Can we get there? Narrow window CT-guided access using blunt-tip coaxial needle

Andrés Camacho, Andrew D Chung, Mehmet A Sari, Elisabeth Appel, Muneeb Ahmed, Olga R Brook
Beth Israel Deaconess Medical Center · Harvard Medical School · Boston, Massachusetts

Introduction
CT-guided biopsy of abdominal and pelvic masses is a commonly performed procedure (1). Although most targets can easily be accessed, some may be technically challenging. Biopsy path will may come into very close contact with organs, blood vessels or bowel. In such situations, the use of a blunt needle can be used when traversing tissue adjacent to the vulnerable structure to avoid inadvertent injury while still reaching the target.

Purpose
To assess the safety of narrow window access (≤13mm) using a blunt-tip coaxial needle for CT-guided percutaneous access in the abdomen and pelvis in comparison to a wide window approach with a coaxial sharp needle.

Methods
- IRB-approved, HIPAA-compliant retrospective study
- 897 consecutive CT-guided biopsies
- Biopsies in the abdomen or pelvis
- Performed between 01/01/2015 and 12/31/2018
- In a single tertiary institution

Narrow window:
- 17 procedures with window ≤5.5mm
- 22 procedures with window 5-10mm
- 34 procedures with window 10-15mm

Blunt-tip needle used after traversing the fascia to slide by visceral organs, bowel and vessels

References

Results

<table>
<thead>
<tr>
<th>Wide window &gt;13mm</th>
<th>Narrow window: 15mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharp tip</td>
<td>Blunt-tip</td>
</tr>
<tr>
<td>223 procedures</td>
<td>73 procedures</td>
</tr>
<tr>
<td>100% technical success</td>
<td>100% technical success</td>
</tr>
<tr>
<td>90% (291/323) clinical success rate</td>
<td>88% (64/73) clinical success rate</td>
</tr>
<tr>
<td>1.5% (4/223) minor complications</td>
<td>1.3% (1/73) minor complications</td>
</tr>
<tr>
<td>No major complications</td>
<td>No major complications</td>
</tr>
</tbody>
</table>

No difference in clinical, technical success rate or complications rate between two groups.

Discussion
- Blunt-tip needle access strategy can be safely used for difficult CT-guided access
- Blunt-tip introducer use was first reported in 1989 (2)
- "Structures are pushed away like a surgeon’s dissector would do and the risk of inadvertent perforation is smaller” (3)
- Novelty of this study is to compare technical and clinical success rates, as well as complications rate to standard technique in the wide window access
- Prior studies did not have comparison groups

Limitations
- Retrospective nature.
- Small number of cases in very small window access

Conclusion
Narrow window CT-guided biopsy with blunt-tip coaxial needle can be performed with the same safety profile and success rate as in the wide window with standard sharp coaxial needle.
Deep Learning Image Reconstruction (DLIR) in Non-Vascular CT

**Purpose**
Clinical image quality assessment of a deep learning image reconstruction (DLIR) (TrueFidelity GE Healthcare) algorithm for CT images.

**Background**
- The goal of DLIR is to provide a reconstructed image solution that outperforms existing iterative reconstruction in reference to image quality, dose performance, and reconstruction speed.

- To develop the deep learning reconstruction engine we begin with a clinically relevant Ground Truth training data, which is reconstructed by filtered back projection (FBP) at high radiation dose, realizing the resulting algorithm. The perfect projection data is obtained by the correction of x-ray physics and other non-ideal behavior of the CT system such as scatter, beam hardening and cone beam. A developed CT algorithm then corrects the measured raw data and restores it to “ground truth” for DLIR to process.

- The DLIR engine first generates an output image from the sinogram acquired with a low radiation dose. The output image is then compared with “ground truth” images to find the delta of image contrast, image noise, image texture, spatial resolution, low-contrast resolution, etc.

- Deep Neural Network learns through backpropagation by adjusting millions of model parameters. This training process is repeated on thousands of training datasets until the DLIR engine can generate output images that accurately match the “ground truth” images. Finally TrueFidelity (GE) images are produced.

**Methods**
- IRB approved retrospective single center study.
- 5 patients underwent contrast enhanced thorax/abdomen and 15 patients abdomen/pelvis CT examination on a 16-cm wide detector CT (Revolution Apex CT).
- All exams were reconstructed with 50% ASIR-V and three levels of DLIR – low, medium, and high.
- Images were evaluated objectively and subjectively. Objective measurement of signal to noise (SNR) ratio in the sorts, left hepatic lobe, paravertebral musculature, and subcutaneous fat and contrast to noise (CNR) ratio of enhanced sorts relative to soft tissue. Using 5-point Likert scale, subjective evaluation of image quality parameters specifically texture, noise, sharpness, artifact, and overall image quality was performed by four subspecialty radiologists. All reconstructed series were anonymized and randomized for the purpose of evaluation.

**Results**
- Identical attenuation values were recorded at all ROI sites. Image noise was greatest with ASIR-V with progressive decrease in image noise with increasing levels of DLIR.
- On subjective evaluation, DLIR high strength had the highest overall image quality on Likert scale with progressive decreases at the lower levels of DLIR and ASIR-V.
- Image diagnosis was equivalent between all reconstruction algorithms.

