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Brief Report

Identification of high-risk patients with acute coronary syndrome using point-of-care echocardiography in the ED

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ABSTRACT

Stratifying risk of patients with acute coronary syndrome (ACS) in the emergency department (ED) remains a frequent challenge. When ST-elevation criteria are absent, current recommendations rely upon insensitive and time-intensive methods such as the electrocardiogram and cardiac enzyme testing. Here, we report on a series of cases, where emergency physicians used a simplified model for identifying regional wall motion abnormalities by point-of-care echocardiography in patients presenting with chest pain to the ED. With the use of a simplified model described herein, high-risk patients with ACS were identified rapidly in a cohort usually difficult to risk stratify.

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1. Background

Stratifying risk of patients with acute coronary syndrome in the emergency department (ED) remains a frequent challenge. Current American Heart Association recommendations suggest that high-risk patients with unstable angina/non–ST-elevation myocardial infarction (UA/NSTEMI) undergo early invasive strategy if they are at elevated risk of clinical events (class I) [1]. These criteria generally require significant time and are poorly specific, thus potentially delaying myocardium-saving interventions in patients who have an electrocardiographically occult coronary artery thrombosis.

Previous studies have shown regional wall motion abnormalities (RWMAs) to be the first clinically evident sign of acute cardiac ischemia, even before chest pain or electrocardiogram (ECG) changes [2]. Regional wall motion abnormalities indicate large areas of myocardium at risk in the setting of acute ischemia and can be used to identify patients who are at higher risk of cardiac events [3]. Previous studies evaluating use of echocardiography to evaluate for RWMAs in the ED in the setting of acute ischemia have all been completed using echocardiography technicians and cardiologists [2-4]. Only one recent study has shown that ED providers can improve their recognition of RWMAs with basic training [5].

We hypothesized that, in patients with UA/NSTEMI, point-of-care (POC) echocardiography performed by ED physicians could help identify RWMAs. Here, we describe 3 cases in which the ED providers identified RWMAs on bedside echocardiogram in patients with high-risk features of UA/NSTEMI. In each case, initial POC echocardiography correlated with clinically significant acute occlusive coronary lesions and identified patients with significant myocardium at risk earlier than standard methods.

2. Methods

This prospective case series was conducted at an urban safety-net hospital designated by the county as a STEMI-receiving center with both an emergency medicine residency and an emergency ultrasound fellowship program. Emergency physicians (the authors) with fellowship training but without formal echocardiography training performed the echocardiograms. Before the study, all the study physicians watched a brief 10-minute video on focused assessment of wall motion abnormalities in vascular territories.

2.1. Patient selection

Emergency department patients aged 18 and older who presented with ongoing chest pain suspected to be due to ongoing cardiac ischemia by the primary provider based on history, examination, and clinical findings between August 1, 2013, and January 15, 2014, whereas any of the above 3 providers were working clinically in the ED. Patients were excluded if they had a STEMI on their ECG, known history of coronary artery disease, or had a cardiac arrest.

2.2. Data collection

Patient demographics, medical history, and clinical presentation were documented, along with ECG results, cardiac enzyme results, and video clips of their bedside echocardiograms.

2.3. Technique

All POC echocardiograms were performed using a phased array transducer (5-1 MHz) attached to a SonoSite M-Turbo ultrasound system (Bothell, WA). The heart was examined using 3 standard cardiac views (parasternal long, parasternal short, and apical 4-chamber axes).

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The examinations were focused on specific and isolated assessment of RWMAs rather than comprehensive evaluation. In each case, the ED provider made rapid assessments of global systolic function, the absence or presence of pericardial effusion, basic assessment of ventricular size rations, and global assessments for RWMAs. The traditional 17 wall motion segments were simplified into a modified 3-area evaluation corresponding roughly to coronary artery perfusion territories based on American Society of Echocardiography (ASE) guidelines and cardiac magnetic resonance imaging data of patients with acute coronary ischemia (Fig. 1) [6,7]. Although there is significant overlap in perfusion supply to these territories, the simplified ASE-based color scheme was chosen to provide the most representative example for teaching. Regional wall motion abnormalities were identified as dichotomously present or absent rather than a graded scale.

