What Is the Efficacy of the European Society of Cardiology 0/1-Hour Algorithm for Diagnosing Acute Myocardial Infarction?

TAKE-HOME MESSAGE

The European Society of Cardiology (ESC) 0/1-hour algorithm is highly sensitive for the diagnosis of acute myocardial infarction.

METHODS

DATA SOURCES

The authors searched PubMed, EMBASE, Scopus, Web of Science, and the Cochrane Central Register of Controlled Trials between January 1, 2008, and May 31, 2019, for published studies, using the key words "myocardial infarction," "troponin," "0/1 hour algorithm," and "emergency department." They also manually searched the references of original and review articles. There were no language restrictions.

STUDY SELECTION

Three reviewers independently screened titles and abstracts to identify potentially relevant articles, with full texts reviewed for inclusion. A fourth reviewer confirmed inclusion and exclusion of the studies. Eligible studies included prospective cohort studies that evaluated the diagnostic accuracy of the ESC 0/1-hour algorithm for the evaluation of suspected acute coronary syndrome. Studies could use either the high-sensitivity cardiac troponin T (hs-cTnT) (Roche) or the high-sensitivity cardiac troponin I (hs-cTnI) (Abbott). Studies using the

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Editor's Note: This is a clinical synopsis, a regular feature of the *Annals'* Systematic Review Snapshot (SRS) series. The source for this systematic review snapshot is: **Chiang CH, Chiang CH, Lee GH, et al. Safety and efficacy of the European Society of Cardiology 0/1-hour algorithm for diagnosis of myocardial infarction: systematic review and meta-analysis. *Heart.*** 2020;106:985-991.

Results

Diagnostic accuracies of ESC 0/1-hour algorithm for diagnosing acute myocardial infarction with each high-sensitivity troponin assay.

Assay	No. of Studies (No. of Participants)	Sensitivity (95% CI), %	Specificity (95% CI), %	NPV (95% CI), %	PPV (95% CI), %
hs-cTnT (Roche)	7 (7,744)	98.4 (95.1–99.5)	91.2 (86.0–94.6)	99.6 (99.0–99.9)	51.3 (30.8–71.3)
hs-cTnI (Abbott)	4 (5,095)	98.1 (94.6–99.3)	N/A	99.3 (95.9–99.9)	N/A
hs-cTnI (Siemens)	3 (3,864)	98.7 (97.3–99.3)	95.9 (94.1–97.2)	99.6 (99.2–99.8)	73.4 (69.5–77.0)

NPV, Negative predictive value; *PPV*, positive predictive value; *N/A*, not available (insufficient data for pooling results).

The initial search yielded 385 potential studies, of which 15 were included for analysis (n=11,014 participants). Overall, 64% of participants were men and the mean age was 61 years. The overall pooled prevalence of acute myocardial infarction was 16%, with a range of 2% to 32%. One hs-cTnT assay was used, whereas 2 hs-cTnI assays were used. The ESC 0/1-hour algorithm rule-out was highly sensitive for the diagnosis (Table). The hs-cTnT ruled out

hs-cTnI (Dimension Vista) were excluded. However, studies using other assays not yet recommended by the 2015 ESC guidelines were included if 3 or more cohorts were available. The primary outcome was acute myocardial infarction defined by the third universal definition.[1] Secondary outcomes included death and major adverse cardiac events. When multiple studies used overlapping data sets, only the studies with largest sample size and most complete data sets were included.

DATA EXTRACTION AND SYNTHESIS

Three reviewers independently abstracted data on the study demographics and outcomes. Methodological quality was assessed with the Quality Assessment of Diagnostic Accuracy Studies–2 tool.[2] Continuous variables were reported as mean and 95% confidence intervals (CIs) or median and interquartile ranges. Categoric variables were represented as numbers or percentages. The authors used bivariate random-effects modeling for the meta-analyses and I^2 statistics to assess heterogeneity. Publication bias was assessed with Deek's test.[3]

55% of patients as low risk for acute myocardial infarction, whereas the hs-cTnI ruled out 50%. The ESC 0/1-hour algorithm ruled in 18% of patients for acute myocardial infarction with the hs-cTnT and 14% with the hs-cTnI. For patients in the rule-out group, 30-day mortality was 0.1% (95% CI 0.0% to 0.4%) and increased to 0.8% (95% CI 0.5% to 1.2%) at 1 year. For patients in the observation group, 30-day mortality was 0.7% (95% CI 0.3% to 1.2%), increasing to 8.1% (95% CI 6.1% to 10.4%) at 1 year. For the rule-in group, 30-day mortality was 1.8% (95% CI 0.4% to 4.2%) and increased to 10.0% (95% CI 7.8% to 12.4%) at 1 year.

