How Lasers Are Used to Treat Cancer

The word LASER stands for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.

Laser light is different from regular light. The light from the sun or from a light bulb has many different wavelengths and spreads out in all directions. Laser light, on the other hand, has a single, high energy wavelength and can be focused in a very narrow beam. This makes it both powerful and precise.

Lasers can be used instead of blades (scalpels) for very careful surgical work, such as repairing a damaged retina in the eye or cutting body tissue. They can also be used to heat and destroy small areas (such as some tumors), or to activate light-sensitive drugs.

Types of lasers

Lasers are named for the liquid, gas, solid, or electronic substance that is used to create the light. Many types of lasers are used to treat medical problems, and new ones are being tested all the time. The main types of lasers currently being used in cancer treatment include:

- Carbon dioxide (CO_2)
- Argon
- Neodymium: yttrium aluminum garnet (Nd:YAG)

Doctors and other health professionals who use these lasers need special training in

how to operate and safely handle them.

Carbon dioxide (CO_2) lasers

The CO_2 laser can cut or vaporize (dissolve) tissue with fairly little bleeding. It does very little damage to the surrounding or deep tissue. This type of laser is sometimes used to treat pre-cancers and some early-stage cancers.

Argon lasers

The argon laser, like the CO_2 laser, only goes a short distance into tissue. It is useful in treating skin problems and in treating some types of eye tumors. It's sometimes used during colonoscopies (tests to look for colon cancer) to remove polyps before they become cancer. It also can be used with light-sensitive drugs to kill cancer cells in a treatment known as *photodynamic therapy (PDT)*. Another way it can be used is to help stop bleeding by sealing blood vessels in patients who are getting radiation therapy for certain types of cancer. This might be needed in some cases because radiation therapy can damage the blood vessels near the tumor, causing them to tear and bleed.

Nd:YAG (Neodymium: Yttrium-Aluminum-Garnet) lasers

Light from this laser can go deeper into tissue than light from other types of lasers, and it can make blood clot quickly. Nd:YAG lasers can be used through thin flexible tubes called *endoscopes* to get to hard-to-reach parts inside the body, such as the esophagus (swallowing tube) or the large intestine (colon). This light can also travel through flexible optical fibers (thin, clear tubes) that are put into a tumor, where the light's heat can destroy it.

Treating cancer with lasers

Lasers can be used in 2 main ways to treat cancer:

- To shrink or destroy a tumor with heat
- To activate a chemical – known as a *photosensitizing agent* – that kills only the cancer cells. (This is called *photodynamic therapy* or *PDT*.)

Though lasers can be used alone, they are often used with other cancer treatments, such as chemotherapy or radiation therapy.

Shrinking or destroying tumors directly

The CO_2 and Nd:YAG lasers are used to shrink or destroy tumors. They can be used with thin, flexible tubes called *endoscopes* that let doctors see and work inside certain parts of the body that could not otherwise be reached except by major surgery. Using an endoscope also helps position the laser beam to accurately hit its target.

Lasers are used this way to treat many kinds of cancer. Here are some examples:

- In the colon and rectum (large intestine), lasers can be used to remove polyps, which are small growths that might become cancer.
- Lasers can be used to treat certain skin pre-cancers and cancers, as well as pre-cancers or very early cancers of the cervix and surrounding areas.
- Lasers can sometimes be used to treat cancer that has spread to the lungs from other areas, as well as cancer that is causing a blockage in the airway.
- In certain cases, small cancers of the head and neck may be treated with lasers.
- A type of laser treatment called*laser-induced interstitial thermotherapy (LITT)* can be used to treat some types of tumors, such as certain tumors in the liver and brain. It uses heat to help shrink tumors by damaging cells or depriving them of the things they need to live (like oxygen and food).

Photodynamic therapy

For most types of photodynamic therapy (PDT), a special drug called a *photosensitizing agent* is put into the bloodstream. Over time it is absorbed by body tissues. The drug stays in cancer cells for a longer time than in normal cells.

Photosensitizing agents are turned on or activated by certain types of light. For example, an argon laser can be used in PDT. When cancer cells that contain the photosensitizing agent are exposed to light from this laser, it causes a chemical reaction that kills the cancer cells. Light exposure must be carefully timed so that it’s used when most of the agent has left healthy cells, but is still in the cancer cells.

PDT is sometimes used to treat cancers and pre-cancers of the esophagus (swallowing tube), bile duct, bladder, and certain kinds of lung cancer that can be reached with endoscopes.

PDT is also being looked at for use in other cancers, such as those of the brain, pancreas, and prostate. Researchers also are looking at different kinds of lasers and

new photosensitizer drugs that might work even better.

To learn more about PDT, see Photodynamic Therapy[1].

Treating cancer-related side effects with lasers

Lasers are also being looked at to treat or prevent side effects of common cancer treatments. For instance, low-level laser therapy (LLLT) might be helpful in treating the arm swelling (lymphedema[2]) that can result from breast surgery. Lymphedema in the arm is a risk when lymph nodes in the armpit are removed during surgery. Some studies are also looking at LLLT for preventing or treating severe mouth sores caused by chemotherapy.

Benefits and limitations of laser treatment

Lasers have some benefits and drawbacks compared with standard surgical tools. Each person's case is different, so it's important to discuss the pros and cons of laser therapy with your doctor to decide if it might be right for you.

Lasers have some advantages (pros) and disadvantages (cons) compared with standard surgical tools.

Positive aspects of laser treatment

- Lasers are more precise and exact than blades (scalpels). For instance, the tissue near a laser cut (incision) is not affected since there is little contact with skin or other tissue.
- The heat produced by lasers helps clean (sterilize) the edges of the body tissue that it's cutting, reducing the risk of infection.
- Since laser heat seals blood vessels, there is less bleeding, swelling, pain, or scarring.
- Operating time may be shorter.
- Laser surgery may mean less cutting and damage to healthy tissues (it can be less invasive). For example, with fiber optics, laser light can be directed to parts of the body through very small cuts (incisions) without having to make a large incision.
- More procedures may be done in outpatient settings.
- Healing time is often shorter.

Limitations of laser treatment

- Not many doctors and nurses are trained to use lasers.
- Laser equipment costs a lot of money and is bulky compared with the usual surgical tools used. But advances in technology are slowly helping reduce their cost and size.
- Strict safety precautions must be followed in the operating room when lasers are used. For example, the entire surgical team and the patient must wear eye protection.
- The effects of some laser treatments may not last long, so they might need to be repeated. And sometimes the laser cannot remove all of the tumor in one treatment, so treatments may need to be repeated.

Hyperlinks

1. www.cancer.org/cancer/managing-cancer/treatment-types/radiation/photodynamic-therapy.html
2. www.cancer.org/cancer/managing-cancer/side-effects/swelling/lymphedema.html

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