Acute coronary syndrome risk prediction of rapid emergency medicine scoring system in acute chest pain

An observational study of patients presenting with chest pain in the emergency department in Central Saudi Arabia

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ABSTRACT

الأهداف: تقييم صحة التشخيص للنتيجة الطبية الطارئة السريعة (REMS) لتصنيف اختطار متلازمة الشريان التاجي الحادة (ACS) الناجمه من ألم الصدر اللا قلبي.

الطريقة: أجريت دراسة رصدية مستعرضة بين المرضى الذين يحضرون مع ألم في الصدر إلى قسم الطوارئ بمدينة الأمير سلطان الطبية العسكرية، الرياض، المملكة العربية السعودية، لمدة 6 أشهر من شهر يناير إلى يونيو عام 2016. جرى تقييم جميع المرضى من خلال أخذ عينات غير احتمالية باستخدام بروتوكولات قياسية للمعالم الفسيولوجية REMS، وتم التأكد من وجود ACS من خلال تخطيط القلب واختبار انزيم القلب والأوعية (إذا دعت الحاجة). تم تحليل البيانات باستخدام الحزمة الإحصائية للعلوم الاجتماعية SPSS الاصدار 15 وأخيراً تم تحديد صلاحية REMS باستخدام قيمة قطع 17.

النتائج: كان 176 (70.4%) من المرضى من الرجال الذين تتراوح أعمارهم بين 49 + 8.5 سنوات. وكان متوسط معدل REM للمرضى 9.3 + 4.5 والحساسية 81.6%، والخصوصية 90.05% وتم الحصول على القيمة التنبؤية الإيجابية من 66.67% وقيمة التنبؤية السلبية من 95.26% .

الخاتمة: النتيجة الطبية الطارئة السريعة هي أداة بسيطة وصحيحة إلى حد ما ويمكن استخدامها لتشخيص ACS مع الموارد المحدودة في طب الطوارئ.

Objectives: To assess the diagnostic validity of the rapid emergency medical score (REMS) for the risk stratification of acute coronary syndrome (ACS) from non-cardiogenic chest pain.

Methods: An observational cross-sectional study was carried out among patients presenting with chest pain to the Emergency Department of Prince Sultan Military Medical City, Riyadh, Kingdom of Saudi Arabia, for 6 months from January to June 2016. All patients, included through non-probability convenience sampling, were assessed using standard protocols for the physiological parameters of the REMS, and ACS was confirmed through electrocardiography, cardiac enzyme testing, and angiography (if needed). Data were analyzed using Statistical Package for Social Sciences software version 15 (SPSS Inc, Chicago, IL, USA). The validity of REMS was determined using a cutoff value of 17.

Results: In total, 176 (70.4%) of patients were men with a mean age of 49±8.5 years. The mean REM score of the patients was 9.3±4.5, and a sensitivity of 81.6%, specificity of 90.05%, positive predictive value of 66.67%, and a negative predictive value of 95.26% were obtained.

Conclusion: Rapid emergency medical score is a simple and fairly valid tool that may be used for diagnosis of ACS with limited resources in emergency medicine.

