

CT Helical Head Scanning

Katherine Dewis

Matilda Nyekiova, John Crossman and Peter McGookin

Radiation Protection Group, Medical Physics

Royal Berkshire Hospital

How we got involved?

- New Consultant Radiologist
- CT Helical heads scans at previous hospital
- Sagittal and Coronal reconstructions for trauma head imaging
- A protocol was set up on the scanner
- A number of patients were imaged
- Radiologist wanted doses for a talk he was giving to a Clinical Governance meeting in Radiology

Helical Head – Initial Assessment

- Current Sequential Head
 - Local DRL – DLP = 963 mGycm
 - Local Dose = 2.3 mSv
- Helical DLP values from 8 patients
 - Range of DLP values 1343 – 3238 mGycm
 - Average DLP of 2519 mGycm
 - Average Effective Dose 5.6 mSv (Range 3.0 – 7.8 mSv)
- National DRL for ‘Routine Head’ 930 mGycm

Scan Parameters

| Scan Type | Axial | | Helical |
|-------------------|-------|-------|------------------------|
| Rotation Time (s) | 1 | 1 | 0.5 |
| Slice Width (mm) | 5 | 5 | 0.625 (20 Collimation) |
| Pitch | N/A | N/A | 0.531 |
| kV | 140 | 120 | 140 |
| mA | Smart | Smart | Smart |
| Min mA | | | 100 |
| Max mA | 330 | 330 | 635 |
| Noise Index | 2.8 | 2.8 | 3.0 |
| Total Time | 2 | 5 | 8.06 |

Tube Current Modulation – Noise Index

- Tube Current Modulation is the Automatic Exposure Control for CT
- Modulates the tube current as the scan happens
- For Axial Scans:

Noise Index = 2.8 Max mA = 330 (330mAs per rotation)

- For RANDO phantom the mA range was 204 - 330

- For Helical Scans:

Noise Index = 3 Max mA = 650mA (325mAs per rotation)

- For RANDO phantom 650mA was used for the whole scan
- Actually getting a Noise Index close to 5

Conclusions

- The helical head protocols have not been optimised
- Contacted a neighbouring hospital who have the same scanner
- Their LDRL for helical head scans was 1100 mGycm (compared with 2500 mGycm)
- They use a lower kV (120) and a higher noise index (7.06)
- This protocol was used to scan the RANDO phantom
- Additionally we varied other parameters for our helical protocol and scanned the RANDO phantom.
- The doses were calculated for each scan and the image quality assessed

Effective Dose – For RANDO phantom

| Protocol | Current Helical | Other Hospital Protocol | Current but 120kV | Current but Noise Index 6 | Current but Noise Index 9 | Current but pitch 0.969 | Current with pitch 0.969 Noise Index 6 |
|----------------|-----------------|-------------------------|-------------------|---------------------------|---------------------------|-------------------------|--|
| DLP (mGycm) | 2659 | 1012 | 1903 | 1560 | 721 | 1578 | 952 |
| Dose (mSv) | 5.9 | 2.6 | 4.8 | 3.5 | 1.6 | 3.5 | 2.1 |
| Dose Reduction | | 56% | 19% | 41% | 73% | 41% | 64% |

Current Sequential scanning Dose is 2.3 mSv

Image Quality

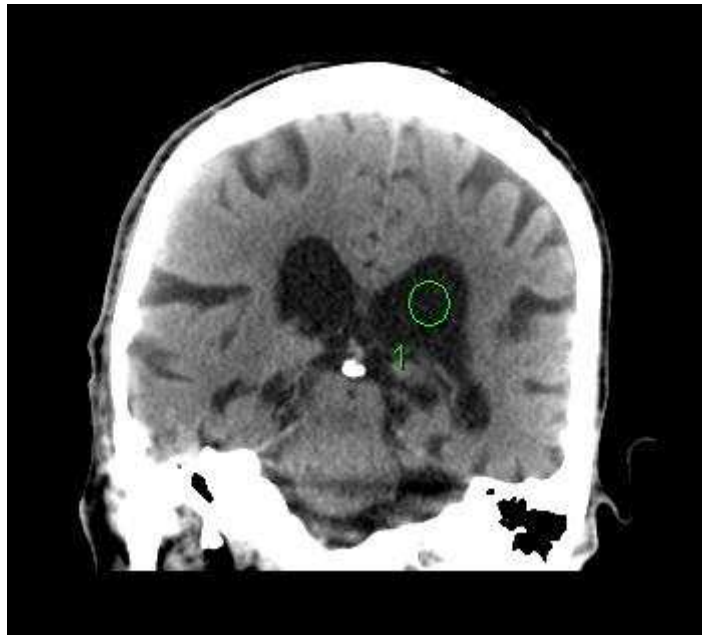
- Assessment of image quality was made from a ‘Physics’ point of view
- ROI place on axial, coronal and sagittal reconstructions
- ROI place in a uniform region of within the phantom with no bony structures or air gaps
- Noise
 - Standard Deviation of CT Number

