



Evaluation of Renal Masses

- Incidentally found simple renal cysts need no further imaging
- Most incidentally detected angiomyolipomas can be definitively diagnosed on imaging
- A renal mass protocol CT or MRI examination is indicated for all other suspected solid renal masses and complex cysts
- Image-guided percutaneous biopsy is recommended for patients with small (≤ 4 cm) enhancing renal masses, with suspicion of infection, or metastasis from a extra-renal cancer, or those who are poor nephrectomy candidates and are being considered for ablative therapy

The vast majority of solid renal masses in patients with a history of hematuria are primary renal cell carcinoma. Because this cancer is relatively unresponsive to chemotherapy or radiotherapy, resection or ablation of early stage disease is the only option with possibility of cure. However, small renal masses are now commonly detected incidentally during US, CT, or MRI examinations for non-urologic indications. A significant proportion of these smaller masses are benign (Table 1).

CT and MR imaging techniques can differentiate between benign and malignant lesions in some cases, such as angiomyolipomas containing fat. Until recently, percutaneous biopsy was not considered accurate enough for diagnosis. Therefore, masses that were not definitively benign on imaging were routinely resected or ablated without a confirmed diagnosis of malignancy because of the high likelihood of renal carcinoma.

Recent advances in radiological and pathologic techniques have increased the accuracy of image-guided percutaneous biopsy and its use has been shown to decrease the likelihood of finding a benign lesion after nephrectomy. Therefore, percutaneous biopsy has a role to play in the diagnosis and management of small renal masses, and has the potential to spare many unnecessary and potentially morbid surgical procedures.

Incidentally Detected Lesions

Simple renal cysts are common in the general population and if these are detected incidentally by ultrasound, CT, or MRI, no further diagnostic imaging is necessary. The presence of fat in a renal mass, which can be detected by ultrasound, CT or MRI, implies that the lesion is an angiomyolipoma (Figure 1). Further



Figure 1. Angiomyolipoma. Intravenous contrast enhanced CT shows a 2 cm fat-containing mass (arrow), characteristic of angiomyolipoma, in the upper pole of the right kidney.

diagnostic imaging is recommended for all other solid-appearing renal masses and complex cystic masses.

Table 1. Fraction of Solid Renal Masses that are Benign¹	
All sizes	12.8%
< 1 cm	46.3%
1 - < 2 cm	22.4%
2 - < 3 cm	22%
3 - < 4 cm	19.9%
4 - < 5 cm	9.9%
5 - < 6 cm	13.0%

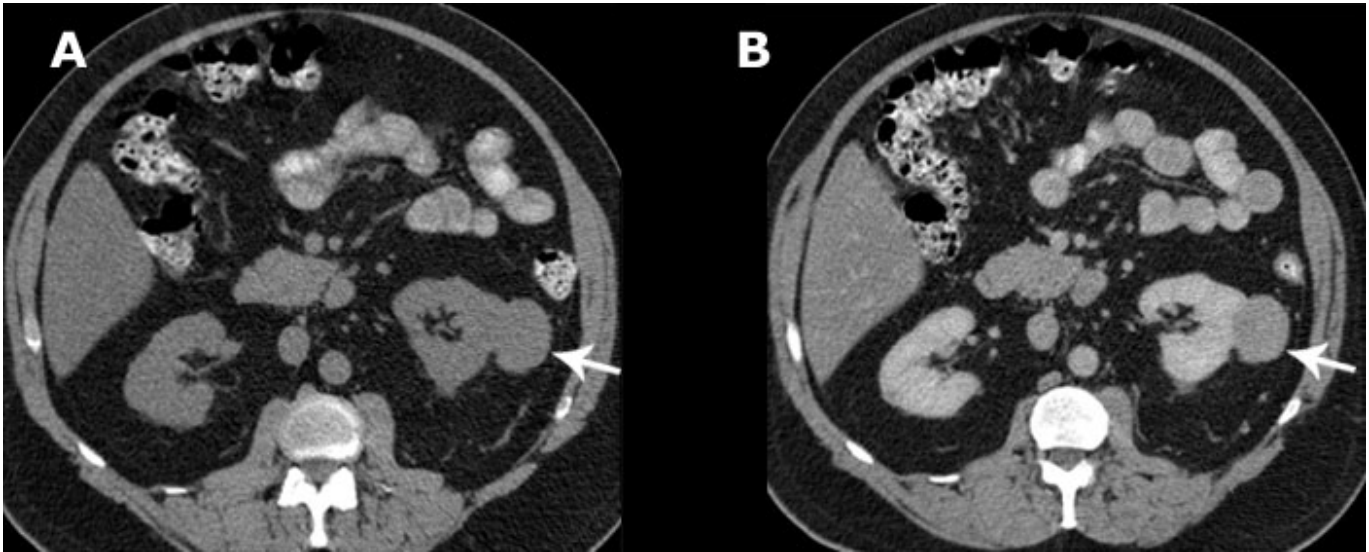


Figure 2. Renal mass protocol CT. CT image prior to intravenous contrast administration (A) demonstrates a 3.5 cm mass (arrow) in the left kidney. This measures 39 Hounsfield units corresponding to soft-tissue density. After administration of intravenous contrast (B), the mass (arrow) demonstrates enhancement increasing to 68 Hounsfield units. Percutaneous needle biopsy revealed that this lesion was a benign oncocytoma and the patient was spared surgery.

