Accelerated diagnostic pathways (ADP) have been designed to identify low-risk chest pain patients in the emergency department. This review article discusses the Asia-Pacific Evaluation of Chest Pain Trial (ASPECT) score, the Accelerated Diagnostic Protocol for Chest Pain Trial (ADAPT) score, the Emergency Department Assessment of Chest Pain Score (EDACS), the HEARTScore and the HEART pathway. These ADPs have been validated in various studies and aid the emergency provider with identifying the low-risk chest pain patient who is appropriate for discharge home, while at the same time highlighting those patients who would benefit from further in-patient work up. These approaches should be paired with patient input and shared decision-making strategies. [West J Emerg Med. 2017;18(3)474-478.]

INTRODUCTION

Chest pain is one of the most frequent complaints of patients presenting to the emergency department (ED). Approximately 10-20% of patients who present to the ED with chest pain are suffering from an acute coronary syndrome (ACS), requiring early intervention and treatment. In the remaining 80% of patients chest pain symptoms are explained by other, often not life-threatening, conditions. Distinguishing patients suffering from ACS from those who are not based on their chest pain history and physical examination is difficult as no history or examination variables have sufficient predictive value to rule in or rule out ACS, if considered in isolation. Admission for further workup of chest pain patients for the evaluation of ACS is costly, time consuming and places patients at risk of adverse events during their evaluation. Early discharge is also not without risk, as up to 2-5% of patients with ACS are inappropriately discharged from the ED every year. Missed ACS remains a top malpractice claim in the United States. These current care patterns of over- and under-testing demonstrate that the low-risk chest pain evaluation is a diagnostic dilemma for emergency clinicians.

The American College of Cardiology and American Heart Association (ACC/AHA) have developed guidelines in an attempt to standardize the approach to patients with chest pain. The 2010 and 2014 guidelines recommend the use of the Global Registry of Acute Coronary Events (GRACE) score or thrombolysis in myocardial infarction (TIMI) risk score as part of the initial evaluation for possible ACS. However, neither TIMI nor GRACE was designed for ED chest pain risk stratification. The TIMI score was designed to be applied to patients with unstable angina or non ST-elevation myocardial infarction (NSTEMI) to determine their risk for 14-day mortality, new or recurrent acute myocardial infarct (AMI) or severe recurrent ischemia requiring urgent revascularization. The GRACE score was developed to risk stratify patients with confirmed ACS to estimate their in-hospital, six-month and three-year mortality. While these scores were subsequently validated in an ED setting, they lack the sensitivity needed to
Table 1. Low-risk patients as classified in the ASPECT, ADAPT and APACE trial.6,7,8

| ASPECT                                    | ADAPT                           | Modified ADAPT                     |
|-------------------------------------------|---------------------------------|------------------------------------|
| Contemporary troponin, myoglobin and CK-MB negative at 0 and 2 hours | Contemporary troponin negative at 0 & 2 hours | High sensitive troponin negative at 0 & 2 hours |
| ECG without new ischemic changes          | ECG without new ischemic changes | ECG without new ischemic changes   |
| TIMI score 0                              | TIMI score 0                     | TIMI score 0 or 1                  |

ASPECT, Asia-Pacific Evaluation of Chest Pain Trial; ADAPT, Accelerated Diagnostic Protocol for Chest Pain Trial; APACE, Advantageous Predictors of Acute Coronary Syndrome Evaluation; CK-MB, creatine kinase-MB; ECG, electrocardiogram; TIMI, thrombolysis in myocardial infarction.

Table 2. TIMI score.3

| TIMI, thrombolysis in myocardial infarction; ECG, electrocardiogram |
|-------------------------------------------------|-----------------|
| Age ≥ 65                                        | + 1             |
| ≥ 3 CAD (coronary artery disease) risk factors  | + 1             |
| Known CAD (stenosis ≥ 50%)                      | + 1             |
| Aspirin use in past 7 days                      | + 1             |
| Severe angina (≥ 2 episodes in 24 hours)        | + 1             |
| ECG ST changes ≥ 0.5mm                         | + 1             |
| Positive cardiac marker                        | + 1             |
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Table 3. Emergency Department Assessment of Chest Pain Score (EDACS).

| Clinical characteristics | Score |
|--------------------------|-------|
| Age                      |       |
| 18 – 45                  | + 2   |
| 46 – 50                  | + 4   |
| 51 – 55                  | + 6   |
| 56 – 60                  | + 8   |
| 61 – 65                  | + 10  |
| 66 – 70                  | + 12  |
| 71 – 75                  | + 14  |
| 76 – 80                  | + 16  |
| 81 – 85                  | + 18  |
| 86 +                     | + 20  |
| Male sex                 | + 6   |

Aged 18 – 50 years and either:

|                           |       |
|---------------------------|-------|
| known coronary artery disease or ≥3 risk factors | + 4   |

Symptoms and signs

|                          |       |
|--------------------------|-------|
| Diaphoresis              | + 3   |
| Radiates to arm or shoulders | + 5   |
| Pain occurred/worsened by inspiration | - 4   |
| Pain is reproduced by palpation | - 6   |

In this study more patients were identified as low risk by EDACS compared to ADAPT, and no patients identified as low risk had a 30-day MACE event. However, in the first U.S. validation study EDACS had lower sensitivity for MACE.

HEARTScore

The HEARTScore was developed to score predictors of primary end points based on clinical experience and previous medical literature. Predictors included history (H), electrocardiography (ECG) (E), Age (A), Risk factors (R) and Troponin (T), forming the HEART score. Each of the five factors is scored with 0, 1, or 2 points (Table 4). Patients were followed for six weeks for a primary end point of major adverse cardiac event (MACE), including AMI, primary coronary intervention (PCI), coronary artery bypass graft (CABG) or death.

