

Cryotherapy

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.

What is Cryotherapy?

Cryotherapy, also called cryosurgery, cryoablation or targeted cryoablation therapy, is a minimally invasive treatment that uses extreme cold to freeze and destroy diseased tissue, including cancer cells. Although cryotherapy and cryoablation can be used interchangeably, the term “cryosurgery” is reserved best for cryotherapy performed using an open, surgical approach.

During cryotherapy, liquid nitrogen or argon gas is applied to diseased cells located outside or inside the body. Physicians use image-guidance techniques such as ultrasound, computed tomography (CT) or magnetic resonance (MR) imaging to help guide these freezing substances to treatment sites located inside the body.

What are some common uses of the procedure?

Cryotherapy can be applied topically (on the skin surface), percutaneously, or surgically. Topical cryotherapy is used typically in the case of skin and eye lesions. When the lesion is situated below the skin surface, a needle-like therapy probe or applicator needs to be placed either through the skin. Occasionally, a surgical incision is required.

Cryotherapy is used to treat:

- skin tumors.
- pre-cancerous skin moles.
- nodules.
- skin tags.
- unsightly freckles.
- retinoblastomas, a childhood cancer of the retina.
- prostate, liver, and cervical cancers, especially if surgical resection is not possible.

Cryotherapy is also being used to treat tumors in other parts of the body, such as the kidneys, bones (including the spine), lungs, and breasts (including benign breast lumps called fibroadenomas). Although further research is needed to determine its long term effectiveness, cryotherapy has been shown to be effective in selected patients.

How should I prepare?

Some physicians recommend taking ibuprofen (400 mg) a half-hour before this procedure to relieve minor discomfort; others give a dose of antibiotics before cryotherapy as a way to guard against infection.

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.

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. Some physicians recommend a short, overnight hospital stay after cryotherapy of deep tumors. In the case of cryotherapy performed using a large, surgical incision (cryosurgery) a short hospitalization will be required.

Percutaneous cryotherapy can be performed as an outpatient service, but may require a short, overnight hospital stay.

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?



Cryotherapy probes

In this procedure, ultrasound, computed tomography (CT) or magnetic resonance (MR) imaging, a cotton swab or spray device, cryoprobe and bronchoscope may be used.

Ultrasound scanners consist of a console containing a computer and electronics, a video display screen and a transducer that is used to scan the body and blood vessels. The transducer is a small hand-held device that resembles a microphone, attached to the scanner by a cord. The transducer sends out high frequency sound waves into the body and then listens for the returning echoes from the tissues in the body. The principles are similar to sonar used by boats and submarines.

The ultrasound image is immediately visible on a nearby screen that looks much like a computer or television monitor. The image is created based on the amplitude (strength), frequency and time it takes for the sound signal to return from the patient to the transducer.

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.

The traditional MRI unit is a large cylinder-shaped tube surrounded by a circular magnet. You will lie on a moveable examination table that slides into the center of the magnet.

Some MRI units, called short-bore systems, are designed so that the magnet does not completely surround you; others are open on the sides (“low-strength” open MRI). These units are especially helpful for examining patients who are fearful of being in a closed space and for those who are very obese. Newer open MRI units may provide high quality images for many types of exams; however, open MRI units with older magnets may not provide this same quality. Certain types of exams cannot be performed using open MRI. For more information, consult your doctor.

The computer workstation that processes the imaging information is located in a separate room than the scanner.

Cryotherapy to treat tissue located outside the body uses a cotton swab or spray device.

Cryotherapy to treat tissue located inside the body requires image guidance and a cryotherapy applicator or cryoprobe, a thin wand-like device with a handle or trigger or a series of small needles. The cryoprobe is connected via tubing to a source of nitrogen or argon gas. Most cryotherapy units use argon gas and are approved by the U.S. Food and Drug Administration (FDA).

A bronchoscope, a thin, lighted tube used to examine the inside of the trachea and bronchi, or the air passages that lead into the lungs, may also be used.

The cryotherapy system is generally housed in the procedure room. It is a computer that can be used to control the flow of the cooling agent, which is typically stored in nearby gas tanks.

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?

Cryotherapy applies nitrogen or argon gas at extremely cold temperatures to destroy diseased tissue. To destroy diseased tissue located outside the body, liquid nitrogen is applied directly with a cotton swab or spray device. For tumors located below the skin surface and deep in the body, the physician will use image-guidance to insert one or more applicators, or cryoprobes, through the skin to the site of the diseased tissue and then deliver liquid nitrogen or argon gas.

Living tissue, healthy or diseased, cannot withstand extremely cold conditions and will die from:

- ice formation in the fluid outside cells, which results in cellular dehydration.

- ice formation within the cell. At approximately -40°C (-40°F) or less, intracellular lethal-ice crystals begin to form and will destroy almost any cell.
- bursting from both swelling caused by ice expansion inside the cell or shrinking caused by water exiting the cell.
- loss of blood supply. Cells die when their blood supply is choked off by ice forming within small tumor vessels, causing clotting. The extreme cold is maintained for at least 10-15 minutes to assure that lethal-ice temperatures have been reached for a sufficient time.

Because cryotherapy consists of a series of steps that lead to cell death, tumors are repeatedly frozen and thawed; typically two freeze-thaw cycles are used.

