Ultrasound QC Workshop

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Ultrasound Accreditation – ACR QC Requirements

• A QC program must be in place for each ultrasound unit.
• Must have program documentation describing the goals and responsibilities of the QC program.
• QC program must be directed by a medical physicist or the supervising radiologist/physician.
• QC testing must be done at least semiannually. Must keep documentation of QC results and corrective action on site.

Ultrasound Accreditation – Required QC Tests

• Assurance of electrical and mechanical safety.
• Photography and other hard copy recording.
• System sensitivity and/or penetration capability.
• Image uniformity.

Ultrasound Accreditation – Additional Recommendations

• Low-contrast object detectability.
• Accuracy of vertical and horizontal distance measurements (acceptance).
• For each unit, perform tests with 2 commonly used transducers of different scan formats.
• Use of a phantom is optional at this time.
ACR Recommended QC for Breast Ultrasound

- Maximum depth of visualization and hardcopy recording with a tissue-mimicking phantom.
- Image uniformity.
- Electrical-mechanical cleanliness (safety).
- Vertical and horizontal distance accuracy.
- Anechoic void perception.
- Ring down.
- Lateral resolution.
- Quality control checklist.

References – QC Testing


References – QC Testing


Where do I begin?

- What tests do you intend to perform?
- Can the tests be performed with the available equipment?
- Who will perform the tests?
- Talk to the sonographers.
Talk to the Sonographers

- Find out the most commonly used transducers and system settings.
- Find out what the user expects you to do or not to do with their systems. There are some settings the user may not want you to adjust.
- Make a list of systems and transducers with serial numbers. Most systems are on wheels and have a habit of moving around even when they're not supposed to be moved. Transducers tend to migrate as well.

Talk to the Sonographers

- Look for brightness and contrast controls on the exam monitor. Do the sonographers adjust them?
- Learn how to print an image. Does the site already have a QC program in place for the processor or laser printer?
- Find out who is responsible for calling service on these systems and make sure they know you. You should be informed if a transducer is replaced.

The QC Tests

- Check transducers carefully for cracks and delamination. Note any obvious damage to the cords and connectors of the transducers.
- Check for dusty air filters.
- Make sure the image monitors are clean.
- Check for frayed electric cables or other physical damage to the system.
- Check the working condition of the wheels and wheel locks.

Electrical and Mechanical Safety
Photography and Hardcopy Recording

- On the exam monitor, compare the test pattern or the grey bar in the patient image to that at acceptance.
- Compare the hard copy image to the exam monitor image.
- QC must be performed for the film processor or laser printer and for soft copy display monitors.

Sensitivity / Depth of Penetration

- Set the maximum transmit power, place the transmit focus at the deepest depth, and set an appropriate TGC for imaging in deep regions.
- Measure the depth at which echo signals in a tissue mimicking phantom disappear into the noise.

Uniformity

- Adjust settings to obtain as uniform an image as possible.
- Look for vertical or radially oriented lines or streaks.
- Look for horizontal bands and brightness transitions between focal zones.
Low Contrast Detectability

- An example of a phantom for low contrast detectability.
- These objects are an anechoic void, -9 dB, -6 dB, -3 dB. Diameters are 2.4 mm, 4 mm, 6.4 mm.

Vertical & Horizontal Distance Accuracy

- Vertical Criterion: 1.5% of the actual distance or 2 mm, whichever is greater
- Horizontal Criterion: 3% of the actual distance or 3 mm, whichever is greater
- Phantom also has anechoic voids, spatial resolution and ring down (dead zone) targets

Other Considerations

- The ACR recommends tests with only two transducers per system.
- Should you really ignore the other transducers? Is a visual examination sufficient?
- Would a quick uniformity image be sufficient? Would a testing device that checks for individual transducer element response be sufficient?

Quantitative QC Tests

- Most ultrasound phantom tests are extremely subjective in nature. Lack of reproducibility in the results can be a problem.
- Several groups are working on quantitative analyses of QC results. But are these methods quick to perform and easy to implement? Are these tests sufficient?
- My personal answer: Not Yet.
**Doppler Testing**

- **The ACR currently does not have any recommendations for Doppler testing.** Doppler testing requires physical measurements of hemodynamic values, not a subjective judgment of image quality.
- **Defective transducers have a large affect on accurate flow detection.**

**Doppler Tests**

- Doppler signal sensitivity
- Doppler angle accuracy
- Color display and gray-scale image congruency
- Range-gate accuracy
- Flow readout accuracy

**References – Ultrasound Accreditation**

- Program requirements can be found at http://www.acr.org/accreditation/Ultrasound/ultrasound_reqs.aspx
- Program testing instructions can be found at http://www.acr.org/accreditation/Ultrasound/qc_forms/clinical_testing_instructions.aspx

**References – Breast Ultrasound Accreditation**

- Program requirements can be found at http://www.acr.org/accreditation/breast/breast_ultrasound_reqs.aspx
References – Ultrasound Phantoms

• http://www.cirsinc.com/main_us.html
• https://www.gammex.com/catalog/default.php?cPath=21_22
• http://www.atslabs.com/
• http://www.kyotokagaku.com/products_ultr_qap.html
• http://www.fantom.suite.dk/

References – Quantitative QC

• See The Nickel and First Call Testing at http://www.4sonora.com/.
• See UltraIQ at http://www.cablion.net/EN/Producten/Radiologie/UltraIQ.htm.