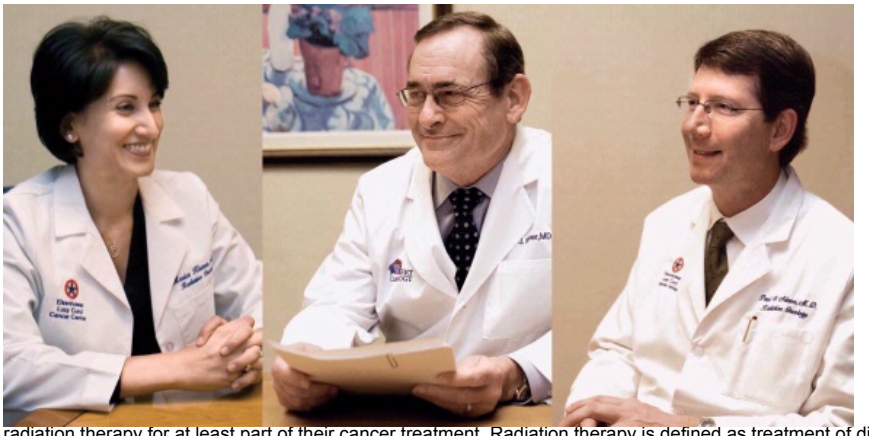
Advances in Radiation Therapy



Half of all cancer patients receive radiation therapy for at least part of their cancer treatment. Radiation therapy is defined as treatment of disease with ionizing radiation. It uses high-energy rays to prevent cancer cells from growing and dividing. Radiation therapy is a very targeted treatment, and is designed to damage the cancer cells while minimizing damage to normal surrounding tissues. There have been many major advances in radiation therapy since physicians began treating cancer patients with radiation more than 100 years ago. Today, sophisticated technology makes it possible to deliver very precise beams of radiation during treatment, allowing us to kill the cancer cells and spare dose to normal tissues.

Eisenhower Medical Center offers patients the most sophisticated radiation technology available today. Recently a group of Eisenhower physicians met to discuss the advances in radiation therapy. Participants included Monica Khanna, MD, a Board Certified Radiation Oncologist; Paul Adams, MD, a Board Certified Radiologist and Radiation Oncologist; and Board Certified Cardiologist Philip Shaver, MD, who moderated the session.

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DR. SHAVER: We're here to discuss where the treatment has come in the last several years, and some new advances here at Eisenhower Medical Center. I think it may be surprising to some that half of all people with cancer get radiation as at least part of their cancer treatment.

You can administer radiation therapy externally or internally. When it is given internally, it can be put directly into tissue itself or a body cavity. Because the radiation is given over short distances, it is called brachytherapy [from the Greek brachy, meaning "short"]. I think a lot of patients are familiar with brachytherapy as a treatment for prostate cancer utilizing seed implants. In the field of external beam radiation, the radiation is delivered by utilizing ionizing energy (with a linear accelerator), meaning as the energy passes through tissue, it dislodges electrons, creating an ionizing beam of radiation which can kill and damage cells. It destroys cancer cells because it prevents the cancer cell from replicating. Dr. Khanna, can you tell us about the evolution of external beam radiation in the past few decades, and where we stand now?

DR. KHANNA: In the past, the delivery of radiation treatments was relatively primitive. We used to plan in only two dimensions. Ten to fifteen years ago, 3-D (three-dimensional) conformal radiation therapy came to fruition and helped us target the cancer more precisely. The major impact in the field of radiation therapy has come with the advent of Intensity Modulated Radiation Therapy (IMRT). IMRT provides far greater beam shaping capabilities than 3-D radiation therapy. IMRT is a technique in which the radiation beams are aimed from many directions, and the intensity and strength of the beams are controlled by sophisticated computer systems. IMRT is delivered by a specially equipped linear accelerator that allows us to deliver highly precise radiation beams to the cancer and minimize irradiating the normal tissues surrounding it.

DR. SHAVER: I understand a linear accelerator is an electrical device for the acceleration of subatomic particles which in the medical setting are X-rays to treat cancer. Using a linear accelerator, how can you target a tumor that is deep in the body and pass through normal tissue and avoid damaging that healthy tissue?

DR. ADAMS: With the advent of IMRT, we are able to define the field of radiation and have what we call "nonuniformity." The nonuniform beams of radiation allow us to wrap and angle beams of radiation around normal tissue and target the tumor. IMRT allows us to define an irregularly shaped structure (for example, a tumor) utilizing virtual computer simulation. The computer then optimizes the radiation plan by using several techniques. First, the energy of the radiation beam utilized is modulated. Second, multiple beams, as many as seven to nine, coming from different directions, all allow us to give a high dose of radiation to our target and minimize dose to normal healthy tissue.

