

## CLINICAL PRESENTATION AND RADIOLOGY QUIZ QUESTION

A 54 year old white woman presents with urinary urgency and frequency, with three episodes of hematuria, and a sensation of pressure in the pelvis. The patient denies fever, chills, or flank pain. Urinalysis shows positive protein, positive ketones, 5-10 WBCs and greater than 40 RBCs per field. The patient's hemoglobin is 11.2 and her hematocrit is 32.3.

What is the imaging study of choice for hematuria?

- (a) renal CT, performed without contrast
- (b) renal CT, performed without and then with contrast
- (c) intravenous pyelogram (IVP)
- (d) renal ultrasound

<b>RADIOLOGY QUIZ QUESTION, ANSWER, AND EXPLANATION</b>
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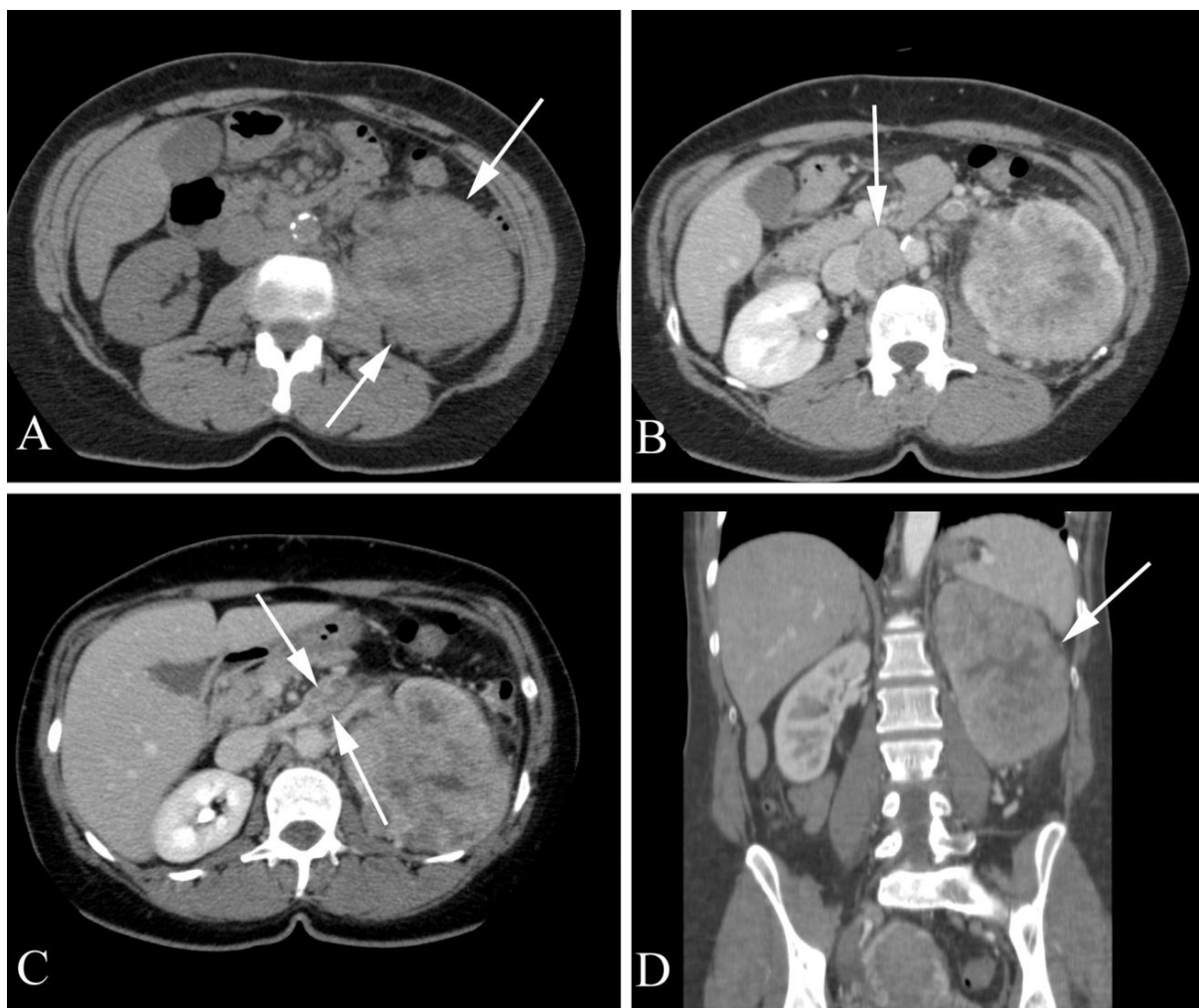
- (a) renal CT, performed without contrast
- (b) renal CT, performed without and then with contrast
- (c) intravenous pyelogram (IVP)
- (d) renal ultrasound

Answer: (b), renal CT, performed without and then with contrast, is the imaging study of choice for hematuria. Images obtained without contrast material are helpful for demonstrating nonobstructing renal calculi which may be obscured following injection of contrast material. Contrast enhanced images typically best demonstrate renal tumors, with early images (done during the nephrographic phase approximately 60-120 seconds after injection) showing renal parenchymal tumors and delayed images (done 8-10 minutes after injection) showing renal collecting system tumors.

