

Think Whole-body Dynamic PET Imaging is for Research Only? Perhaps it's Time to Re-evaluate

With the introduction of continuous bed motion technology, whole-body dynamic PET imaging becomes more practical in clinical routine, and less cumbersome in research settings. Recent research undertaken by Koji Murakami, MD, PhD, demonstrates this, which raises the question: Are we at the advent of a paradigm shift?

By Carl von Gall, MD, Molecular Imaging Business Line, Siemens Healthcare

Since the beginning of positron emission tomography (PET), researchers worldwide have tried to understand the processes underlying the uptake, metabolization, trapping and binding of PET tracers. The preferred method of study has been dynamic PET acquisition (dPET), whereby tracer distribution is acquired over time, typically, from a single bed position. From that continuously acquired data, different time frames are then reconstructed.

However, results have been difficult to reproduce, due to individualized approaches to acquisition time, reconstruction methodology and analytical techniques. Thus, dPET has become a heterogeneous field, which limits its feasibility in both clinical routine use and research settings.

From the clinical routine perspective, institutions faced several obstacles, even when incorporating facilitated

dynamic approaches. Take dual time-point imaging, for example: Protocol setups varied because they were developed according to the designs of the individual institutions and investigators. Subsequently, none of them fit into daily routine environments because of the high individualization and, therefore, lack of standardization. Without standardization, the complexity of patient handling and imaging made dPET impractical in routine use, especially for institutions with high patient throughput.

From the researcher's perspective, dynamic acquisitions of important lesions or organs were only possible if they all fit in the axial field of view (FoV). For most scanners, the FoV spanned between 15 to 21 cm. Due to this limitation, especially in distant lesions or peripheral foci, dPET acquisition is cumbersome and can sometimes be close to impossible.

This changed with the introduction of Biograph mCT Flow™* with FlowMotion™ technology. Implementing continuous bed motion as its core feature, physicians can acquire dPET in a new way: Whole-body dynamic imaging.

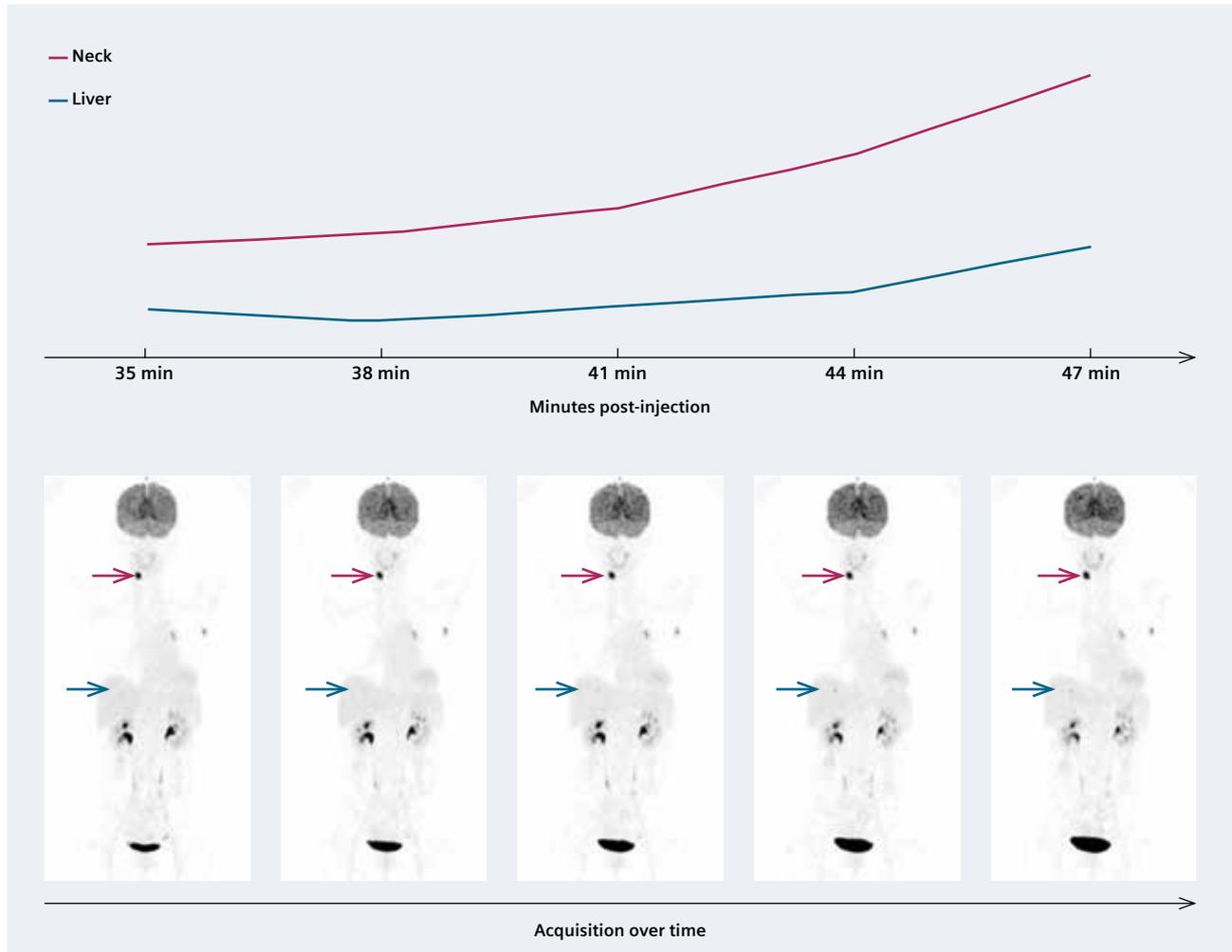
Whole-body dynamic imaging allows the user to overcome the limitations in conventional dPET. It enables dynamic acquisition over the entire scan range by continuously moving the patient in the axial orientation with a defined number of passes until the targeted time period is completed. With this, whole-body dynamic