2.4. Case 1

A 55-year-old man with a history of hypertension, hyperlipidemia, and smoking presented with acute onset intermittent substernal chest pain for approximately 2 hours before arrival. A prehospital ECG showed nonspecific ST changes, and he received 2 sublinguial nitroglycerin tablets that reduced but did not eliminate his pain. In the ED, he was hemodynamically stable but continued to have intermittent chest pain. A repeat ECG confirmed anterior and lateral ST depressions with dynamic T waves (Fig. 2). A POC echocardiogram was performed by the ED provider that showed a large anterior wall RWMA on parasternal long and short views (Video). The interventional cardiologist was contacted before the resulting of his cardiac markers. The patient was taken to cardiac catheterization, where he was found to have a 99% left anterior descending (LAD) artery occlusion that was successfully stented with full reperfusion. His first troponin level resulted at 1.2 ng/L just before the patient was transported to cardiac catheterization. The second set of cardiac markers (sent just before cardiac catheterization) resulted at 26 ng/L. A repeat echocardiogram 1 month later showed excellent cardiac function with an ejection fraction of 50%.

2.5. Case 2

A 37-year-old man with a history of hypertension, hyperlipidemia, and smoking presented with 1 week of progressively worsening and more frequent left-sided chest pressure lasting 30 to 60 minutes, associated with nausea and diaphoresis. His initial ECG was abnormal with lateral ST depressions and inverted T waves that were new compared with a prior ECG from 6 months ago. His pain resolved with medications given in the ED. An initial bedside echocardiogram by the ED providers documented a hypokinetic infero-posterior wall. His initial troponin result was 1.05 ng/L. A repeat ECG showed resolution of his changes after his pain resolved. The case was discussed with cardiology, who recommended only pain and blood pressure control. A second troponin sent 5 hours later increased to 2.10 ng/L. At that time, a formal echocardiogram was performed, and the patient was taken to the cardiac catheterization laboratory, where he was found to have 99% stenosis of his right coronary artery that was successfully stented. One month after discharge, the patient reports no exertional dyspnea or angina.

2.6. Case 3

A 64-year-old man with type 2 diabetes mellitus and hyperlipidemia presented 6 hours of ongoing substernal chest pressure with associated dyspnea. His initial ECG showed sinus bradycardia with lateral ST depressions and inferior T-wave inversions. An ED echocardiogram performed at that time showed RWMAs in the inferior wall. Cardiology was consulted and recommended medical management with aspirin, heparin, and pain control. His first troponin resulted 1 hour after arrival at 0.6 ng/L. He continued to have stuttering chest pain symptoms in the

