THE OBVIOUS AND NOT SO OBVIOUS PITFALLS IN CT IMAGING OF UROEPITHELIAL NEOPLASMS

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Disclosures

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Learning Objectives

- Brief review of epidemiology
- Review early imaging signs of uroepithelial neoplasms
- Understand subtle findings and potential pitfalls that can be used for earlier recognition of these neoplasms

Target Audience:
General and Genitourinary Radiologists

http://www.pathology.washington.edu/about/education/gallery/bladder/
Epidemiology

- Uroepithelial cancers are most common in western Europe and USA, with a lower incidence in Japan
- Male to female ratio is at least 3:1
- Smoking is by far the greatest risk factor
- Up to 30-40% of patients have multifocal disease at presentation
- Outside local metastasis in the pelvis, TCC most commonly metastasizes to bone*

*Spine being the most common
CASE 1: 47 year old female with Stage 4 breast cancer presents for serial follow-up cross sectional imaging to evaluate response to salvage therapy.

Four axial contrast enhanced CT (CECT) each performed approximately 3 months apart (last two far right axial images of the top row are from same date, one slice apart): Subtle increasing luminal diameter of the proximal ureter (red). Incidental note that patient has a duplicated collecting system with a medially positioned upper pole ureter (green). In retrospect, the missed lesion was certainly present but is inconspicuous on the axial image (last image, blue).

Four coronal CECT 3 months apart: The increasing dilatation of the inferior renal pole pelvis is better appreciated (red). Mild focal hydroureter was missed in the third image as there was no contiguous dilatation proximally (green). On the last coronal image, hydronephrosis and hydroureter caused by the enhancing obstructing intraluminal mass is obvious (blue).
Teaching Point

▪ New or increasing hydronephrosis may be a subtle clue and should warrant careful examination of the ureters in multiple planes

▪ Coronal plane is often the most helpful in ureteral TCCs

▪ Focal ureteral dilatation should be investigated and should not be presumed as ureteral peristalsis
CASE 2: 88 year old male smoker presented with a few months history of recurrent hematuria. Initially diagnosed with UTI but returned 2 weeks later with recurrent hematuria with large clots.

Noncontrast CT Stone Protocol (NCT): Mild right hydroureter (red) was correctly identified, however, this was interpreted to be secondary to marked prostatic hypertrophy with intravesicular median lobe protrusion (green). In retrospect, the subtle bladder mass is seen separate from the prostate (blue).

CT Urogram (CTU) 2 weeks later: The enhancing bladder mass adjacent to the right ureterovesicular junction (blue) was correctly identified in this CTU causing mild right hydroureter (green).
Teaching Point

- Bladder outlet obstruction should cause bilateral upstream effects, not unilateral.
- All reconstructed imaging planes should be carefully reviewed which may better demonstrate location, separate from the prostate.
CASE 3: 61 year old female with history of recent aorto-bifemoral graft bypass presented with right flank pain and hematuria.

Coronal and axial NCT: A 3mm mid to distal ureteral stone (red) causing hydroureter and hydronephrosis was seen. There is known left hydroureter where the left ureter crosses the bypass graft (yellow). In retrospect, the a soft tissue mass is seen distal to the stone and focally expanding the ureter (green).

Sagittal and coronal CTU 6 months later: CTU clearly demonstrates a filling defect (green) within the mid to distal ureter consistent with transitional cell carcinoma that was blocking passage of the previously noted 3mm ureteral stone.
Teaching Point

- While searching for the etiology of the patient’s symptoms, be wary of satisfaction of search, a common pitfall when other diagnoses may be missed.
- Small uroepithelial neoplasms may be overlooked on routine Non-contrast CT and CECT, unless appropriate CTU techniques are used.
CASE 4: 53 year old female presented to an outside hospital with left flank pain and clinical suspicion for nephrolithiasis. 1 year later, she presents to UC Davis with hematuria.

Top row: Axial and coronal NCT with mild hydronephrosis (red) and adjacent fat stranding of the left kidney. Initial impression was that the these findings were secondary to a recently passed stone. In retrospect, hydronephrosis was isolated to an upper pole compound calyx and there is subtle density change (blue) between the tumor and the hydronephrotic upper pole calyx.

Axial and coronal CECT 12 months later: A polypoid enhancing left renal pelvis mass (yellow) invading the renal collecting system is now present.
Teaching Point

- Asymmetric hydronephrosis within a kidney warrants careful examination for a specific etiology, especially if a duplicated collecting system is not present.
- On NCT, be wary of subtle soft tissue density changes in the renal collecting system that may be the only clue that there is an obstructing uroepithelial neoplasm.
- Use of hounsfield units in a hydronephrotic pelvis should always be considered.
CASE 5: 63 year old male with a 45 pack year smoking history and several months of painless hematuria presents to the ED with acute suprapubic pain.

