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# Radiofrequency Ablation of Lung Tumors

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*This information 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.*

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## What is Radiofrequency Ablation of Lung Tumors?

Radiofrequency ablation, sometimes referred to as RFA, is a minimally invasive treatment for cancer. It is an image-guided technique that heats and destroys cancer cells.

In radiofrequency ablation, imaging techniques such as ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) are used to help guide a needle electrode into a cancerous tumor. High-frequency electrical currents are then passed through the electrode, creating heat that destroys the abnormal cells

## What are some common uses of the procedure?

Radiofrequency ablation is used to treat early-stage lung cancer.

Radiofrequency ablation is a viable and effective treatment option if you:

- wish to avoid conventional surgery.
- are too ill to undergo surgery.
- have a small number of metastases in your lungs. These are tumors that have spread from a cancer located elsewhere in your body, such as the kidney, intestine or breast.
- have a large tumor that is too large to be removed surgically.

RFA is also used to:

- reduce the size of a tumor so that it can be more easily eliminated by chemotherapy or radiation therapy.
- provide relief when a tumor invades the chest wall and causes pain.

RFA is not intended to replace surgery, radiation therapy or chemotherapy in all patients. It may be effective when used alone or in conjunction with these treatments.

## How should I prepare?

You should report to your doctor all medications that you are taking, including herbal supplements, and if you have any allergies, especially to local anesthetic medications, general anesthesia, or to contrast materials (also known as “dye” or “x-ray dye”). Your physician may advise you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or a blood thinner for a specified period of time days before your procedure.

Prior to your procedure, your blood may be tested to determine how well your liver and kidneys are functioning and whether your blood clots normally.

Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant.

Many imaging tests are not performed during pregnancy so as not to expose the fetus to radiation. If an x-ray is necessary, precautions will be taken to minimize radiation exposure to the baby.

You may be instructed not to eat or drink anything after midnight before your procedure.

Your doctor will tell you which medications you may take in the morning.

You should plan to have a relative or friend drive you home after your procedure.

You may be asked to wear a gown during the procedure.

## What does the equipment look like?



In this procedure, computed tomography (CT) imaging, needle electrodes, an electrical generator and grounding pads are used.

There are two types of needle electrodes: simple straight needles and a straight, hollow needle that contains several retractable electrodes that extend when needed.

The radiofrequency generator produces electrical currents in the range of radiofrequency waves. It is connected by insulated wires to the needle electrodes and to grounding pads that are placed on the patient's back or thigh.

The CT scanner is typically a large, box like machine with a hole, or short tunnel, in the center. You will lie on a narrow examination table that slides into and out of this tunnel. Rotating around you, the x-ray tube and electronic x-ray detectors are located opposite each other in a ring, called a gantry. The computer workstation that processes the imaging information is located in a separate room, where the technologist operates the scanner and monitors your examination.

Other equipment used during the procedure includes an intravenous line (IV) and equipment that monitors your heart beat and blood pressure.

## How does the procedure work?

Radiofrequency ablation works by passing electrical currents in the range of radiofrequency waves between the needle electrode and the grounding pads placed on the patient's skin. These currents create heat around the electrode, which when directed into the tumor, heats and destroys the cancer cells. Because healthy liver tissue is better able to withstand heat, radiofrequency ablation is able to destroy a tumor and only a small rim of normal tissue around the edges of the tumor. At the same time, heat from radiofrequency energy closes small blood vessels and lessens the risk of bleeding.

The dead tumor cells are gradually replaced by scar tissue that shrinks over time.

Ultrasound or computed tomography imaging may be used to help the physician guide the needle electrode into the tumor.

## How is the procedure performed?

Image-guided, minimally invasive procedures such as radiofrequency ablation are most often performed by a specially trained interventional radiologist in an interventional radiology suite or occasionally in the operating room.

Radiofrequency ablation is often done on an outpatient basis. You will be positioned on the examining table. You will be connected to monitors that track your heart rate, blood pressure and pulse during the procedure.

A nurse or technologist will insert an intravenous (IV) line into a vein in your hand or arm so that sedation medication can be given intravenously. Your physician will use CT scanning to precisely locate the tumor. Your skin will be marked at the proper chest wall site.

The area where the electrodes are to be inserted will be sterilized and covered with a surgical drape. Your physician will numb the area with a local anesthetic. A very small nick is made in the skin at the site.

Radiofrequency ablation is performed using one of three methods:

- Surgically.
- Percutaneous, in which needle electrodes are inserted through the skin and into the site of the tumor.
- Thoracoscopic, in which needle electrodes within a thin, plastic tube is threaded through a small hole in the skin in a procedure called a thoracoscopy.

