Motion management comes of age

Advanced motion management delivers virtually motion-free images.

By Joseph J. Diorio

It's quite possible that the most common sentence uttered by PET/CT technicians is "now lie still."

Getting the patient to be still is important for producing clear images. But even the most obedient patients must continue to breathe, and their hearts must continue to beat. There is motion in the human body that simply can't be avoided.

"Motion management is mandatory if you want to achieve high resolution," says Frank M. Bengel, MD, Director of the Department of Nuclear Medicine at the Klinik für Nuklearmedizin, Medizinische Hochschule Hannover, in Germany. "You need to compensate for the motion because the motion-derived blurring of the cardiovascular structures will abolish any benefit that you would have from high resolution. You also need to correct for respiratory motion. If you can do that [...] then we can get great images of any cardiovascular structure, maybe not just chamber walls but also smaller structures like valves."

Motion must be compensated for since it cannot be eliminated.

Siemens Healthineers' respiratory motion management tools provide respiratory gating solutions that help improve delineation and quantification of small lesions. These motion management tools integrate the control of the respiratory monitoring device into the scanner user interface, thereby helping to accelerate the workflow. This integration also allows operators to view the respiratory curve directly on the acquisition console for a quick visual quality control.

Additionally, CardioFreeze, a new cardiac motion management feature that employs dual-gating technology, aides in the examination of the human heart. CardioFreeze divides images into multiple gates and then reconstructs them to provide physicians information on cardiovascular performance.

"Motion Management gives you a series of images that, if you play them in sequence, show you the way the heart beats and contracts. It reduces the respiratory motion so you get a truer image of how the heart is functioning," says Sebastian Fuerst, PhD, a senior systems engineer at Siemens Healthineers.

He compares the system to photographing something that is in rapid motion. "Think of photographing a tennis ball after it has been hit. If the shot exposure is too long, then the image will be blurry. If you open the shutter for a very short amount of time, then you might be able to clearly see the tennis ball. What motion management does is efficiently manage the amount of exposure.

"Motion management has always been a priority for [Siemens Healthineers]," Fuerst explains. "We focused on four areas. One: patient comfort. Two: no additional user interface actions or additional hardware for the clinic. Three: ease of use. Four: reduced scanning time. Over the years, we have continued to improve in each category."

Fuerst explains that respiratory gating provides better information to doctors and clinicians. "You can examine a respiratory wave more precisely, deciding which parts you are most interested in. You can take advantage of [a lot of] additional data that you have acquired."

While the motion management feature is robust, there are still challenges for clinicians. "There is no such thing [as an image free of noise]," Fuerst states. "We've been pushing the sensitivity of PET scanners over the years to detect as much of the activity injected into the patient as possible. It all boils

