Cryotherapy

Cryotherapy uses imaging guidance, a needle-like applicator called a cryoprobe, and liquid nitrogen or argon gas. The treatment creates intense cold to freeze and destroy diseased tissue, including cancer cells. Doctors use cryotherapy to treat a variety of conditions as well as tumors within the liver, kidneys, bones, lungs, and breasts.

Your doctor will tell you how to prepare, including any changes to your medication schedule. Tell your doctor if you are pregnant. Discuss any recent illnesses, medical conditions, allergies, and the medications you take, including herbal supplements and aspirin. You may need to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs), or blood thinners several days prior to your procedure. Ask your doctor if you will be admitted overnight. Leave jewelry at home and wear loose, comfortable clothing. You may need to change into a gown for the procedure. Plan to have someone drive you home.

What is Cryotherapy?

Cryotherapy is also called cryosurgery, cryoablation, percutaneous cryotherapy, and targeted cryoablation therapy. It 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" refers to performing cryotherapy using an open, surgical approach.

During cryotherapy, liquid nitrogen or high-pressure argon gas flows into a needle-like applicator or cryoprobe. This creates intense cold that the doctor uses to freeze and destroy diseased tissue. Doctors use ultrasound, computed tomography (CT) or magnetic resonance (MR) to help guide the cryoprobes to treatment sites within the body.

What are some common uses of the procedure?

Doctors can use cryotherapy topically (on the skin surface), percutaneously, or surgically. They typically use topical cryotherapy for skin and eye lesions. Sometimes, the lesion is below the skin surface. In this case, the doctor places a needle-like therapy probe or applicator through the skin to reach the lesion. Occasionally, this requires a surgical incision.

Doctors use cryotherapy 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 surgery is not possible.

Cryotherapy also treats tumors in the kidneys, bones (including the spine), lungs, and breasts. It also treats benign breast lumps called fibroadenomas. Although further research is needed to determine its long-term effectiveness, doctors find cryotherapy to be effective in selected patients.
How should I prepare?

For skin treatment, some doctors 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. For deeper treatments involving tumors, patients should avoid blood-thinning medications for the recommended period before the treatment.

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.

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.

Some doctors recommend a short, overnight hospital stay after cryotherapy of deep tumors. If the procedure uses a large, surgical incision (cryosurgery) you will need a short hospital stay. Doctors can perform percutaneous cryotherapy on an outpatient basis, but you may need a short, overnight hospital stay.

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 may use ultrasound, computed tomography (CT), or magnetic resonance (MR) imaging, a cotton swab or spray device, cryoprobe and bronchoscope. Cryosurgery may also use laparoscopic surgery.

Ultrasound machines consist of a computer console, video monitor and an attached transducer. The transducer is a small hand-held device that resembles a microphone. Some exams may use different transducers (with different capabilities) during a single exam. The transducer sends out inaudible, high-frequency sound waves into the body and listens for the returning echoes. The same principles apply to sonar used by boats and submarines.

The technologist applies a small amount of gel to the area under examination and places the transducer there. The gel allows sound waves to travel back and forth between the transducer and the area under examination. The ultrasound image is immediately visible on a video monitor. The computer creates the image based on the loudness (amplitude), pitch (frequency), and time it takes for the ultrasound signal to return to the transducer. It also considers what type of body structure and/or tissue the sound is traveling through.

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.

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

Some MRI units, called short-bore systems, are designed so that the magnet does not completely surround you. Some newer MRI machines have a larger diameter bore, which can be more comfortable for larger patients or those with claustrophobia. "Open" MRI units are open on the sides. They are especially helpful for examining larger patients or those with claustrophobia. Open MRI
units can provide high quality images for many types of exams. Open MRI may not be used for certain exams. For more information, consult your radiologist.

Topical cryotherapy uses a cotton swab or spray device.

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

Cryotherapy may also use a bronchoscope. Doctors use this thin, lighted tube to examine the inside of the trachea and bronchi.

The cryotherapy system uses a computer to control the flow of the cooling agent, which is typically stored in nearby gas tanks.

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?**

Cryotherapy uses nitrogen or argon gas to create extremely cold temperatures to destroy diseased tissue. Topical cryotherapy destroys diseased tissue outside the body by applying liquid nitrogen directly with a cotton swab or spray device. Doctors use cryoprobes to treat tumors below the skin surface and deep in the body. Using image-guidance, the doctor inserts one or more cryoprobes through the skin to the site of the diseased tissue. The cryoprobe delivers the liquid nitrogen or argon gas and freezes the diseased tissue.

