



Percutaneous Image-Guided Thermal Ablation of Renal Tumors

- Percutaneous image-guided thermal ablation may be considered for biopsy-confirmed renal cell carcinoma when patients are not good candidates for surgery or there is a clinical need to preserve kidney function
- Ablation therapy is most effective for exophytic tumors <4 cm diameter positioned away from large blood vessels and vital structures (e.g. bowel, ureter)
- Three image-guided ablation therapies are in use at MGH: radiofrequency ablation, cryoablation, and microwave ablation; selection among these is dependent on tumor- and patient-specific factors

While surgical resection remains the standard of care for renal cell carcinoma, there are a number of reasons why percutaneous image-guided ablative therapies are becoming established as a reasonable alternative for selected patients. Ablation therapies are associated with less treatment-related morbidity and mortality than resection, and can, therefore, be used in patients who are not surgical candidates because of comorbid conditions -or because of the need to preserve renal function, especially in those with a solitary kidney or a minimally functioning contralateral kidney. Another consideration is the upsurge in the diagnosis, particularly in the elderly, of small renal cell carcinomas, which are found largely because of increased use of tomographic imaging. Furthermore, if there is residual or recurrent disease after any treatment, ablative therapies can be performed or repeated over time.

There are now three percutaneous image-guided ablative therapies in use at the MGH: radiofrequency ablation (RFA) (which was the first technique to be used here), cryoablation, and microwave ablation. In each case, one or more needles are inserted into the tumor and energy (heat or freezing) is used to destroy the tumor. The different techniques vary in terms of time needed for treatment, ability to monitor the process, and other patient- and tumor-dependent factors. Based on these factors, interventional radiologists in collaboration with urologists select the most appropriate treatment for each individual patient (Table 1).

Technical Success Rate and Patient Outcome

Although most likely to be successful for tumors ≤ 4 cm, percutaneous image-guided ablation has been performed for larger size tumors. Since the kidney is surrounded with fat, which serves as a thermal insulator, the effectiveness of thermal ablation for exophytic tumors is high. In contrast, tumors that are near the renal sinus are close to large blood vessels



Figure 1. Pre-Procedure contrast-enhanced CT shows 3.5 cm partially exophytic left renal cell carcinoma.

that serve as heat sinks and ablation is less likely to be completely successful (Table 2).

In the largest multi-institutional study to date (616 patients treated with either RFA or cryoablation) the technical success rate was reported to be over 90%. In those in whom ablation was incomplete, 70% were seen to have residual or recurrent disease within the first 3 months after initial treatment and most of the remainder were detected within the first year. A second ablative procedure destroyed the remaining tumor in about half these patients and thus the overall incidence of residual or recurrent disease after salvage therapy was 4.2%. The overall 2 year survival rate was 82.5%, including some who died of unrelated causes, and the metastasis-free survival rate for patients with localized, sporadic, unilateral renal tumors was 97% at 2 years.



Figure 2. Axial CT during ablation procedure with patient in a left lateral decubitus position shows probes entering left renal tumor.

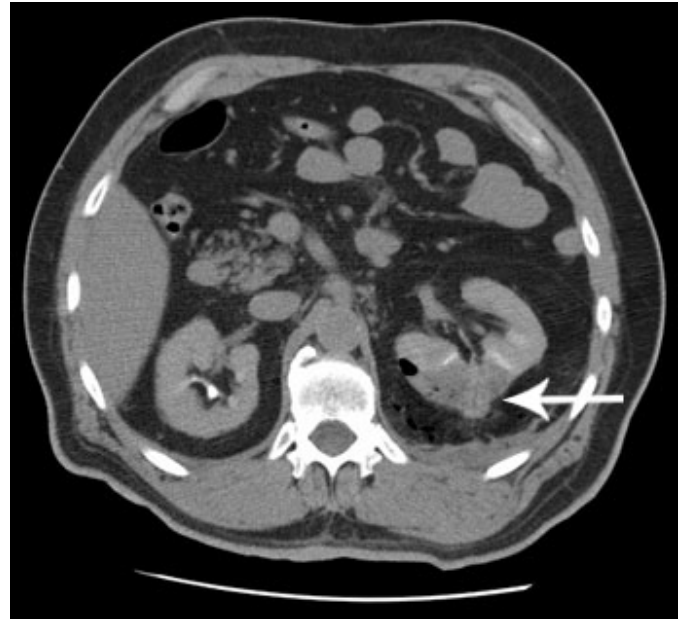


Figure 3. Axial CT immediately following ablation shows tumor shrinkage and a non-enhanced wedge shaped area consistent with ablated bed. No complications were identified.

