HOW DO YOU KNOW IF A PATIENT HAS ACS?

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INTRODUCTION

Aggressive intervention, including fibrinolytic therapy and mechanical revascularization, has been demonstrated to reduce mortality and minimize left ventricular damage consistently when initiated early after the onset of symptoms from acute myocardial infarction (AMI). The need for urgent diagnosis and intervention has prompted many institutions to explore alternate methods for rapid screening of patients who present to the emergency department (ED) with chest pain or other symptoms that might be caused by an acute coronary syndrome (ACS), including the development of specialized treatment centers.

Some EDs focus strictly on the initial triage and treatment of possible AMI patients. Others provide comprehensive diagnostic testing designed to detect AMI and ACS using short term observation, serial ECGs, and biochemical markers of myocardial injury. If AMI and unstable angina are ruled out, some units perform provocative exercise or pharmacological testing using electrocardiography, echocardiography, or radionucleide perfusion imaging as endpoints. Some institutions provide a wide range of therapeutic alternatives for AMI patients, including primary coronary intervention (PCI). Others provide only pharmacological management such as fibrinolysis, heparin, aspirin, beta blockade, glycoprotein IIb/IIIa inhibitors, and clopidogrel. Many institutions have also implemented extensive marketing and community outreach public education programs.

The purpose of this presentation will be to review problems in the traditional triage and treatment of patients who present to the ED with chest pain that may be caused by AMI or ACS, and to illustrate a comprehensive institutional approach to the problem using critical pathways, checklists, and the quality improvement process.

PROBLEM IN THE TRADITIONAL TRIAGE AND TREATMENT OF ED PATIENTS WITH CHEST PAIN

Approximately 7.5 million Americans have had an AMI [1] and there are an estimated 1.1 million new cases each year (FIGURE 1). [2] A variety of treatment options including fibrinolysis, antiplatelet therapy, PCI are available that can reduce mortality and morbidity, particularly for patients with acute ST-segment elevation myocardial infarction (STEMI), but the effectiveness of these therapies diminishes rapidly within the first several hours following symptoms onset. [3]

The traditional evaluation of ED patients with chest pain or other symptoms suggesting acute cardiac ischemia relies heavily on the patient's history, physical examination, and the ECG (FIGURE 2). This approach not infrequently fails to identify a small percentage of patients who are actually suffering an acute MI,

resulting in an inappropriate discharge home from the ED. Such "missed MI" patients are at relatively high risk of death and/or complications for the next 4 to 6 weeks following ED discharge. [2, 4, 5]

ALTERNATIVE SOLUTIONS
(CRITICAL PATHWAYS, OBSERVATION UNITS, MULTIPLE DIAGNOSTIC TECHNOLOGIES)

At the University of Cincinnati, a pioneering strategy was developed during the early 1990s that designated a "Heart ER" as a specialized section of the ED.[6] Low-risk patients are evaluated with serial markers and ECGs for a 9-hour observation period, following which, if the workup is negative an echocardiogram and a treadmill exercise test is performed in the ED. Patients are treated and billed as an outpatient at a cost less than half that of patients who are admitted and evaluated in a more traditional fashion.

The Brigham & Women's Hospital uses a critical pathway approach for evaluating and treating patients with chest pain. The pathways start in the ED and continue through the patient's hospitalization. One of the most innovative components of this system is a series of pre-printed order sets and "checklists" that remind physicians, nurses, and other healthcare professionals of the institution's pathways.
In 1994, the Virginia Commonwealth University Health System's Medical College of Virginia (MCV) implemented a sophisticated approach to the triage and treatment of patients with suspected cardiac ischemia (TABLE 1). [7, 8] The strategy has three basic goals: 1) to rule out acute myocardial infarction; 2) to rule out unstable angina; and 3) to screen for the presence of clinically significant coronary artery disease in patients who are felt to be at risk.