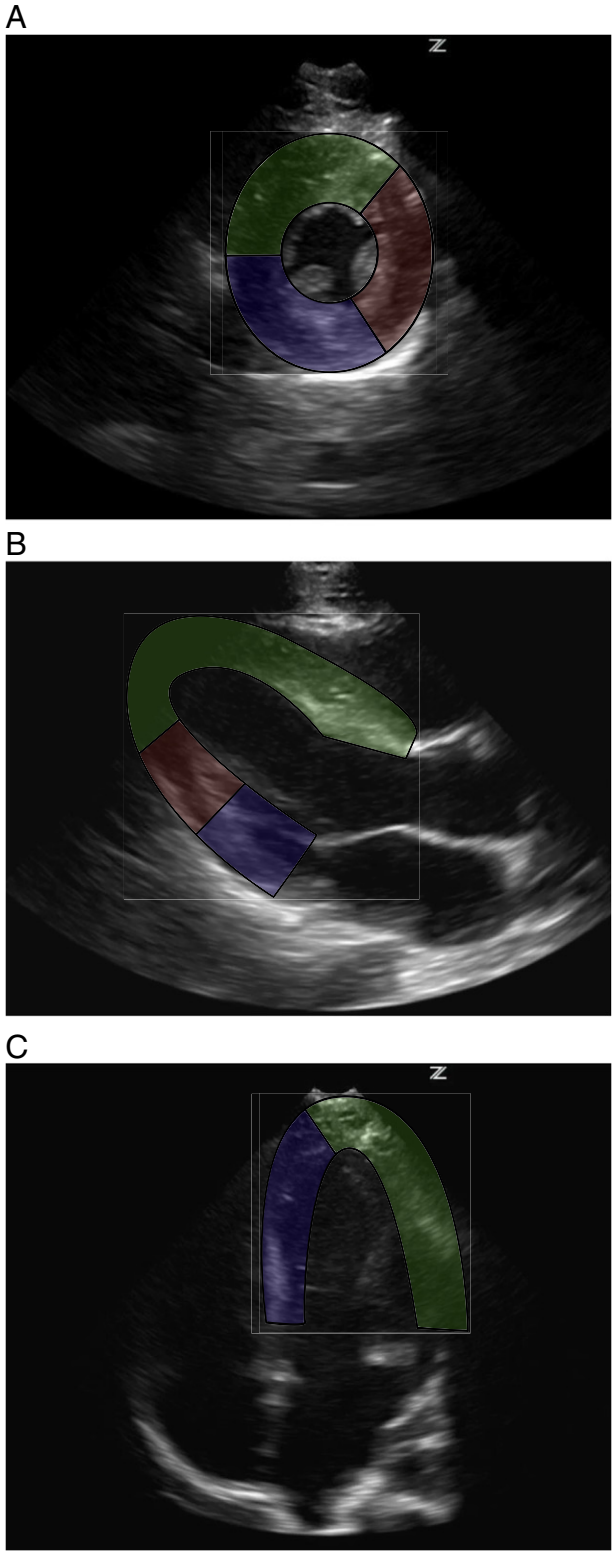

Fig. 1. Simplified, color-coded map for localizing RWMAs as seen on POC echocardiography in standard parasternal short-axis (A), parsternal long axis (B), and apical 4-chamber views (C). Green represents anterior, anterolateral, and ateroseptal segments; blue represents basal and inferior septal segments; and red represents anterolateral and inferolateral segments. Although there is significant individual variation in perfusion territory, with rough approximations, green roughly represents LAD artery distribution, red the circumflex distribution, and blue the right coronary artery distribution.

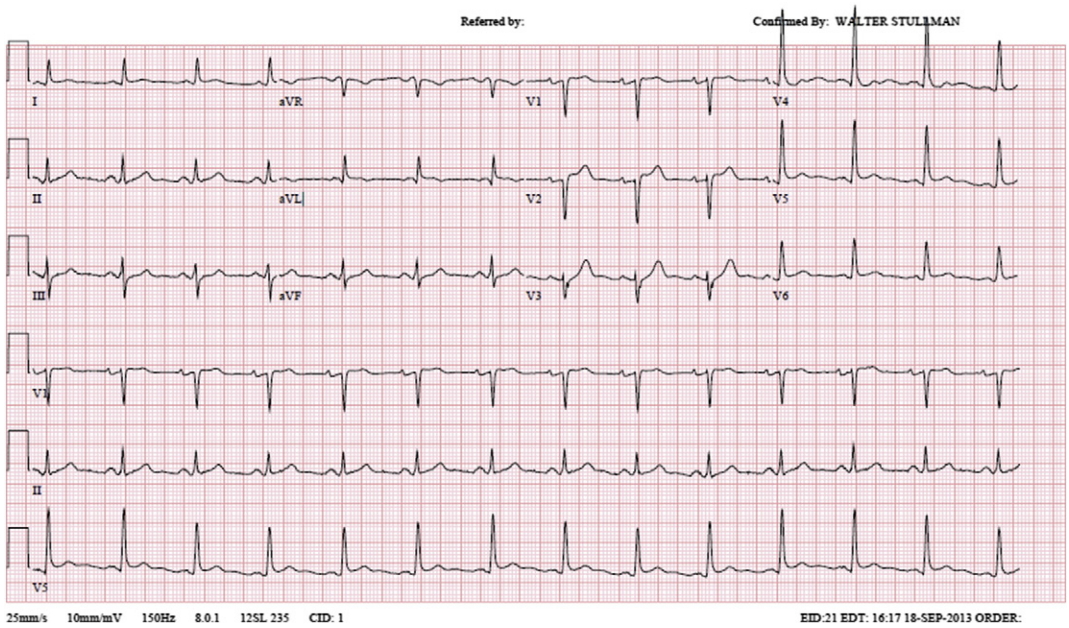

Fig. 2. Electrocardiogram of patient with subtle ST changes in anterior and lateral leads who had a 99% occlusion of the LAD coronary artery.

ED that resolved with more pain medication. A repeat troponin 4 hours later resulted at 15.9 ng/L. The patient was taken to cardiac catheterization after recognition of the rising markers and found to have significant stenosis in his right coronary and circumflex arteries. Both were successfully stented without complications.

