Radiofrequency Ablation (RFA) / Microwave Ablation (MWA) of Lung Tumors

Radiofrequency ablation (RFA) and microwave ablation (MWA) are treatments that use image guidance to place a needle through the skin into a tumor within the chest. RFA passes electrical currents through a needle to create a small region of heat. MWA uses a needle to produce a small region of heat. The heat destroys the lung cancer cells. Your doctor may use RFA or MWA to treat lung tumors or provide pain relief. They are effective options for patients who might have difficulty with surgery and for those for whom surgery is not an option. RFA or MWA may be used to treat lung cancer or tumors that have spread to the lungs from a cancer outside of the chest.

Your doctor will tell you how to prepare. Tell your doctor if there's a possibility you are pregnant and discuss any recent illnesses, medical conditions, allergies, and medications you are taking. Your doctor may advise you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs), or blood thinners several days prior to your procedure. They may also instruct you not to eat or drink anything for several hours before the procedure. Leave jewelry at home and wear loose, comfortable clothing. You may need to wear a gown and to stay overnight in the hospital while you recover.

What are Radiofrequency and Microwave Ablation of Lung Tumors?

Radiofrequency ablation (RFA) is a minimally invasive treatment for cancer. It is an image-guided technique that uses heat to destroy cancer cells. RFA uses ultrasound, computed tomography (CT), or magnetic resonance imaging (MRI) to help guide a needle electrode into a cancerous tumor. RFA passes high-frequency electrical currents through the electrode to ground pads placed on the body. This creates focused heat that destroys the cancer cells surrounding the electrode.

Microwave ablation (MWA) is a minimally-invasive treatment for cancer. MWA uses ultrasound, computed tomography (CT), or magnetic resonance imaging (MRI) to guide placement of a needle-like probe into a tumor. MWA uses microwaves to heat and destroy the tumor. Doctors use MWA for the same indications as RFA. The doctor will typically perform the procedure on an outpatient basis. Or, you may receive general anesthesia and stay in the hospital overnight while you recover. MWA offers low risk and a short hospital stay. It can treat multiple tumors simultaneously. Your doctor can repeat the procedure if new cancer appears.

What are some common uses of the procedure?

Doctors use RFA and MWA to treat early-stage lung cancer and tumors that have spread to the lungs from cancer elsewhere in the body.

Ablation is a viable and effective treatment option if you:

- are not a candidate for surgery due to other existing conditions or limited lung function.
• have multiple metastases in your lungs. These are tumors that have spread from a cancer elsewhere in your body, such as the kidney, intestine, or breast. Your doctor can treat more than one lesion at the same time. However, there may be a limit on the total number of lesions they can treat.

Your doctor can also use ablation with chemotherapy to treat one or more metastases that are growing in spite of chemotherapy.

Your doctor can also use ablation to relieve pain and to:

• reduce the size of a tumor so that chemotherapy or radiation therapy can eliminate it more easily.
• provide pain relief when a tumor invades the chest wall or bone.

Ablation is a complementary technique for treating lung tumors. Your treatment may combine ablation with surgery, radiation therapy, and/or chemotherapy. Your treatment can use ablation alone to treat small tumors and combine it with other therapies to relieve pain.

How should I prepare?

Tell your doctor about all the medications you take, including herbal supplements. List any allergies, especially to local anesthetic, general anesthesia, or contrast materials. Your doctor may tell you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or blood thinners before your procedure.

Prior to your procedure, your doctor may test your blood to check your kidney function and to determine if your blood clots normally.

Women should always tell their doctor and technologist if they are pregnant. Doctors will not perform many tests during pregnancy to avoid exposing the fetus to radiation. If an x-ray is necessary, the doctor will take precautions to minimize radiation exposure to the baby. See the Safety in X-ray, Interventional Radiology and Nuclear Medicine Procedures page (https://www.radiologyinfo.org/en/info/safety-radiation) for more information about pregnancy and x-rays.

Your doctor will likely tell you not to eat or drink anything after midnight before your procedure. Your doctor will tell you which medications you may take in the morning.

Plan to have someone drive you home after your procedure.

You may need to change into a gown for the procedure.

What does the equipment look like?

This procedure uses computed tomography (CT) imaging, needle electrodes, an electrical generator, and grounding pads.

Radiofrequency equipment

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. Insulated wires connect the generator to the needle electrodes and to grounding pads, which are placed on the patient's back or thigh.

Microwave equipment

A straight needle is used.
The microwave generator produces electromagnetic waves in the microwave energy spectrum. It is connected by insulated wires to the needles.

**Computed Tomography (CT) equipment**

The CT scanner is typically a large, donut-shaped machine with a short tunnel in the center. You will lie on a narrow table that slides in and out of this short 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 in a separate control room. This is where the technologist operates the scanner and monitors your exam in direct visual contact. The technologist will be able to hear and talk to you using a speaker and microphone.