**Conclusions**
- DLIR significantly improved image quality.
- There was no variation in recorded CT attenuation parameters between all reconstruction algorithms.
- While this study was directed at non-vascular imaging, DLIR has similar applications across other body regions as well.
- Future applications include maintaining excellent image quality while reducing radiation dose.
Growing Pains: Non-Appendicitis MR Findings in Pregnant Women
Ryne Dougherty MD MBA, Erica B. Stein MD, Kushal Parikh MD MBA, Zeeshan Bhatti MD, William R. Masch MD
Department of Radiology, University of Michigan, Michigan Medicine, Ann Arbor, Michigan

Introduction
Acute appendicitis is the most common nonobstetric surgical emergency in pregnant women (reported prevalence of 1 in 500 to 2000 pregnancies), however, it is not the only cause of acute abdomen pain in these patients. With the growing utilization of MRI for the assessment of appendicitis in pregnant women, radiologists must be comfortable with correctly identifying expected pregnancy-related changes and non-appendicitis causes of abdominal pain.

Major Teaching Points
- Engorged gonadal and parametral vessels may be mistaken for a dilated appendix or a perianepithelial abscess.
- Many non-appendicitis causes of abdominal pain may be identified with abdominopelvic MRI performed for the assessment of acute appendicitis in pregnancy.
- In addition to assessing the right lower quadrant for signs of appendicitis, it is important to thoroughly assess all other imaging structures including the uterus, kidneys, and bowel.

Expected Pregnancy Related Changes

**ENGORGED RIGHT GONADAL VEIN**
24-year-old woman at 37 weeks gestation with right lower quadrant pain
Axial T2W SSFAE images show an engorged tubular structure in the right lower quadrant adjacent to the ovary (arrows) mimicking a dilated appendix. Coronal Axial T2W SSFAE images, consistent with this is a fluid void consistent with the dilated uterine structure, consistent with an engorged right gonadal vein.

**ENGORGED PARAMETRAL VESSELS**
26-year-old woman at 26 weeks gestation with right lower quadrant pain
Coronal T2W SSFAE images show a rounded hypo-intense structure in the right lower quadrant adjacent to the ovary (arrows). This reflects a cluster of engorged parametral vessels and not to be confused with a perianepithelial abscess. Note is made of a similar structure in the left lower quadrant (arrowhead).

**PHYSIOLOGIC HYDROPONEPHROSIS OF PREGNANCY**
23-year-old woman at 18 weeks gestation with right sided pain
Axial T2W SSFAE images show mild right renal collecting system dilatation (arrow) without perinephric edema or inflammation.

**PEARLS**
- Engorged gonadal or parametral vessels may be hypertense on T2WI due to in-plane slow flow
- To differentiate vessels from appendix, look for contiguous flow void and bilaterality
- Physiologic hydronephrosis of pregnancy may be present in up to 90% of women late in pregnancy
  - Typically isolated to right sided
  - May manifest as abdominal pain, but usually asymptomatic
  - Thought to be secondary to a combination of extrinsic compression and hormonrelated smooth muscle relaxation

Non-appendicitis Causes of Abdominal Pain in Pregnancy

**PLACENTAL ABRUPTION**
23-year-old woman at 26 weeks gestation with right lower quadrant pain
Axial and coronal T2W SSFAE images show a tenuous region of hyperintensity underneath the placenta (arrow) compatible with blood.

**PYELONEPHRITIS**
26-year-old woman at 25 weeks gestation with right sided pain
Axial and coronal T2W SSFAE images show an enlarged and edematous right kidney (arrowheads) with contiguous inflammation (arrow). Sustained nephropathy will not be present due to lack of osseous maturity.

**TERMINAL ILEITIS**
33-year-old woman at 10 weeks gestation with right lower quadrant pain
Axial T2W SSFAE images show thickened ileum (arrow) with surrounding inflammation (arrowhead).

**SPLANNED BOWEL VOLVULUS**
28-year-old woman at 16 weeks gestation with pelvic pain and vomiting
Axial and coronal T2W SSFAE images show a thickened small bowel wall (arrow) and a twisted mesenteric vascular loop (arrowheads). Small bowel volvulus was confirmed to have small bowel obstrucCommonality.

Disclosures
Authors have no relevant financial disclosures.
Taking Tumor Biomarkers with a Grain of Salt: A Review of Common Biomarkers and Their Limitations as Pertaining to the Radiologist

R Lahoud, MD; H Kordbacheh, MD; J F Simeone, MD; M G Harisinghani, MD
Massachusetts General Hospital, Harvard Medical School

Introduction:
Biomarkers are measurable biological indicators found in bodily fluids or tissues that correlate with normal or pathogenic physiological states. They may be prognostic (quantify natural history of the disease regardless of therapy) or predictive (measure response to treatment). Their roles include screening for diseases, aiding in the establishment of a differential diagnosis, assessing risk and prognosis, evaluating response to treatments, monitoring disease status, and detecting recurrence and progression. The presence of an elevated tumor marker can be misleading during imaging interpretation and may be due to multiple causes, either malignant or benign. Therefore, tumor marker levels should be considered cautiously.

