

A paper

A New Cancer Treatment: Proton Therapy

A Review of the Literature

Cancer is a widespread disease that is defined as a malignant or invasive growth or tumor that can quickly spread to various sites of the body. Not too long ago, a diagnosis of cancer was thought to be a death sentence to many people. Since scientists are not sure what causes cancer, it is a challenge to develop a cure for it. As technology and medicine have advanced greatly in recent years, survival stories are common, giving hope to those who contract the mysterious disease. There are various methods of treatment that are usually effective, such as radiation and chemotherapy. A relatively new form of treatment, proton therapy, has been proven very effective, and is becoming desired by many patients.

This new form of treatment is similar to older x-ray treatments, but is both safer for the body and more precise. Just as x-rays are used to treat both benign and malignant tumors, a beam of protons is used to radiate tumors (Wallen, 2007). Protons are atoms that carry a positive charge which allow more accurate targeting of a cancerous growth. While Robert Rathbun Wilson first suggested the use of protons in cancer treatment in 1946, it has just recently been put into use on cancer patients (Zhong & Li, 2007). The procedure is conducted in three main phases: preparatory actions, the treatment itself, and the usually easy recovery.

There are a few preparation steps that must be completed. First, the patient is fitted for an immobilization device to put his or her body in the exact same position for each therapy treatment. The device used depends upon the location of the tumor.

Patients with a tumor below the neck receive a full-body mold made of foam liners surrounded by rigid plastic shells. Patients with a tumor in the eye, brain or head are fitted with a custom-made mask. Next, a CT-scan or an MRI is given, creating a 3-D replica of the tumor that is utilized during doctor's planning of treatment (Perry, 2007). The doctor's plan is specific to the individual's cancer; for each case, it must be decided how much dosage will be received and where exactly on the tumor the dosage will be delivered. After the physician reviews this plan, it is transferred to automated machines that make the special devices, apertures and tissue-compensating filters that will be used during therapy. All of these elements of the plan are carefully inspected by many people before the treatment is carried out to ensure complete safety and accuracy (Wallen, 2007).

Using a very large and expensive machine, a team of specialists perform the procedure. The cancerous cells are targeted with the proton beam in a clear method: the protons leave the machine and are steered by magnets toward the tumor. Wallen (2007) clarifies that other pieces of equipment are used to modify the range of the protons, shape of the beam, and to compensate for organ location. The tumor is attacked from various angles at different speeds, resulting in the most successful reduction of size.

Experts state that a great benefit of this method is that protons release most of their energy when they hit the tumor and deliver no extra dose beyond the tumor boundary. Therefore, the dose of radiation conforms to the tumor better and there is less damage to healthy tissue that surrounds it. As a result, the treating physician can give an even greater dose to the tumor while minimizing unwanted side effects. This is

especially important when treating children because it reduces exposure of harmful radiation to growing and developing tissues.

Other people who gain greatly from proton therapy are those with the types of cancer that proton therapy treats most efficiently. Brada (2007) states that these types of cancer include areas around vital organs: lung, prostate, brain, eye, spine, and head and neck cancers. Due to its accurate targeting, the proton beam is safest for these types of cancer. Dr. Ritsuko Komaki says that “proton therapy holds the most promise for treating lung cancer” (Brada, 2007, p. 967), which is also the most widespread and fatal form of cancer today. “According the World Health Organization (WHO), lung cancer is the most common form of cancer worldwide, killing one person every 30 seconds” (Jalla, 2006, p. 1). Many doctors are hopeful that the increase in use of proton therapy will lower these statistics drastically.

With all of its impressive benefits, most assume that the procedure must be perilous or have undesirable side effects. They are wrong in this assumption. In fact, doctors and patients claim that this method is given without any pain or discomfort from the proton beam. Effects after the treatment are found to be minimal, and much less frequent or severe than those resulting from x-ray treatment because less healthy tissue is damaged during the process. Possible side effects do include temporary hair loss and skin irritations in the direct path of the proton beam. Fatigue may also set in, but the intensity of this side effect depends on how large of an area is being treated. Proton therapy is an outpatient procedure that requires a fifteen to twenty minute procedure, daily, for six to seven weeks. Following treatment, the patient should be able to resume

normal activities. A patient will likely see his or her doctor every three to four months for a follow-up exam, a relatively simple process (Perry, 2007).

If this amazing treatment is so effective and results in minimal disruption of one's life, then why don't more people receive it? The answer to this question is simply the cost of equipment and facilities needed to perform proton therapy. The machines that are used in this method, called cyclotrons or synchrotrons, are nearly ten feet in diameter and weigh up to several hundred tons. Medical facilities that offer proton therapy use areas as large as 90,000 square feet to hold the massive machines ("Proton therapy: A better way to kill tumors", 2007). For these reasons, over the past dozen years, there were only two hospitals that treated large volume of patients with proton therapy. In 2007, the number of facilities increased to a whopping six, with one of the new facilities being located at the University of Florida Medical Center in Jacksonville (Zhong & Li, 2007). Hospitals want to be able to administer this treatment, but "building and equipping a facility carries financial and logistical challenges that dwarf nearly any other capital project" (Huff, 2007, p. 65). Nonetheless, according to senior oncology researcher Joseph McCaffrey, "Many hospitals are starting to consider proton therapy seriously". He states that, if nothing else, the addition of a proton therapy facility is "an opportunity for hospitals to distinguish themselves on a national if not a worldwide scale" (Huff, 2007, p. 66).

Whatever the motive may be to house a treatment facility, the financial burden has been far too immense for many hospitals. At the current cost of purchasing and running these machines, an immense amount of patients must be served to cover the high cost. Recently, however, designs for compact and more affordable equipment have

become closer to reality. Scientists at Lawrence Livermore National laboratory have drafted a machine that would fit in any major cancer center, and cost a fifth as much as current devices. The first clinical prototype will be tested in the near future at the UC Davis Cancer Center, which shared funding of the project with Livermore (“Proton Therapy: A better way to kill tumors”, 2007).

To fabricate a smaller version of these successful machines means instant wealth, so there is a struggle like that of the space race to be the first to develop a compact, affordable proton therapy machine. In 2006, a Belgium-based company announced the launch of its first compact proton therapy machine that would cost a mere thirty million dollars. Also, companies in California and Boston joined the race to develop and use a mini machine at the beginning of 2008. They plan to acquire a single-room proton system that will be a building block for more systems within their facilities in the future. This machinery has yet to be approved by the FDA, however, so they are not able to join the race at this time (Huff, 2007).

This healthy competition to expand the presence of proton therapy facilities benefits the citizens of the world. As the use of proton therapy increases, the millions of people whose bodies are homes to cancer will have hope that their unwanted disease will be cured. The friends and families of these patients will enjoy of a much longer life spent with those who were once infected with cancer. A diagnosis of cancer no longer will be viewed as a death penalty, or even a severe shortening of life, but it will hopefully be viewed as a sickness that is treated, overcome, and gone forever.

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