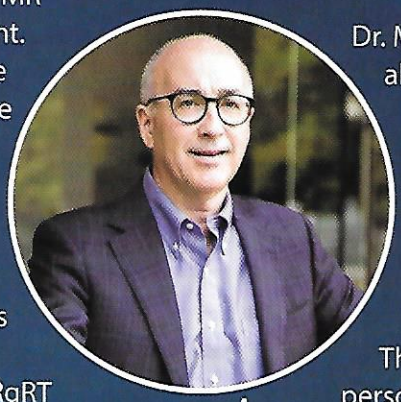
WE BUILT:

MAGNETIC RESONANCE-GUIDED RADIATION THERAPY (MRgRT)

To have precise radiation treatment, you have to be able to see a tumour so you can accurately target it. Hence the need to obtain images from a patient and proceed with treatment in a timely manner.

To solve this problem, a team at Princess Margaret Cancer Centre developed the MRgRT concept–a facility combining the power of MR imaging with radiation treatment. Putting these structures into the same space allows patients to be scanned and treated in a short time frame, without having to leave the facility.



That's exactly what is happening today at The Princess Margaret, where patients have been regularly treated in the MRgRT suite since 2014.

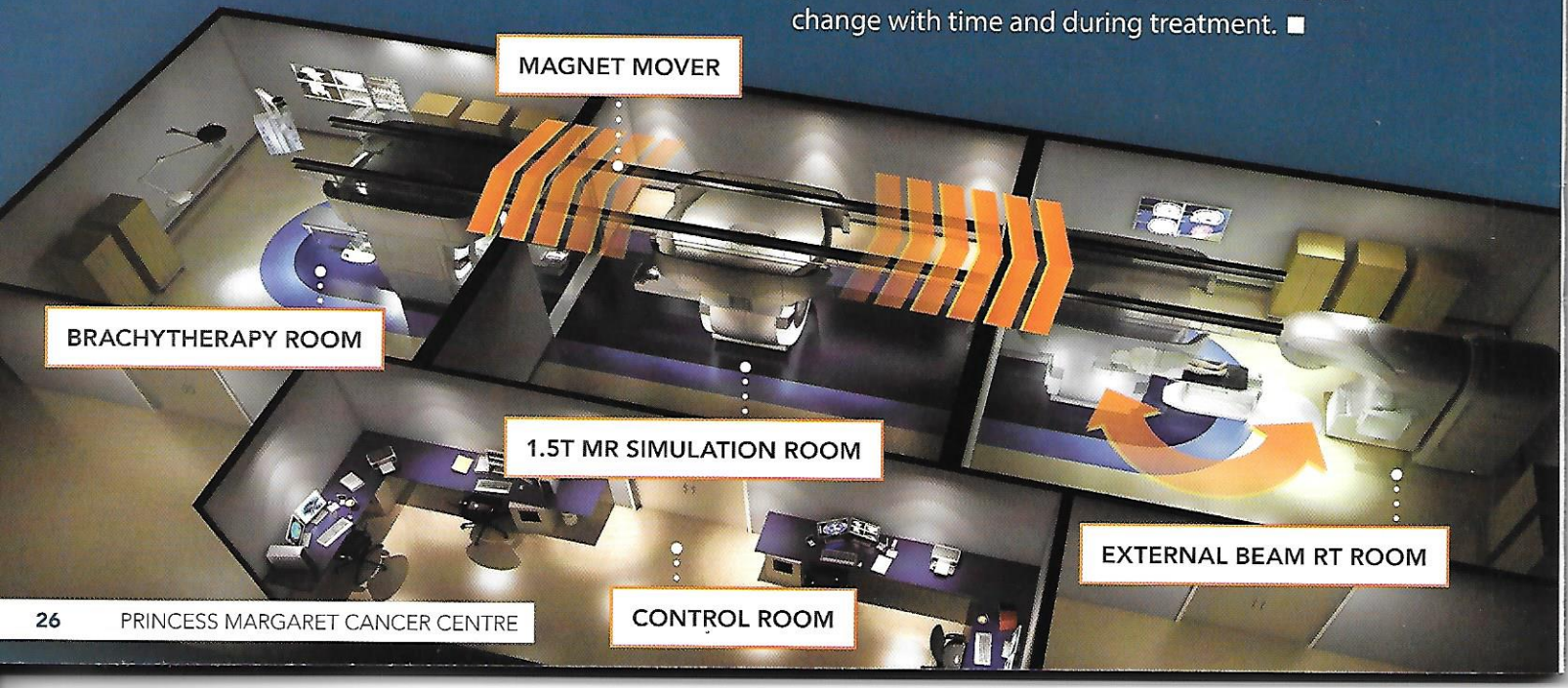
"It gives us a window, an ability to see things that we were never able to see before, and that opens up opportunities," says **Dr. Michael Milosevic**, Director of Research, The Princess Margaret's Radiation Medicine Program.

