



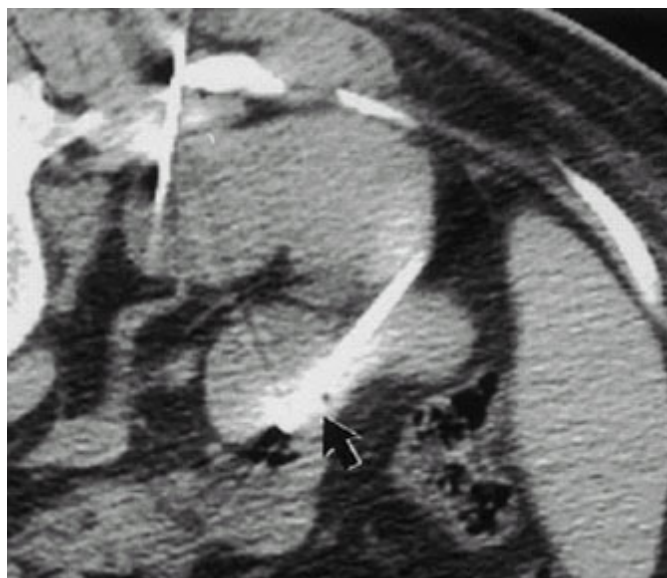
Percutaneous Radiofrequency Ablation of Tumors in the Liver and Kidney

- Percutaneous radiofrequency ablation (RFA) may be considered for biopsy-confirmed tumors that cannot be resected or when patients are not good candidates for surgery;
- RFA is most effective for tumors <2.5 cm diameter positioned away from large blood vessels and vital structures (e.g. colon, ureter);
- Treatment outcome for 1° liver cancers (hepatocellular cancer) is generally good;
- There is significant risk of local recurrence of disease when metastases to the liver from colon cancer are treated;
- RFA treatment of renal cell carcinoma is promising but long term follow-up data is not available.

Surgical resection of tumors is the established method of treatment for renal cell carcinoma, primary liver cancers, and isolated metastases from colorectal carcinoma to the liver. However, resection is not always possible because of the position of the tumor, the extent of disease, or patient co-morbidities. Percutaneous radiofrequency ablation (RFA) is relatively new treatment that is suitable for many patients for whom resection is not possible. The benefits of RFA over resection include reduced treatment related morbidity and mortality, preservation of more functional tissue in the organ, and outpatient treatment. The first clinical application of percutaneous RFA in the United States for a liver tumor was performed at MGH in 1996 and the first percutaneous RFA treatment of a renal tumor at MGH was in 1998. Consequently, the data on treatment outcome is limited and more follow-up studies are needed.

Indications for Liver Tumor RFA

Percutaneous RFA is most effective on tumors < 3 cm (but tumors up to 5.5 cm may be considered for treatment) deep within hepatic parenchyma and remote from large blood vessels, which can cool the tissue and prevent full ablation. If the tumor is close to the hepatic hilum, then RFA may damage a central bile duct, causing atrophy and jaundice. If the tumor is close to a vulnerable structure, such as the diaphragm or the gut wall, there is risk of RFA damage and subsequent perforation. RFA can be combined with surgery of larger tumors and ablation of smaller tumors.



Transverse CT image showing RFA electrode (arrow) in a renal tumor. A second tumor contains a biopsy needle that was removed before RF ablation was performed.

Percutaneous RFA is best suited to patients with unresectable primary liver cancer (hepatocellular cancer), who usually are cirrhotic. It can also be considered for patients with unresectable liver metastases from colorectal cancer when there is no evidence of tumors elsewhere. In addition, RFA may be considered for patients with liver metastases from other primary cancers (e.g. breast, esophageal) although they are more likely to have occult disease in other tissues. In addition, patients

with symptomatic neuroendocrine tumor liver metastases will benefit from RFA as it will reduce symptoms and improve the quality of life.

From the available data, outcome for patients with hepatocellular tumors, when they are slow growing and encapsulated, appears to be excellent. However, it is difficult to compare the effectiveness of RFA with resection because those that who are treated with RFA generally have a greater number of lesions and/or

co-morbidities. Nevertheless, published studies suggest that patients with single primary liver tumors < 3 cm in diameter have a comparable survival rate after surgery or RFA.

For patients with metastatic colorectal cancer, the risk of local recurrence of disease after ablation of tumors <2.5 cm is about 20% and about 70% for tumors greater than 4 cm.

	Indications	Limitations
General	Patients not candidates for surgery	Maximum tumor diameter, 5.5 cm
	Tumors must be accessible percutaneously	Maximum number of tumors, 3-4 tumors with none > 4 cm Contraindicated in cases of sepsis, severe debilitation, or uncorrectable coagulopathy
Liver Tumors	1 ^o liver cancers (hematoma and hepatocellular cancer), including those in cirrhotic patients	Proximity to vital structures, e.g. bowel, diaphragm, bile duct (danger of perforation, obstruction)
	Neuroendocrine tumors (to debulk and reduce symptoms)	Proximity to large blood vessels (incomplete ablation due to cooling effect)
	Metastatic disease from colon cancer	
Renal Tumors	Single functional kidney	Proximity to colon or small intestine
	Biopsy confirmed renal cell carcinoma tumors in peripheral location and no metastatic disease	Proximity to large vessels or ureter (danger of ureteral damage and increased likelihood of incomplete ablation due to cooling effect.)
	Life expectancy > 1 yr and < 10 yrs	

Indications for Renal Cell Carcinoma RFA

Indications for RFA include renal cell carcinoma in patients with co-morbidities that preclude surgery, a solitary kidney, or a minimally functioning of contralateral kidney, or co-morbidities that preclude surgery. Patients must be screened by a urologist who must confirm the diagnosis by biopsy and show that the disease is confined to the kidney, with no extra-renal extensions, vascular invasions or metastases. Since the kidney is surrounded with fat, which has limited blood supply for cooling, the effectiveness of RFA for exophytic tumors is high.