CT

A renal protocol multidetector CT scan (Figure 2) is recommended for further diagnostic imaging, unless the patient cannot tolerate iodinated contrast agents. The renal protocol scan acquires three sets of images: a non-contrast image followed by those acquired 40 and 100 seconds after the injection of contrast agent during the corticomedullary (arterial) and nephrographic phases of enhancement, respectively. Three-dimensional reconstruction of the corticomedullary enhancement phase shows the vasculature, which can be useful for surgical planning. However, small renal masses and renal cancers with certain histologies (e.g. papillary cancer) can be difficult to detect in this early phase. Detection of these masses is optimal during the nephrographic phase.

Tumors that enhance may be malignant but can also represent benign lesions such as adenoma, oncocytoma, and leiomyoma. These need further evaluation, either with long-term follow-up imaging or biopsy.

MRI

If the patient cannot tolerate iodinated intravenous contrast, MRI is an alternative modality for renal mass characterization. Non-contrast images are acquired first, followed by gadolinium contrast-enhanced MR angiography, MR venography, and MR urography at a series of time intervals after the injection of contrast agent. Any mass that shows enhancement is suspect for malignancy.

Image-Guided Percutaneous Biopsy

Percutaneous biopsy with CT (Figure 3) or ultrasound guidance is indicated for patients with a small solid renal mass and known extrarenal primary malignancy, patients who are not surgical candidates because of

medical co-morbidity or non-resectability, or patients with a mass that may be caused by infection. New evidence suggests that biopsy is also indicated for small (≤ 4 cm) enhancing renal masses.

Percutaneous CT-guided biopsy has been shown to be safe (Table 2) and accurate. Needle-track seeding is extremely rare, occurring in $<0.01\%$ of cases. Sensitivity for the diagnosis of malignancy is reported to be 80-92% and specificity, 83-90%. At MGH, both core and fine needle biopsies are performed, which is incrementally better than either method alone. Diagnostic specimens are obtained in $>95\%$ of cases. Histologic and immunocytochemical studies of biopsy samples can definitively diagnose lipid-poor angiomyolipoma, which cannot be diagnosed on imaging alone, and metanephric tumors. Oncocytomas can be distinguished from oncocytic renal cell carcinomas with a strong degree of confidence using appropriate staining and ultrastructural studies. Consequently, at MGH, biopsy preceding surgery has resulted in a decreased nephrectomy rate for benign lesions from 20% to 4% of all ≥ 4 cm renal masses resected.

Patient Preparation and Care for CT-Guided Percutaneous Biopsy

Patients must have normal coagulation studies and be taken off anti-coagulant medication. Patients may drink clear fluids but must not eat after midnight on the day of the procedure. Biopsy procedures are generally performed under conscious sedation with local anesthesia. After completion of the procedure, patients are observed for 3 hours and can expect to go home that day. Hematuria may occur and last up to 10 days after the procedure.

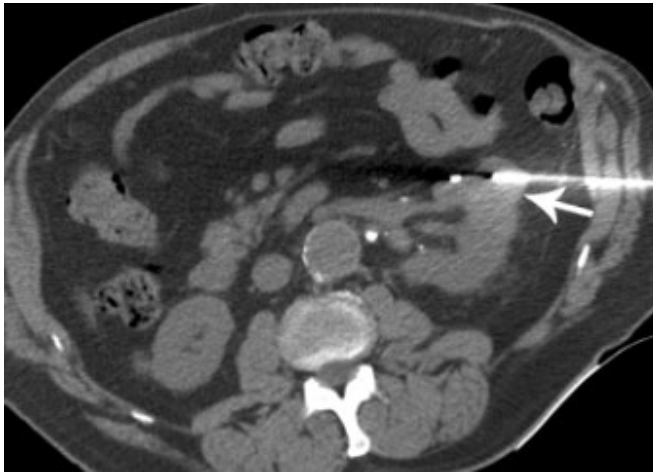


Figure 3. CT-guided percutaneous biopsy. A left lateral approach has been used to insert a percutaneous core biopsy needle through a 3 cm left renal mass (arrow). Pathologic diagnosis revealed papillary renal cell carcinoma. Because of medical contraindications to nephrectomy, the mass was treated with radiofrequency ablation.

Table 2. Complication Rate of Percutaneous CT-Guided Biopsy at MGH (407 cases)

Complication	% (n)
Minor*	3% (13)
Overnight Admission	2% (9)
Significant Bleeding†	1% (3)
Death, blood transfusion, surgical intervention, intensive care admission	0

*e.g. small perinephric hematoma

† large perinephric hematoma (subjective)

Follow-Up Imaging

Follow-up imaging is usually performed for the majority of tumors found to be benign on biopsy, especially oncocytomas. The timing of follow-up examinations is individualized for each patient, depending on their histopathology results.

Scheduling

Renal protocol CT can be performed at Mass General West Imaging in Waltham, Mass General Imaging Chelsea, or the main MGH campus. MRI can be performed at all these facilities as well as Mass General Imaging in Charlestown. All these studies can be ordered online via the Radiology Order Entry (<http://mghroe>) or by calling 4-XRAY (617-724-9729). Before a percutaneous image-guided biopsy is performed, the patient should be evaluated by a urologist. Biopsies are performed only on the main campus and can be scheduled by calling 617-726-8396. A [procedure request form](#) is available on the MGH Radiology website, <http://www.massgeneralimaging.org>.

Further Information

For further questions on radiology examinations and procedures for renal masses, please contact, [Anthony Samir, M.D.](#), Abdominal Imaging and Intervention (617-726-8396).

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