MRI "Triple Rule-Out": MRI for Acute Chest Pain Evaluation

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Purpose: The purpose of this educational exhibit is to review the indications, sequences, and findings of (1) acute pulmonary embolism, (2) acute aortic syndrome, and (3) ischemic heart disease. In addition, we will review the current evidence available on the accuracy of MRI for making the correct diagnosis of these causes of acute chest pain.

Background: Acute chest pain is a very frequent indication for presentation to the emergency department, for which three critical diagnoses – (1) pulmonary embolism (PE), (2) aortic dissection (AD), and (3) myocardial infarction (MI) – require rapid and accurate diagnosis. Computed Tomography Angiography (CTA) plays an integral role in the initial diagnosis and management of patients with PE and AD. CTA is also indicated to evaluate for coronary artery disease (CAD) in patients with an intermediate pre-test probability of CAD and who initially do not have laboratory or electrocardiographic findings of acute MI. This has led to the greater use of thoracic CTA to rapidly and accurately exclude these three deadly causes of acute chest pain ("triple rule-out"). As a result of improvements in MRI techniques and a growing awareness of the radiation risks of CT, MRI is being used more frequently in the diagnostic work-up of younger, hemodynamically stable patients with acute chest pain in the emergency department.

Outline of Content:

1. MRI for PE (Figure 1)
    a. What are the limitations of CTA for PE?
    b. How are whole chest coverage and isotropic, high-spatial resolution achieved in a very rapid image acquisition?
    c. What artifacts are frequently encountered with pulmonary MRA?
    d. What data have been published on the role of MRA for PE?
2. MRI for AD (Figure 2)
    a. What are the differences between AD, intramural hematoma (IMH) and penetrating atherosclerotic ulcer (PAU)?
    b. What MRI techniques are used for diagnosing AD, IMH and PAU?
        i. Can non-contrast-enhanced MRA techniques be used?
    c. What does the referring clinician need to know in patients with AD?
3. MRI for MI (Figure 3)
    a. When should MRI be performed in patients with acute MI?
        i. How are T2-weighted and delayed myocardial enhancement techniques used to determine prognosis?
    b. How is myocardial stress-rest perfusion imaging used for patients with intermediate pre-test probability of CAD?
    c. How is acute MI differentiated from myocarditis and Takotsubo cardiomyopathy?
    d. When is coronary MRA indicated for patients with CAD?

Summary: Although CTA remains the "gold standard" for the diagnosis of pulmonary embolism and aortic dissection and catheter angiography is indicated in patients with acute MI, MRI is increasingly being used to evaluate patients presenting to the emergency department with acute chest pain. This is particularly true for the work-up of younger patients in whom minimizing exposure to ionizing radiation is important. For patients with acute myocardial infarction, MRI is currently the standard of reference for determining infarct size, which is critical in determining prognosis.

Figure 1 – 33 year-old female with acute left lower lobe pulmonary embolus (arrow).

Figure 2 – 67 year-old male with acute descending aortic dissection (arrow).

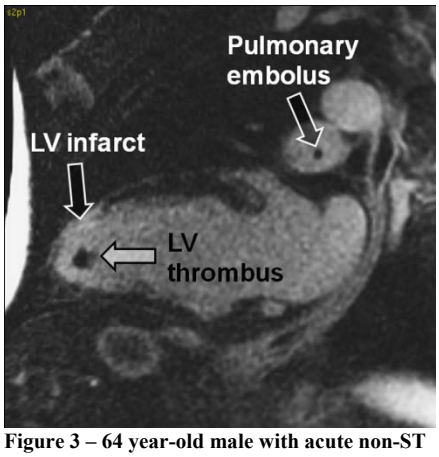

Figure 3 – 64 year-old male with acute non-ST elevation myocardial infarction in the left ventricular (LV) apex, LV thrombus and pulmonary embolus.