Accreditation of Nuclear Medicine Facilities

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Thanks

- Nathaniel Roth, PhD – D-SPECT images
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- The technologists of Henry Ford Hospital for performing ACR imaging every quarter.
- Jeanne Moceri, CNMT – assists with the ACR process at HFH.
- Rosemary Gallagher, PhD – Digirad information

Disclaimer

- ACR physics subcommittee for nuclear medicine accreditation.
- My facility is ACR accredited for nuclear medicine, nuclear cardiology, and PET.
- I have attempted to provide accurate information. The ACR should be contacted for the most current and correct information.

Nuclear Medicine Clinical Exams Required by ACR
Module 1, Module 2, and Module 3

<table>
<thead>
<tr>
<th>Module 1 Planar</th>
<th>Module 2 SPECT</th>
<th>Module 3 Nuclear Cardiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole body or spot bone</td>
<td>Bone SPECT</td>
<td>SPECT myocardial perfusion</td>
</tr>
<tr>
<td>Select one additional study for each module</td>
<td></td>
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</tr>
<tr>
<td>Whole body bone</td>
<td>Brain SPECT</td>
<td>MUGA</td>
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<tr>
<td>Spot bone</td>
<td>Hepatic blood pool</td>
<td>Gated SPECT</td>
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<tr>
<td>Hepatobiliary</td>
<td>Liver SPECT</td>
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</tbody>
</table>
**Planar uniformity**

**Planar resolution**

**SPECT**

**Uniformity**

**Resolution**

**Contrast**

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### Common Pitfalls

- Incomplete paperwork
- Failure to read and then follow instructions
  - Acquisition of data for too many counts or
  - Wrong matrix size
  - Etc.
- Incomplete submission of data
- Submission of data that is uninterpretable
  - Overexposed
  - Color

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### Plan for a Successful Experience

- Go to the website and review the process and standards.
- Review your policies and procedures.
  - Are they current?
  - Do they meet the accrediting organizations standards.
- Start the application process
  - Make a list of what needs to be done and assign a person to follow each task.
  - Make a list of questions.
  - Set a timeline for completing the application

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### Plan for a Successful Experience

- Make sure that all routine maintenance and SPECT quality control are done prior to starting phantom studies.
- Remember that if the camera is not capable of performing a certain function, it is not required.
  - Attenuation correction on systems that only acquire 180º data
  - Planar images on the new special purpose cameras, i.e. D-SPECT and CardiArc.
- Note any deviations from the standard protocol on the camera data sheet.
ACR Quality Control Requirements

- Acceptance and annual tests
  - Performed at installation and yearly
  - May be performed by the medical physicist.
  - Alternatively, may be performed by a qualified nuclear medicine technologist or a physicist in training
    - Use protocols NEMA protocols, or
    - Protocols approved by the qualified medical physicist and the results documented in the annual report.

ACR Quality Control Requirements

- Annual performance tests for gamma cameras
  - Intrinsic and system uniformity
  - Intrinsic or system spatial resolution
  - Sensitivity
  - Energy resolution
  - Count rate parameters
  - Multiple window spatial registration
  - Formatter/Video display
  - SPECT performance
  - System interlocks

ACR Quality Control Requirements

- Dose Calibrator Performance Tests
  - “Test” measurement of battery voltage (if applicable)
  - Zero adjustment (if applicable)
  - Background adjustment
  - Constancy
  - Linearity
  - Accuracy with NIST traceable standards
  - Geometry

ACR Quality Control Requirements

- Thyroid Uptake and Counting Systems
  - ¹²³I capsule or long-lived standard calibration check
  - Count of background
  - High voltage/gain checks
  - Energy resolution
  - Chi-square test
Radionuclides

- Most facilities will have to perform phantom studies for 2 isotopes
  - $^{99m}\text{Tc}$
  - $^{201}\text{Tl}$ or $^{67}\text{Ga}$
- If only licensed for $^{99m}\text{Tc}$ or only using $^{99m}\text{Tc}$
  - AU send letter stating that only $^{99m}\text{Tc}$ is used
- New data must be submitted if a second isotope is added.