Axial and coronal NCT: Small 3mm stone in the distal right ureter (red) was correctly identified as the etiology of the patient’s pain. In retrospect, there is definite intraluminal thickening and density change (yellow) in the right coronal NCT image.

Axial, coronal and coronal MIP CTU: A soft tissue filling defect (yellow) narrowing the residual medial contrast opacified distal right ureteral lumen is seen on the axial image. Soft tissue filling defect is much more apparent on coronal reconstructions, particularly on the MIP reformats (yellow).
Teaching Point

- Focal ureteral dilation should prompt further close examination for an intraluminal soft tissue mass
  - Appropriate use of windowing may elucidate subtle density differences even on NCT
- Use of coronal planes and MIP reconstructions can make small lesions obvious
CASE 6: 57 year old male with history of BPH initially presented with hematuria. 2 years later, presents with recurrent hematuria.

Axial and coronal CECT: Initial CT was found to have a punctate stone in the inferior right renal pelvis (blue). In retrospect, the lower pole calcification was associated with a subtle soft tissue density in the lower pole calyx best appreciated on the coronal plane (red).

Axial and coronal CECT 2 years later: A large heterogeneous mass is seen extending from the lower pole calyces into the renal pelvis with associated curvilinear calcification (red).
Teaching Point

- Be wary of satisfaction of search when finding a renal calculus in the setting of hematuria
- Carefully exam in multiple planes to evaluate if there is an associated soft tissue density
- Irregular indistinct punctate calcifications have been associated with renal pelvis TCC
  - This is thought to be secondary to calcium deposition in the interstices of papillary growth

Dinsmore et al, Radiology 1988
CASE 7: 86 year old male with distant history of prostate cancer presenting with hematuria.

Coronal and axial CECT: Initial CT was significant for a few renal lesions that were not definitely cystic (red) and a multiphase renal mass protocol was recommended. However, the patient was lost on follow-up. In retrospect, an obvious small upper renal calyceal mass was present (yellow).

Coronal and axial CECT 2 years later: A large infiltrating upper pole mass (yellow) is seen invading the superior right renal pole with adjacent lymphadenopathy.
Teaching Point

- Consider first independently evaluating the renal corticomedullary parenchyma followed by a second pass through the renal collecting system to avoid distractors, such as hyperdense cysts which may inadvertently divert attention from otherwise obvious uroepithelial neoplasms.
CASE 8: 68 year old male with history of jejunal carcinoma presenting with painless hematuria.

Axial and sagittal CECT: Initial CT for jejunal carcinoma follow-up screening. Focal ureteral dilatation was thought to be secondary to peristalsis measuring up to 1cm in diameter (red). In retrospect, there is a subtle soft tissue density change in the area of focal dilatation (yellow). Moreover, the dilation is larger than what may be expected for normal peristalsis.

Axial and sagittal CTU 2 years later: Intraluminal TCC is obvious on this CTU (yellow).
Teaching Point

- While ureteral dilatation may be secondary to transient peristalsis, consider 5-6mm an upper limits of normal for ureteral diameter which should prompt careful multi-planar investigation for intraluminal masses, and consideration of CTU
  - In a study reviewing CTU protocol optimization, the mean contrast-distended ureteral short axis diameter was 4.1mm\(^1\)
  - In a review of 212 patients, 96% of patients had an unobstructed ureteral diameter of 3mm or less\(^2\)

\(^1\) Dillman et al, JCAT 2007
\(^2\) Zelenko et al, AJR 2003
CASE 9: 61 year old male presents with 1 day history of painless hematuria.

Axial, coronal and sagittal CECT: While the soft tissue thickening (red) on the right lateral bladder wall was not missed in this case, this emphasizes how much more apparent it is on the coronal and more so, on the sagittal reconstructions. Low grade papillary urothelial carcinoma was found at cystoscopy.
Summary

- The most common urothelial neoplasm is TCC
- New or increasing hydronephrosis or focal ureteral dilatation are subtle clues that warrant careful investigation
  - Consider use of CTU in cases of subtle mild hydronephrosis seen on NCT
  - Consider 5-6mm an upper limits of normal for ureteral diameter which should prompt careful multi-planar evaluation for intraluminal masses
- Always evaluate the kidneys and ureters in multiple planes. Coronal reformats often make subtle filling defects more obvious
Summary Continued

- Asymmetric hydronephrosis within a kidney warrants careful examination for a specific etiology
- On NCT, be wary of subtle soft tissue density differences in the renal collecting system
- Consider evaluating hounsfield units in a hydronephrotic renal pelvis
- Small uroepithelial neoplasms may be overlooked on routine NCT and CECT, unless appropriate CTU techniques are used
- Be wary of satisfaction of search or other distracters
Mimics

- Always consider a non-neoplastic etiology of uroepithelial filling defects:
  - Sloughed renal papillae
  - Normal renal papillae projecting into the calyx
  - Blood clots
  - Mycetomata
References


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Thank you

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