Continuing Medical Education Article

Cardiac Dedicated Ultrafast SPECT Cameras: New Designs and Clinical Implications

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Disclosure
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Target Audience
This article contains information of value to physicians who interpret cardiovascular nuclear medicine procedures, technologists who perform cardiovascular nuclear medicine procedures, and nuclear medicine residents and nuclear cardiology fellows in training.

Objectives
On successful completion of this activity, participants should be able to describe:

1. The differences in imaging performance between new solid-state ultrafast cardiocentric imaging devices and conventional dual-detector rotating SPECT cameras.
2. The clinical trials that confirm the diagnostic accuracy of the new ultrafast cardiocentric imaging devices.

Questions
1. Resolution recovery/noise reduction algorithms require details of what components of the imaging system?
   A. The collimator.
   B. The detectors.
2. Why do resolution recovery/noise reduction algorithms reduce imaging time without sacrificing image quality?
   A. They increase the sensitivity of the detectors.
   B. They reduce noise.
   C. They move scattered photons into the correct location.
   D. They create smoother images.

3. How do CZT detectors improve energy resolution, compared with NaI detectors?
   A. More photons interact with the crystal.
   B. Energy is determined by averaging information from the entire crystal.
   C. The photon is directly converted to an electric pulse without scintillation.
   D. Scintillation is brighter within CZT crystals.

4. Why are some types of attenuation artifacts less of a problem with some new cardiocentric cameras?
   A. Detectors are closer to the patient.
   B. Patients are imaged upright.
   C. Photon detection is 3-dimensional.
   D. Higher-sensitivity detectors reduce attenuation.

5. What feature of new dedicated cardiac cameras may enable dynamic SPECT?
   A. Simultaneously acquired views.
   B. Faster detector response time.
   C. Faster overall acquisition times.
   D. None of the above.

6. Resolution recovery/noise reduction algorithms allow faster imaging times and are now used by most manufacturers in the reconstruction of myocardial perfusion SPECT images. What have the clinical trials shown with regard to images reconstructed with these algorithms?
A. Image quality and diagnostic accuracy are better with these algorithms than with conventional reconstruction methods.

B. Left ventricular volume and left ventricular ejection fraction are essentially identical to those obtained with conventional reconstruction methods.

C. The diagnostic accuracy of images is similar to that of images obtained with conventional reconstruction methods.

D. Image quality is improved relative to conventional reconstruction methods only if attenuation correction is used.

7. New dedicated cardiac SPECT cameras are equipped with multiple detectors designed to image the left ventricle simultaneously from multiple projections. This feature allows all of the following except:
   A. Attenuation correction without a transmission image.
   B. Consistent angular data needed for dynamic studies.
   C. Count sensitivity superior to that obtained with conventional dual-detector SPECT cameras.
   D. True 3-dimensional acquisition geometry.

8. CZT solid-state detectors outperform NaI(Tl) detectors in terms of energy resolution. Which of the following myocardial perfusion imaging protocols depends on the superior energy resolution of CZT detectors?
   A. 1-d low-dose rest/high-dose stress Tc MPI.
   B. 1-d low-dose stress/high-dose rest Tc MPI.
   C. Stress-redistribution thallium MPI.
   D. Simultaneous dual-isotope (stress thallium/rest Tc) MPI.

9. Advances in hardware and software have increased the count sensitivity of new dedicated cardiac SPECT cameras, allowing diagnostic-quality images in shorter imaging times. Which of the following statements is true?
   A. This gain in sensitivity can be traded for an exponential reduction in the injected dose to reduce the patient’s exposure to radiation.
   B. This gain in sensitivity can be traded for a linear reduction in the injected dose to reduce the patient’s exposure to radiation.
   C. Shorter imaging times result in an increased likelihood of motion artifacts.
   D. Shorter imaging times result in diagnostic-quality images only if attenuation correction is performed.
10. A nuclear cardiology laboratory now has a new dedicated cardiocentric SPECT camera and is targeting a 40% decrease in patients’ exposure to radiation. The new camera provides a 5-fold increase in count sensitivity over conventional dual-head SPECT cameras. Rest and stress conventional imaging times are 15 and 12 min, respectively. For the laboratory to achieve its goal while maintaining the same count density of the images, rest and stress imaging times should be:

A. 4.2 and 3.36 min, respectively.
B. 4.8 and 3.84 min, respectively.
C. 4.2 and 2.24 min, respectively.
D. 3.4 and 2.42 min, respectively.