CME-SAM EXAMINATION ANSWER KEY – 28:2
“Delayed Enhancement Magnetic Resonance Imaging in Nonischemic Myocardial Disease”

The Journal of Thoracic Imaging includes CME-certified content that is designed to meet the educational needs of its readers. This article was certified for 1.5 AMA PRA Category 1 Credits™. This activity was available for credit through March 31, 2014.

LEARNING OBJECTIVES

After completing this CME-SAM activity, physicians should be better able to:

- Differentiate ischemic from nonischemic patterns of myocardial delayed enhancement
- List the most common myocardial regions that present delayed enhancement in patients with hypertrophic cardiomyopathy
- Describe how to optimize delayed enhancement imaging in patients with cardiac amyloidosis
- Learn the prognostic implication of the presence of myocardial delayed enhancement in patients with myocarditis

ANSWERS

*1. The main advantage of Phase-sensitive delayed enhancement sequence compared with standard inversion recovery gradient technique is:

A. No need for gadolinium administration
B. Less need for selection of the ideal myocardial inversion time
C. Shorter delay from contrast administration to image acquisition
D. Faster image acquisition
E. It can be performed in any cardiac plane

[Correct answer: b
Option a is incorrect. Both sequences require gadolinium administration
Option c is incorrect. The contrast delay is similar between the two techniques
Option d is incorrect. There is no difference in acquisition time between the techniques
Option e is incorrect. Both sequences can be performed in any cardiac plane]

See Reference 5 of the article for further study.

*2. In a patient with ischemic heart disease the most common delayed enhancement pattern is:

A. Subendocardial and following a coronary artery distribution
B. Subepicardial and following a coronary artery distribution
C. Midwall, not following a coronary artery distribution
D. Along the right ventricular side of the septum
E. Subendocardial, not following a coronary artery distribution

[Correct answer: a.
Option b is incorrect. Delayed enhancement due to ischemic heart disease is not subepicardial.
Option c is incorrect. Delayed enhancement due to ischemic heart disease is not in the midwall and typically follows a coronary artery distribution.
Option d is incorrect. Delayed enhancement due to ischemic heart disease does not commonly involve the right side of the ventricular septum.
Option e is incorrect. Delayed enhancement due to ischemic heart disease follows a coronary artery distribution]

See Reference 10 of the manuscript for further study.

*3. The presence of delayed enhancement in a patient with myocarditis is associated with:

A. Treatment response
B. Concomitant myocardial infarction
C. Increased mortality
D. Better long-term survival
E. A non-viral etiology

[Correct answer: c.
Option a is incorrect. There is no association between treatment response and the presence of delayed enhancement.
Option b is incorrect. The presence of delayed enhancement in myocarditis follows a noncoronary territory distribution differently from what happens in ischemic heart disease.
Option d is incorrect. Delayed enhancement in a patient with myocarditis is associated with a poor prognosis, being an independent predictor for all cause mortality and cardiac mortality.

Option e is incorrect. The presence of delayed enhancement does not help on defining the etiology.

See Reference 16 of the manuscript for further study.

*4. In patients with hypertrophic cardiomyopathy, the presence of delayed enhancement is:
   A. Commonly seen in the right side of the ventricular septum
   B. Subendocardial, in a coronary artery distribution
   C. Global and independent of the degree of myocardial hypertrophy
   D. Not associated with prognosis
   E. Seen at the junction of the right ventricular free wall with the ventricular septum

[Correct answer: e.

Option a is incorrect. Delayed enhancement in the right side of the ventricular septum is not a common finding in patients with hypertrophic cardiomyopathy.

Option b is incorrect. Delayed enhancement in patients with hypertrophic cardiomyopathy does not follow a coronary artery distribution.

Option c is incorrect. The presence of delayed enhancement is more evident in areas of more extensive myocardial hypertrophy.

Option d is incorrect. Several studies have demonstrated poor prognostic implication of the presence of delayed enhancement in patients with hypertrophic cardiomyopathy.

See Reference 22 of the manuscript for further study.

*5. Diffuse myocardial infiltration in amyloidosis can be problematic for delayed enhancement imaging because:
   A. Patients cannot receive gadolinium
   B. Images must be obtained with a higher scan delay
   C. It is difficult to detect abnormal delayed enhancement on thin ventricular walls
   D. Nulling of the abnormal myocardium may mimic a normal study
   E. Global subepicardial enhancement is difficult to separate from epicardial fat

[Correct Answer: d.

Option a is incorrect. Amyloid is not a contraindication for gadolinium.

Option b is incorrect. In cardiac amyloidosis, it has been shown that a shorter scan delay provides superior images.

Option c is incorrect. Thin ventricular walls is not a feature of cardiac amyloidosis.

Option e is incorrect. Cardiac amyloidosis does not present as global subepicardial delayed enhancement.

See Reference 30 of the manuscript for further study.

*6. On figure 13 of the manuscript, the mechanism of abnormal contrast delayed enhancement along the right ventricular free wall is increased volume of distribution of gadolinium due to:
   A. Fibrosis
   B. Inflammatory reaction
   C. Ischemic injury
   D. Viral infection
   E. Drug reaction

[Correct answer: a.

Option b is incorrect. The mechanism of delayed enhancement in arrhythmogenic right ventricular dysplasia is not related to inflammatory reaction.

Option c is incorrect. The mechanism of delayed enhancement in arrhythmogenic right ventricular dysplasia is not related to ischemic injury.

Option d is incorrect. The mechanism of delayed enhancement in arrhythmogenic right ventricular dysplasia is not related to viral infection.

Option e is incorrect. The mechanism of delayed enhancement in arrhythmogenic right ventricular dysplasia is not related to drug reaction.

See Reference 40 of the manuscript for further study.

*7. In a patient with dilated cardiomyopathy, which delayed enhancement pattern is most consistent with a nonischemic etiolog?
   A. No delayed enhancement
   B. Subendocardial
   C. Subepicardial
   D. Transmural
Correct answer: a.
Option b is incorrect. This pattern is seen in ischemic disease.
Option c is incorrect. This is an uncommon pattern and can be associated with amyloidosis or sarcoidosis.
Option d is incorrect. This is an ischemic pattern.

See Reference 11 of the manuscript for further study.

*8. Delayed enhancement and 18-FDG avidity on PET involving the right ventricular free wall are most characteristic of which disease?
   A. Amyloidosis
   B. Lyme disease
   C. Sarcoidosis
   D. Churg-Strauss syndrome
   E. Arrhythmogenic right ventricular dysplasia

Correct answer: c.
Option a is incorrect. This pattern of delayed enhancement and 18-FDG avidity is not characteristic of amyloidosis.
Option b is incorrect. This is not a common pattern in Lyme disease, which most commonly is associated with midwall left ventricular delayed enhancement.
Option d is incorrect. This is not typically seen in Churg-Strauss syndrome, which usually has patchy subendocardial, midwall, and subepicardial left ventricular delayed enhancement.
Option e is incorrect. Arrhythmogenic right ventricular dysplasia can show right ventricular delayed enhancement, but not 18-FDG avidity on PET scan.

Please see the following references for further study: