Image Guided Radiation Therapy

Improving Accuracy and Confidence in Cancer Treatment

By Scott P. Edwards

For years, radiation oncologists have faced a huge challenge when treating their patients: how to deliver an appropriate dose of radiation to a tumor site without harming surrounding healthy tissue and organs.

To ensure they were targeting the entire tumor with a therapeutic dose of radiation, they often had to build in a margin of healthy tissue around the tumor as well.

While effective at treating tumors, this approach was not without drawbacks. Because internal organs and certain tumors are prone to movement, such as those in the lung and prostate gland, the radiation field changes, often requiring the delivery of radiation to some healthy tissue to ensure that the tumor receives a full dose of radiation. In addition, radiation oncologists were often forced to reduce the amount of radiation targeted at tumors close to critical structures.

In the late 1990s, however, the technology for delivering radiation to tumors drastically improved, allowing radiation oncologists to adjust radiation beams with greater accuracy to deliver the dose directly to the target and spare nearby tissue. Today, many hospitals, including Baystate Medical Center, are using image-guided radiation therapy, or IGRT, to verify a tumor's location even more accurately and thus further reduce the margin of healthy tissue that is affected.

Radiation oncologists at the Baystate Regional Cancer Program were the first in the region to begin offering intensity modulated radiation therapy (IMRT) at the D'Amour Center for Cancer Care in 2004. IMRT was used to "paint" precise radiation doses on even the most complex tumor shapes, allowing higher doses to be delivered at reduced risk to adjacent tissue.

"IGRT is a shift in degree, rather than a radical shift, in how we provide radiation therapy," says Brian Acker, MD, chief of Radiation Oncology at Baystate. "It is, however, an important shift because we can cut in half the margin of healthy tissue that is hit by the radiation beam."

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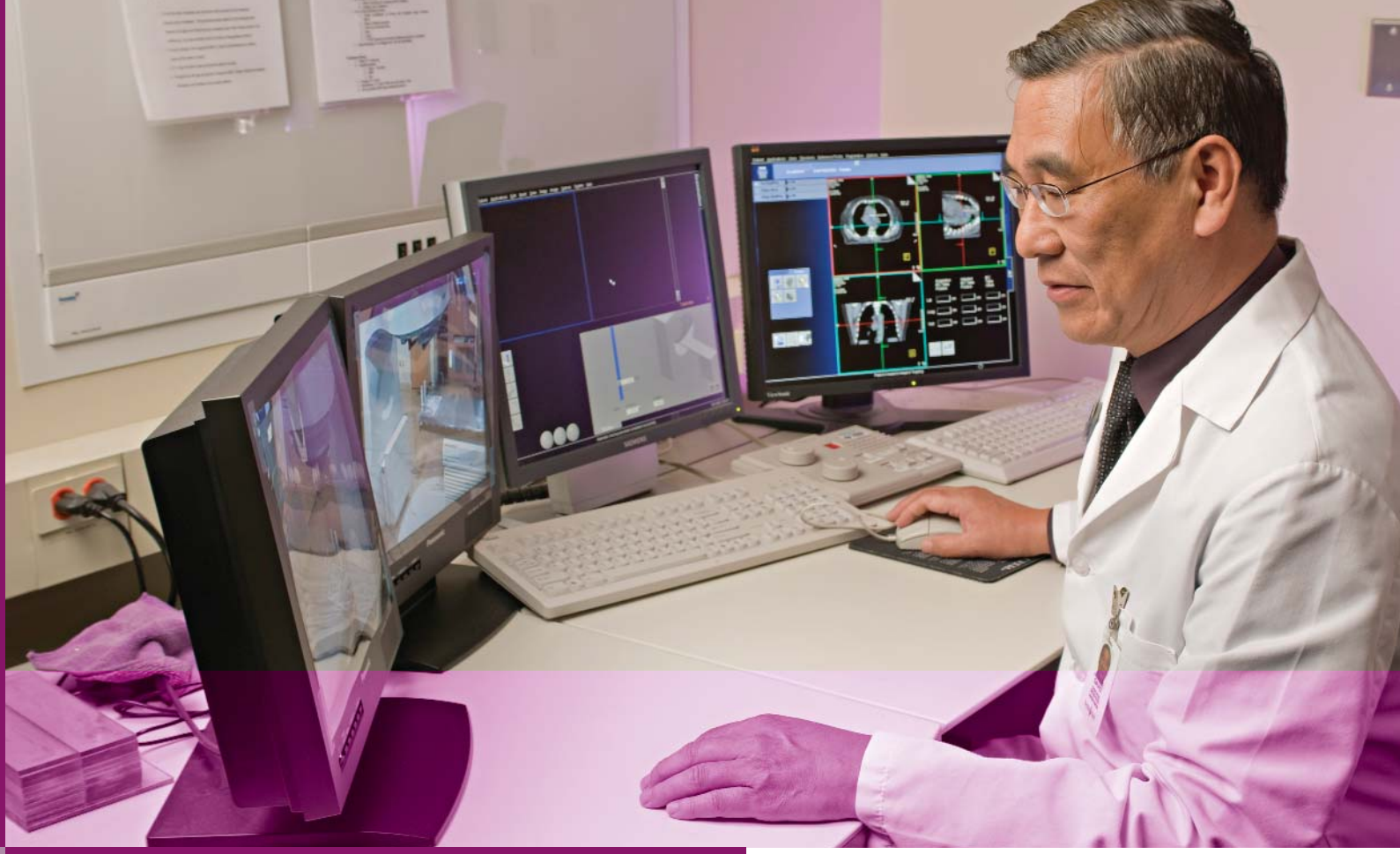

