Assessing CT Image Quality and Matching Protocols Across Vendors

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Relevant Conflicts of Interest

No Relevant Conflicts

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Why Do Protocols Vary?

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Why Do Protocols Vary?

- Old technology
- Vendor implementation
- "Pseudo-modalities"

Old vs. New Technology

Vendors

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Vendors

• Virtual non-contrast... Ok
• Mono/Mixed Energies? Maybe
• Iodine map? No equivalent

New Pseudo-Modalities
Why Match Protocols?

- Physicians like consistency
  - Flow
  - Comfort
  - Ability
- Reduce variability in “Image Quality”

Not Necessarily:

- Best Image
- Best Dose
- “Optimized” as an individual machine

How can we reduce variability?
• Not ideal...
• Fast
• Not a bad start
• Practical

• Assumes
  – Technology is about the same
  – Non-dose parameters are comparable

• Clinical-ish
• Quantitative-ish?
• Not just dose
• Fast-ish?
What is Image Quality?

- Is this good image quality?
  - Yes
  - No
  - Need more info

Fast and Dirty

- Section chief says ok or not
- Great for issues that are not subtle
- Great initial step

Research-ish

- Complaint verified by section chief
- 1+ Radiologists rate
- Alter Protocol
- 1+ Radiologists rate
Ratings

- Contrast?
- Resolution?
- Noise?
- SNR?
- Sufficient Grey-White differentiation?
- Malleus and the incus visible and well defined?

Ratings Example

<table>
<thead>
<tr>
<th>DRF</th>
<th>Image Quality Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Protocol</td>
</tr>
<tr>
<td></td>
<td>Preoperative</td>
</tr>
<tr>
<td>216</td>
<td>3.167</td>
</tr>
<tr>
<td>21.5</td>
<td>3.168</td>
</tr>
</tbody>
</table>

Task-based image quality was assessed using a 14-point scale: 0, unsuitable for the task; 1, suitable for task with low confidence in findings; 2, suitable for task with medium confidence in findings; 3, suitable for task with high confidence in findings (read diagnostic for soft tissue readings); 4, suitable for diagnostic soft tissue readings; and 5, suitable for diagnostic readings with high confidence in findings. Although the same scale is used for assessing both.

Image Quality Metrics

- Contrast
- Noise
- CNR
- MTF
- NPS
What is in the Literature?

CT protocol management: simplifying the process by using a master protocol concept

\[ mA_{\text{new master}} = mA_{\text{original}} \times \frac{F_1}{F_2} \times \frac{F_3}{F_0} \]

• \( \sigma = 0 \)
• Assume you have a scanner with a protocol you like

Methods for CT Automatic Exposure Control Protocol
Translation between Scanner Platforms
Sarah G. McKinnon, Ph.D., J. Anthony Jettum, Ph.D., Rami Lando, M.D., and John W. Bevra, Ph.D.
Department of Radiology, University of California-Davis Medical Center, Sacramento, California

• Need to:
  – Know your machines
  – Know your protocols
  – Assess variability on a large scale

The role of informatics
Optimization Stakeholders

- JC PC.01.03.01 A26
  - A Lead Tech
  - An Interpreting Physician
  - A Medical Physicist
- ... err kinda?

Optimization Stakeholders

- Who else?
  - Imaging Admin
  - Lead Tech at each site/region
  - Section Chiefs

Starting Point

- A good current protocol you trust
- Other sources
  - AAPM online protocols
  - “Overview of Resources Available for CT Protocol Optimization”
  - CTISUS
  - Published Literature
  - Etc.
Optimization Process: Permission
• Lock down machines
• Policy about who can alter protocols
  – "This" patient vs. system
• Imaging admin buy in
  – No consequence, no care?

Optimization Process: Iteration
• Issue: Peds CT Chest Angio "too noisy" at site X
• Dose too low
  – Confirmed by literature search and site comparison
• Plan: Bump mA on machine

Optimization Process: Iteration
• Do: Compare scanned phantom with and without bump then scan a new patient
  – Might just jump to patient
Optimization Process: Iteration

- Check: Ask Peds section chief if new image quality is acceptable

Optimization Process: Iteration

- Act: Either this becomes the new standard or update the plan and try again

Time vs Effort vs Outcome

- What do you have FTE to do?
- Impression is ok
- Quantitative Deep dive is better
- Proactive to head off issues
**Prioritize**
- Most Performed
- Complaints
- Pediatric
- Specialty Scans
- Highest Dose

**What Do the Regulations Say?**
- ACR and JC regs don’t really call out matching standardization
  - Reviewed
  - Based on Standards

**Beyond fiddling with numbers**
- Could keep scanners from doing certain scans, business decision
  - Used those old scanners and protocols for a long time – was that malpractice
- Admins important
Should They Match?

• Do you limit new to match old?
  – Probably not
• Do you reroute around old machines
  – Maybe

Cite This Talk/Handout


Thank You!