In contrast, tumors that are near the renal sinus are close to large blood vessels that serve as heat sinks and ablation is less likely to be completely successful. In addition, there is risk of ureteral damage.

Although, there is limited data on survival, experience at MGH indicates that percutaneous RFA of exophytic renal tumors < 5 cm is a highly promising treatment.

	Advantages	Disadvantages
Resection	More complete data on survival	Major surgery requiring several day hospital stay and 6 week recovery
	Lower likelihood of local disease recurrence in metastatic colon cancer	Complications of liver tumor resection include bleeding, jaundice, bile leak, and those resulting from prolonged bed rest Mortality after liver tumor resection, <2%
RFA	Low complication rate	Major complication rate of liver tumor RFA, 2% (hemorrhage, neoplastic seeding, intrahepatic abscesses, jaundice, intestinal perforation)
	Outpatient procedure for 80% of cases	Mortality rate of RFA of liver tumor, 0.3%
	Little post-procedural pain	Complications of renal tumor RFA include microscopic hematuria, pain, urinary fistula, or ureteral obstruction requiring stent or nephrostomy tube

Patient Preparation and Procedures

Standard staging protocols required before RFA ablation include a pre-ablation image study (CT or MRI), a chest radiograph or CT, bone scintigraphy, tumor biopsy, and evaluation by a urologist for renal tumors or a liver surgeon for liver tumors. RFA 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 six hours prior to treatment.

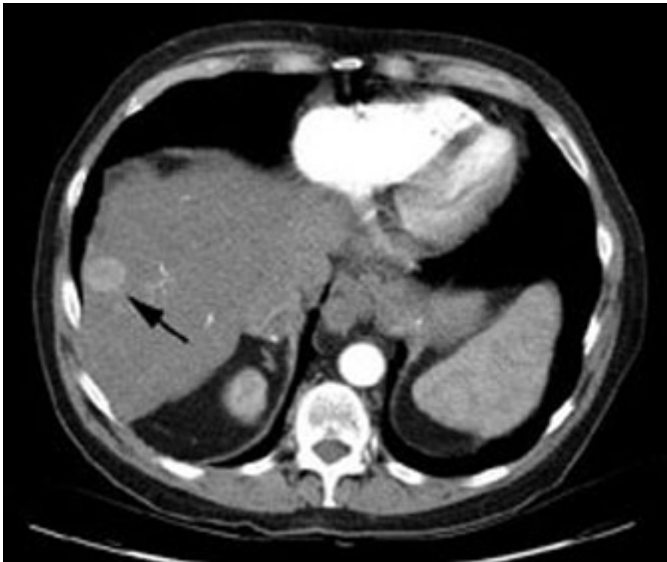
The RFA procedure is carried out with the patient under conscious sedation and local anesthetic. Selected patients may require general anesthesia if they do not meet the criteria for conscious sedation. Under CT guidance (or US guidance if the entire tumor and adjacent structures can be seen this way) a radiofrequency electrode the size of a 17 gauge needle is inserted into a tumor. Once in place in the center of a tumor, a 490-500 kHz alternating current is applied, which generates radiofrequency and heat at the tip of the electrode. The surrounding tissue is heated to 50-100°C and maintained at that temperature for sufficient time to cause irreversible cell damage and necrosis of the tumor. 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 is usually ablated to 0.5-1 cm beyond the tumor margin.

The ablated tissue remains in place and, over time, is absorbed and replaced with scar tissue. Total treatment time is 1-2 hours. At the time of the procedure, it is not possible to assess treatment success, which is determined on follow-up.

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.

All patients need follow-up imaging (usually a CT or MRI) after 1 month to assess the success of the RFA. Complete ablation in one treatment is more likely if the tumor is small. In patients with liver tumors, 30-55% of patients with tumors 3.1-5.0 cm in diameter and 75-85% of those with tumors greater than 5.0 cm can expect to need a second treatment to complete ablation. For patients with renal cell carcinoma, <10% return for a second ablation treatment if their tumor was <3 cm, whereas 30-40% return if their tumor was 3-5 cm in diameter.

When tumor ablation appears complete, patients should return for follow-up scans at 3 months, 6 months, and 1 year. After that, follow-up of those with liver cancer should continue at six monthly intervals and those with renal cancer should continue annually.



Liver Tumor Before RF Ablation - The tumor (arrow) in the liver takes up contrast material which is white on CT scan.



Liver Tumor After RF Ablation - After RF ablation, the tumor (arrows) no longer takes up the contrast material. If part of the tumor had continued to take up contrast material, that part could be treated again with RF ablation.

Scheduling

Before an RFA procedure can be scheduled, patients are first evaluated by a urologist for renal tumors or a liver surgeon for liver tumors, respectively.

Appointments for an RFA procedure are made through the nurse coordinator in the Interventional Radiology Clinic, 617-724-2239.

Further Information

For further questions on RFA, please contact Debra A. Gervais, M.D., Abdominal and Interventional Radiology, dgervais@partners.org, (617-726-8396), Kenneth K. Tanabe, M.D., Surgical Oncology, ktanabe@partners.org, (617-724-3868) or Francis J. McGovern, M.D., Urology, fmcgovern@partners.org, (617-726-3650). More information on [RFA](#) is also available on the Radiology website.

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