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More than 8 million patients present with chest pain annually. Thus, chest pain is the second most frequent complaint of patients in the emergency medicine departments.[1] However, less than 5% of patients presenting with chest pain have ST segment elevation myocardial infarction (STEMI), and up to 25% have non-ST segment elevation myocardial infarction (NSTEMI).[2] This poses a diagnostic challenge to clinicians in the Emergency Department or primary healthcare settings with limited resources for differentiating pain due to acute coronary syndrome (ACS) from non-cardiac causes, such as pleural and pericardial irritations, gastrointestinal reflux, pulmonary embolism, hyperventilation, musculoskeletal pain, and cholecystitis.[3] The maintenance of a high index of suspicion for ACS in patients with chest pain is a common practice in emergency medicine because early treatment of serious outcomes associated with untreated ACS is beneficial. Thus, unnecessary tests, such as electrocardiography (ECG) and cardiac enzyme test, and prolonged stay of patients with chest pain increases the burden of the disease on patients and health care settings. The diagnosis of ACS in patients with STEMI can be quickly made through ECG and biochemical marker testing. However, only a small number of patients who presented with chest pain was observed in this setting. Moreover, the limited sensitivity of ECG (16%) and biomarker testing (40%) along with its unavailability at the primary healthcare settings inhibits accurate diagnosis.[4] Considering this perspective, simple guidelines or scoring systems are required for an objective measurement of the risk stratification of chest pain due to ACS and appropriate allocation of healthcare resources. For patients with confirmed ACS, several well-validated scoring methods, such as platelet glycoprotein IIb/IIIa In unstable angina: receptor suppression using integrilinô therapy (PURSUIT), thrombin inhibition in myocardial infarction (TIMI), global registry of acute cardiac events (GRACE), and Fast revascularization during instability in coronary artery disease (FRISC) risk scores, can be used for risk outcomes.[5,6] However, none of these risk scores have been used in differentiating chest pain caused by ACS from non-cardiac pain in an emergency setting. The rapid emergency medicine score (REMS) is an abbreviated version of the acute physiology and chronic health evaluation II (APACHE II). It is based on physiological parameters such as pulse rate, mean arterial pressure (MAP), respiratory rate, Glasgow coma scale (GCS) score, oxygen saturation, and age, which are very simple and can be easily applied in an emergency setting.[7] Moreover, it is frequently used in the Emergency Department for risk stratification and has been validated as an excellent predictor of mortality in non-surgical patients.[8] Considering its simplicity and accuracy, it can be considered a predictive tool for differentiating chest pain caused by ACS from non-cardiac chest pain. However, studies regarding its validity and application for the risk prediction of ACS among patients with acute chest pain who present in the Emergency Department are not available. Thus, the present study was designed to assess diagnostic validity of REM Score for risk stratification and identification of patients with ACS from those with non-cardiogenic chest pain. Moreover, it helps in early diagnosis and appropriate treatment with the use of simple physiological variables, thereby improving outcome and promoting cost-effectiveness.

Methods. Data on the scoring systems for the risk stratification of patients with chest pain and application of REMS were obtained from Google scholar and PubMed." Studies on the scoring system for risk stratification in patients diagnosed with ACS and the application of REMS to predict in-hospital mortality are available. However, studies regarding the scoring system or use of REMS for differentiating pain caused by ACS from non-cardiac chest pain are not available. This cross-sectional study conformed to the tenets of the Declaration of Helsinki and was approved by the research ethics committee of Prince Sultan Military Medical City, Riyadh, Kingdom of Saudi Arabia (KSA). It was conducted in the Emergency Department for 6 months from January to June, 2016. Approximately 250 consecutive patients with chest pain and aged over 14 years who presented in the Emergency Department were included in the study through a non-probability sampling. Patients with traumatic chest pain and post-cardiothoracic surgery or those who were referred from other hospitals after the provision of an initial treatment were excluded from the study, considering their vital signs that were probably altered owing to early assessment and intervention. The purpose, procedure, and risk/benefits of the present study were explained to the patients, and written informed consent was obtained. The patients were evaluated through history taking and physical examination, and their vital signs were obtained using standard protocols.

A scheme of protocol was followed, and the parameters of REM are shown in **Figure 1 & Table 1**. Radial pulse, blood pressure, and MAP were recorded using an automatic machine. Respiratory rate and GCS were assessed and recorded by the nursing staff in the triage room. Oxygen saturation was obtained using a

digital pulse oximeter that was applied on the patient's index finger of the right hand, and all the patients were assessed with the same oximeter. All data were recorded in the proforma, and the final REMS calculation was also noted. The ECG was carried out using standard protocols and findings were interpreted by an ER physician. In patients with normal ECG findings, cardiac enzyme tests, such as the troponin test, were carried out to diagnose ACS in case of NSTEMI. Patients who are highly suspected with ACS, but have normal ECG findings and cardiac marker levels were referred to the on-call cardiology team in the Emergency Department for angiography to confirm the absence/presence of ACS. All the patients were managed in accordance with the standard protocol for ACS treatment. Data were analyzed by using The Statistical Package for the Social Sciences (SPSS Inc, Chicago, IL, USA) version 15. The mean and standard deviations were calculated for the quantitative variables, whereas the frequency and percentages were obtained for the qualitative variables. A cutoff value of 17 was considered for REMS, and the validity was calculated in the form of sensitivity, specificity, and positive and negative predictive values, considering the confirmed diagnosis of ACS based on ECG findings and cardiac enzyme tests along with angiography in highly suspected patients.