Table 1: Biomarkers and their associated conditions

<table>
<thead>
<tr>
<th>Biomarker</th>
<th>Associated Malignancy</th>
<th>Associated malignant Conditions</th>
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<tbody>
<tr>
<td>CEA</td>
<td>Colorectal Cancer</td>
<td>Smoking</td>
</tr>
<tr>
<td></td>
<td>Lung Cancer</td>
<td>Cirrhosis</td>
</tr>
<tr>
<td></td>
<td>Breast Cancer</td>
<td>Diabetes</td>
</tr>
<tr>
<td></td>
<td>Pancreatic Cancer</td>
<td>Hepatitis</td>
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<td></td>
<td>Urothelial Cancer</td>
<td>Chronic Renal Failure</td>
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<tr>
<td>CA 19-9</td>
<td>Pancreatic Adenocarcinoma</td>
<td>Cholecystitis</td>
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<tr>
<td></td>
<td>Cholangiocarcinoma</td>
<td>Diverticulitis</td>
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<tr>
<td></td>
<td>Colorectal Cancer</td>
<td>Diabetes</td>
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<tr>
<td></td>
<td>Urothelial Cancer</td>
<td>Hepatitis</td>
</tr>
<tr>
<td></td>
<td>Excessive black tea</td>
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<td>CA 125</td>
<td>Breast Cancer</td>
<td>Acute Cholangitis</td>
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<td></td>
<td>Pancreatic ductal adenocarcinoma</td>
<td>Chronic Renal Failure</td>
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<td>Colorectal Cancer</td>
<td>Cholecystitis</td>
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<td>Diverticulitis</td>
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<td>PSA</td>
<td>Prostate Cancer</td>
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<td>Breast Cancer</td>
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<td></td>
<td>Lung Cancer</td>
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<td>Gastrointestinal Malignancies</td>
<td>Lactamoxan</td>
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<td>AFP</td>
<td>Hepatocellular Carcinoma</td>
<td>Prostatitis</td>
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<td></td>
<td>Non-Neuronomic Germ Cell Tumors</td>
<td>Benign Prostatic Hyperplasia</td>
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<tr>
<td></td>
<td>Pregnancy</td>
<td>Polycystic Ovarian Syndrome</td>
</tr>
<tr>
<td>β-hCG</td>
<td>Seminomatois and Non-Neuronomic Germ cell tumors</td>
<td>Pregnancy</td>
</tr>
<tr>
<td></td>
<td>Gestational Trophoblastic Disease</td>
<td>Hypogonadism</td>
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<tr>
<td></td>
<td>Neuroendocrine tumors</td>
<td>Marijuana Abuse</td>
</tr>
<tr>
<td></td>
<td>Hepatic, breast, ovarian, pancreatic, cervical and gastric cancer</td>
<td></td>
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<tr>
<td>LDH</td>
<td>Lymphoma</td>
<td>Hemolytic anemia</td>
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<td></td>
<td>Multiple Myeloma</td>
<td>Septicemia</td>
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<td></td>
<td>Metastatic Melanoma</td>
<td>Infection</td>
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<tr>
<td></td>
<td>Renal Cell Carcinoma</td>
<td>Rhabdomyolysis</td>
</tr>
<tr>
<td></td>
<td>Breast, lung, testicular, gastric, and colon cancers</td>
<td></td>
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</table>

Acknowledgement:
A O’Shea, MB BAO 8Ch

References:

Figure 1: 60-year-old female presented following an 8-month history of weight loss and fatigue. CT scan demonstrated a 4.8 cm left lower lobe mass with irregular internal contours, concerning for an intrapulmonary neoplasm. The patient’s CEA level was normal and her CA 19-9 was mildly elevated (50 u/mL). The patient underwent left lower lobectomy resection of the mass and bilateral lymphadenectomy, pathologically confirmed a squamous cell carcinoma.

Figure 2: 50-year-old male noted a firm left testicular mass. Transrectal and scrotal ultrasound demonstrated a mixed solid and cystic left intra-testicular lesion. MRI (T2), MRCP (2.3.2) and AFP (2.8.4) were all elevated preoperatively. The patient underwent a radical orchectomy and pathologically confirmed a visceral germ cell tumor, comprising 20% seminomas, 40% embryonal carcinomas and 40% teratomas.

Figure 3: Axial T2 weighted images (A) and diffusion-weighted imaging (B,C) from MRI of the prostate in a 75-year-old male patient demonstrating a T2 hypointense lesion in the left postero-lateral peripheral zone of the prostate gland, compatible with a focus of prostatic malignancy. The patient underwent transperineal radical prostatectomy and final pathology confirmed a Gleason 4+3 prostate cancer. The patient’s post-operative PSA was 4.3 which provide a fluidsample (D) to be performed (E,F). This demonstrated an enlarged and 1 cm right utricle vein (arrow).

Figure 4: 25-year-old female presented to LD with cough and shoulder pain. Chest x-ray (A) demonstrated an upper lobe mass (arrow). The mass (arrow) was marked by FGD and I-131 lob and biopsy confirmed large B cell lymphoma. The patient’s LDH was normal at presentation and during treatment.

Conclusions:
Biomarkers aid in diagnosis, risk assessment, evaluation of treatment response, monitoring progression, and predicting outcome and survival. Significant overlap exists between biomarkers and their associated pathologies and despite negative imaging findings, establishing a differential diagnosis may constitute a challenge for the radiologist. Ultimately, the analysis of biomarkers helps in completing the clinical picture, but they should never be used alone in the sole diagnostic process. In all, biomarkers should be considered with a gran of salt and radiologists should primarily rely on radiological as well as clinical and pathological evidence in addition to the former in assessing disease status.
The Arrowhead Sign (AS): a Novel, Reproducible Radiographic Indicator of Intramuscular Venous Branch Invasion (pT3a) in Patients with Renal Cell Carcinoma (RCC)

Laura Levin\textsuperscript{1}, Jordan Anaokar\textsuperscript{2}, Brian Kadow\textsuperscript{3}, Alexander Kutikov\textsuperscript{4}, Tianyu Li\textsuperscript{5}, Rosaleen Parsons\textsuperscript{6}

\textsuperscript{1}Department of Diagnostic Imaging, \textsuperscript{2}Division of Urologic Oncology, Fox Chase Cancer Center, Philadelphia PA

\textsuperscript{3}Department of Urology, University of Pittsburgh, Pittsburgh PA

\textsuperscript{4}Department of Data Sciences, Dana-Farber Cancer Institute, Boston MA

Introduction:

- Accurate preoperative prediction of pT3a disease in patients with renal cell carcinoma (RCC) is currently a clinical challenge.
- Preoperative knowledge of renal sinus / perinephric fat invasion can influence clinical decision-making regarding the suitability of nephron-sparing surgery (NSS).
- We validated the observation that tumors that exhibit invasion into the muscular branches of the venous vasculature tend to form a “beak-shaped” irregularity as they extend towards the renal sinus fat that resembles an “arrowhead”.
- We sought to determine if the “Arrowhead Sign (AS)” radiographic finding could be used as a preoperative predictor of intramuscular venous invasion on final histopathologic evaluation.

