



1. The difference between the number of spins aligned with rather than against the main magnetic field is approximately what?
 - A. 1 in a 100
 - B. 1 in a 1000
 - C. 1 in a 1,000,000
 - D. 1 in a 1,000,000,000
2. T2 relaxation describes what?
 - A. Loss of longitudinal magnetization
 - B. Loss of transverse magnetization
 - C. Regrowth of longitudinal magnetization
 - D. Regrowth of transverse magnetization
3. Of the following traditional sequences, which is a common choice for suppressing signal from fat?
 - A. Spin echo
 - B. Phase contrast
 - C. Inversion recovery
 - D. Gradient echo
4. A spin echo is formed by:
 - A. Applying a negative magnetic field gradient
 - B. Flipping magnetization using a second radiofrequency pulse
 - C. Saturating magnetization from fat
 - D. Reversing the direction of the B0
5. An advantage of parallel imaging includes:
 - A. Increasing phase encoding steps
 - B. Generating more signal while reducing noise
 - C. Reduction of aliasing artifacts
 - D. Reduction of susceptibility artifacts
6. Parallel imaging gains speed by:
 - A. Sacrificing spatial resolution
 - B. Sacrificing temporal resolution
 - C. Sacrificing SNR
 - D. Sacrificing reconstructed field-of-view
7. Your patient complains of chest pain and shortness of breath following the vasodilator stress perfusion sequence. Telemetry is notable for complete heart block. What is the most appropriate next course of action?
 - A. Immediately move the patient to Zone 4 to begin resuscitation
 - B. Give oxygen, IV epinephrine and abort study
 - C. Reassure patient, observe and continue study
 - D. Give IV aminophylline and reevaluate
8. In what outpatient clinical situation are invasive coronary angiography and stress MRI considered equivalent as appropriate modalities for risk stratification?
 - A. Symptomatic, high pre-test probability of CAD, interpretable ECG and able to exercise
 - B. Asymptomatic, high global CAD risk, uninterpretable ECG, unable to exercise
 - C. Symptomatic, intermediate pre-test probability of CAD, uninterpretable ECG, able to exercise
 - D. Symptomatic, low pre-test probability of CAD, interpretable ECG, unable to exercise
9. Which is true regarding phase contrast velocity mapping?
 - A. It involves an equal and opposite phase shift

- B. The magnitude image contains useful data on flow
- C. In-plane velocity mapping can provide quantification of flow
- D. Slower moving blood/protons undergo a greater phase shift than faster moving blood/protons

10. Which of the following is true regarding potential errors in CMR flow assessment?

- A. Background phase shift errors occur because of turbulent flow in high velocity jets.
- B. Aliasing occurs when the velocity exceeds the chosen velocity range.
- C. The velocity of small, very high velocity jets can usually be measured accurately.
- D. Partial volume effects/errors occur more frequently with through plane imaging than for in-plane imaging.

11. If parallel imaging is increased to reduce the scan time for cine imaging, what is the effect on the resultant image?

- A. Decrease in spatial resolution
- B. Decrease in signal to noise ratio
- C. Increase in spatial resolution
- D. Increase in temporal resolution

12. What is the best strategy to use for cine imaging in a patient with isolated ectopic heartbeats?

- A. Retrospective gating
- B. Prospective triggering
- C. Retrospective gating with arrhythmia rejection
- D. Real time imaging

13. A 55 year-old man presents with moderate concentric left ventricular hypertrophy, but normal left ventricular

size and ejection fraction 62%. On CMR parametric mapping tissue characterization, the septum showed normal T2 and T2* values, low native T1 values and normal extracellular volume (ECV) values. The most likely diagnosis is:

- A. Hypertrophic cardiomyopathy
- B. Cardiac Amyloidosis
- C. Anderson-Fabry disease
- D. Myocardial iron overload

14. A 78 year-old man presents with 8 months of progressive shortness of breath and significant renal failure. CMR reveals small bilateral pleural effusions and a small pericardial effusion. There was moderate-severe concentric left ventricular hypertrophy (septum measuring up to 20 mm) with a left ventricular ejection fraction of 68%. Parametric mapping showed global LV native T1 values of 1100 ms (normal range 960 +/- 25 ms), and global T2 values of 54 ms (normal range 48 +/- 3 ms). No gadolinium-based contrast agent was administered for contrast-enhanced imaging. The most likely diagnosis is:

- A. Hypertrophic cardiomyopathy
- B. Myocarditis
- C. Cardiac Amyloidosis
- D. Anderson-Fabry disease

15. What is the threshold percentage of late gadolinium enhancement that has been associated with an increased risk of sudden cardiac death in patients with hypertrophic cardiomyopathy?