Results. The present study included 250 patients (176 male and 74 female; mean age, 49±8.5 years) with suspected chest pain due to ACS who presented to the Emergency Department of Prince Sultan Military Medical City, Riyadh, KSA, for 6 months. One hundred and seventy-six of the patients were men (70.4%), and 74 were women (29.6%). **Table 2** shows the descriptive analysis of the various attributes of the REM score. The evaluation of the physiological variables used in REMS showed that the mean heart rate was 93±6.7 beats per minute; MAP, 127±9.2 mmHg; mean respiratory rate, 19±5.8 breaths/min; mean oxygen saturation, 87 + 5.1%; GCS, 14.3±0.6; mean REM score, 9.3±4.5.

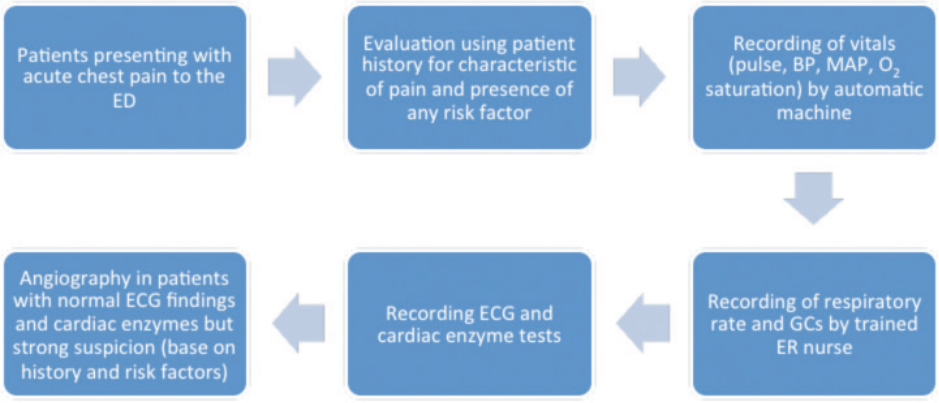

Figure 1 - Algorithm of the standard protocol followed for each patient presenting with chest pain, BP - blood pressure MAP - mean arterial pressure, ECG - electrocardiography, GCs - glasgow coma scale

Table 1 - REM scoring system.

	Scores						
Variables	0	+1	+2	+3	+4	+5	+6
Age (years)	<45		45-54	55-64		65-74	>74
MAP (mmHg)	70-109		110-129 50-69	130-159	>159 ≤49		
Heart rate (bpm)	70-109		110-139 55-69	140-179 40-54	>179 ≤39		
RR (breaths/min)	12-24	25-34 10-11	6-9	35-49	>49 ≤5		
O_2 saturation (%)	>89	86-89		75-85	<75		
GCS	14 or 15	11-13	8-10	5-7	3 or 4		

Upper and lower valuesn of variables, GCS - Glasgow coma scale, RR - respiratory rate

In total, 49 (19.6%) of 250 patients who presented with acute chest pain to the Emergency Department were diagnosed with ACS based on ECG, biomarker testing, and angiography results. **Table 3** depicts a contingency table comparing REMS with the presence of ACS. Forty patients with an REMS of >17 were also diagnosed with ACS (true positive), whereas 181 patients with a score of 0-16 were diagnosed with chest pain due to non-cardiac causes (true negative). **Table 4** shows the clinical validity of the REMS in diagnosing acute chest pain due to ACS. These results show that REMS has a sensitivity of 81.6% (confidence interval, CI: 68.64-90.02), specificity of 90.05% (CI: 85.13-93.47), positive predictive value of 66.67% (CI: 54.06 CI 68.64-90.0277.27), and negative predictive value of 95.26% (CI: 91.24-97.49).

Table 2 - Descriptive analysis of the attributes of REMS.

Attributes of the REM score	Mean value
Age	49±8.5 years
Heart rate beats per minute	93±6.7
Mean pulse pressure (mm Hg)	127±9.2
Respiratory rate (breaths/min)	19±5.8
Mean oxygen saturation	87±5.1%
Mean GCS	14.3±0.6
Mean REMS	9.3±5.1

GCS - Glasgow coma scale, REMS - rapid emergency medicine score

Table 3 - Contingency table of REMS with confirmed diagnosis of ACS.

Relationship of ACS with REM score	Presence of ACS		Total
	Yes	No	
REM score			
17-26	40	20	**60**
0-16	9	181	**190**
Total	**49**	**201**	**250**

ACS - acute coronary syndrome, REMS - rapid emergency medicine score

Table 4 - Validity of REMS in diagnosing acute chest pain due to ACS.

