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World Renowned PET Center at Uppsala University One of First to Implement Discovery MI

The PET Center at Uppsala University (Uppsala, Sweden) is known worldwide for bringing many new PET tracers into production. With a cyclotron on-site, the center has developed up to 100 different tracers. Currently, in addition to ^{18}F-FDG, 20 tracers are routinely used in clinical applications and another 20 are used in research to measure receptors in different diseases within the brain, heart or other organs.

Many of the isotopes have a very short half-life and therefore can be utilized only within the center, explains Jens Sörensen, MD, PhD, Professor in the Department of Surgical Sciences, Radiology, nuclear medicine physician and a researcher in the PET Center.

People come from all over the world for some of the specialized PET exams available at Uppsala.

"We focus on characterization of how the tracers work, how they bind and how they could be used optimally with a PET scan," Professor Sörensen says. In addition to ^{18}F-FDG, the PET Center most often uses somatostatin receptor analogs such as ^{68}Ga-DOTATATE, used for neuroendocrine tumor imaging. Other compounds labeled as a PET tracer include ^{18}F-Fluoride, ^{11}C-Acetate, various amino acids and Oxygen-15 (^{15}O) water.[1]

Uppsala's PET Center was one of the first institutions in the world to acquire GE Healthcare's newest

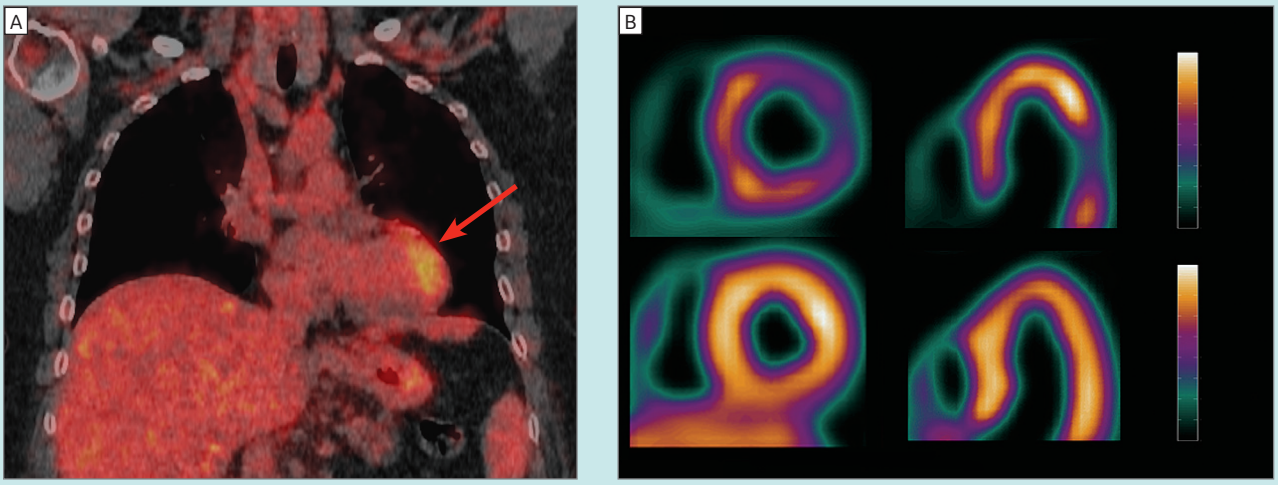

Figure 1. (A) Discovery MI ^{18}F-FDG PET and (B) ^{15}O-water myocardial blood flow (MBF, top right) and viability (perfusable tissue index PTI, bottom right) images of a 60-year-old female patient (weight 92 kg) with cardiac sarcoidosis. The FDG image shows the cardiac sarcoidosis in the lateral heart wall (red arrow), whereas the ^{15}O-water images show reduced blood flow but preserved viability in the same area.

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>
> *Professor Mark Lubberink*

PET/CT system, Discovery™ MI. The center's long tradition of excellence in PET tracer development and PET scanning made Discovery MI an ideal solution to add to existing advanced PET technology, such as Discovery IQ and SIGNA™ PET/MR. "The new Discovery MI is an optimized system for both clinical use and research," Professor Sörensen adds.

Mark Lubberink, PhD, Professor of Molecular Imaging and Medical Physicist at Uppsala, has also evaluated the new Discovery MI. "We are very impressed with the image quality; it is better than we expected, especially for the non-routine imaging with the different compounds such as myocardial imaging with ^{15}O-water. We can really see that the increased sensitivity and the timing resolution result in a much better image quality than we can get on our other scanners."

That increased sensitivity should enable a reduction in injected dose and/or scan time, adds Professor Sörensen. "For some protocols, we think we can do both. It may be more relevant to utilize the faster throughput with a specialized tracer when we want to scan as many patients as possible," he says. For some tracers, the half-life is so short that it must be used quickly once it is manufactured.

"We anticipate by using ^{18}F-Fluoride in the detection of bone metastases, we can increase patient volume from 12-15 to at least 25 patients daily on a single PET/CT scanner compared to our prior generation system," Professor Sörensen says. "That is what we can accomplish in an entire week with a gamma camera; therefore, this will have a significant impact in patient care."

The ability to lower dose also creates new possibilities for PET imaging in pediatric patients. Professor Sörensen believes Discovery MI can drastically lower dose, making it feasible to utilize PET across more pediatric diseases including malignancies and neurological disorders such as epilepsy. The high-end CT also enables low-dose imaging with initial results indicating attenuation correction scans can be lowered to 0.02 mSv in brain imaging.

