



## Update on Image Guided Ablation of Liver Tumors

- Percutaneous image-guided ablation may be considered for biopsy-confirmed hepatocellular cancer (HCC) as a bridge to liver transplantation or a primary treatment for those who are not candidates for transplantation
- Ablation for colorectal cancer (CRC) metastases may be considered for patients who are not candidates for surgical resection, when other treatments fail, or when new metastases appear
- Ablation is more effective for tumors <3 cm diameter positioned away from large blood vessels and hilar structures

Surgery remains the first line treatment for hepatocellular cancer (HCC) and metastases from colorectal cancer. However, surgery is not an option for many patients. In such cases, percutaneous image-guided ablation of liver tumors is a minimally invasive treatment option that is being increasingly utilized for non-surgical candidates or for patients with hepatocellular carcinoma who are awaiting liver transplantation.

The benefits of ablation over resection include reduced treatment related morbidity and mortality, preservation of more functional tissue in the organ, and the ability to perform therapy as an outpatient procedure. Ablation is carried out by inserting a radiofrequency electrode under CT- or US guidance into a tumor. Once in place, high frequency alternating current delivered through the electrode results in ionic agitation and friction, which in turn generates heat. Tissues heated to 50-60°C and maintained at that temperature for at least 6 minutes undergo irreversible cell damage and necrosis. Three to four overlapping ablations are necessary to treat most tumors and to ensure that the zone of ablation extends 5-10 mm beyond the tumor margin in order to achieve a satisfactory surgical margin. For tumors close to the diaphragm or other organs, a non-ionic solution (such as 5% dextrose in water) is injected in order to displace vital structures away from the tumor and thus minimize the risk of non-target organ injury. This technique also has benefits in terms of pain control, making it possible to use conscious sedation instead of general anesthesia when the tumor is close to the diaphragm.

The effectiveness of ablation may be limited when a tumor is adjacent to a blood vessel >5 mm in diameter because of the cooling effect of blood flow (heat sink effect). In these cases, thermal ablation may be combined with percutaneous ethanol ablation to treat tumor close to the vessel margin, for more complete treatment. Tumors that are close to the hepatic hilum should not be treated with ablation because of the risk of bile duct injury. Tumor recurrence or incomplete



**Figure 1.** White arrow points to a hepatoma in the left hepatic lobe prior to radiofrequency ablation.

ablation remains a challenge as tumors approach 5 cm in size. In these cases, combination treatment with ablation plus chemoembolization or ablation plus alcohol injection has been shown to be better, at least for HCC tumors.

Contrast material enhanced CT or MRI remain the mainstay in assessing efficacy of treatment. Successfully treated tumor should not demonstrate any areas of enhancement and the zone of ablation should extend at least 5 mm beyond the margins of the original tumor. It is important to keep in mind that ablation does not extract tissue from the body but rather burns tumor in place, leaving a volume of scarred tissue. The efficacy of local control is usually first assessed one month after treatment. When there is no residual tumor, continued follow-up imaging studies are obtained at three-month intervals for one year. If residual or recurrent tumor is identified, repeat ablations covering the area of recurrence plus a margin, may be performed.

## Hepatocellular Cancer

Liver transplantation is the treatment of choice for selected patients with HCC. Surgical resection is often inappropriate because of hepatic cirrhosis and a randomized prospective trial has indicated that there is no difference in survival for patients treated with surgical resection or ablation, with an equivalent 4-year survival rate of 68%. Another trial showed that ablation is equal to or better than percutaneous ethanol ablation and achieves efficacy in fewer sessions. However, for tumors >3 cm, ablation in conjunction with chemoembolization or percutaneous ethanol injection may be better than ablation alone.

According to the Milan criteria, liver transplantation is successful if transplanted patients have no single tumor greater than 5 cm or no more than 3 tumors each greater than 3 cm. Ablation can serve as a "bridge" to transplant by maintaining transplant patients within the Milan criteria. A cirrhotic liver improves efficacy because of the insulating effect of the cirrhotic tissue. In addition the pseudocapsule surrounding an HCC tumor can also insulate the heat within the tumor.

