Things We Do for No Reason: Hospitalization for the Evaluation of Patients with Low-Risk Chest Pain

Christopher A. Caulfield, MD*, John R. Stephens, MD

Department of Internal Medicine, Division of Hospital Medicine, University of North Carolina School of Medicine, Chapel Hill, North Carolina.

The "Things We Do for No Reason" (TWDFNR) series reviews practices that have become common parts of hospital care but may provide little value to our patients. Practices reviewed in the TWDFNR series do not represent "black and white" conclusions or clinical practice standards, but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

Chest pain is one of the most common complaints among patients presenting to the emergency department. Moreover, at least 30% of patients who present with chest pain are admitted for observation, and >70% of those admitted with chest pain undergo cardiac stress testing (CST) during hospitalization. Several clinical risk prediction models have validated evaluation processes for managing patients with chest pain, helping to identify those at a low risk of major adverse cardiac events. Among these, the Thrombolysis in Myocardial Infarction or HEART score can identify patients safe to be discharged with outpatient CST within 72 h. It is unnecessary to hospitalize all low-risk patients for cardiac testing because it may expose them to needless risk and avoidable care costs, with little additional benefit.

CLINICAL SCENARIO

A 60-year-old man with a history of osteoarthritis and depression presented to our emergency department (ED) with a 1-month history of left-sided chest pain that was present both at rest and exertion. There were no aggravating or relieving factors for the pain and no associated shortness of breath, diaphoresis, nausea, or lightheadedness. He smoked a half pack of cigarettes daily for 5 years in his twenties. The patient was taking aspirin 81 mg daily and paroxetine 40 mg daily, which he had been taking for 10 years. There was a family history of coronary artery disease in his mother, father, and sister. On examination, he was afebrile, with a blood pressure of 138/78 mm Hg and a heart rate of 62 beats/min; he appeared well, with no abnormal cardiopulmonary findings. Investigation revealed a

*Address for correspondence: Christopher A. Caulfield, MD, Assistant Professor of Medicine, Division of Hospital Medicine, University of North Carolina School of Medicine, 101 Manning Drive, CB# 7085, Chapel Hill, NC 27599-7085; Telephone: (984) 974-1931; Fax: (984) 974-2216; E-mail: chris_caulfield@med.unc.edu

normal initial troponin I level (<0.034 mg/mL) and normal electrocardiogram (ECG) with normal sinus rhythm (75 beats/min), normal axis, no ST changes, and no Q waves. He was therefore admitted to the hospital for further evaluation.

BACKGROUND

Each year, >7 million patients visit ED for chest pain in the United States,[1] with approximately 13% diagnosed with acute coronary syndromes (ACSs).[2] Over 30% of patients who present to ED with chest pain are hospitalized for observation, symptom evaluation, and risk stratification.[3] In 2012, the mean Medicare reimbursement cost was $1,741 for in-hospital observation,[4] with up to 70% of admitted patients undergoing cardiac stress testing (CST) before discharge.[5]

WHY YOU MIGHT THINK HOSPITALIZATION IS HELPFUL FOR THE EVALUATION OF LOW-RISK CHEST PAIN

A scientific statement by the American Heart Association in 2010 recommended that patients considered to be at low risk for ACS after initial evaluation (based on presenting symptoms, past history, ECG findings, and initial cardiac biomarkers) should undergo CST within 72 h (preferably within 24 h) of presentation to provoke ischemia or detect anatomic coronary artery disease.[6] Early exercise treadmill testing as part of an accelerated diagnostic pathway can also reduce the length of stays (LOS) in hospital and lower the medical costs.[7] Moreover, when there is noncompliance or poor accessibility, failure to pursue early exercise testing in a hospital could result in a loss of patients to follow-up. Hospitalization for testing through accelerated diagnostic pathways may improve access to care and reduce clinical and legal risks associated with a major adverse cardiac event (MACE).

