

## Radiofrequency Ablation of Liver Tumors

*This procedure is reviewed by a physician with expertise in the area presented and is further reviewed by committees from the American College of Radiology (ACR) and the Radiological Society of North America (RSNA), comprising physicians with expertise in several radiologic areas.*

### What is Radiofrequency Ablation of Liver Tumors?

Many methods of minimally invasive therapy have been tried in recent years to eliminate tumors in organs like the liver. One of the most promising is called radiofrequency ablation, sometimes referred to as RFA. A special needle electrode is placed in the tumor under the guidance of an imaging method such as ultrasound or computed tomography (CT) scanning. A radiofrequency current then is passed through the electrode to heat the tumor tissue near the needle tip and ablate—or eliminate—it. The heat from radiofrequency energy also closes up small blood vessels, thereby minimizing the risk of bleeding. In general, radiofrequency ablation causes only minimal discomfort and may be done as an outpatient procedure without general anesthesia. Admission to the hospital is not usually necessary.

### What are some common uses of the procedure?

Two types of liver tumor have been the main targets of radiofrequency ablation: hepatocellular carcinoma, which is a primary liver cancer, and colon cancer that spreads (metastasizes) to the liver. Many patients with a malignant liver tumor are not good candidates for surgery, sometimes because their tumor is too widespread or inaccessible, or because of other medical conditions that make surgery especially risky. In other cases, so much liver tissue would have to be removed with the tumor that not enough would be left to provide adequate liver function. For many of these patients, radiofrequency ablation is a viable and effective treatment option.

Some liver tumors that have failed to respond to chemotherapy or have recurred after initial surgery may be treated by radiofrequency ablation. If there are multiple tumor nodules they may be treated in one or

more sessions. In some cases radiofrequency ablation has made it possible to operate on a patient after eliminating several small liver tumors that were too spread out to remove surgically. In general, radiofrequency ablation is most effective if the tumor or tumors are less than two inches in diameter. Although radiofrequency ablation can be used to treat larger tumors, the results are not as good. Typically radiofrequency ablation is not used to treat liver tumors if there is active cancer outside of the liver.

### How should I prepare for the procedure?

You will be asked to avoid food and liquids starting at midnight the evening before treatment. Your doctor will tell you which medications you may take in the morning. If you take aspirin, you may be instructed to stop 10 days beforehand. Consult your doctor if you are taking Coumadin or another blood thinner. If your doctor does not plan to admit you to the hospital overnight, you should arrive at the clinic with someone who will drive you home afterwards.

### What does the equipment look like?

There are three main components of the equipment needed for radiofrequency ablation: needle electrodes, an electrical generator and grounding pads. The needle electrodes come in two forms: simple straight needles and straight needles that contain multiple curved, retractable electrodes that are kept inside the needle until its tip is positioned within a tumor. When properly positioned, a plunger on the hub of the needle is advanced so that the electrodes extend from the needle tip. When fully extended, these electrodes resemble an open umbrella or Christmas tree. The radiofrequency generator is connected by insulated wires to the needle electrodes and to grounding pads that are placed on the

patient's back or thigh. The generator produces alternating electrical current in the range of radiofrequency waves.



## How does the procedure work?

Radiofrequency ablation works by passing electrical current in the range of radiofrequency waves between the needle electrode and the grounding pads placed on the patient's skin. The current creates heat around the electrode inside the tumor and this heat spreads out to destroy the entire tumor but little of the surrounding normal liver tissue. Basically the tumor is destroyed by "cooking" it. The tumor cells exposed to the heat are killed immediately. Because healthy liver tissue withstands more heat than a tumor, radiofrequency ablation is able to destroy a tumor and a small rim of normal tissue about its edges without affecting most of the normal liver. The dead tumor cells are gradually replaced by scar tissue that shrinks over time.

