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Ottawa Risk Scale in Predicting the Outcome of Chorionic Obstructive Pulmonary Disease Exacerbation in Emergency Department; a Diagnostic Accuracy Study

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Abstract: **Introduction:** The disposition decision is a great challenge for clinicians in managing patients with chronic obstructive pulmonary disease (COPD) exacerbation. This study aimed to evaluate the accuracy of Ottawa COPD Risk Scale (OCRS) in predicting the short-term adverse events in the mentioned patients. **Methods:** This prospective diagnostic accuracy study was conducted on COPD exacerbation cases who were referred to the emergency department (ED). Patients were followed up for 30 consecutive days for adverse events including the need for intubation, non-invasive ventilation, myocardial infarction, readmission, and death from any cause, and finally the accuracy of OCRS in predicting the outcome was evaluated. **Results:** 362 patients with the mean age of 65.55 ± 10.65 (6- 95) years were evaluated (58.0% male). Among the patients, 164 (45.3%) cases were discharged from ED, and 198 (54.7%) were admitted to the hospital. 136 (37.6%) cases experienced at least one of the studied short-term adverse events. The mean OCSD score of this series was 1.96 ± 2.39 (0 – 10). The area under the curve of OCRS in predicting the outcome of COPD patients was 0.814 (95%CI: 0.766 – 0.862). The best cut-off point of the scale in predicting the outcome was 1.5. The sensitivity and specificity of the scale were 75.75% (95%CI: 69.6% – 81.42%) and 89.63% (95%CI: 83.67% – 93.66%), respectively. By employing this threshold, 48 (13.25%) cases would have unnecessary hospitalization, and 17 (0.04%) would be discharged incorrectly. **Conclusion:** The OCRS has acceptable level of prediction accuracy in predicting the short-term adverse event of COPD patients. The use of this scoring in the routine practice of ED clinicians can lead to a reduction in unnecessary admissions and unsafe discharge for these patients.

Keywords: Pulmonary Disease, Chronic Obstructive; Risk Assessment; Patient Outcome Assessment; Sensitivity and Specificity; Clinical Decision Rules

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a serious and frequent respiratory condition ranking as the third cause of disability-adjusted life-years among old aged people according to the latest Global Burden of Disease (1). Each year, more than 3 million people die from COPD around the world (2). This respiratory disorder, mostly caused by smoking, is characterized by progressive and poorly reversible airway obstruction due to chronic inflammation (3).

Exacerbation of COPD is defined as an acute deterioration in the usual stable course of the disease. This condition could lead to many emergency department (ED) visits (4). Patients with COPD exacerbation could sufficiently benefit from treatments in the ED to be discharged after a few hours with no risk. However, a small number of the patients might experience critical short-term adverse events, necessitating hospital admission and aggressive management to ensure a safe outcome (5).

It is not reasonable to admit all patients with COPD exacerbation, as many hospitals have a shortage of beds and staff. On the other hand, unnecessary hospital admission could bear undesirable health and financial consequences. Therefore,

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the disposition decision is a great challenge for clinicians in managing patients with COPD exacerbation (6). A valid set of criteria in deciding whether to continue treatment in the ED, admit, or discharge the patients would be cost-effective and safe. Therefore, the scores and tools that have been developed to predict the outcomes of COPD exacerbation are very helpful.

The Ottawa COPD Risk Scale (OCRS) is a tool designed to predict outcomes of COPD exacerbation. The primary purpose of this scale is to assist physicians in deciding whether to admit COPD patients or discharge them with no need for complex and expensive diagnostic tests (7). Utilizing the OCRS in the disposition decision of patients with COPD exacerbation in ED can remarkably reduce unnecessary hospitalizations and unsafe discharges (8).

To date, few studies have assessed the validity of OCRS prospectively. Therefore, we aimed to evaluate the accuracy of the OCRS in predicting short-term adverse events of the patients with COPD exacerbation, referred to the ED.

2. Methods

2.1. Study design and setting

This prospective diagnostic accuracy study was conducted at Imam Hossein and Shohadaye Tajrish Hospitals in Tehran, Iran, affiliated with Shahid Beheshti University of Medical Sciences, from January 2021 to December 2022. All patients were informed about the study's purpose and procedures, and written informed consents were obtained. The study protocol was in accordance with the Declaration of Helsinki. The institutional review board of Shahid Beheshti University of Medical Sciences reviewed and approved this study (Ethics code: IR.SBMU.MSP.REC.1398.271).

