# Effective dose estimation for CT component of SPECT/CT systems

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# Contents

- Background
- Method
- Results
- Discussion
- Conclusion
- Further Work

# Background

**IRS**

- MPE and RPA for a number of trusts in mainly in North West England
- Mostly deal with diagnostic

**Me**

- Worked with IRS for nearly 6 years
- Specialist areas CR/DR, CT & R&D

**RLUH**

- IRS do diagnostic but own in-house medical physics for Nuclear Medicine
- The have 2 SPECT/CT systems and support 3 others in region

# Background

**SPECT/CT**

- 1 GE Hawkeye @ RLUH
- 1 Siemens Symbia T@ RLUH
- 2 GE Hawkeye (Whiston, Warrington)
- 1 Siemens Symbia T (Aintree)

- IRS do performance checks on CT component
- RLUH do performance checks on SPECT component

**Can we work together to estimate the Effective Dose to a patient undergoing treatment on one of these units?**

# Method

## Proposal

- Use ImpaCT CTDI phantom to confirm console readout
- Use CTDI to estimate DLP
- Convert DLP to Eff. Dose using published conversion factors
- Compare results with published data

## Simple?

# Method

DLP to Eff. Dose

- Doses to Computed Tomography Examinations in the UK – 2003 Review (Table 3)
- Table 13 used for Typical doses

| Region of Body | Eff. Dose per DLP for Adult (mSv per mGycm) |
|---|---|
| Head & Neck | 0.0031 |
| Head | 0.0021 |
| Neck | 0.0059 |
| Chest | 0.014 |
| Abdo & Pelvis | 0.015 |
| Trunk | 0.015 |

# Method

Examinations

- Brain SPECT (eg brain perfusion scan [Tc99m-HMPAO] or bone scan [Tc99m-MDP])

  Probably best represented by Head

- Body SPECT (eg bone scan [Tc99m-MDP], Neuro-Endocrine Tumour (NET) imaging [primarily In111-Octreotide or I123-MIBG)] or Parathyroid adenoma localistation [Tc99m-MIBI]

  Probably best represented by Trunk

# Results

CTDI

- Measured with Radcal dosimeter and 10cm pencil chamber
- Used ImpaCT CTDI phantom, both head and body parts
- Used clinical protocol on Symbia, but QA protocol on Hawkeye

# Results

## Comparison

| | GE Infinia Hawkeye | | Siemens Symbia T | |
|---|---|---|---|---|
| | Head | Body | Head | Body |
| $CTDI_{w/vol}$ (mGy) | 5.69 | 4.09 | 10.95 | 1.75 |
| DLP (mGycm)* | 113.8 | 81.8 | 219.11 | 34.98 |
| Eff. Dose (mSv) | 0.35 | 1.227 | 0.460 | 0.525 |
| Typical Eff. Dose (mSv) | 1.5 Routine Head | 5.3 Abdomen | 1.5 Routine Head | 5.3 Abdomen |

*As Hawkeye slice is fixed at 20cm, DLP calculated for 20cm length for both scanners and body parts

# Discussion

GE Infinia Hawkeye

- Much longer scan time (25s)
- Very different to diagnostic scanner
- Axial scans ($CTDI_w$)
- Slice was restricted to 20cm using clinical protocol although QA protocol had 1cm slice – This was used to verify CTDI
- Very easy to interpret parameter and results

# Discussion

Siemens Symbia T

- Shorter Scan time
- Pretty similar to diagnostic scanner
- Helical scans ($CTDI_{vol}$)
- Uses CareDose (no impact on these results)
- Parameters difficult to interpret (slice / collimation combination – took email to Siemens to interpret)
- Able to use clinical protocol

# Discussion

Method for DLP to Effective Dose

- ???
- Perhaps this can only really be answered with further study

# Discussion

## Comparison with Published Data

- As images are not meant to be diagnostic, Eff. Dose would be expected to be lower than typical diagnostic values – This is the case
- Interestingly, the ratio of measured Eff. Dose values on the Hawkeye (Head/Body) is almost same as ratio of typical values – 0.35/1.22 = 1.5/5.3 = 0.28

  Does this suggest that the a fraction of typical values would be worth using (25%)?

# Conclusion

- Method for checking displayed CTDI good
- A good collaboration between Diagnostic & NM Physicists
- Baseline values have been set now for future comparison

# Further Work

- Study with TLD / Rando to confirm / establish conversion factors
- Work on a Philips scanner
- Collect data from many other scanners to establish typical CTDI / DLP / Eff. Dose

# Thanks

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