



Best Practices in X-Ray and Ultrasound of Infants

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Outline

- The physicist's role in:
 - Selection for purchase
 - Equipment configuration and optimization
 - Acceptance testing
 - Developing a technique chart
 - Staff training
 - Periodic testing
 - Monitoring image quality
 - Monitoring radiation dose
- Conclusion

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Purchase Selection of X-Ray for Infants

- Understand use
 - How old will the oldest patient imaged be?
 - What is the likely workload of this unit?
 - Is use of this unit likely to change?
 - Will urgent x-rays be acquired on this unit?
 - What will the training of the people using this unit be?
- Advocate for needed features
 - Advocate for displayed dose and dose indices
 - Advocate for an appropriate service contract
- Advocate against costly extras that are not useful
- Advocate for interchangeability
 - Minimum kVp
 - Minimum mAs
 - Granularity of mAs
 - Detector size
 - Filtration options
 - Tech comfort
 - Fit with existing equipment in NICU
 - Durability
 - Resistance to liquids

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Purchase Selection of Ultrasound for Infants

- Understand use
 - How old will the oldest patient imaged be?
 - Will this unit be used in a neonatal ICU?
 - Is use of this unit likely to change?
 - What will the training of the people using this unit be?
- Advocate for needed features
 - Pediatric radiologist should be involved in transducer selection
 - Advocate for an appropriate service contract
- Advocate against costly extras that are not useful
- Advocate for interchangeability

- Sector, 4 – 12 MHz, Doppler
- Wideband array, 5 – 8 MHz
- Curved, 4 – 8 MHz
- Linear, 7 – 15 MHz, Doppler



Configuration and Optimization of Infant X-ray

- Filtration
 - Pediatric units
 - Shared-use units
- Techniques
 - Unprogrammed
 - Disable techniques that aren't needed
 - Adjust for filtration
 - May need to adjust after acceptance testing



Configuration and Optimization of Infant Ultrasound

- Pediatric radiologist will have default preferences
- Physicist should be familiar with any new/different features
- Keep a list of radiologist's original preferences for each transducer and exam type
- Physicist needs to know how to change protocols
- After use, physicist will adjust protocols for radiologist
- Find out from the vendor what the prerequisites are for exchanging a damaged transducer for a new one



Acceptance Testing of Infant X-Ray

- Test kVp accuracy down to the lowest kVp available
- Test mAs linearity down to the lowest mAs available
- If filtration can be changed, test all possible settings with an infant phantom (or 2 – 4 inches of Lucite)
- Perform any tests you need to set initial techniques
- Perform any tests you need to educate technologists on this specific unit; include tests to make graphs
- Perform all your usual x-ray tests including light field and scatter
- Program and post your technique chart
- Compare to specifications and/or contracted capabilities



Acceptance Testing of Infant Ultrasound

- Test each transducer's most common default protocol
- Also turn each feature on and off for each transducer and note changes
- Essential: uniformity, distance accuracy (both directions), near field, resolution, and monitor grayscale
- If possible also test visibility of cysts and other lesions, low contrast, and Doppler accuracy
- If possible, run through every protocol for every transducer, checking just uniformity
- Compare to specifications and/or contracted capabilities



How to Develop a Technique Chart

- Make sure filtration is as it will be, measure output; this can be used to estimate ESE
- Place low-contrast test object on detector with 1 inch (extremity) up to 5+ inches Lucite on LCTO; acquire images at multiple mAs for multiple kVp; evaluate CNR
- Work with your pediatric radiologists to agree on a reasonable balance of ESE and CNR



Staff Training for Infant X-Ray

- First gain buy-in from manager
- May have to overcome knowledge left from screen/film and CR, and teach new dose indices
- Images and graphs are extremely persuasive
- One hour once or twice a year may be sufficient
- Peer pressure is persuasive
- The easier you make it for the technologists to succeed, the more they'll cooperate



Periodic Testing of an Infant X-Ray Unit

- Make sure filtration remains close to initial value
- Test over the applicable range of kVp and mAs for that unit
- Check all of the programmed techniques
- Test programmed chest and abdomen techniques with a 2 – 4 inch thick Lucite or other infant phantom
- Perform all your usual x-ray tests including light field and scatter
- Compare measurements to acceptance test results



Periodic Testing of an Infant Ultrasound Unit

- Test each transducer's most common default protocol
- Also turn each feature on and off for each transducer and note changes
- Essential: uniformity, distance accuracy (both directions), near field, resolution, and monitor grayscale
- If possible also test visibility of cysts and other lesions, low contrast, and Doppler accuracy
- Compare with results from acceptance tests



Monitoring Image Quality of an Infant X-ray Unit

- The first week, look at every single infant image, the kVp, mAs, dose indices, and radiologists' comments on image quality in the report as well as through any other channels
- If necessary, change the settings and chart or prepare to return to train x-ray technologists again
- Join the radiography QC group and look at selected images every month
- Monitor the unit's statistics at least quarterly: reject rate, distribution of DI in sent and in rejected images



Monitoring Image Quality of an Infant Ultrasound Unit

- The first week, look at every single infant image and radiologists' comments on image quality in the report as well as through any other channels
- If necessary, discuss with pediatric radiologist changing protocols
- Join the sonography QC group and look at selected images every month



Monitoring Radiation Dose of an Infant X-Ray Unit

- For the first few weeks following any significant change, check distributions of DI, of kVp, and of mAs weekly
- If necessary, talk with the manager about training
- Monthly check distributions by DI, by kVp, by mAs, and by technologist
- A small number of technologists deviating is an opportunity for peer teaching
- Encourage radiologists to establish a policy for which infant exams will be ultrasound first



In Conclusion, Physicists Should Assist With:

Radiography

- Purchase Decisions
- Acceptance & Annual Testing
- Technique Chart Development
- Routine QC Including Image Review, Repeat Rates, and Distribution of Dose Indices
- Technologist Training and Educational Materials
- Compliance with Technique Chart

Sonography

- Purchase Decisions
- Acceptance & Annual Testing
- Routine QC Including Image Review
- Policy Development Based on ACR Appropriateness Criteria
- Appropriate Training/Apps
- Compliance with Policy

Advocating for patients and staff


