Beating hearts are finally still with 4D PET image reconstruction

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A development in 4D image reconstruction compensates for blurring caused by the beating of the heart, say researchers at the Society of Nuclear Medicine's 59th Annual Meeting. The new method provides sharper-than-ever images of cardiac function to help pinpoint heart defects for better diagnoses and treatment.

Cardiovascular disease is the number one killer across the globe. More people die from diseases of the heart and circulatory system than any other cause of death, according the World Health Organization. This molecular imaging technique uses positron emission tomography (PET), which creates a visualization of the heart's viability, allowing physicians to view potential heart disease.

The new method of 4D PET image reconstruction works by taking data from specific points—almost like taking individual frames of a film reel—when patients are taking air into their lungs or when blood is being forced by a contraction of their heart muscle. Where other diagnostic imaging procedures—such as X-rays, computed tomography and ultrasound—offer predominately anatomical pictures, PET allows physicians to see how the heart is functioning. The visual representation of this functional information can be further enhanced with image reconstruction techniques such as this one, which uses quantitative image data and a special algorithm that transforms the original image into a crystal-clear 4D image that has none of the hazy areas ordinarily caused by the rhythmic movements of the heart and lungs.

"People have previously worked on compensating for either cardiac or respiratory motion in image reconstruction in the past, but our research is the first viable reconstruction of a PET image with compensation for both cardiac and respiratory motion using all the PET data," says Si Chen, Ph.D.,lead author of the study and research scientist for the department of engineering physics at Tsinghua University in Beijing, China.

Researchers used PET data from multiple cardiac stress tests to gauge the effect of the new method on image resolution and signal-to-noise ratio, which is a measurement comparing the desired imaging signal to the background, or noise. The imaging contrast between myocardium, or muscle walls of the heart, and heart chambers in the reconstructed 4D images was significantly improved—by 15 percent—with the new method. In addition, image noise was found to be 60 percent lower than with conventional methods of image reconstruction with cardiac gating. This technology has potential benefits beyond better image quality. The increased signal-to-noise ratio of reconstructed PET images can also be used to limit patient exposure and table time.

"This research provides an opportunity to further improve the diagnostic accuracy of cardiac PET imaging, which can be exchanged to some degree for faster scanning and lower dose," says Chen.

An estimated two to three years of research, including multiple phases of clinical evaluation, will need to be conducted before this technique can be rolled out for general clinical use.

Provided by Society of Nuclear Medicine