Table 1. Advantages and Disadvantages of Surgical Resection and Ablation Therapy

	Advantages	Disadvantages
Resection	More complete data on survival Definitive pathologic analysis/ margin status	Major open or laparoscopic surgery requiring a 2-3 day hospital stay and 2-4 week recovery;
Percutaneous Image-guided Ablation	Low complication rate Outpatient procedure for 80% of cases Little post-procedural pain	Complication rate of percutaneous image-guided ablation of renal tumors, 6% (hemorrhage, microscopic hematuria, pain, urinary fistula, or ureteral obstruction requiring stent or nephrostomy tube)

Table 2. Indications for and Limitations of Percutaneous Image-Guided Ablation

	Indications	Limitations
Renal tumors	Patients not ideal candidates for surgery Single functional kidney or other need to preserve renal function Biopsy confirmed renal cell carcinoma tumors in peripheral location and no metastatic disease Familial syndromes predisposing to multiple RCCs Life expectancy > 1 yr and < 10 yrs	Tumors must be accessible percutaneously Risk of ureteral damage if tumor is close to ureter Increased likelihood of incomplete ablation if tumor is close to blood vessels due to temperature moderating effect Contraindicated in cases of sepsis, severe debilitation, or uncorrectable coagulopathy

Patient Selection

Before a patient is scheduled for percutaneous image-guided ablation, he or she is assessed by a urologist and a radiologist, the diagnosis of renal cell carcinoma must be confirmed by biopsy, and the disease must be confined to the kidney, with no extra-renal extensions, vascular invasions or metastases. The position of the tumor must be evaluated because of the risk of ureteral or bowel damage. In addition, hemorrhage is more likely to occur after treatment of central tumors.

Patient Preparation and Procedures

Standard staging protocols required before thermal ablation include a pre-ablation image study (CT or MRI), (Figure 1) a chest radiograph or CT, tumor biopsy, laboratory studies including CBC, platelet, PT, PTT, and BUN/creatinine, and evaluation by a urologist and a radiologist. Percutaneous image-guided ablation is normally performed as an outpatient procedure but patients may be admitted prior to the treatment if coagulopathy needs to be treated. If patients are on anti-coagulant therapy, they must cease prior to the procedure. No food or drink may be taken for at least 8 hours prior to treatment.

Percutaneous image-guided ablation is carried out with the patient under conscious sedation and local anesthetic. Selected patients may require general anesthesia if they do not meet the criteria for conscious sedation. Under CT guidance (or US guidance if the entire tumor and adjacent structures can be seen this way) one or more applicator needles are inserted into a tumor (Figure 2). For tumors near the ureter, a ureteral stent is inserted, which is flushed with 5% dextrose solution during the procedure to minimize the temperature change and protect the ureter. If the tumor is close to the bowel, a needle or catheter is inserted alongside the tumor margin and sterile fluid injected to displace the bowel to a safe distance away (hydrodissection), about 2 cm.

When the applicator needles are in place and protective steps taken, the treatment is applied, either heating the tissue to 50 - 100° C (RFA or microwave ablation) or freezing to 20-40° C (cryoablation). Each treatment can ablate a roughly spherical region up to 3-4 cm in diameter. Tumor and ablation geometry is usually irregular and, in order to decrease the risk of tumor recurrence, some normal tissue may be ablated to 0.5-1 cm beyond the tumor margin (Figure 3). The ablated tissue remains in place and, over time, may be absorbed or remain stable. Total treatment time is 1-2 hours. Treatment success may only be determined on follow-up imaging.

After the procedure, patients rest for a few hours while being closely monitored for signs of complications. After this time, they will be able to go home provided that there are no signs of bleeding or other complications. If any complications occur, they will stay in hospital overnight or until well enough to go home.

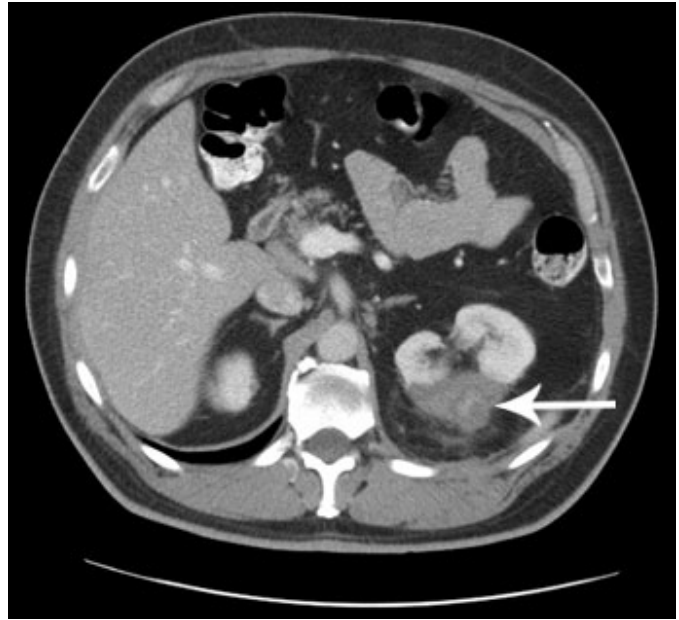


Figure 4. Axial CT at 3 months post ablation shows ablated bed as a non-enhanced wedge shaped area.

Follow-up Imaging

All patients need follow-up imaging (usually a CT or MRI) after 1 month to assess the technical success of the ablation therapy (Figure 4). If tumor ablation appears complete at one month, patients should return for follow-up scans at 3 months, 6 months, and 1 year. After that, follow-up should continue annually.

Scheduling

Before a percutaneous image-guided ablation procedure can be scheduled, patients are first evaluated by a urologist and a radiologist. Appointments for radiologist evaluation for an ablation procedure are made through the nurse coordinator in the Interventional Radiology Clinic, 617-724-2239.

Further Information

For further questions on thermal ablation, please contact [Debra A. Gervais, M.D.](#), Abdominal and Interventional Radiology, 617-726-8396, or [Francis J. McGovern, M.D.](#), Urology, 617-726-3650.

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Janet Cochrane Miller, D. Phil., Author

Raul N. Uppot, M.D., Editor