Once the cells are destroyed, the white blood cells of the immune system work to clear out the dead tissue. There is some evidence to suggest that this procedure also stimulates the immune system to attack remaining cancer cells.

How is the procedure performed?

Percutaneous image-guided procedures such as cryotherapy are most often performed by a specially trained interventional radiologist in an interventional radiology suite or occasionally in the operating room.

This procedure is often done on an outpatient basis. However, some procedures may require admission. Please consult with your physician.

You will be positioned on the examining table.

If topical cryotherapy is performed, your physician will apply liquid nitrogen to the area with a cotton swab or spray device.

For tumors deep inside the body that can be approached through the skin, your physician will perform a percutaneous procedure and insert thin, needle-size applicators or cryoprobes.

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 sedative medication can be given intravenously. You may also receive general anesthesia.

The area where the applicators or cryoprobe are to be inserted will be shaved, sterilized and covered with a sterile drape. A very small nick is made in the skin at the site.

Using imaging guidance, the physician will insert one or more applicators or cryoprobes through the skin to the site of the diseased tissue. Once the applicators or cryoprobe(s) are in place, the liquid nitrogen or argon gas is delivered. Imaging is used to guide the placement of the applicators, and monitor the freezing process. At the end of the applicators, an “ice ball” forms and can be visualized using US, CT or MRI.

Some tumors require multiple applicators to freeze completely. For example, to treat prostate cancer, six to eight applicators are inserted through the perineum (the tissue between the rectum and the scrotum and penis) using ultrasound guidance.

At the end of the procedure, the applicator(s) are removed and pressure will be applied to stop any bleeding. The opening in the skin is covered with a bandage. No sutures are needed.

Your intravenous line will be removed.

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.

If you receive a general anesthetic, you will be unconscious for the entire procedure and monitored by an anesthesiologist.

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.

You may experience discomfort from having to be still during the procedure.

Following percutaneous cryotherapy, you should be able to resume your usual activities within 24 hours.

If you have had open cryosurgery, you should be able to resume your usual activities within seven to 10 days. You should avoid lifting heavy objects for at least 72 hours. Consult your physician as to when you can resume your usual activities.

Who interprets the results and how do I get them?

The interventional radiologist or physician treating you will determine the results of the procedure and will send a report to your referring physician, who will share the results with you.

What are the benefits vs. risks?

Benefits

- When an open surgical approach is taken, the recovery time following cryosurgery of kidney or liver tumors may be less than for open, surgical removal of the tumor.
- For percutaneous cryotherapy, the patient may stay overnight or be released several hours after the procedure. Cryotherapy causes less pain during and after the procedure compared to heat-based treatments such as radiofrequency ablation. Overnight stays for pain control are usually not needed.
- Percutaneous cryotherapy is less traumatic than open surgery since only a small incision is needed to pass the probe through the skin, which limits damage to healthy tissue. Consequently, percutaneous cryotherapy is less costly and results in fewer side effects than open surgery. A patient usually can resume activities of daily living 24 hours after the procedure, if not sooner. However, caution about heavy lifting may extend for several days after abdominal treatment.
- For treatment of fibroadenomas, cryotherapy causes minimal scar tissue and no apparent calcifications.

Risks

- Like any percutaneous procedure, bleeding may result – both from the puncture and the freezing of tissues such as the liver, kidney or lung.
- Damage to normal structures may occur. During liver cryotherapy, the bile ducts may be injured. During kidney cryotherapy, the ureter, collecting system or adjacent bowel may be damaged. The rectum may be damaged during prostate cryotherapy. Any treatment of the abdomen may result in damage to the bowel and cause a hole in the bowel, which may release bowel contents into the abdomen and can lead to infection.
- If freezing occurs near the diaphragm, fluid can accumulate in the space around the lungs.
- If the procedure is in or near the lung, the lung may collapse.

- Nerve damage may result. Completely frozen nerves can cause motor weakness or numbness in the area supplied by the nerves.
- Complications related to medications, including anesthesia, administered during the procedure may occur.
- Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant.
- This procedure involves exposure to x-rays. However, radiation risk is not a major concern when compared to the benefits of the procedure.

Specific possible complications related to the cryotherapy of prostate cancer:

- Permanent impotence since nerves controlling sexual potency are commonly involved in the freezing process. However, nerves can regenerate, resolving the problem in some patients.
- While the patient is under anesthesia, a bladder tube is positioned to drain urine until the swelling of the bladder neck—as a result of the procedure—resolves.
- May cause urethral sloughing; that is, blocking of the urine stream with dead tissue. Sloughing is reduced by keeping the urethra warm with sterile water circulating continuously through a catheter placed in the urethra during the procedure.

What are the limitations of cryotherapy?

Cryotherapy is an alternative cancer treatment when surgical removal of a tumor may be difficult or, for some patients, impossible. However, its long-term effectiveness is still being examined. Currently, little published data deal with the long-term results of percutaneous cryotherapy but long-term follow-up for prostate cancer suggests cancer-control rates are similar to surgery or radiation therapy.

Cryotherapy is considered a localized therapy. It can only treat disease at a single site. It cannot treat cancer that has spread to other parts of the body. Because physicians treat the tumors they see on radiologic images, microscopic cancer may be missed.

Although its use in the bone, kidneys, liver and lung is promising, percutaneous cryotherapy had been considered investigational; however, promising results are now emerging such that insurance companies will pay for the procedure in select patients.

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