Dual Energy Workflow

William P. Shuman MD, FACR  FSCBTMR
Department of Radiology
University of Washington

SCBTMR Winter Symposium
Sanibel, Fl.,  February 11-12,  2012
Conflict of Interest Statement

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

- No support for equipment or salaries
Acquiring the Dual Energy Scan

• Typical Indications:
  • Cirrhosis, R/O new HCC
  • Known small liver mass: Characterize
  • Small renal mass: hyperdense cyst vs. solid
  • Hematuria
  • R/O pancreatic carcinoma or mass
  • Characterize adrenal mass
  • CT aortogram, renal compromised
  • Stent, endoleak
Ko JP et al, J Thoracic Imag 2012; 27:8
DE Raw Data: Post Processing

- Easiest and Fastest:
  - By technologist at CT console
  - May be automated protocol

- Alternative:
  - By radiologist at dedicated workstation
  - By radiologists at PACS workstation
    - Thin client architecture
AW Postprocessing at CT console
AW Postprocessing Workstation
PACS Workstation with Thin-Client AW Postprocessing
AW Thin Client on PACS
Postprocessing: How

• Create several series, each at a different monoenergy (kev)

  • Which kev’s are best?

    • Depends on tissue of interest
MonoCompare

Generates 4 volumes.
Loads up to 1150 GSI data files.
Kev slider bar
Dual Energy Spectral Imaging: HCC

40 kev

130 kev
Dual Energy Spectral Imaging: HCC

40 kev

60 kev
Dual Energy Spectral Imaging: HCC
keV vs. CNR of Iodine: 51 keV

Portal Vein

Liver
Postprocessing: How

- Which kev’s are best for display?
  - Depends on tissue of interest
  - Liver kev’s:
    - 40, 50, 70 (100 kVp equivalent), and 77 (120 kVp equivalent)
Postprocessing: How

• Consider other types of post processing
  • **Material density**
    • Water w/o iodine – iodine w/o water
    • Calcium w/o iodine – iodine w/o calc.
    • Water w/o calcium – calc. w/o water
MDCompare

Generates 4 volumes.
Loads up to 1150 GSI data files.
Dual Energy Spectral Imaging: HCC

Water only

Iodine only
Dual Energy Spectral Imaging: HCC

Water Only

Iodine Only
Postprocessing: How

- Consider other types of post processing
  - Spectral density plots
    - HU density vs. kev
  - Scatter plots
Dual Energy Spectral Imaging: HCC

70 keV
Postprocessing: How

- Consider other types of post processing
  - Virtual unenhanced
Generates 4 volumes.
Loads up to 1150 GSI data files.
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
Postprocessing: How

- Consider other types of post processing
  - Renal stone composition
Kidney Stones

Reformat

Kidney Stones Analysis
What do we push to PACS?

- Routine DECT post-processed series
  - 40, 50, 70, kev series
  - 77 kev series is the 120 kVp equiv.
- Any specialized post-processed series
- All are archived
(1) Scout (2 images)
✓ (2) NON CON (726 images)
   (3a) ART PH/120sec DEL (742 images)
   (3b) ART PH/120sec DEL (742 images)
   (4) Mono 44 kev (193 images)
   (5) Mono 50 kev (177 images)
   (6) Mono 70 kev (177 images)
   (99) Screen Save (1 image)
   (200) Smart Prep Series (10 images)
   (301) 60keV (742 images)
   (302a) 2.5 STND (186 images)
   (302b) 2.5 STND (186 images)
   (303) 2.5 STND NON-CON (182 images)
   (350) 3D AORTA (16 images)
   (352) AORTA MIP (16 images)
   (601a) CORONAL BODY (1 image)
   (601b) CORONAL BODY (119 images)
   (603a) CORONAL BODY (1 image)
   (603b) CORONAL BODY (119 images)
   (999) Dose Report (1 image)
   (9999) CT ABDOMEN W CONT (2 images)
   (99999) MEDRAD Injection Images (1 image)
Dual Energy CT: Work Flow (Siemens)

Scanner

Raw data B
(140kV)

Images B

Raw data A
(80/100kV)

Images A

Diagnostic image:
weighted average

PACS

Dual Energy Task Card

Multi KV; Material Specific; Advanced

MMWP

Courtesy: Alec Megibow
Image Review: How Long??

- Time of single energy review
- Plus time of DECT series (4 – 6)
  - Incremental 2 - 5 minutes
  - Lots of incremental information
Conclusion

- Dual energy workflow requires understanding of how to optimize the technology.
- Combination of technologist workflow and radiologist workflow works best.
- Automated processing at CT console, plus customized processing at PP workstation, and/or thin-client workstation in PACS.
- Can be time efficient
  - produces substantial incremental info