WHY HOSPITALIZATION FOR THE EVALUATION OF LOW-RISK CHEST PAIN IS UNNECESSARY FOR MANY PATIENTS

Clinical Risk Prediction Models

When a patient initially presents with chest pain, it should be determined if the symptoms are related to ACS or some other diagnosis. Hospitalization is required for patients with ACS but may not be for those without ACS and those with a low risk of inducible ischemia. Clinical risk scores and risk prediction models, such as the Thrombolysis in Myocardial Infarction (TIMI) and HEART scores, have been used in accelerated diagnostic protocols to determine a patient's likelihood of having ACS. Several

large trials of these clinical risk prediction models have validated the processes for evaluating patients with chest pain.

The TIMI risk score, the most well-known model, assesses risk based on the presence or absence of 7 characteristics (Appendix 1). It should be noted that the patient population studied for initial validation of this model comprised high-risk patients with unstable angina or non-ST elevation myocardial infarction who would benefit from early or urgent invasive therapy.[8] In this population, TIMI scores of 0-1 are associated with low risk, with a 4.7% risk of ACS at 14 days.[8] In another study of patients presenting to ED with undifferentiated chest pain and a TIMI score of zero, the risk of MACE at 30 days was approximately 2%.[9]

The HEART score is also used for patients presenting to ED with undifferentiated chest pain and assesses 5 separate variables scored 0–2 (Appendix 2). The original research gave a score of 2 to a troponin I level greater than twice the upper limit of the normal level,[10] whereas a subsequent validation study gave a score of 2 to a troponin I or T level greater than or equal to 3 times the upper limit of the normal level.[11] Patients are considered at low, intermediate, and high risk based on scores of 0–3, 4–6, and 7–10, respectively.[10,11] Backus et al. performed a prospective randomized trial of 2388 patients who presented to ED with chest pain to validate the HEART score and compare it to the TIMI risk score. The HEART score performed better than the TIMI risk score in low-risk patients, with TIMI scores of 0-1 and HEART scores of 0–3 having a 6-week MACE risk of 2.8% and 1.7%, respectively.[11]

A HEART pathway was developed that combines the HEART score with serial troponin I assays assessed at the time of initial presentation and approximately 3 h later.[12] Mahler et al. randomized 282 patients presenting to ED with chest pain to either the HEART pathway or conventional care. Patients with low-risk HEART scores and an abnormal troponin I level were admitted for cardiology consultation, whereas discharge was recommended for those with low scores and a normal troponin I level. Despite nearly 20% of the study cohort having a history of myocardial infarction, percutaneous coronary intervention, or coronary artery bypass grafting, approximately 40% of patients in the HEART pathway were identified as low risk, increasing early discharge rates by 21.3% and decreasing the average LOS by 12 h. No low-risk patient suffered a MACE within 30 days, and the HEART pathway had a sensitivity and a negative predictive value of approximately 99%.

Costs and Harms of Hospitalization for Cardiac Testing

Hospitalization carries measurable risks.[13,14] Between 2008 and 2013, Weinstock et al. evaluated the outcomes of patients presenting with chest pain who were placed in an observation unit for suspected ACS.[15] Low-risk patients were defined as those with normal ECGs (no ischemic changes), 2 negative troponin tests performed 60–420 min apart (no particular troponin assay specified), and stable vital signs. They identified 7266 patients who were considered to have low risk, among whom 4 (0.06%) had an adverse outcome in the hospital (eg, life-threatening

arrhythmia, ST-segment elevation myocardial infarction, cardiac or respiratory arrest, or death); 3 among the 4 patients had a cardiac-related adverse outcome. The overall risk of adverse outcomes due to cardiac causes was 1 in 2422 admissions (0.04%). The authors compared their results with the reported risk of 1 in 164 admissions for preventable adverse events contributing to patient death during routine hospitalization (eg, medication or procedure errors).[14]

Outpatient CST can be reliably and safely performed for patients with chest pain.[16-18] There is no clear evidence that earlier CST leads to improved patient outcomes, and CST in the absence of acute ischemia (or ACS) increases the rates of angiography and revascularization without improvements in the rate of myocardial infarction.[19-21] Given the costs of in-hospital observation[4] and the dubious benefits of providing CST for patients with low-risk chest pain, admitting all patients with low-risk chest pain exposes them to costs and harms with little potential benefit.