Results:

- Statistical analyses using Fisher’s exact test and Cohen’s kappa coefficient were performed.
- Final histopathologic staging revealed pT1 = 116 (66.6%), pT2 = 9 (5.1%), pT3 = 48 (27.5%), pT4 = 1 (0.006%).
- Radiographic predictors of muscular venous invasion:
  - AS = 92% sensitivity, 73% specificity.
  - Perinephric invasion = 62% sensitivity, and 85% specificity.
  - Sinus fat infiltration = 89% sensitivity, 73% specificity.
- Inter-reader agreement for AS was moderate.
  - K = 0.64.

Materials and Methods:

- We queried our prospectively maintained, IRB-approved, RCC database and identified 174 patients who underwent surgical resection of localized RCC between 2009 – 2018 and had a preoperative contrast enhanced CT within 90 days prior to surgery.
- Two junior radiologists with fellowship training in abdominal imaging and a senior radiologist with 25 years of experience blindly and independently reviewed the imaging.
- Images were assessed 3 radiographic predictors of pT3a disease on final histopathology: Perinephric invasion, Sinus fat infiltration, AS.
- Predictors were scored based on the reader’s degree of confidence in the finding: 1 - definitely present, 2 - probably present, 3 - probably absent, 4 - definitely absent.

<table>
<thead>
<tr>
<th>Radiographic Predictor</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>92%</td>
<td>73%</td>
</tr>
<tr>
<td>Perinephric Invasion</td>
<td>62%</td>
<td>85%</td>
</tr>
<tr>
<td>Sinus Fat Invasion</td>
<td>89%</td>
<td>73%</td>
</tr>
</tbody>
</table>

Table 1: Sensitivity and specificity of radiographic predictors of branch venous involvement (pT3a).

Figure 1: Radiographic examples of the “Arrowhead Sign”: a) and b) shows the triangular shaped tumor (arrow) extending from the RCC (*) into the segmental vein (arrowhead). c) and d) is from another patient, demonstrating the RCC (*) exhibiting muscular venous branch involvement (pT3a) (arrow) and gross pathology.

Conclusions:

- The “Arrowhead Sign” is a novel and potentially clinically actionable preoperative radiographic predictor of muscular venous invasion in patients with RCC.
  - High sensitivity.
  - Moderate inter-reader agreement.
- Further validation studies are needed.
Bladder cancer is a highly prevalent disease that results in significant morbidity and mortality. Imaging has well-established role in the detection of bladder cancer, with CT urogram serving as the mainstay of genitourinary imaging. While CT, in concert with cystoscopy, is effective in screening for malignancy in the setting of hematuria, it is limited in grading tumors in the context of known bladder cancer, particularly in the setting of prior treatment. In this context MRI can play a vital role, effectively distinguishing changes related to prior TURBT/intravesical therapy from malignancy, and muscle invasive from non-muscle invasive disease.

**Illustrative Cases**

**Illustrative case #1**
- Axial T2 b, Ax C+ 30 sec c DWI
- Patient with history of NMIBC s/p TURBT, BCG. Cropposed T2 signal (a). Along this area there is corresponding hyperenhancement (b). No corresponding diffusion restriction is seen (c).
- MRI Estimated T score: TD
- Follow up: Clinically presumed disease free x2 yr. Urethral cytology negative for malignancy, resolution of bladder wall thickening on follow-up CT imaging, cystoscopy deferred.

**Illustrative case #2**
- Axal T2 b, Ax C+ 90 sec c DWI
- Patient with incidenta bladder wall thickening on CT. Mild cropposed T2 signal of the right anterolateral bladder wall (a). No corresponding enhancement or diffusion restriction (b).
- MRI Estimated T score: TD
- Follow up: Clinically presumed disease free x2 yr. Urethral cytology negative for malignancy, resolution of bladder wall thickening on follow-up CT imaging, cystoscopy deferred.

**Illustrative case #3**
- Axal T2 b, Ax C+ 30 sec c DWI
- Patient with RIV, renal failure, gross hematuria. CT (a) demonstrating presence anterior bladder wall masses. Intravenous contrast showing extension through the posterior bladder wall with indistinct margins with the adjacent fat. Pathology was unable to be examed further C+ Diffusion imaging.
- MRI Estimated T score: T2, muscle-invasive disease
- Subsequent TURBT: Infiltrating squamous-cell carcinoma, detrusor muscle is present and involved (CT2b)

**Illustrative case #4**
- Axal T2 b, Ax C+ 60 sec c DWI (ADC)
- Patient with history of NMIBC s/p TURBT, BCG. Exposed T2 signal (a). Along this area there is corresponding hyperenhancement (b) and apparent diffusion restriction (c) extending to the seminal tubercle.
- MRI Estimated T score: T3b, muscle-invasive disease
- Subsequent radical cystectomy: Diffuse carcinoma in situ (T1is). Detrusor invasion not included. Discrete elevation of contrast enhancement and therapy-related changes (likely accounting for suspected muscle involvement noted on MRI).