2.2. Study population

All patients with COPD exacerbation who attended the ED were studied. The inclusion criteria were 1) admission with COPD exacerbation, defined as increase in at least two of the following symptoms two symptoms of breathlessness, sputum volume and sputum purulence; 2) previous COPD diagnosis or a history of at least one year of chronic dyspnea or cough with sputum; 3) a history of at least 15 pack-years of smoking with moderate to severe airflow obstruction; 4) age 50 years or older.

The extremely ill patients who, after 2 to 12 hours of management in ED, had a saturation of oxygen <85%, heart rate >130 beats/min, systolic blood pressure < 85mmHg, confusion, long-term hemodialysis, chest pain indicating heart attack requiring treatment, or ST–T interval changes indicating ischemia were excluded. The inclusion and exclusion criteria were selected upon the original study of the OCRS by Stiell et al. (8).

Table 1: Baseline characteristics of the studied cases

Variable	Value
Gender	
Male	210 (58.0)
Female	152 (42.0)
Age (year)	
Mean ± SD	65.55 ± 10.65
Triage level (ESI)	
1	44 (12.2)
2	51 (14.1)
3	267 (73.8)
Medical history	
Hypertension	210 (59.2)
Diabetes mellitus	65 (18.3)
Heart failure	41 (11.5)
Chronic renal failure	6 (1.7)
Stroke	23 (6.2)
Cancer	11 (3.1)
Surgical history	
Coronary artery bypass graft	23 (6.4)
Percutaneous coronary intervention	7 (1.9)
Peripheral vascular intervention	64 (17.7)
History of intubation	
Yes	11 (3.0)
No	351 (97.0)
Vital signs on arrival	
Hear rate (/minute)	94.85 ± 18.89
Respiratory rate (/minute)	9.61 ± 4.13
Temperature (Celsius)	36.90 ± 3.08
O2 Saturation (%)	86.75 ± 6.73
ECG on arrival	
Atrial filtration	34 (9.4)
Right axis deviation	110 (30.4)
Atrioventricular block	54 (14.9)
Right bundle branch block	81 (22.4)
Sinus tachycardia	104 (28.7)
Chest x-ray findings	
Pneumonia	109 (30.1)
Plural effusion	98 (27.1)
Cardiomegaly	140 (38.7)
O2 therapy in emergency department	
Venturi mask	187 (51.7)
Non-rebreathing mask	141 (39.0)
Non-invasive ventilation	17 (4.7)

Data are presented as mean ± standard deviation (SD) or frequency (%). ESI: emergency severity index; ECG: electrocardiography.

2.3. Data gathering

A general practitioner was responsible for data gathering under the direct supervision of an emergency physician specialist. The following data were collected from the enrolled patients: gender, age, triage level, medical and surgical history, previous intubation, arrival vital signs (blood pressure, heart rate, respiratory rate, temperature, oxygen saturation), electrocardiography (ECG) on arrival, findings of the chest X-ray,

Table 2: Screening performance characteristics of the Ottawa Risk Scale in predicting the outcome of patients with chronic obstructive pulmonary disease (COPD)

Characteristics	Value (95%CI)
Sensitivity	75.75% (69.6% – 81.42%)
Specificity	89.63% (83.67% – 93.66%)
Positive predictive value	89.82% (83.95% – 93.78%)
Negative predictive value	75.38% (68.61% – 81.13%)
Positive likelihood ratio	8.82 (5.60 – 13.88)
Negative likelihood ratio	0.32 (0.25 – 0.41)
Total accuracy	86.5% (82.7% – 90.3%)

CI: confidence interval.

and O_2 therapy in the ED. The OCRS score was calculated for all the patients in a 3-stage review system. 1) Initial assessment step: history of coronary artery bypass graft (CABG), history of intervention for peripheral vascular disease, history of intubation for respiratory distress, and arrival heart rate >110 beats/min. 2) Investigations step: acute ischemic changes in arrival ECG, evidence of pulmonary congestion on chest X-ray, hemoglobin <100 g/L, urea >12 mmol/L, serum CO_2 >35 mmol/L. 3) reassessment after treatment step: oxygen saturation <90% on room air or usual O_2, heart rate >120 beats/min. Each of the mentioned criteria, is allocated a score between 1-3, resulting in a total score between 0-16.

2.4. Outcomes

Patients were followed up for 30 consecutive days for short-term adverse events including the need for intubation, non-invasive ventilation, myocardial infarction, readmission, and death from any cause.