Renal CT performed without contrast (a) will not demonstrate all renal parenchymal tumors nor will it demonstrate tumors of the renal collecting system, ureters, or bladder, and (a) is incorrect. Intravenous pyelogram (IVP) (c) and renal ultrasound (d) are notably inferior to renal CT (b) as a method of evaluation for hematuria, and (c) and (d) are incorrect.

IMAGING STUDY AND QUESTIONS
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A CT of the abdomen and pelvis was obtained without and with contrast material. Selected images from the study are shown below.

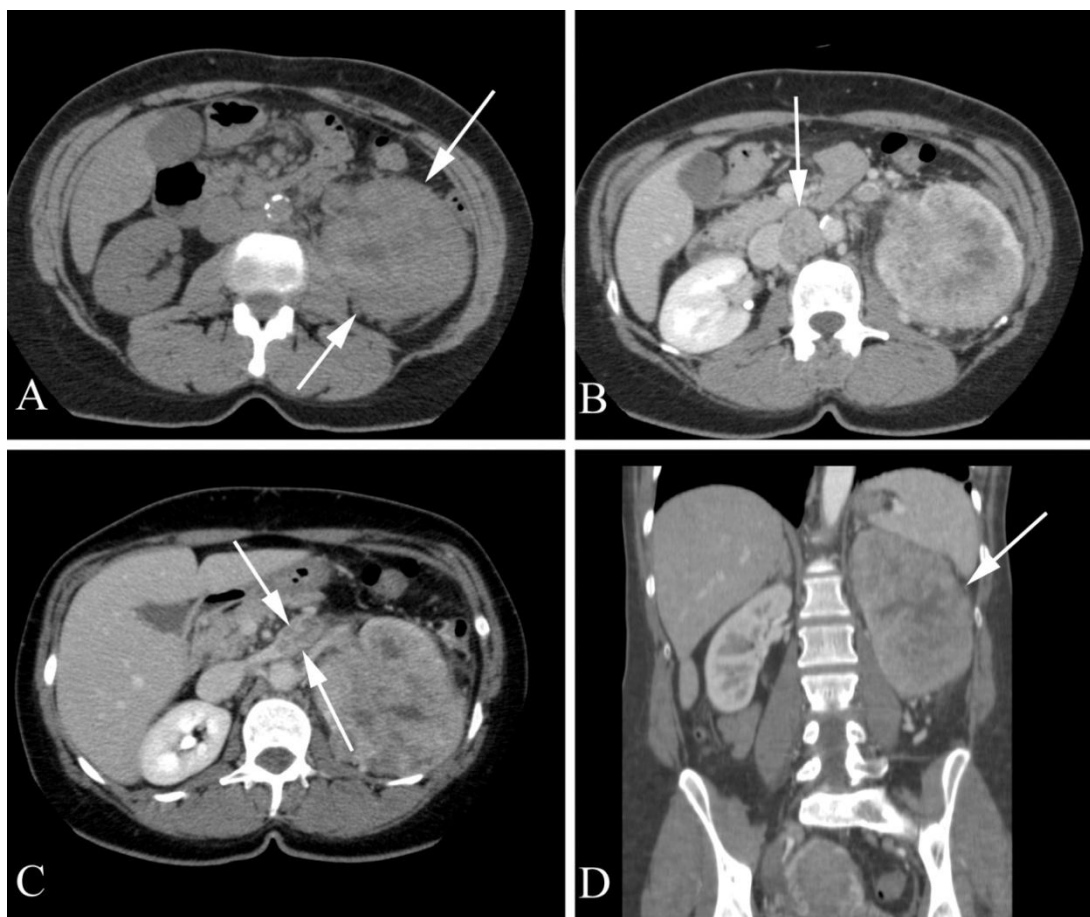


Imaging questions:

- 1) What is the abnormal structure located between the arrows in A? Hint: this is same abnormality indicated by the arrow in D.
- 2) What is the structure indicated by the arrow in B?
- 3) What abnormality is indicated by the arrows in C?
- 4) What is the diagnosis?
- 5) What is the next step in patient management?