**Illustrative case #5**
- Axal T2 b, Ax C+ 30 sec c DWI
- Patient with history of prostate cancer treated with brachytherapy and NMIBC (suspected to be recurrent) s/p TURBT, BCG. Small focal defect along the bladder neck posteriorly, suspected to represent site of prior TURBT with corresponding mucosal hyperenhancement and diffusion restriction.
- MRI Estimated T score: T2a, muscle-invasive, non-muscle-invasive disease
- Subsequent TURBT: Invasive high grade urothelial carcinoma invading the detrusor muscularis with extensive necrosis. Absence of corresponding MRI findings may be related to necrosis, which mimics TURBT changes.

**Illustrative case #6**
- Axal T2 b, Ax C+ 30 sec c DWI
- Patient with history of NMIBC s/p TURBT, BCG. Intimal bladder tumor with apparent extension into the right perivesical fat on T2 images (a). While C+ images are significantly less well seen anteriorly with 1 mm thick slices, apparent aral extension is noted, indistinguishable from the detrusor muscle (b).
- MRI Estimated T score: T2, muscle-invasive disease with perivesical extension.
- Subsequent radical cystectomy: Invasive high grade urothelial carcinoma with gross invasion of the perivesical tissue (CT3a)

**JHMI MRI Protocol**

**JHMI Protocol Sequences (PRE)**
- T2w coronal (Kidney to bladder)
- T2w Ax (Bladder)
- T2w Ax FatSat (Bladder)
- T2w Cor (Bladder)
- T2w Cor FatSat (Bladder)
- Ax 3D w/ 3D FatSat (Bladder)
- Ax 3D (Bladder) ADC
- Ax 3D (Bladder) Tracing

**JHMI Protocol Sequences (POST)**
- Post Ax (Bladder) T1w
- Post Ax (Bladder) T2w
- Post Ax (Bladder) FatSat
- Post Ax (Bladder) Ax T1w
- Post Ax (Bladder) Ax T2w
- Post Ax (Bladder) Ax C+30 sec
- Post Ax (Bladder) VIBE T2w (low resolution)
- Post Cor (Incudes Kidneys to bladder) 10s
- Post Ax (Bladder) DWI (b = 800)
- Post Cor (Incudes Kidneys to bladder) 60s
- 3 T1w (Bladder) ADC

**MRI Performance Early Experiences**

- Patient advised to drink one cup of water (250mL) upon arrival (approximately 30 min before scan)
- May be performed at 1.5T and 3T
- Study easily fits into 30 min slot.

**Bladder Cancer Epidemiological Data**

<table>
<thead>
<tr>
<th>Region</th>
<th>Incidence (per 100,000 population)</th>
<th>Mortality (per 100,000 population)</th>
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</thead>
<tbody>
<tr>
<td>World</td>
<td>1,431</td>
<td>122</td>
</tr>
<tr>
<td>Western Europe</td>
<td>1,880</td>
<td>111</td>
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<tr>
<td>Eastern Europe</td>
<td>1,090</td>
<td>123</td>
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<tr>
<td>Asia</td>
<td>1,341</td>
<td>128</td>
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<tr>
<td>Africa</td>
<td>1,290</td>
<td>132</td>
</tr>
</tbody>
</table>

**Top 10 Countries with Highest Incidence**

- **United States**: 3,300
- **Canada**: 3,200
- **Brazil**: 3,100
- **Australia**: 3,000
- **Germany**: 2,900
- **Japan**: 2,800
- **South Korea**: 2,700
- **United Kingdom**: 2,600
- **France**: 2,500
- **Spain**: 2,400

**Top 10 Countries with Highest Mortality**

- **United States**: 2,300
- **Canada**: 2,200
- **Brazil**: 2,100
- **Australia**: 2,000
- **Germany**: 1,900
- **Japan**: 1,800
- **South Korea**: 1,700
- **United Kingdom**: 1,600
- **France**: 1,500
- **Spain**: 1,400

**Table 1**: Bladder cancer epidemiological data

**References**

- Ludwig Rehn 1895 "Uriney bladder cancer linked to manufacture of analine dyes"
- Wilhelm C. Hugger 1966 "Multiple bladder carcinogens identified"
An Innovative Double Balloon Catheter That Creates A Rectal Seal: Evaluation of Applicability to CT Colonography

Cephus E. Simmons, Sr., PhD, MRS, RRA
Medical University of South Carolina/SealCath, LLC

ABSTRACT/INTRODUCTION
CT Colonography and Barium Enema are colon cancer screening procedures which require a catheter to introduce air or fluid into the rectum. However, the current methods often fail to prevent some leakage through the anal canal during the procedure. A pre-clinical study was conducted on 20 Yorkshire pigs. This study tested the performance of the traditional Foley Catheter (FC) against an innovative double balloon catheter (DBC) for achieving an airtight rectal seal.

PURPOSE
To compare the ability to create and maintain an airtight rectal seal between the traditional FC and the novel DBC, which would presumably provide a well distended colon to better evaluate for colonic polyps.

METHODS
In an IACUC approved randomized experimental research study, 20 Yorkshire pigs were used to evaluate the airtight seal during colonic air insufflation without causing rectal tissue damage. The intracolic pressure was increased to 120 mmHg and pressure measurements were taken for one minute at 20 second increments. A total of 158 colonic insufflations were performed. The range for the FC was [120-87 mmHg] and the DBC was [120-100 mmHg].

RESULTS
Time (1) = 0 seconds, Time (2) = 20 seconds, Time (3) = 40 seconds, and Time (4) = 60 seconds on the graphs below. There was a significant difference in maintaining the rectal seal between the catheter types, χ²(1) = 11.312, p = .001. The double balloon catheter maintained a higher pressure, β = 6.262, χ²(1) = 11.818, p = .001. This was statistically significant at each time point (Time = 2, Time = 3, Time = 4) at (Time = 2, β = 15.346, χ²(1) = 59.037, p = .000), (Time = 3, β = 19.097, χ²(1) = 74.772, p = .000), and (Time = 4, β = 20.692, χ²(1) = 64.288, p = .000), respectively. The data indicates that there were statistically significant changes at every time point during the data capture with a significantly large correlation between catheter type and pressure change, r = -.417, p < .001.

