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# Original Contributions

# PROGNOSTICATING CLINICAL PREDICTION SCORES WITHOUT CLINICAL GESTALT FOR PATIENTS WITH CHEST PAIN IN THE EMERGENCY DEPARTMENT

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□ **Abstract—Background: Assessment of patients with chest pain is a regular challenge in the emergency department (ED). Recent guidelines recommended quantitative assessment of ischemic risk by means of risk scores. Objective: Our aim was to assess the performance of Thrombosis in Myocardial Infarction (TIMI); Global Registry of Acute Coronary Events (GRACE); history, electrocardiogram, age, risk factors, and troponin (HEART) scores; and the North America Chest Pain Rule (NACPR) without components of clinical gestalt in predicting 30-day major adverse cardiac events (MACE). Methods: We performed a prospective cohort study in adult patients who attended the ED with undifferentiated chest pain. Clinical prediction rules were applied and calculated. The clinical prediction rules were modified from the original ones, excluding components requiring judgment by clinical gestalt. The primary outcome was MACE. Performance of the tests were evaluated by receive operating characteristic curves and the area under curves (AUC). Results: There were 1081 patients included in the study. Thirty-day MACE occurred in 164 (15.2%) patients. The AUC of the GRACE score was 0.756, which was inferior to the TIMI score (AUC 0.809) and the HEART score (AUC 0.845). A TIMI score ≥ 1 had a sensitivity of 97% and a specificity of 45.7%. A GRACE score ≥ 50 had a sensitivity of 99.4% and a specificity of 7.5%. A HEART score ≥ 1 had a sensitivity of 98.8% and a specificity of 11.7%. The NACPR had a sensitivity of 93.3% and a specificity of 51.5%. Conclusions: Without clinical gestalt, the modified HEART score had the best discriminative capacity in predicting 30-day MACE.** © **2017 Elsevier Inc. All rights reserved.**

□ **Keywords—acute coronary syndrome; chest pain; decision support techniques; myocardial infarction**

## INTRODUCTION

Patients with undifferentiated chest pain account for a significant proportion of attendance and burden of the emergency department (ED) (1). Prompt and accurate diagnosis of acute coronary syndrome (ACS) is crucial for patients' immediate management to achieve better outcome. However, within the heavy patient load, genuine cardiac events contribute to only a minor proportion (2,3). It is well known that normal initial electrocardiogram (ECG) and biomarker do not exclude ACS. As a result, serial blood tests and investigations are required. This leads to prolonged length of stay and ED overcrowding, which are of tremendous concern (4). In the era of high-sensitive troponin, the false-positive rate further aggravates the burden to the health care system. Therefore, an objective, reproducible tool for clinical risk stratification is useful to tackle this

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diagnostic challenge. As stated in their recent guidelines, both the American Heart Association and the European Society of Cardiology recommended the use of risk-stratification models to guide management in patients with chest pain (5,6). It ensures rapid accurate diagnosis of ACS and appropriate discharge of low-risk patients. These risk scores can also be used to assess prognosis in ACS patients. However, most of the existing scores contained elements of clinical gestalt with subjective input from attending physicians, which may affect the consistency and reproducibility of the scores.

In this study, we compared the diagnostic accuracies of four commonly used scores, with removal of the components of clinical gestalt. The assessed scores are the Thrombosis in Myocardial Infarction (TIMI) score; the Global Registry of Acute Coronary Events (GRACE) score; the history, electrocardiogram, age, risk factors, and troponin (HEART) score; and the North America Chest Pain rule (NACPR) (7–10). Initially, the TIMI and the GRACE scores were developed for post-ACS prognostication, these scores were then validated for the prediction of major adverse cardiac events (MACE) for patients with undifferentiated chest pain (11). Our aim was to identify the best clinical prediction score without components of clinical gestalt for early and safe discharge of low-risk patients.

## MATERIALS AND METHODS

### *Study Design and Setting*

We performed a prospective cohort study in the ED of a tertiary referral hospital with daily attendance of > 600 patients. The study period was from February 2016 to June 2016. Patients aged > 18 years who complained of chest pain in the triage were included. Twelve-lead ECGs were obtained. Patients were excluded if ST-elevation myocardial infarction (STEMI) was diagnosed, or there were clearly established alternative diagnoses on presentation not related to cardiac ischemia (e.g., aortic dissection, pulmonary embolism, pneumothorax, and herpes zoster). Ethics approval was obtained from the local Institutional Review Board (CREC/16093). Verbal consent was obtained from the participants of the study.

### *Data Collection*

Data were collected prospectively in form of standardized data collection sheets filled by the attending clinician. Consecutive samples were recruited. Prior training sessions had been arranged for the clinicians in the study center for familiarization of the data collection form. Patients' demographic data, relevant medical history, drug history, smoking status, and other cardiovascular risk factors were recorded. The presenting vital signs were recorded for score calculations. A standard 12-lead ECG was performed for each included patient. We adopted troponin as the cardiac marker in calculation of scores. The troponin level was measured after initial assessment by the attending clinician. We used the Abbott ARCHITECT STAT® high-sensitive troponin I assay in our study. A level > 99$^{th}$ percentile was considered positive. Sex-specific cutoffs were adopted according to manufacturer's recommendation. The upper reference limits were 34.2 ng/L for male and 15.6 ng/L for female. The coefficient of variation of the troponin assay was < 4% and the lower limit of detection was 10 ng/L. Outcome variables were traced by reviewing all patients' written and electronic hospital records, laboratory test results, intervention reports, and death registries.

### *Clinical Prediction Scores*

The components of the evaluated clinical prediction models were shown in Table 1.

The initial definitions of these scores included subjective components that required the attending clinician's subjective judgment. In our study, we made modifications to these scores so that these subjective components were omitted. In this manner, we were able to explore the accuracy risk scores based only on objective parameters without clinical gestalt.

### *TIMI Score*

The TIMI score for unstable angina/non-STEMI was introduced by Antman et al. in 2000 (7). It consists of seven risk factors weighed one mark each. Total marks of one or less indicate lower risk at 14 days in terms of all-cause mortality, acute myocardial infarction (AMI), and severe recurrent ischemia prompting urgent revascularization. In our study, we had modified "the use of aspirin in the past 7 days" into "the use of antiplatelets in the past 7 days." Patients on aspirin, clopidogrel, Ticagrelor, and other antiplatelets were defined as positive exposures to antiplatelets. We omitted the item "severe angina ≥2 episodes in 24 hours," which involved the clinician's subjective judgment. It was also inapplicable for cross-sectional risk stratification of chest pain patients in the ED in a single time point.

### *GRACE Score*

This score was developed by the Global Registry of Acute Coronary Events. It is an international registry designed to track in-hospital and long-term outcomes of patients presenting with ACS (12). It comprises 8 components with different weighing. Web-based calculator is readily