- A. 50
- B. 20
- C. 15
- D. 5

16. What is the best technique to identify mural thrombus?
- A. First pass perfusion imaging
 - B. Late Gadolinium Enhancement
 - C. Cine Gradient Echo Imaging
 - D. T1W imaging
17. What is the whole body SAR (specific absorption rate) limited to if an MRI system is operating in "first level controlled"?
- A. 2W/Kg
 - B. 4W/kg
 - C. 0.5 degree Celsius temperature rise
 - D. 2KW/kg
18. In the American College of Radiology Guidelines what does 'Zone 4' within in an MRI Department refer to?
- A. The room containing the MRI magnet
 - B. The area open to the general public outside the MRI environment
 - C. The equipment room
 - D. The control room
19. Scanning patients with MRI-conditional implantable cardiac electronic devices does NOT generally require:
- A. Knowledge of the pacemaker leads manufacturer and model
 - B. Device re-programming
 - C. Chest X ray prior to MRI
 - D. External defibrillator and CIED programmer to be available
 - E. Monitoring with continuous ECG and pulse oximetry
20. Artifact in CMR images in CIED patients:
- A. Is similar in pacemakers and defibrillators
 - B. Is similar in MR conditional and non-MR conditional devices
 - C. Is worse with inspiration
 - D. Is better with steady state free precession cine imaging compared with spoiled gradient echo cine imaging
 - E. Can be improved on late gadolinium imaging by reducing the bandwidth of the inversion prepulse
21. Which of the following is TRUE about LGE (late gadolinium enhancement)?
- A. The usual reason for LGE is intracellular uptake of Gadolinium
 - B. Subendocardial diffuse pattern of LGE is pathognomonic for cardiac amyloid
 - C. LGE in basal septum is pathognomonic for cardiac sarcoid
 - D. Extent of LGE in HCM provides prognostic information as to the arrhythmic risk of SCD (sudden cardiac death)
 - E. Fatty metaplasia in the myocardium appears bright due to extensive Gd uptake by fat's T1 properties
22. What is the most common benign tumor of the cardiac valves?
- A. Myxoma
 - B. Fibroelastoma
 - C. Fibroma
 - D. Angiosarcoma
23. In the context of the differential diagnosis between athlete's heart and cardiomyopathies, which of the following features is suggestive of cardiomyopathy?
- A. Ratio of LV-to-RV end-diastolic volume=1
 - B. LVH with concomitant LV dilatation
 - C. Asymmetric LVH

D. Absence of LGE

24. Which of the following features is a physiological cardiac adaptation to regular sport activity?

- A. Predominant LV dilatation
- B. Predominant RV dilatation
- C. Balanced RV and LV dilatation
- D. Sub-epicardial LGE

25. What scanner should T2* mapping for iron overload be performed?

- A. At 3 Tesla scanner
- B. At 1.5 Tesla scanner
- C. At 1.5 or 3.0 Tesla scanner
- D. At any scanner irrespective of the static field

26. How many echoes should the multi-echo T2* gradient-echo sequence have?

- A. At least 8 equally spaced echoes from 2 to 18ms
- B. Less than 8 equally spaced echoes
- C. At least 8 equally spaced echoes
- D. The number of echoes are irrelevant

27. A 25 year old female is referred for further assessment of a patent ductus arteriosus diagnosed on echocardiography after a murmur was noted on physical examination. Phase contrast flow analysis on CMR reveals the following information.

Main pulmonary artery:

HR 50 bpm

Antegrade flow 60 ml/beat, no retrograde flow.

Ascending aorta:

HR 80 bpm

Antegrade flow 80 ml/beat, no retrograde flow.

What is the approximate shunt flow across the PDA (Qp:Qs rounded to one decimal place)?

