



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. In RFA, high-frequency electrical currents are passed through an electrode, creating a small region of heat. In MWA, microwaves are created from the needle to create a small region of heat. The heat destroys the lung cancer cells. RFA and MWA may be used to treat lung tumors or provide palliative care. They are effective treatment options for patients who might have difficulty with surgery and for those for whom surgery is not an option due to the spread of a tumor to the lungs from the primary tumor or cancers outside the chest.



Your doctor will instruct you on how to prepare. Inform your doctor if there's a possibility you are pregnant and discuss any recent illnesses, medical conditions, allergies and medications you're taking. Your doctor may advise you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or blood thinners several days prior to your procedure and instruct you not to eat or drink anything for several hours beforehand. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown, and you may need to be admitted overnight for observation.

What are Radiofrequency and Microwave 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 uses heat to destroy cancer cells. It uses imaging techniques such as ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) to help guide a needle

electrode into a cancerous tumor. High-frequency electrical currents are then passed through the electrode to ground pads placed on the body, creating focal heat that destroys the cancer cells surrounding the electrode.

Microwave ablation (MWA) is also a minimally-invasive treatment for cancer. MWA also uses ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) to guide placement of a specialized needle-like probe into a tumor. MWA uses microwaves to heat and destroy the tumor and is used for the same indications as RFA. The procedure is typically performed on an outpatient basis or with overnight observation in the hospital with general anesthesia. For the patient, MWA offers low risk and a short hospital stay. Ablation can be used to treat multiple tumors simultaneously. The procedure can be repeated if new cancer appears.

MWA is a promising treatment in the lung, where RFA may be limited by the aerated lung's low electrical conductivity and poor thermal conduction. These characteristics do not degrade the volume heating of microwaves, allowing for larger ablation zones than RFA.

What are some common uses of the procedure?

Radiofrequency and microwave ablation are used to treat early-stage lung cancer and tumors that have spread to the lungs from the primary lung cancer or cancers in other parts of the body.

Ablation is a viable and effective treatment option if you:

- are not a candidate for surgery due to comorbidities or limited lung function.
- have multiple metastases in your lungs. These are tumors that have spread from a cancer located either in the lung or elsewhere in your body, such as the kidney, intestine or breast. More than one lesion can be treated at the same time. However, there may be a limit on the total number of lesions that can be treated.

Ablation can also be used as an adjunct to chemotherapy for treating one or more metastases that are growing in spite of adequate control with chemotherapy.

Ablation can also be used for palliative care (treatment of pain) and to:

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

Ablation is a complementary technique for treating lung tumors and can be combined with surgery, radiation therapy and or chemotherapy. It can be used alone to treat small tumors and can be combined with other therapies for palliative care.

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 containing iodine (sometimes referred to as "dye" or "x-ray dye"). Your physician may advise you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or blood thinners for a specified period of time before your procedure.

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

Women should always inform their physician and 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. See the Safety page for more information about pregnancy and x-rays.

You will likely 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.

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. It is connected by insulated wires to the needle electrodes and to grounding pads that 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, 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 control room, where

the technologist operates the scanner and monitors your examination in direct visual contact and usually with the ability to hear and talk to you with the use of a speaker and microphone.

Other equipment that may be used during the procedure includes 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, which when directed into the tumor, 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 heat and destroy the cancer cells. Heat closes small blood vessels and lessens the risk of bleeding. The dead tumor cells are gradually replaced by scar tissue.

Ultrasound, computed tomography or magnetic resonance 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 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 be positioned on the examining table.

You may 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 planned site of entry on the skin of the chest wall.

The area where the needles are to be inserted will be sterilized and covered with a surgical drape.

Your physician will numb the area with a local anesthetic.

Intravenous conscious sedation and/or general anesthesia may also be used in addition to local anesthetic. The type of anesthesia to be used will be determined during the initial evaluation.

A very small skin incision is made at the site.

Ablation is performed using one of three methods:

- Surgery.
- 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 are 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, 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 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 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 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. Most of the sensation is at the skin incision site, which is numbed using local anesthetic. You may feel pressure when the catheter is inserted into the vein or artery.

If the procedure is done with sedation, the intravenous (IV) sedative will make you feel relaxed, sleepy and comfortable for the procedure. You may or may not remain awake, depending on how deeply you are sedated.

Pain immediately following 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 may need to be admitted overnight.

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 within a few hours to a week 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 all of a tumor, a reduction in the total amount of tumor may extend life for a significant time.
- 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 so that chemotherapy may be resumed almost immediately in patients who need it.
- 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.

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 membrane. If the patient becomes short of breath, the fluid will have to be removed using a needle or a chest tube may need to be placed to remove it.
- Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant. See the Safety 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 the Safety page for more information about radiation dose from interventional procedures.
- Severe pain after ablation is uncommon, but may last a few days and require a narcotic for relief.
- Though rare, an occasional patient with certain types of underlying lung disease may become worse after ablation, and can be fatal. A benefit/risk discussion at the initial clinical visit is recommended.
- 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 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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