This procedure may use other equipment, including an intravenous line (IV), ultrasound machine and devices that monitor 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. The heat is directed into the tumor where it heats and destroys the cancer cells. 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.

Microwave ablation works by producing electromagnetic waves in the microwave energy spectrum. These microwaves create heat around the needle, which heats and destroys the cancer cells. Heat closes small blood vessels and lessens the risk of bleeding. The dead tumor cells are gradually replaced by scar tissue.

The doctor may use ultrasound, computed tomography, or magnetic resonance imaging to help guide the needle electrode into the tumor.

**How is the procedure performed?**

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

Ablation is often done on an outpatient basis.

You will lie on the procedure table.

The doctor or nurse may connect you to monitors that track your heart rate, blood pressure, oxygen level, and pulse.

A nurse or technologist will insert an intravenous (IV) line into a vein in your hand or arm. This will allow sedation medication to be given intravenously.

Your physician will use CT scanning to precisely locate the tumor. They will mark your skin at the planned site of entry on the skin of the chest wall.

The doctor will sterilize and cover the area where the needles will be inserted with a sterile drape.

Your doctor will numb the area with a local anesthetic. This may briefly burn or sting before the area becomes numb.

Your doctor may use intravenous conscious sedation and/or general anesthesia in addition to local anesthetic. They will determine the type of anesthesia to be used during the initial evaluation.
The doctor will make a very small skin incision at the site.

Ablation uses one of three methods:

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

Using imaging-guidance, your doctor 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 or by placing multiple needles into different parts of the tumor to ensure no tumor tissue is left behind.

At the end of the procedure, the doctor will remove the needle electrode and apply pressure to stop any bleeding. They will cover the opening in the skin with a dressing. No sutures are needed.

The doctor or nurse will remove your IV line before you go home.

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

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

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

The doctor or nurse will attach devices to your body to monitor your heart rate and blood pressure.

You will feel a slight pinch when the nurse inserts the needle into your vein for the IV line and when they inject the local anesthetic. Most of the sensation is at the skin incision site. The doctor will numb this area using local anesthetic. You may feel pressure when the doctor inserts the catheter into the vein or artery. However, you will not feel serious discomfort.

If the procedure uses sedation, you will feel relaxed, sleepy, and comfortable. You may or may not remain awake, depending on how deeply you are sedated.

Your doctor can control your pain immediately following ablation with medication via IV or by injection. Afterward, oral pain medication can control any mild discomfort. You may feel nauseous. Medication can ease this as well.

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. However, 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. 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 may need to stay in the hospital overnight while you recover.

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

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

Computed tomography (CT) or magnetic resonance imaging (MRI) of the lung is performed several weeks following radiofrequency ablation. A radiologist will interpret these CT or MRI scans to detect any complications, to ensure that all of the tumor tissue has been treated, and to assess any residual tumor.

**What are the benefits vs. risks?**

**Benefits**

- Ablation 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 ablation 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 ablation.
- Lung function is better preserved after ablation 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 ablation, the procedure may be repeated, or radiation therapy may eliminate the remaining tumor cells. Ablation 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 ablation. The procedure may be repeated multiple times if necessary.
- Even when ablation does not remove the entire tumor, a reduction in the total amount of tumor may provide benefit in some patients.
- It may take less time to recover from ablation than it does from conventional surgery.
- Ablation is a relatively quick procedure and recovery is rapid. Chemotherapy may resume almost immediately in patients who need it.
- Ablation is less expensive than other treatment options.
- No surgical incision is necessary—only a small nick in the skin that does not need stitches.

**Risks**

- It is not uncommon for passage of the needle 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 (usually) to drain the air allowing the small hole in the lung to heal.
- Significant bleeding into the lung is an uncommon complication of ablation.
- Fluid may collect in the space between the lung and its covering. If the patient becomes short of breath, the fluid will have to be removed using a needle or a chest tube.
- Women should always tell their doctor and x-ray technologist if they are pregnant. See the Safety in X-ray, Interventional Radiology and Nuclear Medicine Procedures (https://www.radiologyinfo.org/en/info/safety-radiation) page for more information about pregnancy and x-rays.
- This procedure may involve exposure to x-rays. However, radiation risk is not a major concern when compared to the benefits of the procedure. See Radiation Dose in X-ray and CT Exams (https://www.radiologyinfo.org/en/info/safety-xray) for more information about radiation dose from interventional procedures.
- Severe pain after ablation is uncommon. It may last a few days and require medication for relief.
- Though rare, an occasional patient with certain types of underlying lung disease may become worse after ablation. This can be fatal. A benefit/risk discussion at the initial clinical visit is recommended.
Any procedure that penetrates the skin 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 and Microwave Ablation of Lung Tumors?**

Ablation 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 ablation treatments.

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