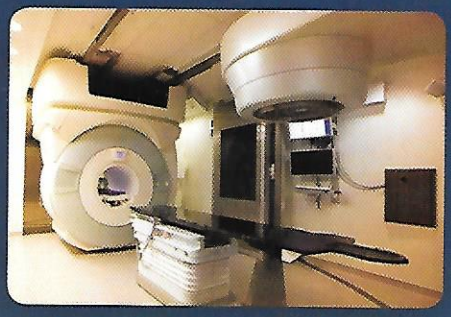
The MRgRT is anchored around a magnetic resonance scanner that can move between a pair of radiation suites via rails that are mounted on the ceiling. This allows patients to be scanned and treated in the same facility rather than having to visit two or three different locations to achieve the same result.

Dr. Milosevic points out that the imaging alone is not what makes this facility so beneficial for patients. It's the precision of the imaging and how closely it's integrated with the treatment. That gives doctors, medical physicists, and radiation therapists the information they need to treat the cancer.

The MRgRT allows us to explore personalized approaches where we take images just before treatment, design the radiation plan, and treat a patient in ways that could never have been achieved before.

The more the MRgRT is used to treat patients, the more we learn to help future patients. That's because the data captured through treatments provides new information about how tumours change with time and during treatment. ■

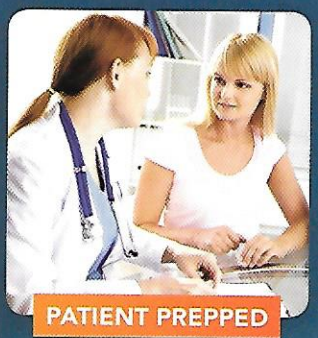


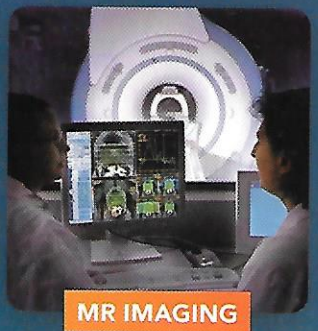


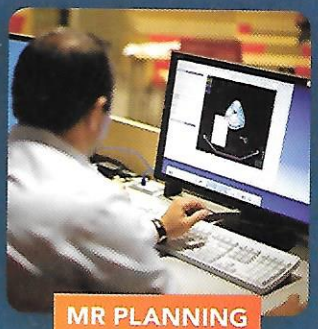
MAGNETIC RESONANCE-GUIDED RADIATION THERAPY (MRgRT) SUITE

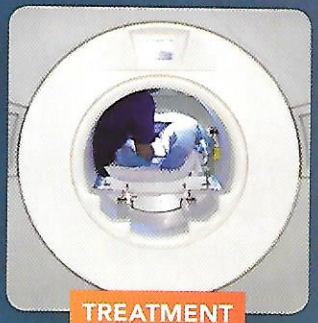
The MRgRT includes an MRI Scanner in the treatment room, a Linear Accelerator, and a Brachytherapy Procedure Suite (pg. 30)

HOW THE MRgRT WORKS:
ONE FACILITY. ONE TEAM. PERSONALIZED MEDICINE.









COMBINED IMAGING FOR A PRECISE DIAGNOSIS

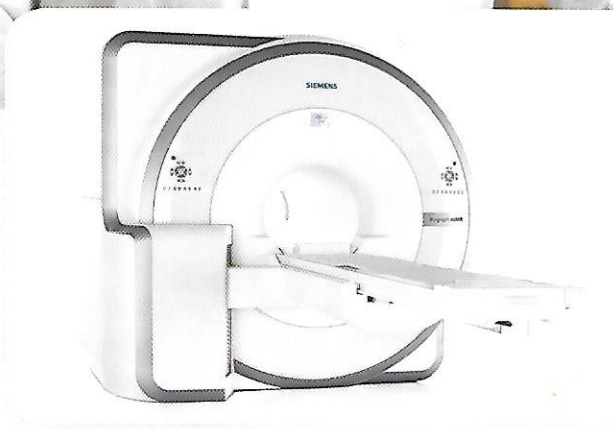
Dr. Patrick Veit-Haibach
Clinical Director, PET-MRI
University Health Network

Dr. Patrick Veit-Haibach is new to his role as Clinical Director PET-MRI at University Health Network (UHN), but his vision is big and ambitious.

