Dual Energy of the GI Tract

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OBJECTIVES: The bowel

- Physics
- Review the literature
- Opportunities to improve?
  - CT Colonography
  - Better visualization of Crohn disease
  - Focal bowel wall neoplasm or other source of bleeding
- Reduce contrast use, reduce artifacts (metal)
- Assess early response to therapy (nonanatomic)
Bowel Dual Energy Literature

Dual-Energy and Low-kVp CT in the Abdomen

OBJECTIVE. The purpose of this article is to discuss the influence of tube potential on CT images and explore the potential impact of dual-energy CT on imaging of the abdomen and pelvis.

CONCLUSION. Low peak tube voltage (kVp) settings provide high conspicuity of contrast materials at CT but may result in high image noise, particularly in larger patients. Material decomposition at dual-energy CT can differentiate oral stones by their composition and may improve the detection of pathology, intrapelvic calcification, and radiopaque foreign objects.

RadioGraphics

Dual-Energy Multidectioner CT: How Does It Work, What Can It Tell Us, and When Can We Use It in Abdominopelvic Imaging?

Noncathartic CT Colongraphy with Stool Tagging: Performance With and Without Electronic Stool Subtraction

OBJECTIVE. The purpose of our study was to evaluate the performance of noncathartic, dietary unrestricted CT colongraphy, with and without the aid of electronic stool subtraction, for detecting colorectal neoplasia in a high-prevalence referral population.

MATERIALS AND METHODS. Patients with known or suspected colorectal neoplasms were potentially eligible for participation, regardless of the presence or absence of gastrointestinal symptoms. Subjects ingested 21.6 g of barium in nine divided doses. CT colongraphy was performed in the standard fashion. Data sets were randomly evaluated by two of three experienced radiologists, with subsequent reassessment of each data set after
Bowel Dual Energy Literature

Diagnosis of Small Bowel and Colonic Obstruction and Necrosis Using Contrast-enhanced Fast KV Switching Dual-Energy CT (Single-Source Dual-Energy CT)

LUNCHTIME CME:
EXHIBIT HOURS: Sun. 5:00 AM - 6:00 PM
Mon. - Thurs. 7:00 AM - 10:00 PM
Fri. 7:00 AM - 12:00 PM
LOCATION: Lakeside Learning Center

PARTICIPANTS
H. T. - Nothing
A. M. - Nothing
J. K. - Nothing
Y. T. - Nothing

SUBSPECIALTY CONTENT
Gastrointestinal Radiology

CITE THIS ABSTRACT

PURPOSE/AIM
To review advances in imaging technology with fast kv switching dual-energy ct such as material decomposition imaging.

To demonstrate imaging appearance of small bowel vs colonic obstruction and bowel necrosis.

To understand and discuss clinical feasibility of imaging techniques with dual energy CT.

CONTENT ORGANIZATION
1. Principle of material decomposition and virtual non contrast imaging
2. Illustrative cases of small bowel vs colonic obstruction and necrosis
3. Correlation with conventional CT imaging
4. Discussion
5. Summary

SUMMARY
The major teaching points of this exhibit are:
1. Knowledge of imaging techniques with dual energy CT such as material decomposition and virtual non contrast imaging
2. Understanding the mechanism and clinical meaning of imaging techniques
3. Knowledge of clinical feasibility of imaging techniques with dual energy CT
Dual-Energy Based Spectral Electronic Cleansing in Non-Cathartic Computed Tomography Colonography: An Emerging Novel Technique

Ruth Eliahou, MD, Yusef Azraq, MD, Raz Carmi, Shmuel Y. Mahgerefteh, and Jacob Sosna, MD

Semin Ultrasound CT MRI 31:309-314

- Spectral cleansing vs threshold subtraction
- Superior cleansing with material decomposition “electronic cleansing”
  - fewer artifacts from incomplete cleansing or luminal heterogeneity
  - Fewer pseudo-soft tissue structures in lumen 2D & 3D
Dual Source: 90° offset of separate 80 kVp and 140 kVp beams

- Beam hardening
- Smaller FOV for second beam

*Material decomposition and monochromatic images in IMAGE SPACE*
At UAB

- Single Source
  - Standard MDCT images (polychromatic)
  - 140, 80 kVp beams
    - Single fast switching source
    - Near-simultaneous acquisition data sets at 140 and 80 kVp
    - Single fast response Garnet gemstone detector

**Simulated Monochromatic Images in PROJECTION SPACE**
Spectrum of Monoenergetnic Images

- Monochromatic (one color) x-ray energy

keV specifies the photon energy for a monochromatic x-ray source

<table>
<thead>
<tr>
<th>kVp</th>
<th>keV</th>
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<tbody>
<tr>
<td>80</td>
<td>60</td>
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<tr>
<td>100</td>
<td>70</td>
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<tr>
<td>120</td>
<td>77</td>
</tr>
<tr>
<td>140</td>
<td>86</td>
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80 kVp
140 kVp

kVp defines the upper limit x-ray for a polychromatic x-ray beam

Matsumoto K. Radiology 2011
Dual Energy in Daily Practice

Multiphasic Pancreas and Liver exams

Multiphasic liver

Pancreatic Mass

- **PPP**
  - 80 140 kVp

- **PVP**
  - 120 kVp

- **Eq P**
  - 120 kVp

70-78 keV

To PACS

GSI Viewer
- Gastrointestinal stromal tumors
- GI endocrine tumors
- Melanoma metastases to bowel
- Crohn disease
- Other sources of GI hemorrhage
Pre-treatment

Post-treatment
ssDECT GIST
GI Endocrine Neoplasms

- 50 keV
- 70 keV
- 90 keV
- 120 keV

W/L = 520/72
W/L = 400/40
ssDECT Melanoma Metastasis

- 50 keV
- 70 keV
- 90 keV
- 120 keV
ssDECT Melanoma Metastasis
Crohn Disease
dsDECT Crohn Disease

Lower kVp: Improved Iodine Conspicuity

80 kVp

140 kVp

Same pt, same scan (Dual energy CT)

Images courtesy of JG Fletcher MD
Other GI Sources of hemorrhage
ssDECT Metal Artifact Reduction

No MARS

MARS
Observations on ssDE suggest improved ability to detect lesions is possible at lower viewing energies using spectral MDCT.

Optimize viewing energies to individual pt, or use ≈ 50 keV.

Qualitative information and semi-quantitative information is available on independent workstation.

Material decomposition applications interesting.

Much more work needed!
Thanks

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