Parameters	Values
Sensitivity	81.63% (CI: 68.64-90.02)
Specificity	90.05% (CI: 85.13-93.47)
Positive predictive value	66.67% (CI: 54.06-77.27)
Negative predictive value	95.26% (CI: 91.24-97.49)
Diagnostic accuracy	88.4% (CI: 83.84-91.8)

ACS - acute coronary syndrome, REMS - rapid emergency medicine score

Discussion. Acute coronary syndrome causes a substantial financial burden on a country's healthcare system owing to its increasing incidence, morbidity, and mortality. Its prompt diagnosis has always been a challenge for clinicians, particularly in resource-limited settings. Although precise clinical judgment is important in meeting this challenge, a scoring system for its risk prediction is needed for risk stratification. Cardiac markers, ECG findings, and a history of CAD comprise the simplest criteria. However, the limited infrastructure for laboratory diagnosis based on cardiac marker levels or ECG findings limits its applicability even at a primary healthcare setting.[9] More advanced scoring systems, such as TIMI, GRACE, and PURSUIT score, are used for the risk stratification of the mortality and morbidity of myocardial infarction in patients with ACS rather than differentiating it from non-cardiac causes of chest pain.[5,10] The rapid emergency medicine score is based on simple bedside physiological parameters. In addition, it has been previously evaluated as a predictor of in-hospital and long-term mortality in non-surgical patients who presented to the Emergency Department.[7,8] However, studies on its clinical validity for the diagnosis and differentiation of ACS from non-cardiac chest pain at first encounter/triage at a healthcare center were not conducted. Thus, the present study aimed to evaluate a new paradigm in REMS application for the risk stratification of patients with chest pain. Results showed that a sensitivity of 81.6% and a specificity of 90.05% make a fairly valid scoring system for risk stratification. The advantage of this scoring system is its simple physiological parameters, which do not require advanced infrastructure or skills for its assessment. Thus, it can be used and applied easily in primary health care settings or triage room of Emergency Departments, particularly in the first point of contact between the patients and healthcare system that usually lacks laboratory or advanced facilities. Thus, REMS maintains the balance between validity and applicability in resource-limited settings or Emergency Departments with high patient burden. Studies on the validity of REMS for risk stratification in patients presented to the Emergency Department are available. Imhoff et al.[11] studied its applicability for the risk prediction of mortality in patients with trauma, reporting it as a simple and accurate predictor with a

one-point increase that is associated with an OR of 1.51 for in-hospital death.In addition, polito et al[12] reported it to have an equal predictive power as compared with APACHE II for mortality in patients with trauma who presented to the Emergency Department. Olsson et al[13] further validated its use for the prediction of mortality in patients without trauma who presented to the medical Emergency Department, suggesting it to be a superior scoring system compared to RAPS and has an equal predictive accuracy as APACHE II with its simplicity as a highlight.The results of the present study provide information on the initial assessment of REMS and add a new dimension to the application of REMS in a simple setting with a fair validity. However, the limitation of the present study was that all subjects did not undergo angioplasty, which is the gold standard for diagnosing ACS, patients who are most likely to have normal cardiac enzyme levels and unremarkable ECG findings were subjected to further angioplasty because of the standard protocol of the hospital. Thus, further studies are needed to determine a cutoff value and conducting angioplasty as the gold standard for a better evaluation of the patient's condition. Moreover, it can be further modified by incorporating more cardiac-related parameters, such as ECG or cardiac enzyme tests, to increase its validity, thereby making it an even better tool for the risk stratification of patients who presented with chest pain to the Emergency Department. Evidence on its applicability in resource-limited settings can be obtained through further studies conducted at primary healthcare centers. Thus, patients may be managed effectively and efficiently.

In conclusion, The rapid emergency medicine score may be beneficial for the risk stratification of patients present with chest pain to the Emergency Department, and it has fair sensitivity and very good specificity to identify patients with cardiogenic chest pain. Further studies are required for the modification of this scoring system, which can significantly improve its validity. Moreover, it is probably advantageous for clinicians who work in primary healthcare settings with limited resources or overburdened Emergency Departments in tertiary hospitals. Thus, patients are better managed with the use of minimum resources, making it a cost-effective tool.

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