"My goal is to explore combining the functional parameters of PET-MRI technology to deliver improved diagnostic imaging for our patients," says Dr. Veit-Haibach.

He was recruited to lead this new area of research in the spring of 2017. So far, it shows real promise. "This imaging technology works very well for detection and characterization of tumours, but can be also used to explore cardiovascular diseases," says Dr. Veit-Haibach. "We have already seen positive results in primary tumour detection that were not well diagnosed before, but more work is needed to exploit its full potential."

PET-MRI is a hybrid technology that uses state-of-the-art magnetic resonance imaging (MRI) with established molecular imaging tracers like PSMA (pg. 29) and new experimental radiopharmaceuticals to enhance disease characterization. It provides our cancer experts with detailed localized information about a tumour to make a more informed diagnosis and deliver precise treatment.



The PET-MRI machine (above) was acquired in 2016, and it is already being used by imaging specialists who are working with cancer experts at The Princess Margaret and cardiovascular researchers at UHN. The advantage of this fully-integrated system is a dose reduction for the patients and reduced imaging times. It is also more suitable in cases that require a higher soft tissue contrast than what is offered by a standard PET-CT. ■

TRACKING THE ENEMY

PSMA TRIALS

Active since June 2017 - Goal: Treat 37 patients - Complete Trial: End of 2018

Advances in imaging technology are helping **Dr. Alejandro Berlin** take on complex cancer cases that couldn't be treated in the past.

Dr. Berlin is a Radiation Oncologist and a member of The Princess Margaret's Genitourinary Site Group. He and his colleagues are at the forefront of research into a promising method for treating patients with prostate cancer that has spread, including cases in which conventional treatment is no longer possible.

The technique combines a molecule known as PSMA (prostate-specific membrane antigen) with a radioactive tracer that is created in the Cyclotron.

"This small molecule travels within the body and attaches to an area where there are prostate cancer cells," Dr. Berlin says.

Using a combination of PET and MRI imaging, it's possible to see where the cancer has spread by looking at where the PSMA accumulated. This allows doctors to identify the targets for radiation treatment.

"We find deposits of the disease across the body and target those with high precision and focused radiotherapy," says Dr. Berlin.

It's a useful approach when tests show the presence of prostate cancer in a patient who has already undergone treatment.

Dr. David Jaffray, Head of Medical Physics at The Princess Margaret, says there are many challenges in trying to figure out how to treat a prostate cancer that has spread, including determining where it is within the body.

"If it's coming back in some other part of the body because of metastatic spread, where is it?" says Dr. Jaffray. "If you can find where it's localized, you could actually go after that and treat it aggressively."