## Colorectal Metastases

The role of ablation in the treatment CRC metastases isolated to the liver remains to be defined because there are well-established options including surgical resection, which remains the gold standard, and chemotherapy. Resection is associated with an increase in survival from 20% to 40% at 5 years. However, only 20% of patients with CRC metastases are candidates for surgery, because of the position of the tumor, the extent of disease, or patient co-morbidities, and up to 70% will have recurrence after resection. In some cases resection can be combined with intraoperative ablation.

Survival data for those treated with ablation are reported to be 91-93%, 28-69%, and 25-46% at 1, 3, and 5 years, respectively. Metastases smaller than 3-4 cm are more likely to have better outcomes than those with larger tumors. Ablation can also be considered for patients who have already had surgery for CRC metastasis or when other standard therapies have failed. In addition, ablation may be considered for patients who are surgical candidates but for whom "the test of time" approach is favored. Advocates of this approach believe that delaying resection allows additional intra- or extra-hepatic metastases to be detected during short-term follow-up and may avoid unnecessary hepatectomies. The risk of local recurrence of CRC metastases after ablation <2.5 cm is about 20% and about 70% for tumors >4 cm.

## Other Tumors

Image-guided ablation has been used to treat patients with metastases from other primary tumors, including breast, ovarian, and sarcomas. While technically feasible in most cases, additional clinical studies and long-term outcome data are necessary to better define the role of ablation in these patients.

Image-guided ablation may also be used for palliative purposes to alleviate pain from a rapidly growing



**Figure 2.** White arrow points to the zone of ablation. The zone of ablation is larger than the size of the original and no enhancement is present in the tumor, indicating complete ablation.

surface tumor or in the case of hormone-producing neuroendocrine tumors that are causing hormone related symptoms.

## Patient Preparation and Procedures

An irreversible bleeding disorder is an absolute contraindication, but most coagulation disorders can be corrected with fresh frozen plasma or platelets. Patients who have been selected for image-guided percutaneous ablation require a pre-ablation contrast-enhanced CT or MRI study, a chest radiograph or CT, tumor biopsy, and evaluation by a liver surgeon. 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 eight hours prior to treatment.

Ablation is usually carried out with the patient under procedural sedation and local anesthesia. Selected patients may require general anesthesia if they do not meet the criteria for procedural sedation. The total treatment time is 2-3 hours. There is little post-procedural pain.

Complications of percutaneous ablation are reported in approximately 7% of patients. Hemorrhage is the most common complication but major hemorrhage requiring transfusion occurs in <1% of cases. Intrahepatic abscess formation and bowel perforation are uncommon complications. Tract seeding appears to be <1%. Death is rare, <1%.

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. Patients who are treated while under general anesthesia generally stay in hospital overnight.

**Table 1. Percutaneous RFA**

	Indications	Contraindications and Limitations
<b>HCC</b>	<p>Patients not candidates for liver transplantation</p> <p>As a bridge treatment for patients awaiting transplantation</p>	<p>Contraindicated in cases of sepsis, severe debilitation, or uncorrectable coagulopathy</p> <p>Contraindicated when tumor is in close proximity to large blood vessels (incomplete ablation due to cooling effect) or bile duct (danger of perforation, obstruction)</p>
<b>Metastatic Disease</b>	<p>Metastatic disease from colon cancer</p> <p>Palliative treatment for symptomatic neuroendocrine tumors</p>	<p>Maximum tumor diameter, 5.0 cm</p> <p>Maximum number of tumors, 3-4 tumors, all &lt;3 cm</p>

All patients need follow-up imaging (usually a CT or MRI) after 1 month to assess the success of the ablation. Complete ablation in one treatment is more likely if the tumor is small. In patients with liver tumors, 30-55% of patients with tumors 3-5 cm in diameter and 75-85% of those with tumors greater than 5 cm can expect to need a second treatment to complete ablation.

After tumor ablation appears complete, patients should return for follow-up scans at 3 months from the time of their ablation for one year. If there is local recurrence or new tumors develop, these can be treated with ablation provided that the anatomic location is favorable.

### Scheduling

Before an ablation procedure can be scheduled, patients are first evaluated by a liver surgeon as well as an interventional radiologist in the Interventional Radiology Clinic. 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 hepatic tumor ablation, please contact [Ronald S. Arellano, M.D.](#), Abdominal and Interventional Radiology, **617-726-8396**.

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Information on Ablation for patients is also available on the [Radiology website](#).

## References

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