## How is the procedure performed?

Radiofrequency ablation may be done by placing ablation needles through the skin; by placing needles through a tube inserted through small holes in the skin (laparoscopy); or during open surgery. Most radiologists prefer the percutaneous (through-the-skin) approach because it is much less invasive, produces few complications and requires only sedation rather than general anesthesia. In addition, as an outpatient procedure it is relatively inexpensive. Radiofrequency ablation may be repeated as needed should the tumor recur. An ultrasound probe may be used as a "road map" to direct the radiofrequency needle to the correct position on the abdominal surface to reach the tumor, and then to the center of the tumor itself. Alternatively, CT imaging may serve the same purpose. Local anesthetic is injected

into the site where a quarter-inch skin incision is planned, and the patient is sedated by an intravenous injection. Once the needle electrode is in place, radiofrequency energy is applied. For a larger tumor it may be necessary to do overlapping ablations to make certain that no tumor tissue is left behind.

## What will I experience during the procedure?

Radiofrequency ablation is generally done in a room devoted to CT or ultrasound imaging. After you lie down on the examining table the tumor will be located and you will receive intravenous sedation (through a tube previously placed in an arm vein) to avoid discomfort during the procedure. You may or may not remain awake, depending on how deeply you are sedated. The skin area where the needle passes through will be numbed with local anesthetic to further decrease discomfort. Each radiofrequency ablation treatment takes about 12 to 30 minutes and the total procedure will be completed in one to three hours, depending on how many tumor sites have to be treated. After radiofrequency ablation you may receive further medication to prevent pain and nausea as the sedation wears off. Afterwards you will remain in the recovery room until totally awake and ready to leave for home. Only about 2 percent of patients will still have any degree of pain a week after radiofrequency ablation.

Organs and tissues near the liver, such as the gallbladder, bile ducts, diaphragm and bowel loops, are at risk of being injured. When this happens, surgical correction may be necessary. This only happens 3 percent to 5 percent of the time, however, and this risk is related to the location of the liver tumor that is treated.

## Who interprets the results and how do I get them?

Most centers perform a CT or MRI scan of the liver within a few hours to a week after radiofrequency ablation to make certain that all tumor tissue has been destroyed, and also to detect any complications. A radiologist will interpret the CT or MRI scans and determine whether the entire liver tumor appears to have been eliminated. You will then have repeat CT scans every three months to check for new tumors.

## What are the benefits vs. risks?

### Benefits

- Radiofrequency ablation can be an effective treatment for primary liver cancer or cancers that have spread to the liver in selected patients whose disease is unsuitable for surgical resection.
- In most studies, more than half the liver tumors treated by radiofrequency ablation have not recurred.
- Treatment-related serious complications are infrequent.
- Radiofrequency ablation may be used repeatedly to treat recurrent liver tumors.
- Radiofrequency ablation is a minimally invasive treatment that is rapidly completed and often does not require hospital admission. Patients are usually able to resume their usual activities within a few days. In addition, radiofrequency ablation is less expensive than other treatment options.

### Risks

- Depending on the site of treatment, radiofrequency ablation may cause brief or, rarely, long-lasting shoulder pain; inflammation of the gallbladder that subsides after a few weeks; damage to the bile ducts resulting in biliary obstruction; or thermal damage to the bowel.
- Roughly one in four patients may develop a "post-ablation syndrome" with flu-like symptoms that appear three to five days after the procedure and usually last about five days. An occasional patient may remain ill for two to three weeks. Oral acetaminophen commonly is given to control fever.
- Some cases of bleeding have been reported but it usually stops on its own. If bleeding is severe, an additional procedure or surgery may be needed to control it.

## What are the limitations of Radiofrequency Ablation of Liver Tumors?

There is a limit to the volume of tumor tissue that can be eliminated by radiofrequency ablation. This is due to limitations in the size of the "burn" that can be produced with current equipment. Hopefully technical advances will permit larger tumors to be treated. Radiofrequency ablation can destroy many small liver tumors but will not eliminate microscopic-sized tumors and cannot prevent cancer from growing back.

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