In the first retrospective validation study 122 patients presented to the ED with chest pain. Results are presented in Table 5. One (2.5%) of the 39 patients with a low HeartScore (0-3) had a MACE, requiring CABG. This was compared to 12 of 59 (20.3%) patients with a HeartScore of 4-6, and 16 of 22 (72.7%) of patients with a HeartScore of 7-10 points that reached an endpoint. Two deaths occurred in the study; both patients had a HeartScore of eight. After this small retrospective study, a multicenter retrospective study was performed. In this study 34% of patients were identified as low risk, with a risk of MACE of 0.99%. The results of this study are presented in Table 5. Both studies, however, were limited by their observational, retrospective design. Further validation was needed, and the same authors provided a prospective multicenter study. In this study the HeartScore was compared to the TIMI and GRACE scores. A total of 2,440 patients who presented to the ED with chest pain were enrolled in 10 Dutch hospitals. Outcomes measures were the same as the retrospective studies. The results of the HeartScore original study and validation studies are presented in Table 5.

Sixteen patients died (0.7%), 13 of whom died of a cardiac cause. One of these patients was in the low-risk HeartScore group, five were in the intermediate-risk group and seven in the high-risk HeartScore group. The C-statistics of the HeartScore when compared to TIMI and GRACE were as follows: HEART 0.83, TIMI 0.75, GRACE 0.70 (p<0.0001). This study provided additional support for use of the HeartScore as an ADP for low risk chest pain patients.

HEART Pathway

While the HeartScore is predictive of MACE, many clinicians consider the 1.7% risk of MACE in a patient identified

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Table 4. The HEARTScore for chest pain patients in the emergency department.11

| HEARTScore |       |
|------------|-------|
| History    |       |
| Highly suspicious | 2 points |
| Moderately suspicious | 1 point |
| Slightly or non suspicious | 0 points |
| ECG        |       |
| Significant ST-depression | 2 points |
| Nonspecific repolarization | 1 point |
| Normal     | 0 points |
| Age        |       |
| > = 65 years | 2 points |
| > 45 - <65 years | 1 point |
| <= 45 years | 0 points |
| Risk factors* |       |
| >= 3 risk factors or history of CAD | 2 points |
| 1 or 2 risk factors | 1 point |
| No risk factors | 0 points |
| Troponin   |       |
| >= 3x normal limit | 2 points |
| >1 - <3 normal limit | 1 point |
| <= normal limit | 0 points |

* Risk factors: diabetes mellitus, current or recent (< one month) smoker, diagnosed hypertension, diagnosed hypercholesterolemia, family history of coronary artery disease and obesity.
as low risk by the HeartScore to be too high. Furthermore, with
the HeartScore it is possible to have a patient with a low-risk
HeartScore, despite a positive troponin. The Heart pathway was
designed to lower the missed MACE rate of the HeartScore
below 1%, by separating the troponin results from the remaining
“Hear” score and using two troponin measures (at 0 and 3 hours)
instead of one. To be considered low-risk using the HeartScore
pathway you must have a Heart(t) score of 0-3 and have both
serial troponin measures less than the 99th percentile upper-
reference limit.

The first study to validate the HeartScore in the U.S. enrolled
1,070 chest pain patients in an observation unit and revealed
that five patients with an NSTEMI had low-risk HeartScore.13
However, all of these patients had positive serial troponins.
Use of the Heart pathway, with its serial troponins, was 100%
sensitive for ACS and could have decreased observation stays by
80%. A secondary analysis performed on 1,005 participants in the
Myeloperoxide in the Diagnosis of Acute Coronary Syndromes
Study (MIDAS) found the Heart pathway to identify 20% of
patients for early discharge with a 99% (95% CI [97%-100%])
sensitivity for ACS.14 The Heart Pathway Randomized Controlled
Trial evaluated 282 patients and randomized them to the Heart
pathway or usual care. Use of the Heart pathway increased
early discharge by 21% (p<0.0002), median length of stay was
decreased by 12 hours (p=0.013), and objective cardiac testing at
30 days was decreased by 12% (p=0.048), without any MACE
events among patients identified as low risk.

SHARED DECISION-MAKING

In recent years there has been growing attention to shared
decision-making. Shared decision-making involves educating
patients on their health risks, as well as the risks of testing, and
discussing their treatment options. This is often done using
a pictogram developed at the Mayo Clinic called the Chest
Pain Choice.15 In the Chest Pain Choice Trial, a single-center
randomized controlled trial, patients enrolled in the shared
decision-making arm reported greater knowledge, less decisional
conflict and feeling more engaged in the decision-making process
when compared to those receiving usual care. Patients also
decided less frequently to be admitted for further testing, with a
19% absolute difference (95% CI [6%-31%]).

SUMMARY

The low-risk patient with chest pain can be a high-risk
scenario for the emergency physician. Accelerated decision
protocols have been designed to aid the emergency physician in
decision-making with regards to assessment of these patients.
The use of these ADPs can reduce cost, length of stay and risk of
unnecessary testing in chest pain patients. It is important for all
emergency physicians to be familiar with different ADPs, and to
know their benefits and limitations. All of the above-described
ADPs are validated choices for risk assessment of low-risk chest
pain patients in the ED. UsTe of any of these ADPs should be
considered within standard of care. The choice to select a specific
ADP for use in the ED can be done on an institutional level or can
be the choice of the individual practitioner. Within the authors’
(MH, AM, ZD) institution, the Heart pathway was implemented
alongside a shared decision model for its high sensitivity,
negative predictive value and ease of use. Shared decision-
making tools may assist patients with acute chest pain and their
providers to navigate difficult disposition decisions.

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