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Delivering Accuracy

IGRT employs sophisticated imaging technology to increase the accuracy of radiation therapy. During the treatment-planning phase, the radiation oncologist uses a special CT system to image the patient's anatomy and map out the tumor. Precise information on where the tumor and adjacent structures are located is sent to a medical physicist who helps optimize the distribution of the radiation dose.

On the day of treatment, the patient undergoes an additional CT scan to determine if the tumor or internal organs have shifted. Computer software compares the two sets of images. If there is movement of the target treatment area, the radiation field is appropriately adjusted.

"Although IGRT adds some time and complexity to the treatment delivery," says Dr. Acker, "the additional accuracy makes it worth the extra effort, especially for patients whose tumors are located in critical areas. It allows us to confidently deliver high doses of radiation very accurately while protecting adjacent normal structures."

There are several IGRT technologies available. Baystate uses the Siemens Primatom, which consists of a linear accelerator and a CT scanner mounted on a sliding gantry. After the patient is set up on the treatment table, the table is rotated 180 degrees. The CT scanner then slides on rails over the patient and takes three-dimensional pictures that are transferred to a computer system, providing real-time images that are compared to the scans taken during the earlier treatment planning session.

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Prior to IGRT, the radiation oncology team used permanent ink on a patient's skin to align and position the patient and map out the radiation field. Because this is an imprecise measurement, the treatment area was typically expanded to compensate for the movement of the tumor and internal organs from such things as eating, drinking, breathing, and bowel movements. Some types of cancers, particularly prostate cancer, required the implantation of small metal markers in the body to help target the radiation.

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David Chin, PhD, chief of Medical Physics at Baystate, says the CT on rails is a better technology because it can image soft tissue as well as other structures like bone. "Other technologies, like cone-beam and MV and kV CT, can't see soft tissue as well as CT on rails," he says.

Because the radiation is delivered more accurately using IGRT, the radiation oncology team is also able to deliver a higher dose of radiation to the tumor site. Previously, according to Dr. Acker, they had to reduce the dose to help minimize the effects on adjacent healthy structures that might be included in the treatment area.

Candidates for IGRT

Baystate radiation oncologists currently use IGRT primarily for patients whose tumors are located near the spinal cord.

Dr. Acker notes that patients whose tumors are not near critical structures do not need IGRT. "IGRT is particularly important for patients whose tumors are directly adjacent to critical structures and where conventional means of targeting are felt to be insufficient," says Dr. Acker.

For example, the first patient treated at Baystate Medical Center by Dr. Acker using the Primatom system had lung cancer that was not appropriate for surgery because it was situated too close to the spinal cord. "Normally," he says, "we would have had to limit the dose of radiation to avoid damaging the spinal cord. With IGRT, we were able to use a higher dose to treat the tumor and we were able to spare the spinal cord."

Advancing Treatment

Since radiation oncologists at Baystate first began using the Primatom system last October, over a dozen patients have had their cancer treated with IGRT through the Baystate Regional Cancer Program.

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Dr. Acker says IGRT is a "quantitative" improvement in radiation therapy, one that moves Baystate a step closer to full, adaptive radiation therapy. "With IGRT, we're moving closer to being able to adapt therapy on a daily basis depending on how the tumor and anatomy change," he says. "Going forward, we'll be able to adapt treatment as we go to precisely treat a changing tumor."

For more information

or to refer a patient, call the Baystate Regional Cancer Program at 413-794-9338.