Greater cancer detection is possible with 4-D PET image reconstruction

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A study introduced at SNM's 58th Annual Meeting is advancing a positron emission tomography (PET) imaging method that uses new 4D image reconstruction to achieve the highest diagnostic capability for the detection of cancer. Mounting evidence shows that PET imaging, which provides visual representations of bodily functions, is significantly more sensitive when used with cutting-edge 4D image reconstruction technology that accounts for patient respiration and produces clearer, more easily interpreted images.

"PET imaging with 4D image reconstruction could potentially help with early cancer detection, which is an imperative in the field of nuclear oncology," says Si Chen, lead author of the study, Johns Hopkins School of Medicine, Baltimore, Md. "The results of this study and our other studies indicate that the sensitivity of small cancer lesion detection for patients will likely benefit from this novel image reconstruction method, which incorporates an accurate and patient-specific respiratory motion estimation algorithm we previously developed. The improved diagnostic accuracy would allow physicians a more informed understanding of a patient's situation in order to provide better treatment planning for the best possible outcome."

The objective of the study was to quantify the improvement of PET image quality using the 4D PET image reconstruction method with respiratory motion compensation compared to a more conventional 3D PET image reconstruction method. The researchers evaluated the image reconstruction methods using the receiver operating characteristic

(ROC) methodology, which is based on signal detection theory widely adopted in diagnostic radiology. A ROC curve is a graphical plot of the sensitivity versus specificity for lesion detection based on the reconstructed PET images. Realistically simulated PET images were employed in this evaluation study using the 4D XCAT phantom—a digital anthropomorphic phantom that realistically models a typical patient's anatomy, respiratory and cardiac motions. A total of twelve spherical tumors of 10mm diameter were planted inside the lungs and liver of the phantom, which was input to realistic simulation of PET data acquisition using another methodology called Monte-Carlo simulation. The simulated PET data were then reconstructed using both imaging reconstruction methods. The researchers used a mathematical observer, i.e., channelized hotelling observer (CHO), to mimic the interpretation of these PET images by human observers.

Using these methodologies, researchers were able to compare the sensitivity and specificity of the two image reconstruction methods and found that the 4D PET image reconstruction method with respiratory compensation improved the detection sensitivity for the cancer lesions in the liver and lungs. This indicates that evaluation of cancer for lesions smaller than 10 millimeters could be enhanced by compensating for respiratory motion with the 4D image reconstruction method.

More information: Scientific Paper 150: S. Chen, B.M.W. Tsui, Johns Hopkins School of Medicine, Baltimore, MD; "Evaluation of a new 4D PET image reconstruction method with respiratory motion compensation in a CHO study," SNM's 58th Annual Meeting, June 4-8, 2011, San Antonio, TX.

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