Using imaging-guidance, your physician will insert the needle electrode through the skin and advance it to the site of the tumor.

Once the needle electrode is in place, radiofrequency energy is applied. For a large tumor, it may be necessary to do multiple ablations by repositioning the needle electrode into different parts of the tumor to ensure no tumor tissue is left behind.

At the end of the procedure, the needle electrode will be removed and pressure will be applied to stop any bleeding and the opening in the skin is covered with a dressing. No sutures are needed.

Your intravenous line will be removed.

A chest x-ray will be taken to make sure that the lung has not collapsed from an air pocket created during the procedure. If a collapse has occurred, it may be necessary to insert a small tube into the area to remove the air pocket. The tube may need to remain in place for one to several days.

Each radiofrequency ablation takes about 10 to 30 minutes, with additional time required if multiple ablations are performed. The entire procedure is usually completed within one to three hours.

## What will I experience during and after the procedure?

Devices to monitor your heart rate and blood pressure will be attached to your body.

You will feel a slight pin prick when the needle is inserted into your vein for the intravenous line (IV) and when the local anesthetic is injected.

The intravenous (IV) sedative will make you feel relaxed and sleepy. You may or may not remain awake, depending on how deeply you are sedated.

Pain immediately following radiofrequency ablation can be controlled by pain medication given through your IV or by injection. Afterward any mild discomfort you experience can be controlled by oral pain medications. Patients may feel nauseous, but this can also be relieved by medication.

You will have a chest x-ray approximately two hours after the procedure to check for a lung collapse. This occurs in approximately 30% of patients, but only one in 10 patients will need to have a tube inserted in the space between the collapsed lung and the chest wall to remove the air and allow the lung to re-expand. If such a tube is placed, you may or may not need to stay in the hospital for further management. Many patients can go home with this small tube and have it removed within one or two days. You will remain in the recovery room until you are completely awake and ready to return home.

You should be able to resume your usual activities within a few days. Only about two percent of patients still have pain a week following radiofrequency ablation.

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

Computed tomography (CT) or magnetic resonance imaging (MRI) of the lung is performed within a few hours to a week following radiofrequency ablation. A radiologist will interpret these CT or MRI scans to detect any complications and to ensure that all of the tumor tissue has been destroyed.

## What are the benefits vs. risks?

### Benefits

- Radiofrequency ablation (RFA) is much less invasive than open surgery when treating primary or metastatic lung tumors. Side effects and complications are less frequent and less serious when RFA is carried out.
- Patients who have multiple tumors or tumors in both lungs usually are not considered to be candidates for surgery. They may, however, be candidates for RFA.
- Lung function is better preserved after RFA than after surgical removal of a tumor. This is especially important for those whose ability to breathe is impaired, such as current or former cigarette smokers.
- When part of the tumor persists after RFA, radiation therapy may eliminate the remaining tumor cells. RFA very effectively destroys the central part of a tumor—the area that tends not to respond well to radiotherapy.
- If a tumor recurs in the same region, it usually can be retreated by RFA. The procedure may be repeated multiple times if necessary.
- Even when RFA does not remove all of a tumor, a reduction in the total amount of tumor may extend life for a significant time.
- It takes much less time to recover from RFA than it does from conventional surgery.
- RFA is a relatively quick procedure and recovery is rapid so that chemotherapy may be resumed almost immediately.
- Radiofrequency ablation is less expensive than other treatment options.
- No surgical incision is needed—only a small nick in the skin that does not have to be stitched closed.

### Risks

- It is not uncommon for passage of the radiofrequency electrode to produce a condition called pneumothorax. This occurs when a collection of air or gas in the chest cavity collapses part of the lung. Usually no treatment is needed, but some patients may have a chest tube placed for up to a few days to drain the air.
- Significant bleeding into the lung is an uncommon complication of radiofrequency ablation (RFA).
- Fluid may collect in the space between the lung and its covering membrane. If the patient becomes short of breath, the fluid will have to be removed using a needle.

- Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant.
- This procedure may involve exposure to x-rays. However, radiation risk is not a major concern when compared to the benefits of the procedure.
- Severe pain after RFA is uncommon, but may last a few days and require a narcotic to provide relief.
- Though rare, an occasional patient with certain types of underlying lung disease may become worse after RFA, and in severe cases this may be fatal.
- Any procedure where the skin is penetrated carries a risk of infection. The chance of infection requiring antibiotic treatment appears to be less than one in 1,000.

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

Radiofrequency ablation (RFA) may not be practical if the tumor being treated is close to a critical organ such as the central airways, blood vessels, or heart. Large lung tumors and those that are difficult to reach may require repeated RFA treatments.

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