"For some of the clinical protocols and research, the dose is so minimal that we believe it won't impact our decision on which diagnostic modality to use," Professor Sörensen adds. "There is a dramatic difference in the opportunity to lower dose with this new system."

Professor Lubberink will be evaluating the combination of time-of-flight (TOF) imaging and Q.Clear. While it is too soon after the implementation of Discovery MI to know the impact, the effect of TOF imaging on sensitivity is well known, he says. It is a matter of optimizing the quantitation capabilities of Q.Clear in tandem with TOF.

"With TOF and Q.Clear, we expect to see much better recovery of the activity in small lesions and that will provide a big improvement," Professor Lubberink adds. "We are also doing a lot of research where the extended field-of-view in a single bed position is a major advantage."

This early work will have an impact on the type and accuracy of the different tracers and studies performed at Uppsala.

"Because of the increased speed and accuracy, we will be able to move PET to the front of the diagnostic chain instead of it being the last resource," says Professor Sörensen. "We look forward to what will come... it is a brilliant system."

1. Radiopharmaceuticals discussed here may not be approved in every country; may not be available in all markets.

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Case 1
Patient history

A 57-year-old woman with ovarian cancer and peritoneal carcinomatosis.

Discovery MI scan parameters

Acquisition: 12 minute scan time
2 minutes per bed position
Images acquired 1 hour after injection
Injected dose: 244 MBq / 6.6 mCi ^{18}F-FDG

Discussion

In this case, the images clearly show the considerable improvement in image quality using the fast timing resolution of TOF with further enhancement of image contrast using Q.Clear. The improved sensitivity and timing resolution of Discovery MI can provide lower patient dose, shorter scan times for higher throughput and better use of improved spatial resolution and contrast. Q.Clear reconstruction can be optimized for use with different tracers.

The combination of Revolution EVO on this PET/CT enables a large reduction of patient dose and facilitates optimal use of diagnostic CT in association with PET/CT. ■

Case 1

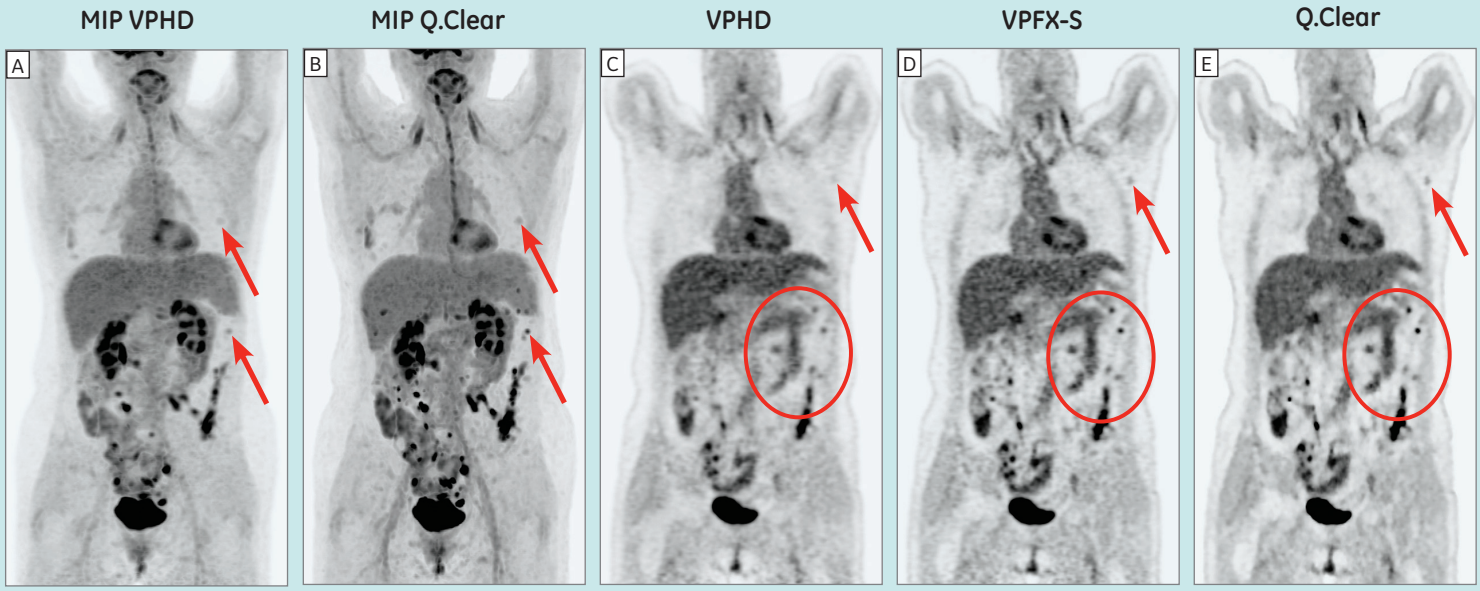

Figure 2. MIP reconstructions with (A) no TOF and (B) Q.Clear. Comparison between (C) conventional OSEM reconstruction, (D) TOF with 385 ps timing resolution and PSF, and (E) Q.Clear beta value of 400. This case demonstrates the improved image quality and small lesion detectability with Q.Clear.