DR. SHAVER: I think you hit on the point that computers are a really critical element that has allowed this technology to advance over the last decade. Dr. Khanna, what's coming to Eisenhower Medical Center that pushes us to the forefront of this technology?

DR. KHANNA: Varian Medical Systems, Inc. is the industry leader in radiation therapy equipment — the best in the world. Eisenhower has had the largest Varian department in Riverside County since the opening of the Lucy Curci Cancer Center in 2002. We have had a long relationship with Varian and have partnered again to bring the latest advance from Varian, the Novalis Tx™ system, to the Coachella Valley. We are among a handful of facilities in California to acquire this cutting edge technology.

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—Monica Khanna, MD

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DR. SHAVER: What is the principal advantage of the new Novalis Tx?

DR. KHANNA: Novalis Tx utilizes Varian's new RapidArc™ radiation therapy technique. It's a unique form of what is called volumetric arc therapy, and enables clinicians to deliver IMRT radiation up to eight times faster than was previously possible. It does that by delivering a dose to the whole volume at once, rather than by repeated multiple beams. The patient is more comfortable since the treatment can be delivered in less than 2 minutes, rather than the 10 to 15 minutes required for conventional IMRT or TomoTherapy.

DR. SHAVER: What are the advantages beyond patient comfort?

DR. KHANNA: The decrease in treatment time minimizes the opportunity for patient movement, thereby increasing the accuracy of the treatment. It's a revolutionary approach. Completing the treatment in less than 2 minutes also reduces the chance of other involuntary anatomical movement during longer treatments. For example, for prostate cancer, there may be gradual filling of the bladder or sudden movement of bowel gas that can displace a target by a few millimeters. That is what we avoid when we deliver the treatment in less than two minutes.

DR. SHAVER: Many of our patients are familiar with proton therapy. How does this compare with Novalis Tx?

DR. KHANNA: Proton therapy has been around for several decades now. There is no research that shows the outcomes are better. With IMRT and the computer software and technology we have at Eisenhower, our side effect profile is significantly less that what we achieved 15 years ago. So protons had an advantage in side effect profile then, but not currently.

DR. ADAMS: It's never been shown in a prospective clinical trial that protons are superior. Currently, there are only a handful of centers in the United States that utilize proton therapy.

DR. SHAVER: Tell us about the technology called IGRT.

DR. ADAMS: IGRT is image guided radiation therapy, and the Novalis Tx will allow us to utilize IGRT for many different kinds of tumors and improve our accuracy. I have

been a radiation oncologist for 20 years, and I think back to when I trained early on, the radiation was aimed essentially by marks placed on the patient's skin. With IGRT, the name says it all. It uses the image of the target to guide the delivery of the radiation.

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DR. SHAVER: As I understand it, it's really critical that you deliver the radiation to the same location each time, and the treatments are often five days a week, for up to eight weeks. So you re-image the patient for each treatment?

DR. ADAMS: That's correct, everyday. It is much more precise and ensures we are treating the correct target area every time.

DR. SHAVER: Does the Novalis Tx have other capabilities?

DR. KHANNA: The Novalis Tx is also the most powerful radiosurgery system available today for treating brain tumors. Radiosurgery is a noninvasive procedure where a large dose of radiation is delivered in a single treatment. With the state-of-theart treatment capability that Novalis Tx offers us, we can take advantage of the latest advances in imaging to deliver high dose radiation with pinpoint precision, targeting the beam to match the tumor shape and avoid nearby critical structures of the brain. Some radiosurgery systems only deliver beams from anterior and lateral approaches, the Novalis Tx can treat from every approach including posteriorly. It offers the highest dose rates and highest resolution beam shapers (2.5 millimeters), thereby allowing us to paint the lesion with a uniform dose while sparing the nearby critical structures. This is an amazing machine.

DR. ADAMS: The improvements in radiation oncology are cumulative. The advances made ten years ago were built upon five years ago, and now, we are taking it to the next level. We have been performing IMRT, IGRT and Radiosurgery at the Eisenhower Lucy Curci Cancer Center for several years, but have now been given an extraordinary platform with the Novalis Tx to improve upon those results.

DR. SHAVER: Which tumors are optimally treated with this device?

DR. ADAMS: Lung and prostate cancer. Liver and spinal tumors. The Novalis Tx is also considered the ultimate tool for brain radiosurgery. We are very lucky to have it here at Eisenhower Medical Center.