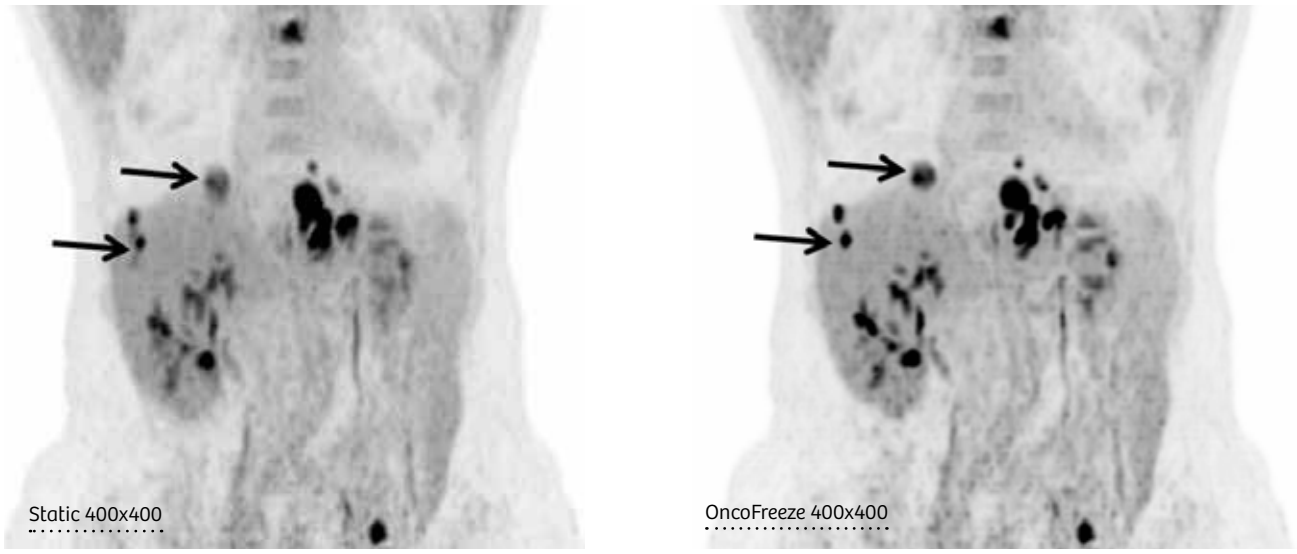

Figure 1: Static images show multiple hypermetabolic liver metastases some of which appear elongated with respiratory-motion-related blurring. OncoFreeze images show similar sharp delineation of the liver metastases, but with high overall image quality and count statistics and low noise levels along with high lesion-to-background ratio.

Data courtesy of University of Tennessee Medical Center
Knoxville, Tennessee, USA
The patient was scanned with a Biograph mCT. 80 min post-inj delay; CT: 120 kV, 202 eff mAs. 64 x 0.6 mm collimation,
PET: FlowMotion table speed 1.5 mm/sec for head neck & pelvis; 0.4 mm/sec with gating for thorax and abdomen.

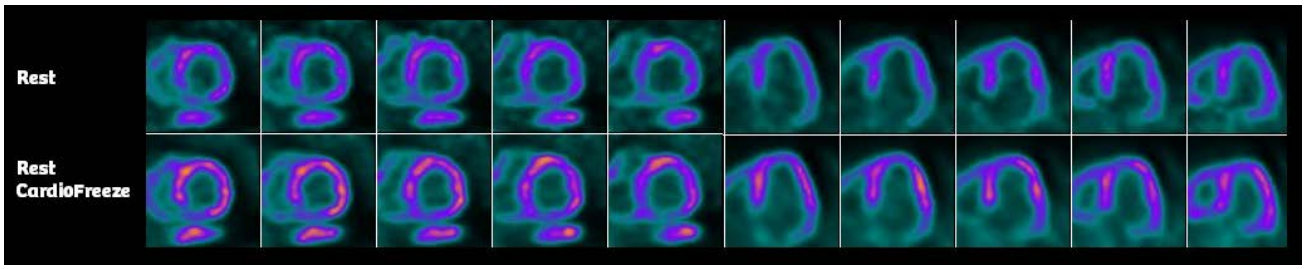

Figure 2: PET/CT myocardial viability study at rest shows a large infarct involving most of inferior wall and apex with thinned out but viable myocardium in the septum. Dilated left ventricular cavity with a low ejection fraction of 26% at rest suggests severe ventricular dysfunction.

Data courtesy of University of Michigan Medical Center
Ann Arbor, Michigan, USA
The patient was scanned with a Biograph mCT 40 and an ECG-gated resting list-mode acquisition 30 minutes post injection.
Low-dose CT for attenuation correction

down to lesion detectability. With respiratory motion, we can see a sort of blurring [in the images], making the lesions appear large and making the boundaries unclear. Our new technology provides physicians with all the data that is acquired in a scan and by that, [we are] improving/reducing the noise levels of the images."

OncoFreeze and CardioFreeze are optional features.

The products/features (mentioned herein) are not commercially available in all countries. Their future availability cannot be guaranteed.