Image Noise – Comparison with current helical protocol

| | Current Helical | Other Hospitals Protocol | Change in kV | Change in Noise Index to 6 | Change in Noise Index to 9 | Change in Pitch | Change in Pitch and Noise Index |
|----------|-----------------|--------------------------|--------------|----------------------------|----------------------------|-----------------|---------------------------------|
| Axial | 2.4 | 2.8 | 3.2 | 3.1 | 4.3 | 3.7 | 3.9 |
| Coronal | 2.7 | 3.9 | 2.3 | 2.9 | 4.2 | 3.2 | 4.0 |
| Sagittal | 2.6 | 3.0 | 2.6 | 2.7 | 3.4 | 2.6 | 3.8 |
| DLP | 2686 | 1026 | 1923 | 1585 | 728 | 1578 | 952 |

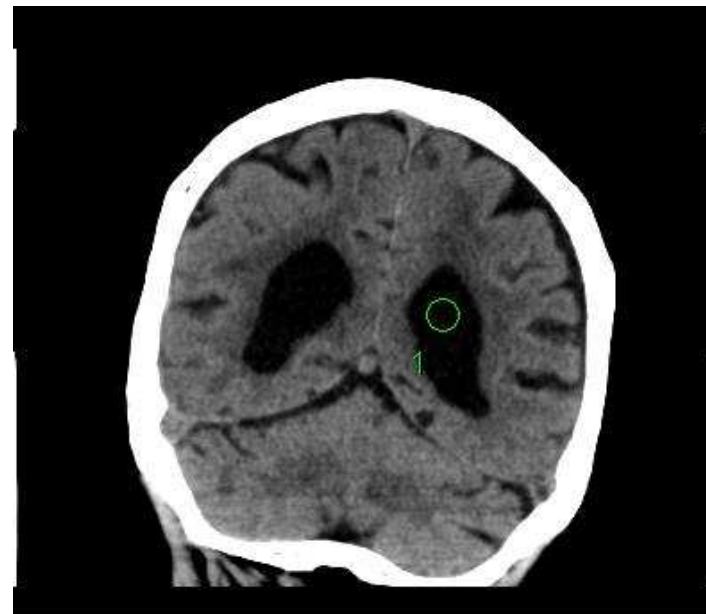
What does this mean clinically?

- Two patient with average DLP
~1400mGycm ~ 3.5mSv



SD = 2.0

- Two patient with average DLP
~3000mGycm ~ 6mSv



SD = 1.4

What Happen Next?

- Work was presented at Clinical Governance Meeting in Radiology
- Our recommendations
 - Current Helical Protocol is not optimised
 - Therefore do not use
 - Could use reconstructed images from current sequential scan
 - Contact GE applications for further help in optimising scan protocol
 - Radiologist to visit the other hospital to examine patient images with regards to image quality

New Protocol Implementation

- New protocol based on neighbouring hospital
- 15 Patients
- DLP = 914mGycm
- Dose ~ 2.2mSv
- Radiologist opinion
 - Clinically acceptable image quality

Other Hospitals

- One other scanner doing CT helical heads
 - Siemens Somatom Definition AS Plus – 128 slices
 - DLP = 968 mGycm
 - Dose ~ 2.2mSv

Conclusions

- Helical CT head doses have reduced from 5.9mSv to 2.3mSv
 - Main factor was another hospital with a lower dose clinical protocol
- Radiologist have been involved in work
 - Highlight importance of not just setting up protocols and scanning patients
- Raised at RPC meeting
 - Highlight the importance of data and information getting to Medical Physics
- CT Users group for radiographers
 - Local hospitals covered by Medical Physics
 - Share problems, protocols and DRLs
- Highlights importance of Medical Physics involvement in CT

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