All patients with chest pain are brought directly into the acute ED treatment unit and get an immediate ECG by nurses. The attending emergency physician is shown the ECG, takes a brief history and examines the patient, and makes an immediate triage decision that assigns patients to one of the five "levels or tracks" (TABLE 1).

TABLE 1:
MCV chest pain evaluation

Level	AMI risk	ACS risk	Strategy	Disposition
1	Very high	Very high	Fibrinolysis &/or PCI	CCU
2	High	High	Heparin, ASA, NTG, GP IIb/IIIa inhibitors, clopidogrel	CCU
3	Moderate	Moderate	Markers, nuclear imaging	9h observation
4	Low	Moderate or low	Nuclear imaging	Home, outpatient stress test
5	Very low	Very low	As needed	Home

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Patients with an obvious AMI or unstable angina are treated promptly in the ED and transferred to the coronary care unit or cardiac catheterization laboratory for further care. Less obvious cases are “fast-tracked” in the coronary care unit with a rest, radionucleide imaging study, serial ECGs and serum markers. The latter two are used in most institutions with chest pain center evaluations. Further evaluation is performed as indicated, including stress testing or cardiac catheterization. Atypical low risk cases have a nuclear imaging agent injected as early as possible after ED arrival. If the gated radionucleide rest study demonstrates evidence of cardiac ischemia or impaired left ventricular function, the patient is admitted to the coronary care unit on a “fast-track” rule out MI protocol. If both studies are negative, the patient is sent home and returns the next day for an exercise radionuclide test.

Recently, 80-lead body map ECG imaging has been added to the armamentarium of diagnostic studies available in our ED. Body surface mapping can be used in chest pain patients presenting to the emergency department to: 1) determine the location and size of the MI; 2) select a reperfusion therapy; and 3) monitor the efficacy of treatment. Our current system uses 80 leads (64 on the chest and 16 on the back) to collect data. The ECG system leads are screen-printed in conductive silver ink onto a disposable vest made up of clear plastic strips that combine at the base to form a single connection. The vest is applied by removing a paper backing to reveal self-adhesive pads at each electrode site. The strips can be positioned and secured in 5-7 minutes, just a few minutes longer than the time needed to acquire a standard 12-lead ECG.

After the strips are in place, the vest is connected to the computer diagnostic unit, and data collection begins. All 80 leads are recorded simultaneously. The device measures the degree of ST-segment elevation or depression in each of the leads and uses algorithms to develop a 3-dimensional representation of the human torso on a computer screen. The torso will remain green in color if there is no significant ST-segment elevation or depression, as would be the case in a normal, healthy individual. Deviations from the 95% confidence interval for normal values at each point on the human chest and abdomen are represented on the screen in red for ST-segment elevation, or blue for ST-segment depression. The degree of ST-segment elevation or depression is represented by the color intensity.

Anterior wall infarction is noted as a patch of red color on the anterior chest, typically with reciprocal, blue ST-segment depression over the back. Inferior wall infarction is noted as a patch of red across the inferior abdomen, often with reciprocal ST-segment depression (blue) anteriorly and/or laterally. Posterior involvement is noted as a patch of red over the back, and right ventricular involvement is noted as a red area over the right chest and in the right axilla. A recent multicenter study has confirmed that the 80-lead body map ECG system is

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capable of detecting lateral, posterior, and right ventricular MI's that are not noted on conventional 12-lead ECGs. [9]

The quality improvement process can optimize each institution's strategy
The key to success with any institutional ACS strategy is the creation of a multi-disciplinary team that can effect change, collect and analyze outcomes data, and constantly fine-tune the critical pathways based on quality improvement principles. At the Medical College of Virginia, our Acute Coronary Treatment (ACT) team meets twice a month. Its membership includes physicians and nurses from the ED, CCU, laboratory, and nuclear medicine. Two technicians collect data on all ED chest pain patients and enter it into a Microsoft Access database. These data are used to modify the program's critical pathways over time.

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