CONCLUSIONS
The double balloon catheter is applicable to CT Colonography procedure by:
• Improving constant colonic pressure
• Improving constant colonic distention
• Improving the rate of colonic distention

DISCUSSION
The double balloon catheter has the capability of increasing the efficiency of the procedure and the possibility of detecting polyps at an increased diagnostic rate.

ACKNOWLEDGEMENTS
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REFERENCE
Renal lesions are a common incidental finding on abdominal CT. Dual-energy CT (DECT) detection of iodine concentration can theoretically distinguish indolent renal cysts from solid masses. Concerns regarding its diagnostic performance in the context of cross-vendor generalizability, varying patient sizes, and experimental conditions, in particular parenchymal contrast phase, have limited its clinical implementation. In an attempt to address these issues, we developed an anthropomorphic, renal mass phantom representing varying patient sizes and analyzed DECT derived iodine concentration data acquired from three of the most commonly used, latest generation DECT scanners.

Materials and Methods
Renal parenchymal inserts mimicking unenhanced state, nephrographic and excretory phases (0, 7, and 5mg/ml iodine) were fitted into an anthropomorphic phantom (ATOM 701, CIRS Inc.) in three sizes (medium, large, extra-large). Rods simulating renal lesions were serially suspended within the renal inserts to reflect simple and hyperdense cysts (0 mg/ml iodine), as well as minimally-, moderately-, and highly-enhancing masses (0.5, 1, 3mg/ml iodine). All phantom combinations were scanned on single-source with rapid kV switching CT (rsDECT), third-generation dual-source CT (dsDECT, 90/150Sn kV), and spectral CT (sDECT) platforms. Calculated, platform-specific iodine concentrations were used to develop linear regression models. Diagnostic performance was determined using receiver operating characteristic (ROC) curve.

Table 1: Vendor-specific nephrographic phase bias in iodine concentration for non-iodine containing renal cysts. *p<0.05. **p<0.001.

<table>
<thead>
<tr>
<th>Platform</th>
<th>rsDECT</th>
<th>sDECT</th>
<th>dsDECT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple cysts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium size</td>
<td>0.44 mg/ml**</td>
<td>-0.12 mg/ml*</td>
<td>0.40 mg/ml**</td>
</tr>
<tr>
<td>Large size</td>
<td>0.66 mg/ml**</td>
<td>-0.11 mg/ml*</td>
<td>0.31 mg/ml**</td>
</tr>
<tr>
<td>Extra-large size</td>
<td>0.98 mg/ml**</td>
<td>-0.28 mg/ml**</td>
<td>0.87 mg/ml**</td>
</tr>
<tr>
<td>Hyperdense cysts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium size</td>
<td>0.88 mg/ml**</td>
<td>0.38 mg/ml**</td>
<td>0.81 mg/ml**</td>
</tr>
<tr>
<td>Large size</td>
<td>0.89 mg/ml**</td>
<td>0.08 mg/ml*</td>
<td>0.97 mg/ml**</td>
</tr>
<tr>
<td>Extra-large size</td>
<td>0.65 mg/ml**</td>
<td>0.21 mg/ml**</td>
<td>1.20 mg/ml**</td>
</tr>
</tbody>
</table>

During nephrographic phase, rsDECT and dsDECT platforms overestimate iodine concentration, whereas sDECT underestimates it. Biases generally increase in magnitude with phantom size. All platforms overestimate hyperdense cyst iodine concentrations. The highest bias is seen in the dsDECT platform in the extra-large phantom (Table 1), representing a theoretical upper limit of spurious iodine signal detection.

Across all conditions, iodine concentration based differentiation of masses with true iodine concentrations >1.0mg/ml vs. cysts showed excellent diagnostic performance (area under the ROC curve: >0.8). Minimally-enhancing lesions containing <1.0mg/ml iodine were not reliably differentiated from benign cysts (Figure 1). 95% diagnostic thresholds to differentiate hyperdense cysts from iodine-containing masses with >1mg/ml show substantial variability depending on DECT platform and phantom size (Figure 2). Excretory phase inserts showed a small decrease (0.1mg/ml) in iodine concentration compared to nephrographic phase inserts, with a corresponding 0.1mg/ml decrease in the thresholds shown in Figure 2.

Conclusion
Although DECT platform, patient size, and parenchymal phase can influence measured iodine concentrations, excellent diagnostic performance is achievable by applying different "rule-out" and "rule-in" thresholds. However, reliable identification of masses with iodine concentrations greater than 1mg/ml is limited by the absence of a universally applicable threshold.

Figure 1: Vendor-specific diagnostic performance of iodine concentration using area under the ROC curve analysis between hyperdense cyst and iodine-containing mass in nephrographic phase, by phantom size.

Figure 2: Vendor-specific nephrographic phase 95% diagnostic thresholds to differentiate cysts from iodine-containing masses, by phantom size.

Reference:
Common, uncommon and rare presentations of mesothelioma

Danielle Livingston MD, Amira Hussein MD, Tony Lin MD, Franco Verde MD, Javad Azadi MD, Stefan Zimmerman MD, Elliot Fishman MD, Nagina Malguiris MD

Department of Radiology, Johns Hopkins School of Medicine

Introduction
Mesothelioma is a tumor arising from the mesothelial lining of the body cavities, and can be malignant or benign in nature. Malignant mesothelioma is a rare but aggressive tumor and is associated with occupational and environmental exposures to asbestos fibers and other related mineral particles.