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 blood vessels, causing clotting. Since the average blood-clotting time is approximately 10 minutes, the extreme cold is maintained for at least 10-15 minutes, if not longer. This helps assure that lethal-ice temperatures have been reached. Direct observation of the ablation temperature is possible with some apparatuses.

Because cryotherapy consists of a series of steps that lead to cell death, tumors are repeatedly frozen and thawed; typically, the doctor will use two or more freeze-thaw cycles.

Once the cells die, the white blood cells of the immune system work to clear out the dead tissue.

**How is the procedure performed?**

A specially trained healthcare professional, such as an interventional radiologist, will usually perform cryotherapy in an interventional radiology suite or the operating room.

This procedure is often done on an outpatient basis. However, some patients may require admission following the procedure. Ask your doctor if you will need to be admitted.

You will lie on the procedure table.

If the doctor performs topical cryotherapy, they 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 doctor will perform a percutaneous procedure and insert thin, needle-size applicators or cryoprobes.

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 to administer a sedative. This procedure may use moderate sedation. It does not require a breathing tube. However, some patients may require general anesthesia.

A doctor or nurse will shave, sterilize and cover the insertion site with a sterile drape.

The doctor will make a very small skin incision at the site.

Using imaging guidance, the doctor will insert one or more applicators or cryoprobes through the skin to the site of the diseased tissue. Once in place, the devices will deliver the liquid nitrogen or argon gas. Aside from the devices, nothing else enters the body. The device creates an “ice ball” by rapidly decreasing the temperature at its tip. This causes all water in the area around the tip of the probe to freeze. Imaging guides placement of the devices and monitors the freezing process. The doctor can visualize the “ice ball” using ultrasound, CT, or MRI.

Some tumors require multiple devices to freeze completely. For prostate cancer, the doctor will insert six to eight applicators through the perineum (the tissue between the rectum and the scrotum and penis) using ultrasound guidance.

At the end of the procedure, the doctor will remove the devices and apply pressure to stop any bleeding. They will cover the opening in the skin with a bandage. Typically, no sutures are needed.

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

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 you receive a general anesthetic, you will be unconscious for the entire procedure. An anesthesiologist will monitor your condition.

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.

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 one to three days.

If you have had open cryosurgery, you should be able to resume your usual activities within seven to 10 days. Avoid lifting heavy objects for at least 72 hours. Ask your doctor when you can resume your usual activities.

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

The interventional radiologist or doctor treating you will determine the results of the procedure. They will send a report to your referring physician, who will share the results with you.
Your interventional radiologist may recommend a follow-up visit.

This visit may include a physical check-up, imaging exam(s), and blood tests. During your follow-up visit, tell your doctor if you have noticed any side effects or changes.

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. Overnight stays for pain control are usually not needed.
- Percutaneous cryotherapy is less traumatic than open surgery. Because the doctor only uses a small incision to pass the probe through the skin, damage to healthy tissue is minimal. As a result, percutaneous cryotherapy is less costly and has fewer side effects than open surgery. A patient usually can resume daily activities 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 post-treatment 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. Liver cryotherapy may cause injury to the bile ducts. Kidney cryotherapy may damage the ureter or collecting system. Prostate cryotherapy may damage the rectum. Any abdominal treatment may damage the bowel. If perforation occurs, contents of the bowel may be released into the abdomen. This can lead to a potentially life-threatening 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 procedure medications, including anesthesia, may occur.
- 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 the Safety in X-ray, Interventional Radiology and Nuclear Medicine Procedures (https://www.radiologyinfo.org/en/info/safety-radiation) for more information about radiation dose from interventional procedures.

Prostate cancer cryotherapy poses specific possible complications, such as:

- 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.
- Urethral sloughing may occur; that is, dead tissue may block the urine stream. 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 surgery may be difficult or impossible for some patients. Doctors are still examining its long-term effectiveness. Currently, there is little published data on the long-term results of percutaneous cryotherapy. However, long-term follow-up for prostate cancer suggests cancer-control rates are like surgery or radiation therapy.

Cryotherapy is 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 doctors treat the tumors they see on radiologic images, they may miss microscopic cancer.

Although its use in the bone, kidney, liver, and lung is promising, doctors continue to research percutaneous cryotherapy to determine longer term clinical outcomes.

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