

# Getting to the HEART of Major Adverse Cardiac Events

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## SCORES AND OUTCOMES AFTER ACUTE CORONARY SYNDROME

Acute coronary syndromes (ACS) constitute a significant proportion of Emergency Room (ER) presentations. Complications arising from ACS and their treatment are associated with significant morbidity and mortality. It is therefore preferable to identify or recognize patients who present to the ER with symptoms and signs of ACS who are likely to develop complications. The complications that need intensive care are related to the development of myocardial infarction (MI), need for percutaneous intervention and coronary artery bypass grafting, as well as the development of acute stroke. Repeated hospitalizations following ACS are also considered as major events. These events are clubbed together and are considered major adverse cardiac events (MACE). There is significant variability in the conditions considered under MACE, with events like aortic diseases also included in some descriptions. It is, therefore, important to identify those patients presenting to the ER with chest pain who have a higher risk of developing MACE during their stay in the hospital and after discharge. Unnecessary overcrowding of the ER can be avoided while also avoiding the premature discharge of susceptible patients.

Several scoring systems have been proposed to predict MACE among patients presenting with acute, non-traumatic chest pain. The Global Registry of Acute Coronary Events (GRACE) and the thrombolysis in myocardial infarction (TIMI) scores have been recommended for improving the diagnosis of MACE among patients with chest pain.<sup>1,2</sup> The GRACE score incorporates key aspects of the presentation of ACS like heart rate, age, systolic blood pressure, cardiac arrest, ST segment changes, serum creatinine, cardiac biomarkers and Killip class to stratify patients. This score is expected to estimate the risk of death or MI among patients presenting with ACS. Two different GRACE scores have been developed one for in-hospital mortality and the other for 6-month mortality. The highest possible score for the GRACE-in hospital score is 363 while the GRACE-6-month score is 263.<sup>3,4</sup> Patients with a GRACE score <109 are considered to be at low risk of MACE while those with a GRACE score >140 are deemed to be at a high risk. Antman et al.<sup>2</sup> developed a simple risk score with broad applicability which could be applied at presentation. This score the TIMI score was derived by selecting independent variables contributing to the prognosis. The TIMI score included age, risk factors for coronary artery disease, prior stenosis of 50% or more, ST segment changes, prior angina, prior use of aspirin and cardiac biomarkers. The authors found an exponential increase in MACE with increasing scores, with a score of 6/7 representing a 40.9% incidence of MACE. Six et al.<sup>5</sup> developed yet another score in the Netherlands for rapid stratification of

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patients presenting with chest pain. This score, called the HEART score, was designed to identify low-risk patients who could have been discharged from the ER earlier. This tool is considered to be easy to apply, using readily available variables, and applied in ER. This tool focuses on short-term outcomes. This score included history, ECG, age, risk factors and troponin. The least possible score is 0, and the maximum possible score is 10. Patients with a score of 3 or less were shown to have a low incidence of MACE and were eligible for early discharge from the ER. On the other hand, patients with a score of 4–6 were considered to be at moderate risk, and 14–17% of them were likely to develop MACE. Patients who scored more than 7 had a MACE incidence of 50–65% and were candidates for urgent or emergent therapeutic interventions. The major drawback of the HEART score is, however, that it is based on a single value of troponin, rather than serial values, which is the usual practice. This drawback was addressed by the HEART pathway which includes a second troponin measurement at 3 hours.<sup>6</sup>

Arispe et al.<sup>7</sup> compared the HEART, GRACE and TIMI scores in their ability to predict MACE among a Spanish cohort. This comparison aimed to look at the impact of the three scores on predicting MACE at 6 weeks. The authors found that the HEART score had the best AUROC (0.743; 95% CI – 0.674–0.812) for predicting MACE. Major adverse cardiac events were found to be more frequent among patients with a high HEART score, followed by the GRACE and TIMI scores in that order. Anwar and Sony<sup>8</sup> evaluated the efficacy and accuracy of the HEART score in a teaching hospital cohort in South India. They included patients presenting to the ER with non-traumatic chest pain. In a 6-month period, they evaluated close to 200 patients and found 60.4% to be in the high-risk category. Myocardial infarction was the most frequent MACE in this cohort. Identification of high-risk patients could aid the ER Physicians in seeking help from appropriate specialists at an earlier stage, using simple tools like the HEART score. In the current era of electronic medical records, machine learning (ML) and artificial intelligence (AI), it could be easier to evaluate such

patients more quickly and effectively. Raheem et al.<sup>9</sup> used Artificial Neural Networks for early prediction of MACE among patients presenting to the ER. Zhang et al.<sup>10</sup> have also reported significant promise in predicting MACE using an AI real-time prediction model, with an AUROC of 0.95 for acute MI <1 month later and 0.999 for all-cause mortality within 1 month.

## CONCLUSION

In conclusion, simple scoring systems, like the HEART score, when combined with AI/ML systems could improve the chances of MACE prediction among patients presenting to ER with acute, non-traumatic chest pain.

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