2.5. Statistical analysis

Data were analyzed using SPSS software version 26. The findings were reported as mean ± standard deviation or frequency (%). The best cut-off point for the scale in predicting the outcome of COPD patients was calculated using the area under the receiver operating characteristics curve (AUC). The screening performance characteristics of the scale (sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios) were calculated using the VassarStats calculator and reported with a 95% confidence interval.

3. Results

3.1. Baseline characteristics of studied cases

In this study, 362 patients that met the inclusion and exclusion criteria were enrolled. The mean age of the patients was 65.55 ± 10.65 (6- 95) years, consisting of 58.0% male cases.

The baseline characteristics of the patients are depicted in Table 1. Among them, 267 (73.8%) were in level 3 Emergency Severity Index (ESI) triage. The most frequent underlying comorbidities in this series were hypertension (59.2%), diabetes mellitus (18.3%), and heart failure (11.5%). History of the patients revealed that 23 (6.4%) patients had CABG, 64 patients (17.7%) had an intervention for peripheral vascular disease, and 11 patients (3.1%) had intubation for respiratory distress. Right axis deviation (30.4%) and cardiomegaly (38.7%) were the most frequent ECG and chest X-ray findings, respectively.

3.2. Outcomes

Among the patients, 164 (45.3%) cases were discharged from ED, and 198 (54.7%) were admitted to the hospital. In this series of patients, 136 (37.6%) cases experienced at least one of studied short-term adverse events (48 (13.3%) cases needed non-invasive ventilation, 31 (8.6%) cases were readmitted after ED discharge, 26 (7.2%) cases needed intubation, 20 (5.5%) cases experienced myocardial infarction, 6 (1.7) cases died within 30 days after discharge, 5 (1.4%) died after admission).

3.3. Screening performance characteristics of OCRS

The mean OCSD score of this series was 1.96 ± 2.39 (0 – 10). Figure 1 shows the frequency distribution of the OCSD score. The area under the curve of OCRS in predicting the outcome of COPD patients was 0.814 (95%CI: 0.766 – 0.862). The best cut-off point of the scale in predicting the outcome was 1.5. Table 2 summarizes the screening performance characteristics of OCRS. The sensitivity and specificity of the scale were 75.75% (95%CI: 69.6% – 81.42%) and 89.63% (95%CI: 83.67% – 93.66%), respectively. By employing this threshold in the present study, 48 (13.25%) of the patients would have unnecessary hospitalization, and 17 (0.04%) would be discharged incorrectly.

4. Discussion

In this study, the OCRS scale was used to predict the short-term adverse events of COPD exacerbation in patients presenting to ED, and it was found that the AUC value was greater than 0.8, indicating a high level of prediction accuracy. Herein, the best cut-off value was detected as OCRS greater than 1, with the sensitivity and specificity of 75.75% and 89.63%, respectively.

The present study's short-term adverse events rate was estimated as 38.01%. In the original study of OCRS validation, 9.5% of the patients had experienced short-term adverse events (8). This rate in similar studies utilizing the OCRS scale was reported as 74% and 20.7%, both from Turkey
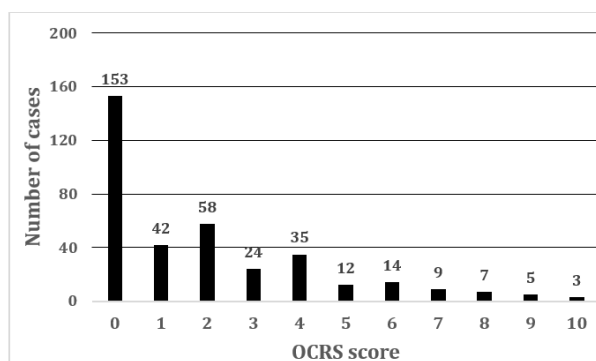
Figure 1: Frequency distribution of the Ottawa Chronic obstructive pulmonary disease Risk Scale (OCRS) score in the studied population.
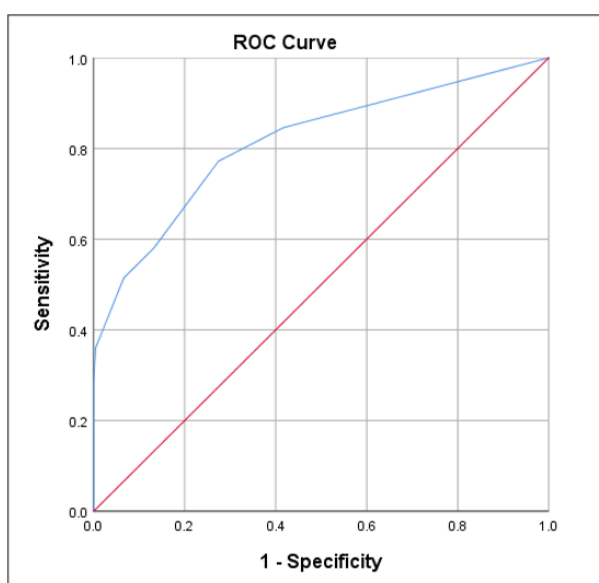