3. Discussion

Identifying patients with UA/NSTEMI who benefit from early invasive strategies remains controversial. Patients with high-risk clinical features likely benefit from more aggressive and invasive treatment, but identifying this subset of patients is clinically challenging. Current recommendations based on ECGs and clinical features are often insensitive in detecting patients at high risk, and serial cardiac markers require significant time delays. Although prior early echocardiographic studies evaluating ED patients performed by cardiologists and echocardiography technicians have shown significant promise of RWMAs to delineate risk, no such study has been performed to our knowledge by ED providers.

There are significant potential limitations to using POC echocardiography for the purpose explored in this article. Often, there is limited ability to obtain adequate views based on body habitus and the inability to improve patient positioning in the acute setting that can limit its usefulness. In these cases, it appears that it may add little to current management strategies for these patients. In addition, obtaining an adequate study requires additional clinician time, although in our experience, identifying large RWMAs takes less than 5 minutes if adequate views can be easily obtained. Finally, differentiating RWMAs due to acute occlusion vs a prior lesion can prove quite difficult even in the hands of a skilled operator. Although, in general, clues regarding the degree of remodeling can be used, this study did not include any patients with prior infarction. Any attempt to further study the use of POC echocardiography for this purpose will have to account for how to differentiate these patients.

Here, we describe the use of POC echocardiography by ED providers using a simplified model for identifying RWMAs. Large territories of myocardium at risk were identified by the ED providers based on a simplified 3-region dichotomized evaluation. This evaluation could help define the high-risk patient population that is often difficult to identify in a timely fashion with current testing. These patients appeared to benefit from early invasive treatment for occlusive thrombi in their coronary arteries.

Based on these cases, we hypothesize that, in patients without prior histories of coronary atherosclerosis, trained ED providers can identify large RWMAs and help prognosticate large areas of myocardium at risk. Although helpful in these cases, further investigation is needed to evaluate the performance of the simplified RWMA model compared with the traditional, more detailed standard version. Additional studies are also needed to better delineate the sensitivity and specificity of bedside echocardiography performed by ED physicians for patients with UA/NSTEMI in comparison with more traditional methods of evaluating risk.

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.ajem.2014.03.003.

References

[1] 2012 Writing Committee Members, Jneid H, Anderson JL, et al. 2012 ACCF/AHA Focused Update of the Guideline for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction (Updating the 2007 Guideline and Replacing the 2011 Focused Update): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Circulation 2012;126(7):875–910. http://dx.doi.org/10.1161/CIR.0b013e318256f1e0.

[2] Sabia P, Afrookteh A, Touchstone DA, Keller MW, Esquivel L, Kaul S. Value of regional wall motion abnormality in the emergency room diagnosis of acute myocardial infarction. A prospective study using two-dimensional echocardiography. Circulation 1991;84(3 Suppl):I85.

[3] Fleischmann KE, Fleischmann KE, Lee TH, et al. Echocardiographic prediction of complications in patients with chest pain. Am J Cardiol 1997;79(3):292–8.

[4] Kontos MC, Kontos MC, Arrowood JA, et al. Early echocardiography can predict cardiac events in emergency department patients with chest pain. Annals of Emergency Medicine 1998;31(5):550–7.

[5] Kerwin C, Tommaso L, Kulstad E. A brief training module improves recognition of echocardiographic wall-motion abnormalities by emergency medicine physicians. Emerg Med Int 2011;2011:483242. http://dx.doi.org/10.1155/2011/483242.

[6] Ortiz-Pérez JT, Rodríguez J, Meyers SN, Lee DC, Davidson C, Wu E. Correspondence between the 17-segment model and coronary arterial anatomy using contrast-enhanced cardiac magnetic resonance imaging. JACC: Cardiovascular Imaging 2008;1(3):282–93. http://dx.doi.org/10.1016/j.jcmg.2008.01.014.

[7] Cerqueira MD. Standardized Myocardial Segmentation and Nomenclature for Tomographic Imaging of the Heart: a statement for Healthcare Professionals From the Cardiac Imaging Committee of the Council on Clinical Cardiology of the American Heart Association. Circulation 2002;105(4):539–42. http://dx.doi.org/10.1161/hc0402.102975.