ACR Phantom Procedure

- Planar only
- SPECT and planar

Planar Only

- Acquisition of flood and resolution phantom
- Intrinsic or extrinsic
- Static acquisition
  - 5 M counts for FOV > 40 cm
  - 3 M counts for FOV < 40 cm
- Recommended Matrix
  - Uniformity: 256x256
  - Resolution: 512x512
- Display in gray scale using the full range.
**Pitfalls**

Wrong Number of Counts

<table>
<thead>
<tr>
<th>Intrinsic Calibration</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>3.1</td>
</tr>
<tr>
<td>2.6</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Wrong Window and No Curvature Correction

Resolution
Planar and SPECT Imaging

- Uniformity as previously described
- Planar resolution using the ACR phantom
  - Zoom factor of 1.33 to 1.46
  - 500 K Counts
- SPECT acquisition
  - 24 M total counts
  - Recommended Matrix: 128 x 128
  - Zoom factor of 1.33 to 1.46
  - 120-128 images over 360º
  - Display in gray scale using the full range.
- Planar uniformity
- Planar resolution
- Composite images for uniformity, resolution and contrast
- All reconstructed SPECT slices

ACR Approved SPECT Phantom

Deluxe Phantom
- Cylindrical phantom
  - Internal radius 10.8 cm
  - Internal length 20 cm
- Lower half
  - 6 pie-shaped sections of Lucite rods
  - Rod diameters: 4.8, 6.4, 7.9, 9.5, 11.1, and 12.7 mm
- Upper half
  - 6 Lucite spheres
  - Sphere diameters: 9.5, 12.7, 15.9, 19.1, 25.4, and 31.8 mm

Planar Resolution Acquisition

Scoring Criteria

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<td>All reconstructed SPECT slices</td>
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**Digirad Planar Resolution**

**Phantom Set-up**

**Option 1 – Pediatric Pallet**
- Circular orbit
- Radius of rotation: 20 cm
- Table height: -13.3 cm

**Option 2 – Imaging Table**
- Circular orbit
- Radius of rotation: 21 cm

**SPECT Phantom Set-up**

- **Vertex Plus**
  - Circular orbit
  - Radius of rotation: 20 cm
  - Table height: -9.8 cm

- **Forte**
  - Circular orbit
  - Radius of rotation: 21 cm
  - Table height: -9.7 cm

- **Vertex Cardio**
  - Roving FOV
  - Table height: -0.4 cm
  - Lateral translation: -8.2 cm

**SPECT Phantom Set-up**

- **GE Hawkeye**
  - Table height: 77
  - Radius of rotation: 21 cm
  - Circular orbit
SPECT Reconstructed Data

Composite Images

With and Without Attenuation Correction

Unacceptable Data
Images Correctly Sized

Images too Small

Images too Large

Special Purpose Imaging Devices

- Currently 2 cameras in this category
  - Spectrum Dynamics: D-SPECT
  - CardiArc: CardiARC camera
- Work with members of the committee to obtain images that are acceptable.
- Spectrum Dynamics has completed their protocol.
- CardiArc is just beginning.
D-SPECT Set-up

DSPECT Results

Current Protocol January 2010

- Flood
  - Tc-99m
  - Tl-201 or Ga-67
  - Counts to acquire
    - 5 M counts for FOV > 40 cm
    - 3 M counts for FOV < 40 cm
  - Recommended Matrix
    - Uniformity: 256x256
    - Resolution: 512x512
  - Display in gray scale using the full range.

Planar Only

Current Protocol January 2010

- Flood
  - Tc-99m
  - Tl-201 and Ga-67 if both are used
  - Counts to Acquire
    - 10 M counts for FOV > 32 cm
    - 5 M counts for FOV < 32 cm
  - Recommended Matrix
    - Uniformity: 256 x 256
    - Resolution: 512 x 512
  - Display in gray scale using the full range.
Planar and SPECT Imaging

Current Protocol

Planar resolution using the ACR phantom
- 256 x 256 matrix
- Zoom factor of 1.33 to 1.46
- 500 k Counts

SPECT acquisition
- 24 M total counts
- Recommended Matrix: 128 x 128
- Zoom factor of 1.33 to 1.46
- < 30 k cps
- Display in gray scale using the full range
  - Planar uniformity
  - Planar resolution
  - Composite images for uniformity, resolution and contrast
  - All reconstructed SPECT slices

SPECT Acquisition
- 32 M total counts
- 128 x 128 matrix
- Zoom factor of 1.4
- Display in gray scale using the full range
  - Planar uniformity
  - Planar resolution
  - All reconstructed SPECT slices with a thickness of 6.6 cm (2 slices)

Summary

- The accreditation process is a learning process.
- Attention to detail is a key for a successful application.
- Physicist should review all the phantom data
- Accreditation is useful for both the accredited facility and the patients seen in that facility.
- All of the forms and criteria shown here are available on the ACR website.

References

- American College of Radiology, Accreditation website.  [www.acr.org](http://www.acr.org)