CT Urography

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Bladder
CT Urography

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Disclosure of financial relationship with relevant commercial interest

Siemens Medical Solutions
Malverne, PA – Consultant

Bladder
Outline

- CT urography technique
- Bladder variants
- Bladder: benign vs malignant
- Urinary Diversions
- Summary
**BWH CT Urography Protocol**

### 64 – Channel MDCT with 3 phases

<table>
<thead>
<tr>
<th>Unenhanced</th>
<th>Nephrographic</th>
<th>Excretory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Abd/Pel</td>
<td>Kidneys</td>
</tr>
<tr>
<td>Delay</td>
<td>--</td>
<td>100 s</td>
</tr>
<tr>
<td>Collimation</td>
<td>1.2 mm</td>
<td>1.2 mm</td>
</tr>
<tr>
<td>Axial Recon/Incr</td>
<td>3/3</td>
<td>3/1.5</td>
</tr>
<tr>
<td>Post Processing</td>
<td>--</td>
<td>-- Cor / Sag / MIP / CPR / VR</td>
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- Iodinated contrast material (300 mgI/ml); 0.5 s rotation time
- AEC w/ quality reference 200 mAs, 120 kVp

Silverman et al Radiology 2006
Distension is needed to assess for masses and wall thickening.

Opacification of urine maximizes CNR and helps detect masses.

Mixing of contrast media and urine provides homogeneous background from which masses can be detected.

Furosemide and saline help with all three!

Sadow et al, RSNA 2006
Normal UVJ Appearance

Intramural ureters can be mass-like + slightly asymmetric

Axial

Cor

Don’t mistake these for TCCs!

Sadow et al, RSNA 2006
Chronic cystitis

- Hemorrhagic cystitis – treatment with cyclophosphamide
- Radiation (>40 Gy) – may be delayed
- Infection – bacteria, schistosomiasis (calcification), TB
- Interstitial – etiology unknown
- Cystitis glandularis, malakoplakia, cystitis cystica
Bladder Neoplasms

- Epithelial (95%): TCC (95%), SCC (4%), Adenocarcinoma (1%)
- Non-epithelial: Leiomyoma, rhabdomyosarcoma, pheochromocytoma, lymphoma
- Metastatic: hematogenous (melanoma), Local (prostate, Cx, rectal)
Bladder Cancer

- Most common GU cancer...by far
- IVU sensitivity only 60%
  (Hillman Radiology ‘81)
- Virtual cystoscopy (gas or CM)
  requires bladder catheterization, scanning twice, and complex 3D post-processing
  (Song Radiology ‘01, Narumi AJR ‘96, Kim AJR ‘02)
- Cystoscopy the only accepted method
Epithelial Bladder Cancer

- Transitional cell carcinoma (95%)
  - smokers, phenacitin, aniline dyes

- Squamous cell carcinoma (4%)
  - schistosomiasis, chronic infection

- Adenocarcinoma (1%)
  - urachus, exstrophy, cystitis glandularis
Bladder Cancer Detection

- CT urography can be used to detect small urothelial neoplasms!
- Here are some examples…
Bladder Ca Diagnosis with CTU

- Solitary, polypoid, mucosal mass
- Multifocal, polypoid, mucosal masses
- Focal or asymmetric wall thickening
Benign Entities Mimic Cancers

• Normal and variant anatomy
• Adherent blood clot
• Intravesical prostate gland
• Post-surgical changes
• Intravesical immunotherapy (e.g. BCG)
Bladder Ca Detection (n=838)

Average risk; Mean age 62 yrs (men), 52 (women)

Sadow et al Radiology 2008
Bladder Ca Detection (n=838)

Negative Predictive value of CTU

- Microscopic Hematuria: 0.984, n=249
- Gross Hematuria: 0.971, n=373
- Urothelial CA: 0.769, n=158

Sadow et al. Radiology 2008
Bladder Ca Diagnosis with CTU

- Solitary, polypoid, mucosal mass
- Multifocal, polypoid, mucosal masses
- Focal or asymmetric wall thickening in the absence of prior BCG treatment or surgical resection

Except for rare inflammatory disorders!
False Negative Readings of CTU

- Clinical reads = 117 of 149 cancers detected (32 FN interpretations)
- Retrospective reads = 15 add’l cancers detected, 17 still undetectable

Sadow et al, RSNA 2006
**Bladder Ca Detection w/ CTU**

- CTU is a sensitive test for bladder cancer; tumors as small as 2 mm may be seen.
- Most cases are missed due to perceptive errors, not imaging technique.
Clinical reads = 649 of 689 pts without cancer were TN reads; there were 40 FP interpretations.
Retrospective reads = 12 of these were interpreted as benign.

Sadow et al, RSNA 2006
Bladder Ca Detection w/ CTU

- FP interpretations can be avoided by recognizing benign variants
- Many FP interpretations represent true limitations of CTU and cystoscopy is needed in these cases
Bladder Ca Detection w/ CTU

- CTU is not as specific for bladder cancer; normal anatomy should be recognized
- Benign conditions, post-op, post-BCG effects may mimic bladder cancer
Why False Positive Readings?

- Trabeculated Wall 5%
- Prostate 15%
- Blood Clot 20%
- Normal Anatomy 24%
- Postop/BCG 23%
- Benign Mass 5%
- Etiology 8%

Sadow et al, RSNA 2006
# BWH CT Urography Protocol

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<td>Pel/Abd</td>
<td>Abd/Pel</td>
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<tr>
<td><strong>Delay</strong></td>
<td>--</td>
<td>70 s</td>
<td>10 - 15 min</td>
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<td><strong>Collimation</strong></td>
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Iodinated contrast material (300 mgI/ml); 0.5 s rotation time
165-200 mAs, 120 kVp

Silverman et al Radiology 2006
A potential alternative approach...

Using 70 sec delay in pelvis, all but one of 47 bladder tumors larger than 5 mm were detected with no false positive findings.

Jinzaki et al. Detection of bladder tumors with dynamic contrast-enhanced MDCT. AJR 2007;188:913-918

118 patients; age 15-87 (mean 62 yrs)

Painless gross hem or recurrent micro hem

CTU: portal venous phase in pelvis (70 sec)

CTU: 0.89 - 0.92 sensitivity; 0.88 - 0.97 specificity

Summary

- CT urography supplemented with IV furosemide can be used to evaluate the bladder.
- Thin (3 mm) sections and multiplanar reformations are particularly helpful.
- Beware of benign entities that mimic cancer – normal variants, blood clot, and BPH.
Summary

- Solitary or multifocal polypoid mucosal masses are likely cancers.
- In the absence of prior surgery or BCG, focal or asymmetric wall thickening is likely cancer.
- In patients who have undergone prior resection or were treated with BCG, focal asymmetric wall thickening may be scarring or cancer.