Total-body PET/CT News & Stories

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Long-axial field-of-view (LAFOV) PET/CT represents a genuine step change in molecular imaging rather than an incremental refinement. Where standard axial field-of-view (SAFOV) scanners are limited to roughly 20 to 35 cm of axial coverage and must acquire the body in sequential or continuous bed positions, LAFOV systems extend coverage beyond 100 cm and capture the great majority of the body volume simultaneously.[1] Combined with silicon photomultiplier detectors and time-of-flight performance now approaching 200 ps, the resulting gain in geometric sensitivity is roughly an order of magnitude.[a,2,3] LAFOV PET scanners such as the Biograph Vision Quadra PET/CT allow for dramatically shorter acquisitions, substantially lower administered activity[b], true multi-organ dynamic imaging, and practical PET imaging times with radionuclides whose count statistics were previously challenging to image on SAFOV scanners.

Our institution's experience with LAFOV PET/CT is long-standing. Investigators here helped design and build one of the earliest research prototypes, and for several years we lived with the somewhat awkward situation of having pioneered a technology we could not offer to our clinical patients. The path from that prototype to a clinical Biograph Vision Quadra PET/CT was therefore as much an exercise in advocacy as in engineering. What ultimately moved the conversation was modeling throughput. Using our own case mix over a standard 8-hour clinical day, a SAFOV time-of-flight PET/CT system supported approximately 15 patients—12 FDG studies at 20 minutes, two PSMA studies and one DOTATATE study at 35 minutes each. Substituting 5-minute acquisitions across all three categories raised that figure to more than 30. Capacity was the argument that resonated with hospital leadership. The gains in image quality and reconstruction speed were key considerations for our clinical leaders. A second practical concern was cost of construction. The system fit within our existing FGI-compliant Biograph mCT-rated scanner room, further improving cost-of-ownership considerations.

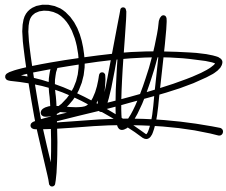
The transition has led to operational changes within the department. When acquisition time falls from 25 minutes to 5 minutes, the scan is no longer the rate-limiting step — patient transport, positioning, injection, and uptake are. We restructured staffing accordingly, adding dedicated patient assistants to manage transport and positioning so that technologists could remain in the control room and focus on image acquisition and reconstruction. This is the part of the LAFOV PET/CT scanner transition that is easy to underestimate and that depends almost entirely on local infrastructure and personnel resources rather than on the scanner itself. Sites that install a LAFOV PET/CT system without redesigning workflow around it may not realize its capacity benefit.

Thankfully, the clinical impact became evident quickly. For example, a patient with lung cancer and progressive back pain, unable to tolerate MRI, was imaged with 8 mCi (296 MBq) of F-18 FDG in a 2-minute total acquisition, with an estimated effective dose of 5.6 mSv; the comparable prior study on our first-generation time-of-flight system had required 12 mCi (444 MBq) and 25 minutes, at an estimated effective dose of 8.4 mSv. During a period of regional cyclotron downtime, when F-18 FDG supply was constrained, we completed diagnostic studies with as little as 4.1 mCi (152 MBq) in 5-minute acquisitions at an estimated 2.8 mSv. Owning a LAFOV PET/CT scanner allowed us to serve our full patient load that day.

The research case is, if anything, stronger as our participation in Zr-89 labeled antibody studies have shown. Zr-89 is a versatile but demanding radionuclide with a 3.3-day half-life, only 23% positron abundance, energetic co-emitted gammas, and administered activities often around 1 mCi (37 MBq). Under a research protocol for Zr-89-DFO-girentuximab imaging of clear cell renal cell carcinoma, a SAFOV PET/CT scanner would require 10 to 20 minutes per bed for the renal field and a further six bed positions for whole-body coverage — roughly 80 minutes of scanner time and two CT acquisitions.[4] On a LAFOV PET/CT system we were able to complete the same study in a single 10-minute acquisition. The gains compound: better patient tolerance, less motion, superior image quality, and a materially lower barrier to trial enrollment. List-mode acquisition also allows the same dataset to be retrospectively down-sampled, letting us ask whether half-dose or half-time protocols preserve lesion detectability — questions with direct implications for antibody and isotope cost as well as for ALARA.[7] Recent work with Zr-89-labeled trastuzumab has extended imaging to 14 days post-injection with approximately 5% residual activity, offering a window into antibody kinetics that was previously inaccessible.[5]

Cost-effectiveness, which was the least intuitive part of our internal case, is increasingly supported by published data showing lower per-patient personnel, radiopharmaceutical, and operational costs for LAFOV PET/CT compared with SAFOV PET/CT systems even under extended-hours alternatives.[6] Our own experience has been consistent with that finding, though the results reflect our particular case mix and staffing model.

LAFOV PET/CT's moment as a tool for daily clinical use is here! It is a general-purpose clinical scanner that happens to enable research that could not otherwise be done. The near-term agenda is clear enough: better data management for the very large datasets these systems generate, AI-assisted kinetic analysis, expansion into cardiac and neurologic applications, and eventually CT-free attenuation correction. For those still deliberating, my advice is to model your own throughput and construction costs, plan the workflow redesign before the installation rather than after, and recognize that the scanner will change both the service you offer patients and the way you read a study, given the dramatic gain in image quality over previous standard acquisitions. You may even end up asking yourself if you need a second LAFOV PET/CT scanner!



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[a] Compared to Biograph Vision PET/CT scanners. Data on file.

[b] Based on bench testing (e.g. improved sensitivity and ToF per NEMA NU-2:2018). Please refer to the approved PET drug prescribing information for dosing and administration instructions.

The statements described herein are based on results achieved in the author'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 institutions will achieve the same results.

Portions of the work described are based on research results that are not commercially available. Zr-89-DFO-girentuximab and Zr-89-labeled trastuzumab are investigational agents. Please refer to approved PET drug prescribing information for dosing and administration instructions. Dose estimates are ICRP-128 based.

Biograph Vision Quadra is not commercially available in all countries. Future availability cannot be guaranteed.

References

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