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UNDERSTANDING PROTON THERAPY AS A CANCER TREATMENT
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Proton therapy as an option for treating cancer

What is it? | Proton vs. radiation therapy | Uses | Risks | With other therapies | What to expect | Takeaway

Proton therapy, also called proton beam therapy, is a kind of particle therapy or radiation therapy. It directs proton beams at cancer cells with precision.

Proton therapy appears to be safer and more effective than conventional radiation therapy, because it can deliver a high dose to a very specific area, with minimal impact on surrounding tissues.

A radiologist uses a high-energy beam of protons, instead of high-energy X-rays, to deliver a dose of radiation therapy to people with cancer.

It is the most advanced radiation therapy available today. It destroys cancer cells but causes less damage than traditional radiation to surrounding healthy tissue. It is also painless and noninvasive.

Proton beam therapy has been in use since 1954[1] in the United States, but its use has not spread widely due to high costs.

Medically reviewed by
Deborah Weatherspoon, Ph.D., M.P.H., M.Sc. on Medical Reviews
By Fredrik Karlsson
February 26, 2019

What is proton therapy?

A radiation oncologist uses a proton beam to treat cancer in the prostate.

Proton therapy is similar to radiation therapy, but it offers a more targeted approach. This means that the risk of damaging tissues around the tumor is lower than with standard radiation.

The treatment is suitable for cancers that involve tumors near sensitive parts of the body, such as the eye, brain, and spinal cord.

Traditional radiation therapy cannot target such tumors because it could damage the surrounding nerves.

Proton therapy may be suitable for treating a range of tumors[2], including cancers that affect the:

- brain, spinal cord and central nervous system (CNS)
- head and neck
- nose and eyes
- rectum and anus
- pancreas
- liver
- bone
- soft tissues of the spine and pelvis, known as sarcoma
- lungs
- breast
- esophagus

It can treat solid tumors, but it cannot treat cancer that has spread to other parts of the body.

The MD Anderson Center at the University of Texas describe proton therapy as a "little ion, cancer-killing machine with sub-millimeter precision" that can target a patient's tumor "while spiring nearby healthy tissues and minimizing side effects. In its most simple terms, that's proton therapy."

However, proton therapy is expensive, and some researchers[3] have questioned whether it provides an overall advantage compared to other, cheaper therapies.

Proton vs. standard radiation therapy

According to the American Society of Clinical Oncology (ASCO), proton therapy may deliver up to 60 percent less radiation to healthy tissue surrounding the target site, while delivering a higher dose to the tumor itself.

In proton therapy, the doctor can decide exactly when and where the proton releases most of its energy. This makes it possible to inflict maximum damage to cancer cells and minimum harm to healthy tissue.

In standard radiation therapy, the X-ray beams deposit energy along their path before hitting their target, for example, in the body's surface and beyond. The X-ray beam continues beyond the tumor, releasing energy and harming tissue. This is called the "exit dose."

In other words, treatment hits the cancer cells that it targets, but it also affects those along the X-ray beam before and after the tumor. This can lead to health problems after treatment.

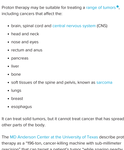
With proton therapy, the doctor can use a higher dose of radiation than in standard radiation therapy, but they can also protect surrounding tissue and vital organs.

In standard radiation, the radiologist may have to use a dose that is lower than desired to minimize the damage to healthy cells. This can limit the effectiveness of treatment.

Proton beams can hit the tumor from different directions.

This also helps to lessen any damage to the surrounding cells, reducing the risk of complications that people usually associate with radiation therapy.

This video explains how conventional radiation and proton therapy affect the body.



Video credit: LomaLindaHealth

Uses and applications

There are two main reasons for choosing proton beam therapy.

Higher dose

Proton therapy is suitable for tumors that need higher radiation doses.

In some cases, the ability to provide higher doses has provided better outcomes for individuals then with conventional radiotherapy.

It has been successful in treating:

- unresectable sarcomas
- tumors in the eye
- tumors alongside the spinal column.

Fewer side effects

Proton therapy carries a lower risk of undesirable side effects as it limits the damage to normal, healthy tissue. This is true even if the dose is the same as in conventional therapy.

This could be useful for treating prostate cancer and cancers that affect the prostate, the spine, the head, and the neck.

Proton therapy is useful for treating childhood cancers[4], because it can target the cancer cells without damaging other cells in a growing body. Children who receive traditional radiation treatment have a higher risk of stunted growth.

Proton therapy with other therapies

Doctors can combine[5] proton therapy with traditional radiation or chemotherapy. They can also use it as a follow-up to surgery.

In 2014, a lawsuit of oncologists reported in the journal Radiotherapy and Oncology that proton therapy "offered an additional gain" for patients with early-stage Hodgkin lymphoma after treatment that involved radiotherapy.

Risks: Secondary cancer

A person who has traditional radiation therapy can sometimes develop secondary cancer, or their cancer can return.

In 2013, another team published results of a study that was carried out to determine whether proton therapy and traditional radiation therapy (conformal radiation therapy) might increase the risk of secondary cancer in normal organs among patients with neuroblastoma.

Neuroblastoma are cancers that develop from immature nerve cells located in different parts of the human body. They typically arise in and near the adrenal glands.

They found that radiation doses observed in normal, healthy organs were lower among patients receiving proton therapy compared to those receiving traditional radiation therapy.

They concluded that while traditional radiation therapy slightly increases the risk of secondary cancer in most organs, proton therapy appears to reduce the risk.

Treatment: What to expect

The procedure begins with a simulation that aims to map out the area for treatment.

Simulation

A CT or MRI scan will identify the area for treatment.

The medical team, usually a radiation oncologist and a radiation therapy nurse, will make and fit the person with a device that holds the body still while treatment is underway.

The type of device depends on the location of the tumor. People with cancer in the head and neck may need a special mask fitted. If the target area is the body, leg, or arm, they will use a cradle device.

An MRI or CT scan will map out the area for treatment. The team will mark on the skin the location toward which they will aim the beam.

Proton treatment usually occurs up to 10 days after the simulation. The person must take care not to wash off the marks before treatment.

Treatment

The individual will lie in a donut-shaped device known as a gantry. This rotates around the person and directs the protons at the tumor.

A synchrotron, or cyclotron, creates and accelerates the protons. The protons are then removed from the synchrotron and magnets direct them to the cancer cells.

During the treatment, the radiation therapist is in another room, but they will see and talk to the patient using a two-way intercom and closed-circuit television.

Treatment may last for 15–30 minutes, depending on the number of locations for treatment. There should be no discomfort.

After this, the radiation therapist comes back into the room and removes the device that helped keep the person still during treatment.

Proton therapy is an outpatient procedure. The number of treatments will depend on the type of cancer and other factors, such as the dosage.

Side effects will be mild compared with those resulting from conventional radiation. There may be redness around the treatment area and some dermatitis[6] but rarely if treatment is to the head or scalp.

Takeaway

Proton beam therapy appears to be a safe and effective treatment for various types of cancer, but it is costly.

For some, the extra costs may be worthwhile in terms of improved health and quality of life and less time lost due to future complications and the adverse effects of conventional radiation therapy. For others, however, the out-of-pocket expense remains prohibitive.

Researchers,[7] reporting in 2018 also noted that there is a lack of clinical trials and long-term evidence to prove the safety and effectiveness of the technique, and the need to develop the technology more fully.

With further development, it might prove a valuable new option for cancer treatment.

People who are interested in trying this type of treatment should speak to their doctor about it.

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