How to Get the Most from Advanced PET Scanners: Harmonizing Quantitative PET Data

Nicolas Aide, MD, PhD, a professor of nuclear medicine and nuclear medicine physician at Caen University Hospital and François Baclesse Cancer Centre, Caen, France, and colleagues* proved that PET data could be harmonized, regardless of the scanner generation or reconstruction method. Since then, his research has led to the creation of a software solution that automates harmonization across scanner manufacture and makes it practical in routine clinical use.

By Greg Freiherr

As technology advances, sensitivity increases. Under most circumstances, the net effect is positive—but not when making quantitative PET measurements to assess the effect of therapy.

With more sensitive detectors and advanced reconstruction techniques, the latest PET/CT systems make lesions easier to see, but they also produce higher standard uptake values (SUVs). The clinical meaning of these SUVs can be skewed by this improved technology.

This is especially so in oncology, where high SUVs typically correlate with tumor growth. If SUVs recorded on advanced PET/CTs are compared to those made on equipment of older design, clinicians may conclude that the cancer appears to have metabolic growth when, in fact, the higher values are due to the increased sensitivity of the machine measuring them.

This is where EQ•PET comes in.
Outcomes

EQ•PET software, developed by Siemens Healthcare and independently validated in clinical studies under a research grant, harmonizes quantitative measurements made on old- and new-generation scanners. The harmonized result is an accurate assessment of patient response to therapy determined by correctly comparing pre- and post-therapy quantitative PET measurements.

Clinical research, published in peer-reviewed journals, indicate that EQ•PET is valid across all types of solid tumors, regardless of tumor size, shape, or location in the body or in the field-of-view of the scanner, according to Nicolas Aide, MD, PhD, who spearheaded the research.

“By validating EQ•PET over a very large series of patients, and by focusing on several types of cancers, we have proved that it works and it works well,” Aide said. “EQ•PET is an efficient tool to get rid of reconstruction variability in quantitative data.”

Aide cautions, however, that while EQ•PET is very good at what it does, various sources of error can still skew the interpretation of SUVs. All who use this proprietary software should follow internationally accepted guidelines for the acquisition of PET data, he said.

“It is important to emphasize that this tool needs to be used within the framework of harmonization programs, which usually give the user all the steps needed to make standard uptake values as accurate as possible,” he said.

If the sources of error are controlled and EQ•PET is correctly calibrated, the software is able to harmonize data obtained on equipment of different generations. This capability should be able to transcend not only the generation, but the make of the equipment. Thus far, however, clinical research performed by Aide has validated the software only on Siemens PET/CT scanners.

“We have validated the capability of EQ•PET to harmonize SUVs within different Siemens PET/CT systems,” Aide said.

The ability to harmonize quantitative PET/CT data promises to impact the management of individual patient therapy; the worldwide use of PET/CT in therapy assessment; and the conduct of multi-center research projects aimed at determining either the utility of PET/CT or the effectiveness of cancer treatment. By harmonizing the quantitative data and leaving it intact, EQ•PET preserves the sensitivity of high-resolution PET/CT images.

“You get the best of the two worlds,” he said. “You get the optimum diagnostic information from the image, because you have selected your reconstruction parameters to achieve the highest lesion detectability possible. And you get harmonized quantitative data [for comparison to previously obtained data].”

Harmonization using EQ•PET is remarkably accurate, according to Aide, who has compared the performance of this software to what can otherwise only be obtained through time-consuming means.

“When applying EQ•PET, the difference is less than 2 percent,” he said.**
Getting as close to perfect is important, he said, because in oncology SUVs are often used to evaluate patient response to therapy. These SUVs are mapped against PERCIST (PET Response Criteria in Solid Tumors) thresholds. An increase of 30 percent or more above the PERCIST threshold suggests the therapy is not effective against the patient’s solid tumor and should be changed. An SUV decline of 30 percent or more indicates the therapy is likely having a positive effect and should be continued.

Aide first proved that PET data could be harmonized three years ago. Using a NEMA (National Electrical Manufacturers Association) IEC PET Body phantom, he and his colleagues developed a mathematical formula that translated quantitative measurements obtained using different reconstruction algorithms into comparable data sets. They proved that this formula could be applied to evaluate data obtained during pre- and post-therapy evaluations of patients with non-small cell lung cancer.

When preliminary data from the research was presented at a scientific meeting in 2013, it caught the eye of Jerome Declerck, PhD, who was a director of science and technology at Siemens Healthcare’s molecular imaging business line at that time. Declerck, who is today a senior advisor for clinical innovations with the company, had been leading the development of software to harmonize PET quantitative data. The software was based on the same concept as the mathematical formula developed by Aide and his colleagues, but it was automated, turning what was essentially an academic exercise into a practical one.

“Dr. Aide was the right partner for us because we understood what we both wanted to achieve, and our objectives were very much aligned,” Declerck said. “We needed to extend the results obtained on a handful of in-house image data to a proper trial with a vast patient cohort.”

Aide and his colleagues did exactly that over the coming two years, harmonizing data that covered a range of solid tumors, including breast cancer, non-small cell lung cancer, and melanoma and liver metastases from colorectal cancer. Aide chose these tumors because they are widely representative of the kinds of tumors seen in routine oncology.

“The idea was to validate EQ•PET across a very large series of lesions, covering all the locations that will be faced in real life,” he said.

The researchers most recently validated EQ•PET in 517 oncology patients examined at multiple locations in France and Australia. The research harmonized data from 1380 lesions, using point-spread function (PSF); PSF plus Time-of-Flight (ToF); and an earlier reconstruction algorithm, called OSEM (ordered subsets expectation maximization).

“We proved that you get the same results with EQ•PET when it is applied to each of these reconstruction methods,” he said. “That means that EQ•PET

“Dr. Aide was the right partner for us because we understood what we both wanted to achieve, and our objectives were very much aligned.”

Jerome Declerck, PhD
Senior Advisor for Clinical Innovations
Siemens Healthcare
can harmonize SUV data from new-generation and former-generation PET/CT systems."

Today EQ•PET is commercially available around the world as part of the multimodality oncology application built into syngo®.via for Molecular Imaging, a software platform designed for advanced data processing and communication.

Once calibrated, the lesion is outlined on the PET/CT image; the area clicked; and the data automatically harmonized with those indicated on an earlier scan. In this way, SUVs from baseline and post-treatment scans can be compared quickly and efficiently.

Calibration is relatively simple. It is achieved by first outlining a region of interest, such as a lung lesion in a baseline PET image. Next the region of interest in a post-treatment image is outlined. The appropriate filter is chosen from EQ•PET, and the software does the rest. From then on, data obtained using new and earlier generation PET scanners are automatically harmonized using the chosen filter, according to Declerck.

"Whenever a new patient comes in, and you want to compare old and new scan data, you don’t have to reenter this filter," Declerck said. "EQ•PET will remember it."

Declerck describes a software that is becoming practical in routine use. Toward that end, according to Aide, EQ•PET is a fast, user-friendly and accurate method for harmonizing quantitative PET data.

** The statements by Siemens customers described herein are based on results that were achieved in the customer’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 customers will achieve the same results.

*** syngo.via can be used as a standalone device or together with a variety of syngo.via-based software options, which are medical devices in their own right. syngo.via and the syngo.via-based software options are not commercially available in all countries. Due to regulatory reasons its future availability cannot be guaranteed. Please contact your local Siemens organization for further details.

References:

