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When the Scan Gets Shorter: Long-Axial PET and the Choices We Make

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PET imaging has been operating for the most part of its history under an unwritten contract: you got a quick scan, or a great scan, but not both. That bargain has been called into question by long-axial field-of-view (LAFOV) PET/CT. A conventional scanner scans approximately 20 cm of the body at a time, meaning that less than 1/8 of the body is in view at any given time. The potential increase in sensitivity by extending the detector to cover the entire body is approximately 40-fold for whole-body imaging, which can be applied to improving image quality, speed, dose, or both [1]. The team claimed to have obtained diagnostic-quality images from about a minute or less of acquisitions with the 194 cm EXPLORER scanner when it was first tested on human volunteers, and from activities injected as low as 25 MBq [2]. This was a feasibility study of a few topics, not a clinical trial. A later study head-to-head with another commercial scanner provided more concrete statistics. Out of 44 patients who were scanned on both systems the same day, the long-axial scanner matched the image quality and lesion quantification of routine imaging in less than 2 minutes, compared to 16 minutes. Although more distracting, even half-minute acquisitions were sufficient to reveal target lesions in certain circumstances [3]. These studies report image quality, but not patient outcomes, and are from early systems and single centers. Nevertheless, the message is clear: speed does not have to compromise diagnostic quality.

This is actually more of a personal preference than anything else for the person on the table. Traditional PET/CT requires patients to stay completely stationary for as long as 20 minutes [4]. Everybody who has been in the PET suite will know what this sounds like: The patient in pain trying to keep his arms up, the anxious one who can't stop breathing, the frail one who's been waiting hours. In a recent Australian study, patients were asked about their experience before and after a metropolitan hospital switched from the traditional, long axial PET/CT. The results were obtained from over 100 patients each. Following this, there were fewer patients reporting the scan as being too long and feeling anxious or concerned about the radiation, and less time was spent in the camera room and uptake room [4]. It wasn't necessarily a bright and sunny all year, however. The groups were not different with regard to claustrophobia and physical discomfort, even though the longer bore [4] was used. It's a kindness of a shorter scan, but it's not the answer to all problems: let's not pretend it is.

The greater question is what do we do with the increased sensitivity. The same increase in speed that contributes to the scan's speed can help to make it lighter. If the Bern scan had been kept for a 10-minute period, then it would have been possible to reduce the injected activity proportionally, resulting in a PET dose below 1 mSv [5]. Some patients are at risk for the consequences of that choice. In a small series of 2 pregnant females, the dose to the fetus from the PET was estimated to be between 0.11 and 0.44 mGy, and the physicians considered the images to be more than adequate for staging [6]. Two patients are a case series, not a guideline, but it demonstrates the possibilities of a dose-first choice. So, the department is at a crossroads. It can save the sensitivity on throughput, treating more patients within the working day and reducing a queue which could be several weeks long. Or it can use the dose, providing less radiation per patient. Both are defensible. The only one I can't defend is letting it be done automatically, by the person who sets the schedule template.

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That default is most likely to be set in money, and the economics are not quite as dire as they sound at the budget meeting. According to a modelling study conducted internationally, the one LAFOV system could process as many patients daily as two traditional scanners, while requiring fewer technologists, less radiopharmaceutical activity and less dose to staff in each country modelled, and even cost less per scan in all countries modelled. The least effective solution that was found to add capacity on conventional scanners was extended operating hours [6]. If this is the case, as it is in practice, speed and dose are not just a matter of solvency or safety. However, a model is not a budget, and savings do not walk on their own. Unless we plan for the gift (with written protocols); open reporting of dose and throughput, and not pay for the volume alone, we will not get the gift to the person on the table. The detector has served its purpose. The meaning of the one-minute scan will be determined by people and not by the scanner in a budget meeting.

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