Comparison of Dual Source 128 slice CT in high pitch and standard pitch modes for CT pulmonary angiography

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Acute pulmonary embolus is a leading cause of adult sudden death

• Acute pulmonary embolus (PE):
  – 2\text{nd} leading cause of adult sudden death
  – 3\text{rd} leading cause of in-patient death
  – 3\text{rd} leading cause of cardiovascular death

• CTPA most accurate testing modality but false positive studies do occur (6\%) and are predominantly related to
  – inadequate contrast
  – motion artifact
CTPA inaccuracy – artifacts
Fast imaging, reduced motion

• Fast image acquisition via a high-pitch helical FLASH study might help eliminate the motion artifact of respiration and the pulsatile motion of cardiovascular structures, thus providing superior luminal contrast via lack of partial-voluming, whilst also reducing dose.

High-pitch scanning
Flash vs conventional
Goals & objectives

• To compare standard pitch CT pulmonary angiography (CTPA) with high pitch (Siemens® Flash Definition) CTPA with respect to:
  – Reducing motion artifact
  – Optimizing contrast enhancement
  – Reducing radiation dose
Methods

- 30 consecutive patients undergoing standard technique (ST) CTPA (pitch 0.9 – 1.2)
- 30 consecutive patients undergoing high pitch technique (HPT) CTPA (2.8 – 3.2)
- Retrospective comparison:
  - Same contrast, volume and flow rate protocols used in both modes.
  - 3 observers rated 60 anonymized (no image or patient data) scans in random order for overall image quality (1 = poor, 5 = excellent):
    - Motion artifact in the:
      - aortic root,
      - ascending aorta and
      - main pulmonary artery
    - pulmonary contrast enhancement
      - main pulmonary artery attenuation mean
      - main pulmonary artery attenuation standard deviation.
- Estimated radiation doses for all 60 studies were recorded.
Methods

- Both groups were scanned in the same institution using the same CT scanner (Definition Flash, Siemens Medical Solutions, Erlangen, Germany).
- Scan parameters were as follows:
  - matrix, 512 x 512;
  - collimation, 1.5 mm;
  - rotation time, 0.75 second.
- Tube current modulation was applied in both groups using integrated Care-dose software (Siemens Medical Solutions, Erlangen, Germany).
- Images were reconstructed at 1-mm slice thickness with no overlap.
- Both groups used the same contrast, volume and flow rate protocols,
  - Omnipaque 350 mg I/mL, injected at 4ml/sec, followed by a 40 mL bolus of saline, via a dual head injector (Stellant CT injector, Medrad, Bayer Healthcare Warrendale, USA).
Results – Overall image quality

Significant improvement in overall image quality:
- HPT mean = 4.2;
- Standard mean = 3.6
- P < 0.01

Global image quality was significantly improved when the HPT CTPA was performed compared to the ST CTPA.
Results – pulmonary artery contrast

No significant difference in pulmonary artery contrast enhancement:
• HPT mean = 401 ± 28
• Standard mean = 355 ± 27

• P < 0.01

No significant difference between HPT CTPA and the ST CTPA – there is no detriment to using HPT CTPA.
No significant difference in vessel Contrast to Noise Ratio:
• MPA HPT mean = 13.0 ± 5.9
• MPA Standard mean = 12.3 ± 5.7

• $P > 0.01$

While HPT CNR was greater in all vessels, at $P > 0.01$ it is not significant.
Results – Overall dose

Significant improvement (lower dose) in the average DLP:

- HPT 309 +/- 66 mGycm
- ST = 519 +/- 108 mGycm

- P < 0.01

Average overall dose was reduced by ~40% when the HPT CTPA was performed.
HPT motion related artifact semi-quantitative scores were significantly higher (less artifact) for:

- Aortic Root (HPT: 3.6 +/- 0.5, ST: 1.9 +/- 0.6)
- Proximal Coronaries (HPT: 2.8 +/- 0.7, ST: 1.4 +/- 0.4)
- MPA (HPT: 3.9 +/- 0.4, ST: 2.7 +/- 0.7)

- $P < 0.01^*$

Motion artifact was significantly improved for three out of five vessels measured when the HPT CTPA was performed. There was no significant difference for the remaining two vessels.
Conclusion

- HPT CTPA offers:
  - 40% reduced dose
  - improved image quality
  - less motion artifact in 3 out of 5 vessels measured
  - no difference in contrast to noise ratio.

- For sites with access to 128 Flash CT, CTPA should be performed in Flash mode.

- These benefits are also likely to apply to thoracic CT aortography but this was not assessed in this study.