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IMAGING STUDY QUESTIONS AND ANSWERS
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A. Unenhanced axial CT shows marked enlargement of the left kidney (between the white arrows).  
 B. Contrast enhanced axial CT demonstrates abnormal decreased enhancement of the enlarged left kidney and lymphadenopathy between the aorta and inferior vena cava (arrow).  
 C. Contrast enhanced axial CT shows a filling defect in the left renal vein (between arrows).  
 D. Contrast enhanced coronal CT shows marked enlargement and heterogeneous contrast enhancement of the left kidney (arrow).

Answers to imaging questions:

- 1) What is the abnormal structure located between the arrows in A? Hint: this is same abnormality indicated by the arrow in D. A large renal mass.
- 2) What is the structure indicated by the arrow in B? An enlarged retroperitoneal lymph node.
- 3) What abnormality is indicated by the arrows in C? Tumor thrombus in the left renal vein.
- 4) What is the diagnosis? Metastatic renal cell carcinoma.
- 5) What is the appropriate next step in patient management? Urology and oncology referral.

## PATIENT DISPOSITION, DIAGNOSIS, AND FOLLOW-UP

The patient was referred to a urologist who performed a nephrectomy and lymph node dissection. The pathologic diagnosis was renal cell cancer with metastases. The patient was also referred to an oncologist. Additional imaging studies included a bone scan and brain MR done without and with contrast, both of which were negative.

Note that in such cases as this, where there is strong evidence of metastatic disease, a nephrectomy may be performed for at least four reasons: 1) to secure a tissue diagnosis including the histopathologic type of renal cell cancer; 2) to eliminate persistent bleeding and anemia; 3) to relieve abdominal pressure caused by a large mass; and 4) occasionally, metastatic deposits from renal cell carcinoma will regress following removal of the tumor-containing kidney.

The most widely used method of staging renal carcinomas is the TNM system, used by American Joint Committee on Cancer (AJCC) and the International Union for Cancer Control (UICC). This patient's primary tumor had invaded Gerota's fascia (indicating a T4 tumor) and she had lymph node metastases (N1) but no distal metastases (M0), so her TNM stage was T4N1M0. She also had renal vein involvement. This indicates she has Stage IV disease, with poor prognosis. With the lack of distal metastases initially, the patient was treated with anti-angiogenic chemotherapy. Unfortunately, she developed a (biopsy proven) metastatic deposit to the vagina, a very rare location for metastatic disease.

## SUMMARY

**Presenting symptom:** Before imaging for hematuria is performed, most algorithms call for excluding multiple benign entities which may produce hematuria, including exercise-associated trauma, infections, certain medications, and dehydration. If these causes can be excluded and the patient has 2 of 3 urinalyses showing greater than 5 RBC's per high power field, contrast enhanced CT and urologic consultation is probably indicated. Hematuria may be caused by renal calculi, renal cell cancer, and cancer of the urothelium (upper tracts or bladder). Patients with hematuria should undergo cystoscopy in addition to CT, because lesions of the bladder mucosa may cause hematuria but be difficult or impossible to see on CT. Of all patients with hematuria, about 8% will have calculi, 5-10% bladder cancer, 1-2% renal cell cancer, and less than 1% upper track cancer. Many patients will never have a specific diagnosis made.

**Imaging work-up:** CT performed without and with contrast material is the imaging study of choice for evaluation of hematuria. CT done without contrast will not detect all renal tumors (particularly those of the urothelium, which show up as filling defects in the contrast column and can be virtually invisible on studies done without contrast). Intravenous pyelograms, once a mainstay in the evaluation of renal abnormalities, have been supplanted by CT. Ultrasound is considerably less sensitive and specific than CT for evaluation of renal tumors, but may be used in pregnant patients where radiation needs to be avoided.

**Establishing the diagnosis:** A presumptive diagnosis of renal cell cancer may be based on the CT study. The CT study also allows evaluation of local and regional disease. The diagnosis is usually confirmed with resected renal tissue (rather than a percutaneous biopsy).

**Treatment:** Treatment of renal cell cancer depends on the stage. Surgery is curative for smaller, contained lesions that have not metastasized, but for cases such as this one where the tumor is large and has already metastasized, the prognosis is poor.

**Take-home message:** Abdomen and pelvis CT performed both without and with contrast material is the study of choice for imaging hematuria. Most of these patients will also require cystoscopy.

## FURTHER READING

Atkins MB. Clinical manifestations, evaluation, and staging of renal cell carcinoma. UpToDate, accessed 11/15/10.

Greene FL et al (editors). AJCC Cancer Staging Manual, Sixth Edition, Springer, Philadelphia PA, 2002.

Renfrew, DL. Renal symptoms. Chapter 1 of *Symptom Based Radiology*, Symptom Based Radiology Publishing, Sturgeon Bay, WI, 2010.

Rose BD, Fletcher RH. Evaluation of hematuria in adults. UpToDate, accessed 11/28/08.