imaging extends the capability of dPET from the FoV to the field of interest. And as such, clinical physicians and researchers may overcome the range limitation and include regions of the body into one dynamic acquisition that used to be out of reach.

Having the capability to consider the bed movements into the acquisition and reconstruction with variable table speed provides a great variety of examination protocols. From shortened dPET protocols and quick time activity curve analysis with syngo®.via PET/CT Oncology Engine Pro, to third-party

analysis tools. Whether it is tracer distribution in a lesion over time, gathering more inside information of a drug's pathway through the body or tracing the metabolic patterns in multiple organs at the same time over a large FoV, it all becomes easily accessible in a single protocol at the click of a button.

One of the early adopters of whole-body dPET imaging is Koji Murakami, MD, PhD, who is Head of the Division of Nuclear Medicine in the Department of Radiology at Keio University School of Medicine, Tokyo, Japan.

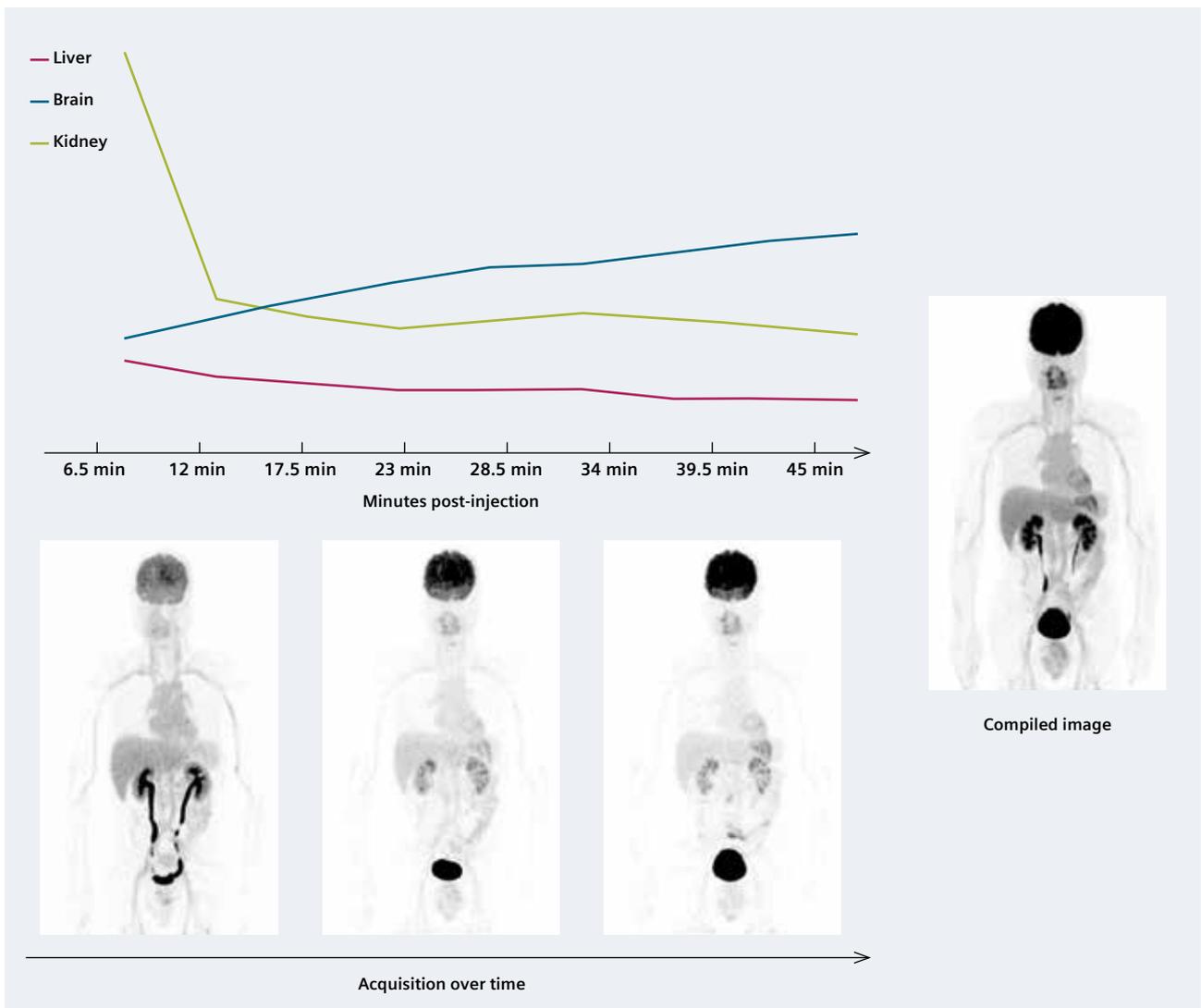


Focally altered metabolism in a patient with malignant disease dynamically acquired 47 minutes post-injection. The graph (top) displays the counts measured in a 1 cm VOI placed over a cervical lesion (red arrow) and demarcates liver lesions over time (blue arrow). The bottom shows the corresponding whole-body images. Data courtesy of the Department of Radiology, Keio University School of Medicine, Tokyo, Japan.



“With FlowMotion, we obtained a major tool to analyze dynamic studies without limitation to one bed position.”

Koji Murakami, MD, PhD, Head of Nuclear Medicine, Department of Radiology
Keio University School of Medicine, Tokyo, Japan



Physiological uptake in a healthy subject dynamically acquired over 45 minutes post-injection. The graph (top) displays the counts measured in a 1 cm VOI placed in the liver, brain and kidney parenchyma on one side. Note the differences in tracer elimination and uptake over time. The bottom shows the corresponding whole-body images with a compiled whole-body of all time frames (right). Data courtesy of the Department of Radiology, Keio University School of Medicine, Tokyo, Japan.

Since 2014, Murakami's department has used Biograph mCT Flow and FlowMotion for facilitated respiratory gating and standardized protocols. As a result, Murakami and colleagues have experienced increased uniformity and reduced noise, while maintaining SUV and image quality. Murakami presented the results of his team's work at the European Association of Nuclear Medicine (EANM) Congress 2015 in Hamburg, Germany.

