Royal Berkshire NHS
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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

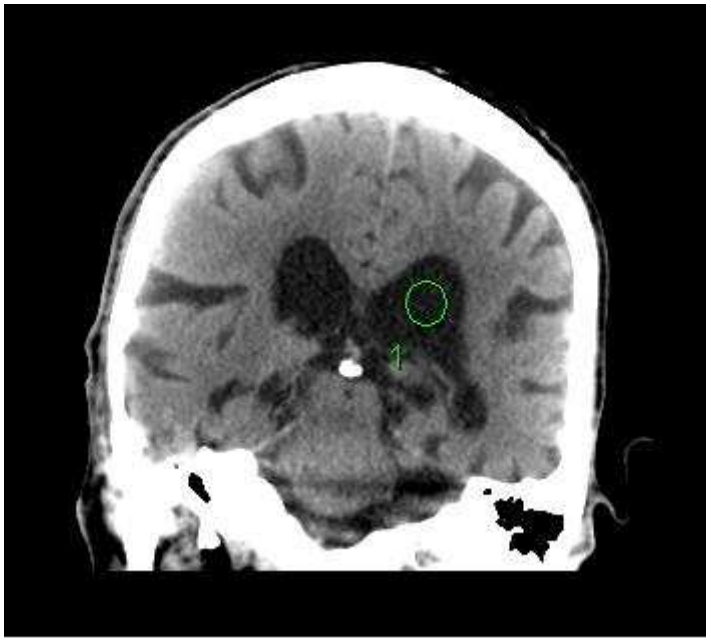
- Assessment of image quality was made from a ‘Physics’ point of view
- ROI place on axial, coronal and sagittal reconstructions
- ROI place in a uniform region of within the phantom with no bony structures or air gaps
- Noise
  - Standard Deviation of CT Number

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**

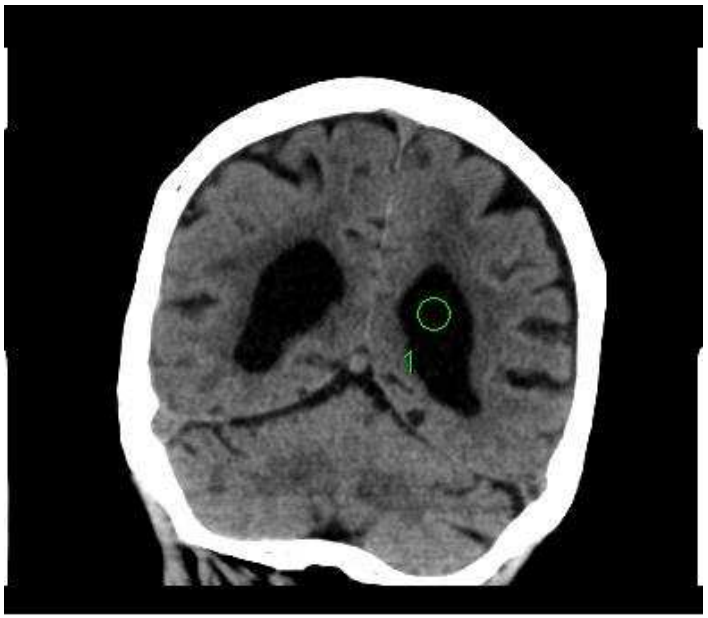
What does this mean clinically?

- 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 Somotom Definition AS Plus – 128 slices
    - DLP = 968 mGycm
    - Dose ~ 2.2mSv

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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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