- A. Qp:Qs 0.8:1

B. Qp:Qs 1.3:1

C. Qp:Qs 0.5:1

D. Qp:Qs 1.9:1

28. The developmental abnormality that gives rise to a sinus venosus defect is best imaged in the following cine SSFP view:

- A. 4-chamber view demonstrating atria and ventricles
- B. right ventricular 2 chamber view demonstrating right atrium and right ventricle
- C. left ventricular 2 chamber view demonstrating left atrium and left ventricle
- D. axial stack covering great vessels (superior vena cava, aorta, pulmonary arteries) and atria

29. Which of the following can be assessed well using CMR in a patient with aortic stenosis?

- A. Left ventricular pressure
- B. The presence of Infective vegetations on the aortic valve
- C. Calcification of the valve and coronary arteries
- D. Valve orifice area by direct planimetry

30. Which of the following is true in the CMR assessment of valve disease?

- A. Multiple valve lesions cannot be assessed
- B. Most prosthetic valves are unsafe in the MR scanner
- C. Good visualization and assessment of the pulmonary valve can usually be obtained
- D. Pulmonary stenosis cannot be assessed well

31. Acute aortic dissection on SSFP cine images can be identified based on which finding?

- A. Direct visualization of the dissection flap
- B. Poor enhancement of the false lumen
- C. High signal intensity in the aortic wall
- D. Abnormal vessel wall distensibility

32. What CMR sequence can establish the diagnosis of an acute aortic intramural hematoma?

- A. First pass perfusion imaging
- B. T1-weighted black-blood
- C. T2-weighted black blood
- D. Late gadolinium enhancement
- E. Steady state free precession

33. For which of the following applications does CMR not have a clinical indication?

- A. Evaluation of anomalous coronary arteries
- B. Assessment of coronary stenosis
- C. Imaging of coronary artery aneurysms
- D. Assessment of aortocoronary bypass grafts

34. For coronary arteries MR imaging in patients with high heart rate (>90 bpm), what would the optimal time for data collection be?

- A. 150 ms after the QRS
- B. Early-diastole
- C. End-systole
- D. Mid-diastole

35. An indication for contrast-enhanced peripheral MRA is:

- A. Left leg weakness
- B. Claudication, plan for revascularization
- C. Giant cell arteritis
- D. AV graft failure in ESRD

36. A type of non-contrast MRA is:

- A. TWIST
- B. CEST
- C. Bolus-chase
- D. QISS

37. What is Swyer-James-MacLeod?

- A. Congenital tricuspid atresia associated with pulmonary hypertension
- B. Unilateral pulmonary vascular hypoplasia and unilateral bronchiectasis
- C. Pulmonary-bronchial fistula
- D. Partial anomalous venous return into left atrium

38. What is the reserve halo sign in pulmonary embolism?

- A. Crescent shape morphology of a fresh pulmonary thrombus
- B. A morphological manifestation of pulmonary infarction
- C. Interventricular septal paradoxical motion associated with right ventricular acute overload
- D. The presence of 2 adjacent low SI structures in axial plane representing respectively a bronchus and occlusive thrombus

39. Regarding incidental findings on Cardiac MRI

- A. Incidental findings are rare (< 1%)
- B. Cardiac MR images have a limited field of view therefore visualization of non cardiac pathology is very limited
- C. Significant incidental findings can occur in as many 1 in 10 cases
- D. The liver is not a common site for incidental findings

40. Regarding detection of incidental findings on Cardiac MRI

- A. Review of prior imaging is generally not helpful
- B. A systematic checklist is critical when reviewing CMR images for incidental pathology
- C. Incidental findings are mostly inconsequential and do not need to be communicated to referring physician
- D. CMR images may show an abnormality but are not helpful in characterizing disease

41. In the context of the differential diagnosis between athlete's heart and cardiomyopathies, which of the following features is suggestive of hypertrophic cardiomyopathy?

- A. Ratio of LV-to-RV end-diastolic volume=1
- B. LVH with concomitant LV dilatation
- C. Asymmetric LVH
- D. Absence of LGE

42. Which of the following features is a physiological cardiac adaptation to regular sport activity?

- A. Predominant LV dilatation
- B. Predominant RV dilatation
- C. Balanced RV and LV dilatation
- D. Sub-epicardial LGE

1. C
2. B
3. C
4. B
5. D
6. C
7. D
8. A
9. A
10. B
11. B
12. C
13. C
14. C
15. C
16. B
17. B
18. A
19. C
20. B

21. D
22. B
23. C
24. C
25. B
26. A
27. D
28. D
29. D
30. C
31. A
32. B
33. B
34. C
35. B
36. D
37. B
38. B
39. C
40. B
41. C
42. C