mortality, the median value was found to be 4 in patients who survived for NEWS and 3 for MEWS. In patients with a mortal course, the median value of NEWS score was 7, and 4 for MEWS (13). In another study evaluating the need for intensive care and mortality of COVID-19 patients admitted to the emergency department, the median value of the MEWS score was found to be 5 in intensive care patients and 6 in patients with a mortal course (14).

In a study comparing the relationship of MEWS and NEWS scores with mortality and the need for intensive care, it was found that the MEWS cut-off value of 3 and above was accepted for the need for intensive care; according to this score, it was determined that the sensitivity was 41.2% and the specificity was 75.7% in terms of the need for intensive care. In the same study, the sensitivity of the MEWS score, which had a cut-off value of 3 in terms of mortality, was calculated as 69.3% and the specificity as 67.6% (13). Again, in a study investigating the effectiveness of the MEWS score in predicting the need for intensive care and mortality in COVID-19 patients, the cut-off value of the MEWS score was taken as 5 in terms of intensive care need; accordingly, its sensitivity was 70%, its specificity was 64.8%, NPD was 92.5%, and PPD was 25.9%. In the same study, it was observed that the cut-off value of the MEWS score was taken as 5 in terms of mortality need, and accordingly, its sensitivity was 57.7%, specificity was 61%, NPD was 94.5%, and PPD was 11.1% (14). In our study, when the MEWS and OPERA scoring systems were compared in terms of hospitalization in the intensive care unit, the sensitivity of MEWS is 69.6%, specificity 63.4%, positive predictive value (PPD) 39.3%, negative predictive value (NPD) 85.9%, while OPERA's sensitivity is 75.4%. specificity 57.4%, positive predictive value 37.7% and negative predictive value 87.2%. When the MEWS and OPERA scoring systems are compared in terms of mortality, the sensitivity of MEWS is 79.1%, specificity 61.4%, positive predictive value 27.9% negative predictive value 93.9%, while OPERA's sensitivity is 90.7%, specificity 56.6% positive predictive value 28.3% and negative predictive value 96.9%. According to these results, it was observed that OPERA was more sensitive than MEWS in terms of both intensive care need and mortality, and the negative predictive value in terms of mortality was higher in OPERA. In terms of specificity, OPERA was found to be less effective than MEWS in both cases. As seen in our study, the MEWS scoring system is useful in obtaining information about the need for intensive care and survival by looking at the vital signs of the patients at the time of admission. However, OPERA scoring, which includes imaging findings and anamnesis, was found to be more sensitive than MEWS, although there was no significant difference. Our study seems to be of clinical importance in patients presenting with dyspnea, as both scorings accurately predict the negative predictive value above 90%, in which there will be no 2-month mortality. Again, both scoring methods are easy to do and can be applied in the emergency department.

Conclusion

Dyspnea affected our diagnostic approach to patients during the pandemic and increased the use of computerized lung tomography. We compared the MEWS score, which was previously thought to predict mortality and intensive care in clinically severe diseases, and the OPERA score, which includes tomographic findings, in terms of predicting 2-month mortality and hospitalization in the intensive care unit. Both MEWS and OPERA scorings were able to predict 2-month mortality similarly, with negative predictive values of 93.9% and 96.9%, respectively.

Authot Statement

All authors have contributed significantly to the design of the study and/or data acquisition or analysis and interpretation of data, drafting the manuscript or critically reviewing it for important intellectual content, and final approval of the version to be submitted. There is no conflict of interest between the authors.

Limitations

The deficiencies in the records of the patients included in our study and the small number of samples due to this limited our evaluations

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