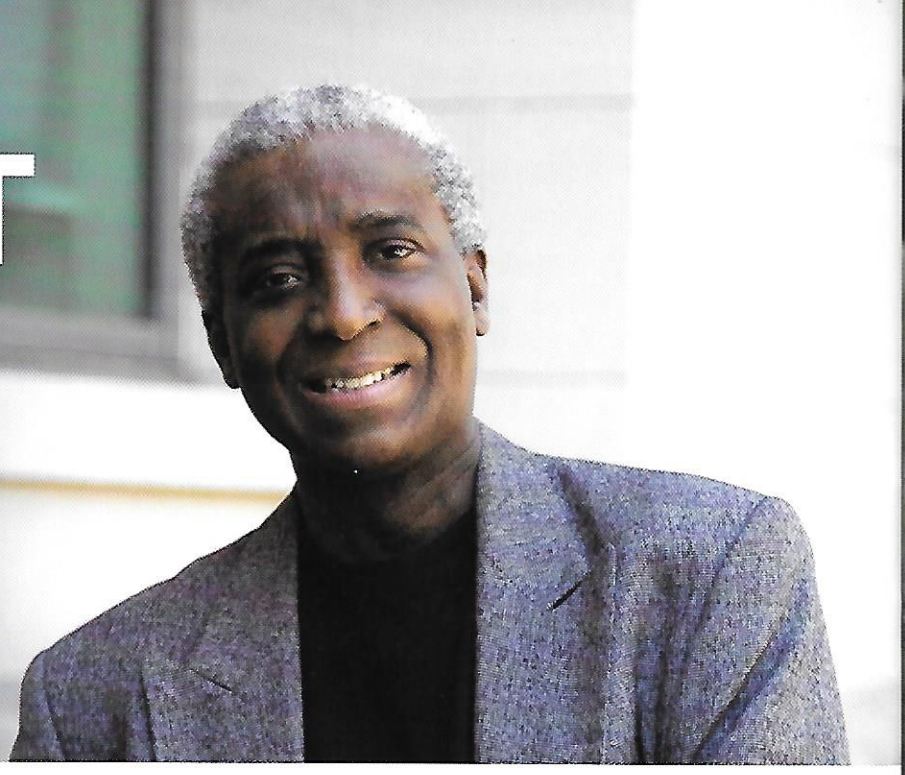
In the past, treatment options were often limited. In some cases, doctors would have to try to treat the cancer with a systemic approach, since they couldn't precisely target it like they can today with the PSMA-based method.

"Now that we can see the disease, we can target it with radiotherapy," Dr. Berlin explains.

The Centre for Probe Development and Commercialization, BC Cancer Agency, Terry Fox Foundation and other partners are working to bring this technology to Canadians. ■

ROBERT KYLE:

'I WANTED TO MAXIMIZE MY CHANCES FOR A CURE'



Robert Kyle survived a heart transplant in 2014, only to be diagnosed with prostate cancer one year later.

Dr. Alejandro Berlin, Radiation Oncologist at The Princess Margaret, laid out Robert's options. He recommended a clinical study to undergo MR-guided High-Dose Rate (HDR) brachytherapy in the MRgRT Suite, followed by a five-week course of external beam radiation.

"Several large trials have shown this combined approach offers a better outcome than external beam radiotherapy alone in high-risk patients," says Dr. Berlin.

Robert didn't hesitate. **"I've probably got t-shirts older than Dr. Berlin, but he's a really smart man. I told him that I wanted to maximize my chances for a cure,"** says Robert.

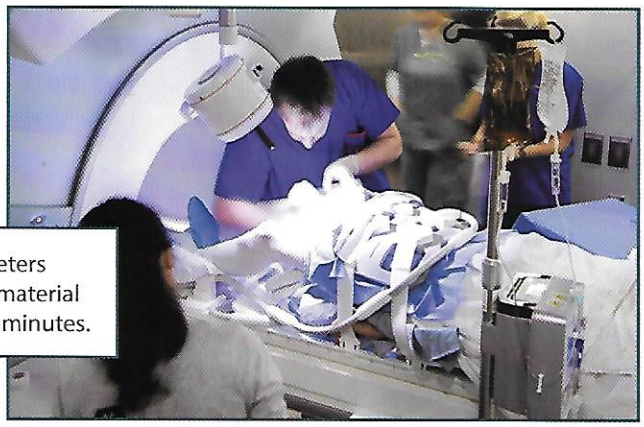
When he arrived for his procedure, he was greeted by Dr. Gerald O'Leary, Anesthesiologist-in-Chief at University Health Network, who had been a part of his heart transplant team and would again serve as his anesthesiologist. Robert's health care team also included two other radiation oncologists, as well as several therapists specializing in radiation, MR imaging, and brachytherapy.

"An extraordinary team, built around the MRgRT, allows us to offer this highly-demanding, aggressive type of treatment to patients who might otherwise have to undergo more conservative treatment," says Dr. Berlin.

Robert's brachytherapy procedure started in the morning, and by noon he was in the recovery room. He experienced no significant side effects and was able to go home the same day.

After four days of recovery, Robert began a five-week course of external beam radiation treatment and later, hormonal injections for a year.

This cutting-edge technology is not only saving lives now, but also allows our scientists to advance research that will change the future of prostate radiotherapy and brachytherapy. ■



BRACHYTHERAPY

The High-Dose Rate (HDR) unit involves placing needles or catheters into the tumour, then pushing a small ball of highly radioactive material through to the site of therapy. The radiation dose is delivered in minutes.