Controlling Radiation Dose with Next-generation PET•CT

Concerns about radiation exposure are front and center in medical imaging. Fortunately, Siemens' continuous efforts to reduce exposure and corresponding technological advances are helping to reduce radiation doses to patients undergoing PET•CT exams, while enabling excellent image quality.

By Evan Godt

Medical imaging specialists live by the principle of reducing radiation dose as low as they can, says Dale L. Bailey, PhD, of the University of Sydney and the department of Nuclear Medicine at Royal North Shore Hospital in Sydney. The trick is balancing this low-dose principle against image quality because if the results are a suboptimal study, that means a patient received a radiation dose with absolutely no clinical benefit.

A Happy Medium

On the CT side, Bailey says there are a number of ways to reduce radiation dose to the patient. Unlike PET, CT dose is directly related to how much of the body is scanned, so limiting the area to be imaged also limits dose. Technologists also can lower the CT tube current parameter, measured in milli Ampere seconds (mAs). "You can drop the beam current, the actual photon flux aimed at patient, and that will have an impact on quality, but you can find a happy medium, where you reduce it to a low level that's adequate for your diagnostic work, but minimizes as much as possible the dose to the patient."

Additionally, there are new computational methods and iterative reconstruction algorithms implemented in the latest Biograph™ mCT PET•CT scanners that have even better signal-to-noise handling properties. This allows technologists to reduce the dose to the patient without sacrificing image quality. Bailey explains that the algorithms have been around for about 20 years, but were too demanding on computing time to be of clinical use until so-called "ordered subset" iterative reconstruction algorithms were developed at Macquarie University and the University of Sydney in the 1990s. Whereas it used to take days for a computer to reconstruct an image, the new generation of iterative algorithms has allowed reconstruction time to be measured in minutes.

Game-changing Technology

With PET, there are not as many parameter adjustments that can be made to reduce dose to the patient as there are with CT. While a technologist can drop the tube current or restrict the range of a CT scan to reduce dose, radiation in PET imaging comes from the injected radionuclides.

If a more sensitive PET camera is used, however, a lower dose of radionuclides can be administered without reducing imaging quality, says Bailey. This is the case with the Siemens Biograph mCT PET•CT scanner with TrueV technology, which extends the axial field of view by about 33 percent over standard PET/CT cameras. This improvement actually increases sensitivity by 80 percent, which might seem counterintuitive given only a one-third increase in axial field, but Bailey explains this is because of the way data are acquired. Sensitivity is the square of the length of the field, so a little extension in length can result in big improvements to sensitivity.

"I think it's actually a game-changer," says Bailey. "You can look at all the PET cameras... but this is a design feature that clearly differentiates the Siemens camera from others."

The added bonus? Since providers in Australia pay by the amount of radionuclide dose used, reducing the dose administered to the patient also cuts operating costs.

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Broadening the View with TrueV

Siemens TrueV technology offers a wider axial field of view. Specifically, it provides axial bed coverage of 216 mm, an increase of 33 percent over the previous generation of scanners.

The wider field of view allows for more efficient imaging of whole-body subjects and gives imaging specialists the ability to lower dose rates or scan times by 50 percent. The acceptance angle in 3D PET acquisition also is increased, which means more lines of response can be measured in a given unit of time. This increases the count rate and sensitivity of the scanner, allowing more flexibility to protocols.