Figure 2: The area under the receiver operating characteristic (ROC) curve (AUC) of the Ottawa Risk Scale in predicting the outcome of patients with chronic obstructive pulmonary disease (AUC= 0.814 (95%CI: 0.766 – 0.862)).

(9, 10). This wide range in the rate of short-term adverse events from different centers could be due to the variation in the patients' clinical condition, the level of facilities, and management strategies. However, the important point that has been consistently emphasized in these studies is a considerable number of short-term adverse events in the patients discharged from the ED. This shows that an accurate and precise criterion for an error-free disposition decision is of great importance.

Several tools have been introduced to help predict COPD exacerbation outcomes. BODE (body mass index, airflow obstruction, dyspnea, and exercise capacity) is one of the most widely used indices for predicting disease severity and mortality. This index derived from an international collaboration in 2004 aimed at finding the risk factors of death in patients with COPD. The validation was performed on 625 patients, yielding an AUC of 0.74 (11). A study from France established "Score 2008" based on age, grade of dyspnea at steady state, and number of clinical signs of severity. The clinical accuracy was assessed on 1824 patients with COPD admitted to the ED. Accordingly, they reported an AUC of 0.83 for Score 2008 to predict in-hospital mortality in COPD patients (12). In another study from the United Kingdom in 2012, the clinical admission data of 920 patients were investigated for the predictors of mortality in COPD patients. They reported that high Dyspnoea, Eosinopenia, Consolidation Acidaemia, and atrial Fibrillation (DECAF) score is a strong predictor of mortality with an AUC of 0.86 (13). While these multicomponent indices could successfully predict long-term mortality, they were not designed for other short-term adverse events.

OCRS was designed to estimate the probability of short-term adverse events in patients with COPD exacerbation. In this study, we measured the AUC for OSCD and it was equal to 0.81, consistent with the previous reports (9, 10). Similar to the original OSCD study, the best cut-off value was above 1, with the sensitivity and specificity of 75.75% and 89.63%, respectively. By employing this threshold in the present study, 48 (13.25%) of the patients would have unnecessary hospitalization, and 17 (0.04%) would be discharged incorrectly. Therefore, OCRS is a useful tool to predict the outcome of COPD exacerbation and ED physicians have approved and supported its applicability and effectiveness in ED.

It should be noted that whether a patient is admitted or discharged from ED is not merely related to disease severity. Many non-medical factors can alter this decision, including hospital crowdedness, access to equipped ED, home care support, and patients' preferences. However, OCRS can help ED clinicians to gauge their disposition decision according to their local practice. In a study on the applicability of the OCRS, 70.2% of the ED physicians confirmed and supported the effectiveness of OCRS to be used in ED for patients with COPD exacerbation (14).

5. Limitations

The findings of this study should be viewed in the context of several limitations. First, this study has a small population. Studies with a larger statistical population are recommended to confirm and expand the findings of this study. It should also be noted that several of short-term adverse events were recorded to assess the performance of OCRS in predicting COPD outcomes. Moreover, the patients were not analyzed in a matched manner regarding the underlying diseases.

6. Conclusion

The results of this study revealed the clinical validity of OCRS in predicting short-term adverse event in COPD patients presenting to the ED. The use of this scoring in the routine practice of ED clinicians can lead to a reduction in unnecessary admissions and unsafe discharge of patients with COPD exacerbation.

7. Declarations

7.1. Acknowledgments

Hereby, the staff of medical records department and treatment staff of Imam Hossein and Shohadaye Tajrish Hospitals are thanked for their cooperation in data gathering for this project.

7.2. Conflict of interest

There is no conflict of interest to declare.

7.3. Fundings and supports

None.

7.4. Authors' contribution

All authors met the four criteria for authorship contribution based on recommendations of the International Committee of Medical Journal Editors.

7.5. Data availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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