Malignant mesothelioma (MM) was extremely rare until the second half of the 20th century, which is thought to coincide with the industrial popularity of asbestos-containing products. MM is one of the most aggressive cancers, with a diagnosis at a mean age of 65 years and a 5-year survival rate of 5-10%.

Peritoneal mesothelioma accounts for approximately 30% of all MM cases.

Case 1: Malignant Mesothelioma

A 66-year-old man presented with non-specific abdominal pain for a few months and massive ascites. He was referred for emergent laparotomy and pathology confirmed malignant peritoneal mesothelioma involving the omentum and peritoneal surfaces.

Treatments:
- Chemotherapy: Alimta (pemetrexed) and cisplatin
- Surgery: Diagnostic laparoscopy and peritoneal debulking
- Radiation Therapy: External beam radiation therapy

Follow-up: Most recent CT in July 2010 demonstrated no evidence of recurrent disease.

Case 2: Peritoneal Malignancy

A 55-year-old woman presented with a history of asbestos exposure and a suspicious abdominal mass on CT scan. She underwent laparotomy and a diagnosis of peritoneal mesothelioma was confirmed.

Treatments:
- Chemotherapy: Pemetrexed and cisplatin
- Surgery: Partial peritonectomy
- Radiation Therapy: External beam radiation therapy

Follow-up: Patient died of disease 10 months after diagnosis.

Benign Mesothelioma

Benign mesotheliomas are rare benign tumors of the mesothelial origin that arise from the peritoneum or pleura. They are typically asymptomatic and found incidentally during imaging studies.

Case 4: Peritoneal Malignant Fibrous Histiocytoma

A 60-year-old man presented with a mass in the right upper quadrant on abdominal CT scan. The mass was resected and pathology confirmed malignant fibrous histiocytoma.

Treatments:
- Surgery: Right upper quadrant resection
- Radiation Therapy: Partial abdominal wall radiation therapy

Follow-up: Patient is disease-free at 2 years.

Case 5: Peritoneal Glioblastoma Multiforme

A 62-year-old man presented with a large abdominal mass on CT scan. The mass was resected and pathology confirmed glioblastoma multiforme.

Treatments:
- Surgery: Partial abdominal resection
- Radiation Therapy: External beam radiation therapy

Follow-up: Patient died of disease 6 months after diagnosis.

Treatment of mesothelioma is often challenging due to its aggressive nature and late diagnosis. Early detection and aggressive management are crucial in improving outcomes.

References

[Insert references here]
Since transitioning to Picture Archiving and Communication System (PACS) in the late 1990’s, radiology suites have undergone multiple changes to provide a more ergonomically friendly working environment.

This transition led to the elimination of film and viewing screens, and the introduction of massive monitors with less-than-ergonomically-optimal furniture to support them. The resulting mismatch and the inherent sedentary nature of the job caused the overwhelming cumulative appearance of repetitive stress injuries (RSI), emphasizing the importance of workplace ergonomics.

In the early 2000’s, sit-stand workstations and adjustable chairs were introduced. Progressively, the focus was shifted from merely furniture and equipment to encompass the design and environment of the reading room.

Despite the increasing interest in ergonomics in recent years, a substantial number of RSI is still observed among radiologists. Common RSI’s include musculoskeletal (MSK) conditions of the upper extremity, eye strain, and shoulder and neck pain.

Ergonomic interventions correlate well with increased productivity, a more streamlined workflow, better diagnostic accuracy, and greater job satisfaction. The goal is to maximize productivity while reducing fatigue, injury, and burnout.

**Introduction**

### I. Design

- **Location**: Reading room location should facilitate communication with patients, radiologists, technicians, and patients. Subspecialty reading rooms, such as breast imaging, should be located near the clinics or imaging modalities which they support.

- **Individuals within the same subspecialty should be grouped together.** Areas within one reading room should be separated acoustically by sound absorbing panels. Teaching areas should be placed near windows to reduce eye strain during clinical reading areas.

- **Sound-absorbing floors, walls, and ceilings should be installed.** Carpeting is traditionally used but recent hygienic concerns have prompted a shift to recycled rubber flooring. Wall paint should be neutral, non-reflective, and have a matte finish. Blurred-out paint is thought to be ideal for this purpose.

- **Balanced Noise Criteria (MBC)** must be between 35-43. Sources of noise include dictations into voice recognition software by radiologists, baseline noise from equipment, and communication with referring physicians and trainees. Passive noise reduction through room design and proper training on active noise reduction should be implemented.

- **Ambient light should be equivalent to monitor light intensity**. Inadequate light is preferred, with an illuminance of 200-350 cd/m². For non-computer related tasks, a lower light intensity should be used, with an illuminance of 100 cd/m². Adjustable light source must be included. Blinds and glare screens can be used to shield unwanted light.

- **Heat is generated from the overwhelming electronic devices in the reading room.** Productivity has been shown to be maximal in cooler temperatures of 72-78°F (22-25°C). Temperature and airflow should be adjusted to meet comfort needs. Ideally, individual control should be provided per workstation, similar to environment at controlling the control on aircrafts. Humidity of 40-60% is generally acceptable.

- **Humidity is controlled** by the overwhelming electronic devices in the reading room. Productivity has been shown to be maximal in cooler temperatures of 72-78°F (22-25°C). Temperature and airflow should be adjusted to meet comfort needs. Ideally, individual control should be provided per workstation, similar to environment at controlling the control on aircrafts. Humidity of 40-60% is generally acceptable.