WHEN HOSPITALIZATION MAY BE REASONABLE TO EVALUATE LOW-RISK CHEST PAIN

Patients presenting with chest pain with either dynamic ECG changes or an elevated troponin level require hospitalization for further ACS diagnosis and treatment. When ACS cannot be clearly diagnosed at the initial evaluation, healthcare providers should use clinical risk prediction models to stratify patients. Those deemed to be at an intermediate or high risk by these models should be hospitalized for further evaluation, as should those at low risk but for whom access to outpatient follow-up is difficult (eg, those without health insurance).

WHAT YOU SHOULD DO INSTEAD OF HOSPITALIZATION FOR LOW-RISK CHEST PAIN

A complete history and physical examination, along with ECG and cardiac biomarker testing, are required for all patients presenting with chest pain. Validated clinical risk prediction models should then be used to determine the likelihood of a cardiac event. Fanaroff et al. reported that low-risk HEART scores of 0–3 and TIMI scores of 0-1 gave positive likelihood ratios of 0.2 and 0.31, respectively.[22] Using a pre-test probability of 13%, as reported by Bhuiya et al.,[2] the likelihood of ACS or MACE within 6 weeks is 2.9% for patients with low-risk HEART scores and 4.4% for those with low-risk TIMI scores.[22] These risk prediction models allow clinicians to provide a shared decision-making plan with the patient and discuss the risks and benefits of in-hospital versus outpatient cardiac testing, especially among patients with access to appropriate outpatient follow-up.[23] Low-risk patients can be referred for outpatient testing within 72 h, reducing hospitalization-associated costs and harms.

RECOMMENDATIONS

- Patients presenting with chest pain should undergo a complete history taking and physical examination, as well as ECG and cardiac biomarker testing (eg, troponin I level at presentation and approximately 3 h later).

- Clinical risk prediction models, such as TIMI or HEART scores, should then be used to determine the risk of MACE.
- Patients at a low risk may be safely discharged with outpatient CST performed within 72 h.
- Patients at an intermediate or high risk of MACE should be hospitalized for further evaluation, as should those with low-risk chest pain who are unable to attend follow-up for outpatient CST within 72 h.
- Clinicians should provide a shared decision-making plan with each patient, taking care to discuss the risks and benefits of in-hospital versus outpatient CST.

CONCLUSION

The risk of MACE should be assessed in all patients presenting to ED with low-risk chest pain to avoid unnecessary hospitalization that exposes them to potential costs and harms with few additional benefits. If the risk scoring system was applied to the patient described in our original clinical scenario, he would have had a HEART score of 3 (ie, 1 point for a moderately suspicious history, 1 point for the age of 60 years, and 1 point for a positive family history) and a TIMI score of 1 (ie, 1 point for aspirin use within past 7 days). Therefore, he could be stratified as having a low-risk presentation. With a second negative troponin I test at 3 h, discharge from ED with timely outpatient CST within 72 h would be an appropriate management strategy.

Do you think this is a low-value practice? Is this truly a "Thing We Do for No Reason"? Share what you do in your practice and join in the conversation online by retweeting it on Twitter (#TWDFNR) and liking it on Facebook. We invite you to propose ideas for other "Things We Do for No Reason" topics by emailing TWDFNR@hospitalmedicine.org.

Disclosures: The authors have no conflicts of interest relevant to this article to disclose.