Commentary

In the United States, chest pain accounts for 6.5 million emergency department (ED) visits per year, making it the second most frequent reason that patients present to the ED.[4] Timely diagnosis of acute myocardial infarction is important to reduce morbidity and mortality[5]; however, it is also important to reduce unnecessary hospital admissions to avoid iatrogenic complications and boarding.[6]

The ESC 0/1-hour algorithm consists of 2 pathways for patients who present with possible acute myocardial infarction without active ischemia on their initial ECG. If symptoms are present greater than 3 hours, acute myocardial infarction is excluded if the patient's hs-cTnI or hs-cTnT is below the assay-specific threshold. If symptoms are present less than 3 hours, acute myocardial infarction is excluded if the patient's initial hs-cTnI or hs-cTnT level and their change in hs-cTnI or hs-cTnT level are below different assay-specific thresholds. This study found that the ESC 0/1-hour algorithm was able to exclude acute myocardial infarction in greater than 50% of patients, with a high degree of sensitivity.

However, it is important to consider several limitations regarding the current review. First, the studies used different types of high-sensitivity troponin testing. Although the sensitivity was similar between all 3 tests, the specificity differed between hs-cTnT (Roche) and hs-cTnI (Siemens), whereas specificity was unable to be determined for hs-cTnI (Abbott) due to insufficient data for meta-analysis. Additionally, the included studies had a variable prevalence of acute myocardial infarction, with many cohorts including high-risk populations, which may not reflect actual practice. This may also influence the positive and negative predictive value of the findings. There was also limited reporting on comorbidities, particularly regarding previous coronary artery disease, congestive heart failure, and chronic renal disease. Because these factors may influence the baseline hs-cTnI and hs-cTnT levels, it may be more challenging to interpret these test results in patients with these comorbidities.

Additionally, the miss rate was greater than 1% in some cohorts, so it cannot be stated with certainty that the ESC 0/1-hour algorithm will be compatible with expectations in the United States. The exact timing of the sample collection was not reported in many studies. Because many of these protocols are contingent on relatively narrow windows, samples collected too early may not identify an elevation that would have been present if collected at the correct interval, thereby decreasing the sensitivity of the test. Alternatively, samples that were collected late may include some cases that would not have been discovered if the correct interval had been followed, which

would artificially inflate the sensitivity compared with the protocol recommendations. Moreover, many of the studies stored samples for a prolonged period, which may have led to some protein denaturation. Outcome assessors were blinded to the results of the index test in only 3 studies. Moreover, 6 studies did not use blinding during the adjudication process for determining the diagnosis of acute myocardial infarction. Several studies did not include all eligible patients because of missing data, which was most commonly due to missing data on repeated testing. Finally, many patients received closer and more structured follow-up than may occur in the nonresearch setting, which may reduce external validity.

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3. Deeks JJ, Macaskill P, Irwig L. The performance of tests of publication bias and other sample size effects in systematic reviews of diagnostic test accuracy was assessed. *J Clin Epidemiol*. 2005;58:882-893.
4. Centers for Disease Control and Prevention. National Hospital Ambulatory Medical Care Survey: 2017 emergency department summary tables. Available at: https://www.cdc.gov/nchs/data/nhamcs/web_tables/2017_ed_web_tables-508.pdf. Accessed June 10, 2020.
5. Roffi M, Patrono C, Collet JP, et al. 2015 ESC guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting Without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). *Eur Heart J*. 2016;37:267-315.
6. Singer AJ, Thode HC Jr, Viccellio P, et al. The association between length of emergency department boarding and mortality. *Acad Emerg Med*. 2011;18:1324-1329.

New Resident Fellow Announced

Each year, *Annals of Emergency Medicine* selects a Resident Fellow (formerly the Resident Editor) to serve on the Editorial Board. We are pleased to announce that Laura A. Dean, MD, of Harvard-Affiliated Emergency Medicine Residency, Boston, MA, has been selected to serve as the new Editorial Board Resident Fellow for the coming year. Dr. Dean received her MD from the Brown University, Providence, RI. Christopher S. Evans, MD, MPH, from Vanderbilt University Medical Center, Nashville, TN, is the immediate past Resident Fellow for the journal. Dr. Evans began his term in October 2019. His service concluded in October 2020.

If you have an idea, an issue, or an experience about which you would like to write, submit an abstract (limit 250 words, double-spaced) through *Annals*' online submission system, Editorial Manager, at www.editorialmanager.com/annemergmed (use the "Residents' Perspective" article type). If your abstract is approved, you will be asked to write the full-length article for the "Residents' Perspective" section. If you have any other questions for Dr. Dean, contact her at annalsfellow@acep.org.