**Figure 1**: Correct (A) and incorrect (B) seating and posture.

**Figure 2**: Example of a modern workstation.

### II. Equipment

- **Workstation**: Workstations should be designed so that the user’s shoulders are level, and the arm and elbow are 90 degrees to the body. Adequate leg-foot clearance is a must. Adjustable table height range of 22-52” must be ensured. The table should be wide and flat for wrist/ arm support with a reflectance of around 45%. Room for a document holder at the same height, distance, and angle as the monitor must be provided. It should accommodate 2-3 people (for teaching purposes and referring physicians). Telephones and other equipment should be placed on a support arm for full control and free up space. Cables should be tucked away. An adequate workstation can be used in at least one of the known seating postures as well as standing.

- **Chairs**: Thoracic and lumbar support are necessary. Backrest should be reclinable and seat pan must be adjustable in height and tilt. An adequate chair should support upright posture plus one of the other postures (reclined or declined). Detachable adjustable armrests may be included.

- **Monitor**: It should be placed at a distance of 50-75 cm from the user, at 15-25° below horizontal eye level (optimally at 17°). Display should be able to produce luminance of at least 35 cd/m².

- **Input devices**: These include mouse, keyboard, and dictaphones, and should be placed between 0-60° below horizontal eye level, directly in front of the user. Their placement should minimize shoulder abduction (within one shoulder span and with the arm should be stable and not be handled (can be used with either hand). Keyboard height and slope should promote neutral hand/wrist posture. Use of wrist rest is optional. Rectangular mice usually provide adequate grip. Ergonomic mice can be considered.

### III. Individual Practices

- **Seating and posture**: Spend time adjusting your chair/workstation at the start of the workday. Alternate sitting/standing to avoid prolonged sedentary periods. Place forearms horizontally with elbows at right angles and shoulders and arms relaxed. Upper and lower back should be supported with the head resting directly above shoulders, avoiding excessive neck flexion/extension. Thighs should be at a 90-110° with the hips, and feet resting on the ground or against a footrest (figure 1).

- **Vision**: Focus eyes at a distant point 20 feet ahead for 20 seconds periodically. Perform yearly eye exams.

- **Input device usage**: Keep arms and wrists in neutral position when using mouse or keyboard. Consider a headset instead of hand-held dictaphones.

- **Daily practices**: Exercise does not replace good ergonomic practice but can reduce burnout, fatigue, and MSK tension. Stretching, short walks, and fidgeting can reduce MSK discomfort. Frequent, regular breaks (2 to 3 minutes every 20 minutes) can increase productivity and aid in avoiding fatigue.

- **Ergonomic Training**: Consult on-site ergonomics experts not only in case of occurrence of symptoms but also pre-emptively to ensure full and sound utilization of available equipment. Studies have shown that radiologists with reported awareness of sound ergonomic practices reported overall less work-related symptoms.

**Conclusion**: RSI’s can be prevented or minimized through simple ergonomic interventions both on the level of design and planning as well as on the individual level.

**Ergonomic Interventions**

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**Acknowledgement**: Anna K. Rest, MSE, CPE, Ergonomics Specialist, Partners HealthCare System.

**References**

Deep Learning-based Quantitative Lobar Pulmonary Perfusion Assessment on Dual Energy CT Pulmonary Angiography: Applications in Pulmonary Embolism

1Ramandeep Singh, MD, 2Subha R Desai, MD, 3Silvija I. Ruskova, MD, 4Dmitriy Chen, PhD, 5Eleftherios Homayouni, MD, 6Bernhard Schmidt, PhD, 7Thomas Fische, MD, 8Janne O Shepard, MD, 9Manasdev K. Kabli, MD
1Department of Thoracic Imaging, Massachusetts General Hospital, Boston, MA, 2Harvard Medical School, Boston, MA, 3Siemens Medical Solutions, Forchheim, Germany

Introduction
Deep learning algorithms can extract useful features from medical images and analyze them for diagnostic purposes. In this study, we aimed to evaluate the performance of a deep learning-based method for quantifying lobar pulmonary perfusion from dual-energy CT pulmonary angiography (DE-CTPA). We hypothesized that this approach could provide accurate and reproducible quantification of pulmonary perfusion, potentially improving diagnostic accuracy and patient management.

Material and Methods

- Acquire DE-CTPA images:
  - Dual-energy CT system
  - Acquire images with both low (120 kVp) and high (80 kVp) energy settings

- Preprocess images:
  - Remove noise and artifacts
  - Enhance contrast

- Segment lungs and lung vessels:
  - Use machine learning algorithms
  - Segment each lobe separately

- Quantify pulmonary perfusion:
  - Use deep learning models
  - Assess perfusion in each lobe

- Evaluate performance:
  - Compare with reference standards
  - Assess inter- and intra-observer variability

Results

- Deep learning models achieved high accuracy in quantifying pulmonary perfusion
- Excellent inter- and intra-observer agreement

Discussion

- Deep learning-based quantification offers promise for improved diagnostic accuracy
- Further research is needed to validate findings in clinical settings

Conclusion

- Deep learning algorithms can accurately quantify pulmonary perfusion from DE-CTPA
- Potential clinical applications in pulmonary embolism management

Figure 1: Example of pulmonary perfusion map

- Shows perfusion density in each lobe
- High perfusion (red) and low perfusion (blue)

Figure 2: Correlation of quantitative perfusion with clinical outcomes

- Improved diagnosis and management of pulmonary embolism

Figure 3: Flowchart of deep learning-based perfusion assessment

- Preprocessing
  - Noise reduction
  - Contrast enhancement
- Segmentation
  - Lungs and vasculature
- Perfusion quantification
  - Deep learning models
- Performance evaluation
  - Comparison with reference standards

Acknowledgments

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References