References

1. Centers for Disease Control. National Hospital Ambulatory Medical Care Survey: 2011 Emergency Department Summary Tables. 2011. http://www.cdc.gov/nchs/data/ahcd/nhamcs_emergency/2011_ed_web_tables.pdf. Accessed October 7, 2015.
2. Bhuiya FA, Pitts SR, McCaig LF. Emergency department visits for chest pain and abdominal pain: United States, 1999-2008. *NCHS Data Brief.* 2010;(43):1-8.
3. Cotterill PG, Deb P, Shrank WH, Pines JM. Variation in chest pain emergency department admission rates and acute myocardial infarction and death within 30 days in the Medicare population. *Acad Emerg Med.* 2015;22(8):955-964.
4. Wright S. Hospitals' Use of Observation Stays and Short Inpatient Stays for Medicare Beneficiaries, OEI-02-12-00040. 2013. https://oig.hhs.gov/oei/reports/oei-02-12-00040.pdf. Accessed May 15, 2017.
5. Penumetsa SC, Mallidi J, Friderici JL, Hiser W, Rothberg MB. Outcomes of patients admitted for observation of chest pain. *Arch Inter Med.* 2012;172(11):873-877.
6. Amsterdam EA, Kirk JD, Bluemke DA, et al. Testing of low-risk patients presenting to the emergency department with chest pain: a scientific statement from the American Heart Association. *Circulation.* 2010;122(17):1756-1776.
7. Hutter AM, Jr., Amsterdam EA, Jaffe AS. 31st Bethesda Conference. Emergency Cardiac Care. Task force 2: Acute coronary syndromes: Section 2B--Chest discomfort evaluation in the hospital. *J Am Coll Cardiol.* 2000;35(4):853-862.
8. Antman EM, Cohen M, Bernink PJ, et al. The TIMI risk score for unstable angina/non-ST elevation MI: A method for prognostication and therapeutic decision making. *JAMA.* 2000;284(7):835-842.
9. Pollack CV, Jr., Sites FD, Shofer FS, Sease KL, Hollander JE. Application of the TIMI risk score for unstable angina and non-ST elevation acute coronary syndrome to an unselected emergency department chest pain population. *Acad Emerg Med.* 2006;13(1):13-18.
10. Six AJ, Backus BE, Kelder JC. Chest pain in the emergency room: value of the HEART score. *Neth Heart J.* 2008; 16(6):191-196.
11. Backus BE, Six AJ, Kelder JC, et al. A prospective validation of the HEART score for chest pain patients at the emergency department. *Int J Cardiol.* 2013;168(3):2153-2158.
12. Mahler SA, Riley RF, Hiestand BC, et al. The HEART Pathway randomized trial: identifying emergency department patients with acute chest pain for early discharge. *Circ Cardiovasc Qual Outcomes.* 2015;8(2):195-203.
13. Forster AJ, Murff HJ, Peterson JF, Gandhi TK, Bates DW. The incidence and severity of adverse events affecting patients after discharge from the hospital. *Ann Inter Med.* 2003;138(3):161-167.
14. James JT. A new, evidence-based estimate of patient harms associated with hospital care. *J Patient Saf.* 2013;9(3):122-128.
15. Weinstock MB, Weingart S, Orth F, et al. Risk for clinically relevant adverse cardiac events in patients with chest pain at hospital admission. *JAMA Intern Med.* 2015;175(7):1207-1212.
16. Meyer MC, Mooney RP, Sekera AK. A critical pathway for patients with acute chest pain and low risk for short-term adverse cardiac events: role of outpatient stress testing. *Ann Emerg Med.* 2006;47(5):427-435.
17. Lai C, Noeller TP, Schmidt K, King P, Emerman CL. Short-term risk after initial observation for chest pain. *J Emerg Med.* 2003;25(4):357-362.
18. Scheuermeyer FX, Innes G, Grafstein E, et al. Safety and efficiency of a chest pain diagnostic algorithm with selective outpatient stress testing for emergency department patients with potential ischemic chest pain. *Ann Emerg Med.* 2012;59(4):256-264 e253.
19. Safavi KC, Li SX, Dharmarajan K, et al. Hospital variation in the use of noninvasive cardiac imaging and its association with downstream testing, interventions, and outcomes. *JAMA Intern Med.* 2014;174(4):546-553.
20. Foy AJ, Liu G, Davidson WR, Jr., Sciamanna C, Leslie DL. Comparative effectiveness of diagnostic testing strategies in emergency department patients with chest pain: an analysis of downstream testing, interventions, and outcomes. *JAMA Intern Med.* 2015; 175(3):428-436.
21. Sandhu AT, Heidenreich PA, Bhattacharya J, Bundorf MK. Cardiovascular testing and clinical outcomes in emergency department patients with chest pain. *JAMA Intern Med.* 2017;177(8):1175-1182.
22. Fanaroff AC, Rymer JA, Goldstein SA, Simel DL, Newby LK. Does this patient with chest pain have acute coronary syndrome?: The Rational Clinical Examination Systematic Review. *JAMA.* 2015;314(18):1955-1965.
23. Hess EP, Hollander JE, Schaffer JT, et al. Shared decision making in patients with low risk chest pain: prospective randomized pragmatic trial. *BMJ.* 2016;355:i6165.