Cardiac MRI in the Emergency Room

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Background: In 2006 in the United States alone, there were approximately 6 million emergency room evaluations for chest pain and related symptoms -- the second most common chief complaint in the ER. During the same time period, MRI for any indication was performed in approximately 621,000 patients during their emergency department visit. Acute coronary syndrome (ACS) encompasses ST elevation myocardial infarction (STEMI), non-ST elevation MI (NSTEMI), and unstable angina. ACS thus accounts for many of the high mortality diagnoses encountered in the emergency department. Failure to diagnose MI is a leading cause of medical malpractice for emergency room physicians.

Methods: Cardiac MRI can evaluate a wide range of parameters useful in diagnosing and risk stratifying patients with possible acute coronary syndrome. Cine MRI can accurately image global and regional left ventricular function. MRI can detect perfusion defects causing acute myocardial infarction (MI) or microvascular obstruction after reperfused MI. Stress MRI can detect significant narrowing or stenosis of the coronary arteries. T2-weighted MRI can detect myocardial edema associated with many conditions including acute or recent myocardial infarction. Early and late gadolinium enhancement images can detect and characterize acute myocardial infarction. Coronary MR angiography, while not as well developed as competing CT technology, can detect coronary stenosis. Thus, cardiac MRI has a wide range of cardiac imaging tools that are well suited to diagnosing and triaging patients with possible ACS

Clinical Trials: Almost all aspects of the cardiac MRI exam have been shown to have high diagnostic accuracy and prognostic value. While fewer studies have applied cardiac MRI to patients with possible ACS, all of these studies had excellent diagnostic accuracy. Kwong et al showed that cardiac MRI had 100% sensitivity for acute MI and 84% sensitivity for ACS (including unstable angina). Plein et al found that adenosine stress MRI was the most sensitive portion of the MRI scan for ACS but that coronary MR angiography was a close second in diagnostic accuracy. In that study, a combined analysis of diagnostic quality portions of the multimodality exam improved the sensitivity of the MRI scan to 95% while maintaining good specificity. Cury et al confirmed the findings of Kwong et al but took a major step forward for documenting that T2-weighted MRI and other factors could be used to differentiate acute from chronic wall motion abnormalities. Thus, MRI specific characterization improved the specificity of the overall results significantly. More recently, Miller et al showed that MRI could reduce costs of managing patients in a chest pain center in a randomized controlled study. Cardiac MRI is also useful in diagnosing a wide range of atypical presentations of chest pain including troponin (+) coronary angiography (-) chest pain which is most commonly due to myocarditis.

Conclusions: Cardiac MRI is capable of diagnosing and triaging patients with possible or probable ACS. It has substantial advantages in terms of the lack of radiation compared with CT or nuclear imaging (SPECT). However, there are substantial infrastructure hurdles to overcome. Even though MRI is already used in ~600,000 emergency room patients per year, handling some significant fraction of the ~6 million US patients with chest pain each year will require a major deployment in scanners and cardiac MRI specific expertise.