Murakami expanded his use of FlowMotion by taking advantage of the whole-body dynamic feature in his oncological patient setting. Just by the first image series, Murakami felt excited:

"Unlike most CT or MR examinations, the time axis is very important in nuclear medicine. But particular to the field of oncology, sometimes we have to obtain a very long axial field of view to cover all lesions. With FlowMotion, we obtained a major tool to analyze dynamic studies without limitation to one bed position."

Notably his department has experimented with dPET studies of varying length. The researchers have conducted early-series studies, acquiring

data soon after injection of the PET tracer, for example, from 30 to 360 seconds post-injection. They have also performed delayed dPET studies spanning 20 minutes.

Recently, the research team has been comparing conventional whole-body PET to compiled whole-body dynamic PET studies. The goal is to document and establish the value of dPET in routine use, and to potentially replace additional static acquisitions in future reporting.

"First we need to determine if we may discriminate additional uptake," Murakami said. "But the objective in the mid-term is to differentiate or improve the diagnosis by analyzing the time-activity curve of a specific disease, and even further, of each individual lesion."

To this end, Murakami has received funding to continue performing research into dynamic PET and expand on studies into compiled imaging as a means to improve routine clinical workflow and further define pathological alterations in glucose metabolism.

Considering Murakami et al.'s promising initial results and acknowledging

that, before FlowMotion, whole-body dPET was impractical, there is reason to believe this approach could bring dPET into clinical routine.

Is this the advent of a paradigm shift? We believe the first steps are made. ■

* Biograph mCT Flow is not commercially available in all countries. Due to regulatory reasons, its future availability cannot be guaranteed. Please contact your local Siemens organization for further details.

The statements by Siemens customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that other customers will achieve the same results.

Setting up dynamic PET protocols

See how easy it is to set up a dynamic PET protocol with FlowMotion.



To watch the video, scan the QR code using the reader app on your smartphone or enter the URL into your internet browser.

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