Dual Energy CT and Patient Dose

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Conflict of Interest Statement

- I administer a grant from GE Healthcare which supports clinical investigation of cardiac CT.

- No support for equipment or salaries
DECT and Dose: Outline

- DECT and fewer phases
- DECT vs. SECT – Dose comparison
- Should every abd. case be DECT ??
- Lowering the iodine dose with DECT
From: Silva AC et al, Radiographics 2011; 31: 1031
DECT and Dose: Fewer Phases

- Single phase DECT for renal masses
  - 202 patients
  - Accuracy for malignant vs. non-malignant:
    - SE dual phase: 96%
    - DE single phase: 95%
  - 50% reduction in radiation dose

Becker GA et al. Invest Radiol 2010: 45: 399
Renal Masses:

Virtual Unenhanced can replace True Unenhanced

Graser A et al. Radiology 2009; 252: 433
Virtual Unenhanced

Small Perfused Renal Mass

From: Silva AC et al, Radiographics 2011; 31: 1031
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Virtual Unenhanced: Incidental Adrenal Adenomas

- Contrast enhanced + unenhanced DECT on 140 pts. with incidental adenoma
  - Compared virtual and true unenhanced for HU measurements of adenomas
  - VU images accuracy 95% when $\geq 1$ cm
  - No sig. difference between VU and TU
- ? No need to bring patient back for TU

Gnannt G et al AJR 2012; 198:138
Adrenal Adenoma: Benign on Virtual Unenhanced

True Unenhanced    HU = 9

Virtual Unenhanced  HU = 7

Gnannt G et al. AJR 2012; 198: 138
DECT and Dose:  Fewer Phases

• Single phase DECT for Liver lesions

• 75 patients

• VU could replace TU in 97% of cases

Barrett T, EJR 2011, in press
Virtual Unenhanced: Increased Lesion Conspicuity ??

Barrett T, EJR 2011, in press
Time to discard the True Non contrast?

- Barrett T. Eur J. Radiol 2011
  - 75 Pts comparing TNC with VNC in 3 phase liver

- De Cecco C Eur Radiol: 2010
  - 40 patients 3 phase liver imaging studies

- Zhang LJ. Eur Radiol 2010
  - 102 3 phase liver imaging studies

Courtesy: Alec Megibow
DECT and Dose: Fewer Phases

- Single phase DECT aortogram - endoleak
  - 2 articles in 2008 – 140 patients
  - Both said single DECT 60 sec. delayed phase can replace SECT 3 phase
  - Equal detection of endoleaks; greater HU
  - 40 - 60% dose reduction with DECT

Stolzmann P et al. Radiology 2008 249: 682
Hersh C et al. Radiology 2008; 249: 692
One Pass DE CT Aortogram: 60% Dose Reduction

Chandarana H et al, Radiol. 2008; 249: 692
Virtual Unenhanced:
Some Artifacts

Barrett T et al, EJR, 2011, in press
DECT vs. SECT: Dose Comparison

• Siemens
  • Multiple articles
  • Dose is comparable
  • With the use of sinusoidal non-linear blending of 80 and 140 kVp, may be able to reduce dose of DECT below that of SECT and have acceptable image quality

Apel A. Eur Radiol 2011; 21: 644
120 kVp

DSDE

Courtesy: Mike Macari, NYU
DECT vs. SECT: Dose Comparison

- GE (GSI)
  - Univ. of WA. experience:
    - 2 years ago: DE 5 – 10% higher dose than our *ultra-low-dose* SE using NI = 35, ASIR 40% (DE 10% lower than SE at most centers)
    - Today: NI and iter. recon. in DE have increased, so DE is 5 – 10% lower dose than our SE now.
Low Dose abdomen + pelvis - 0.6 mSv

100 kVp, 25-38 mA, 0.4 sec

Images courtesy of Pr Maher, Cork University Hospital, Ireland
Should Every Body Case be DECT ??

• “CT can now be performed routinely in DE Mode without additional dose or compromise in image quality…” Invest Radiol 2010; 45: 347

• “Dual Energy CT is equivalent and can be used for routine diagnostic purposes….” AJNR 2011; 32:1994

• “Dual energy CT is now the routine for all my abdomen and pelvis studies….” Alec Megibow, 2011
“In CT, we harm more patients with iodine than we do with radiation....”
Lowering the Iodine Dose with DECT

• DECT pulmonary angio with *half-dose* of iodine vs. SECT with *full-dose* iodine
  • Randomized prospective trial of 94 pts.
  • 51 kEv for DECT
  • DECT with half dose iodine had *higher* HU, SNR, CNR in all pul. art. segments
  • Radiation dose comparable (6.8 vs 7.0 mSv)

Yuan R et al. Radiology 2012: 262: 290
Half Dose of Iodine and DE GSI

W=1000, L=200
DECT IVP: Fewer Phases, Less Iodine

- The Single-Pass DE CT-IVP for Hematuria in Young Adults (or kids) –
  - Three phase reduced iodine contrast bolus
    - 20 cc at 20 minutes
    - 30 cc at 60 seconds (50/50 iodine/saline)
    - 30 cc at 20 seconds (50/50 iodine/saline)
  - Single low-dose dual-energy CT KUB
  - Create virtual non-contrast with MBIR
Conclusion

• Patient radiation dose in dual energy CT currently is slightly lower than low-dose single energy CT.
  • A number of centers using DECT for all exams
  • Advanced iterative reconstruction

• DECT enables substantial reduction of iodine dose for angiograms or for tissue enhancement (50% or greater reduction)
  • Great for patients with renal compromise