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Planting the seeds for the future of cancer care

Sunnybrook will be the first hospital to combine real-time magnetic resonance imaging with the delivery of brachytherapy, saving more lives



Prostate cancer patient Bradley Chapman (above) was one of the approximately 300 annual brachytherapy recipients at Sunnybrook – North America's largest such single-institution program. TIM FRASER

Bradley Chapman wasn't about to let prostate cancer get in the way of his volunteer work. When it came time to schedule his brachytherapy treatment at Sunnybrook's Odette Cancer Centre, in September, Mr. Chapman requested it take place on a Thursday so he could make his weekly delivery of bread to homeless shelters the following Wednesday.

"It took probably an hour to line everything up, maybe seconds for the treatment, and then they cleaned me up and sent me home. Six days later I was doing my bun run," says Mr. Chapman, 75.

That Mr. Chapman was able to return to the activities of his daily life so quickly is a testament to the minimally invasive, highly targeted nature of the treatment he received.

Brachytherapy involves the placement of permanent low-dose-rate radioactive seeds, or temporary catheters that can hold radioactive sources (high-dose-rate), directly into cancerous tissue. Typically used to treat tumours that can be reached with surgical instruments, such as prostate, breast and gynecological cancers, brachytherapy enables doctors to strike tumours with high doses of radiation.

Compared to traditional external-beam radiation therapies, brachytherapy more effectively spares healthy tissue and limits side-effects, such as skin irritation, nausea, fatigue and more.

Mr. Chapman and his oncologist Dr. Andrew Loblaw discussed traditional radiation and surgery as possible ways to treat his tumour, but Mr. Chapman was reluctant. "I thought, I'm not a young guy anymore, so surgery's probably not a great thing." He was also reluctant to undergo external-beam radiation therapy, which would have required daily treatment sessions for as many as eight weeks.

Mr. Chapman says he's happy he opted for high-dose-rate brachytherapy (see box). He is one of approximately 300 brachytherapy patients the Odette Cancer Centre treats annually, making it the largest such single-institution program in North America.

Brachytherapy is a key element within Sunnybrook's Cancer Ablation Therapy (CAT) program, which harnesses a range of precision therapies to destroy tumours without the need for invasive surgery. In turn, patients may experience fewer side-effects and return to their daily lives more quickly.

The Odette Cancer Centre, which has long been a pioneer in the development of brachytherapy, next year

"While radiation is being delivered, we're going to be able to see what's happening at a cellular level and why some tumours respond, why others don't."

Dr. Arjun Sahgal,
head of the Cancer Ablation Therapy program

will complete construction of a one-of-a-kind suite where both the treatment and delivery will be guided in real time by magnetic resonance imaging (MRI).

Currently, Sunnybrook doctors use ultrasound imaging to guide the placement of brachytherapy's radioactive sources. While ultrasound allows for accurate placement, it cannot match the superior tumour-imaging capabilities of MRI. By constructing a brachytherapy suite that also houses an MRI machine, Sunnybrook doctors will become the first in the world to guide placement and the delivery of radiation with real-time MRI.

As a result, they will be able to target tumours with unprecedented precision. For patients, this will mean more effective treatment with fewer side effects. Real-time MRI offers another critical benefit: It will allow doctors to adjust radiation dosage and placement while brachytherapy is being delivered, because they'll be able to immediately see the effect it's having on the tumour.

Low-dose-rate brachytherapy involves the permanent placement of radioactive seeds within the tumour, emitting low levels of radiation for up to one year.

High-dose-rate brachytherapy involves the temporary placement of ultra-slim catheters into a tumour. A radioactive pellet is then inserted into each catheter. Once the dose is delivered, both are retracted.

"There's a unique biology that begins to occur within minutes of giving large doses of radiation to the tumour," says Dr. Greg Czarnota, head of Sunnybrook's Odette Cancer Research Program. "That's what the MRI will allow us to do – target the tumour but monitor the effectiveness of radiation as well."

is being delivered, we're going to be able to see what's happening at a cellular level and why some tumours respond, why others don't, and if they don't, how can we do it better. It's a major new era of research and development."

For his part, Mr. Chapman praises the fast and precise high-dose-rate brachytherapy he received. "Everything seems to be working. I have no complaints. The prognosis... is pretty good, if not excellent. I'm delighted," he says.

Patients like Mr. Chapman can look forward to the day, coming very soon, when this targeted therapy will become even more precise.

"In a way, real-time MRI will make

the body invisible, so that we'll instantly be able to see exactly how the tumour is responding to radiation," says Dr. Calvin Law, chief of the Odette Cancer Centre. "This is a whole new way of treating cancer."

This is the second of a three-part series on new high-precision cancer-radiation technologies coming to Sunnybrook in 2016.

A SUITE SPOT FOR PATIENTS

To a lay person, putting an MRI machine in a brachytherapy suite may seem like no big deal. As it turns out, it is a major engineering feat.

"Building the suite has been a huge challenge," says Dr. Calvin Law, chief of the Odette Cancer Centre. "But it's well worth it, because when we're done we'll have the only facility of its kind, where patients receive the most precise brachytherapy possible."

The structure below the new suite had to be reinforced to handle its massive weight, which includes the weight of the MRI machine and lead shielding.

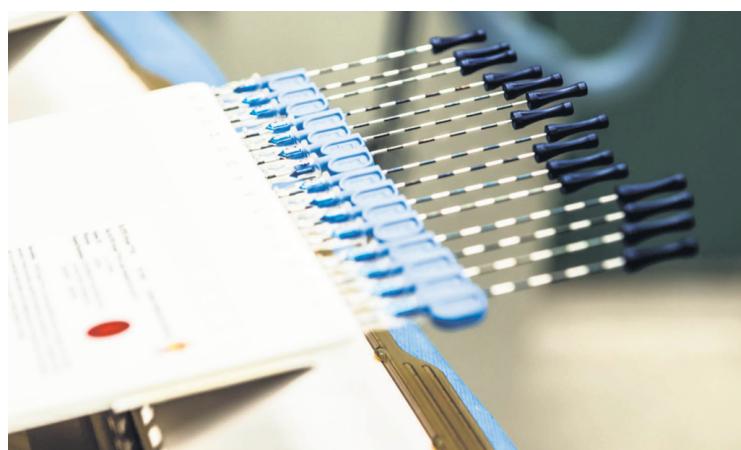
The shielding is unique in that it must block X-rays and MRI-produced radiofrequency signals. Without this protective shield, real-time MRI during delivery of the brachytherapy could not take place in the same space. Engineers also had to take special care to design the space in such a way that it could house anesthetic gases.

"We're making an investment in this suite because it goes back to our theme: Is it helpful for patients? Yes, it's going to shorten their treatment time. It's going to increase efficiency and patient comfort," says Dr. Law.

"Most importantly, it's going to improve treatment outcomes, because treatment will be more precise and customized to individual patients."



Examples of the radioactive seeds and catheters used in brachytherapy treatments.



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