Plenary - MR-PET

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Highlights:

- Simultaneous PET and MRI data acquisition allows the spatial and temporal correlation of the measured signals;
- Simultaneously acquired MR data can be used to improve the PET data quantification;
- Proof-of-principle studies to demonstrate the unique benefits of this novel technology have been performed.

Title: *A Clinical Tool for Radiologists?*
Target audience: radiologists, neuroscientists, technologists and other researchers with an interest in multimodality imaging.
Objectives: In this lecture, we discuss methodological challenges and opportunities provided by this novel technology and present potential oncologic, cardiac, and neuro-psychiatric applications.

Summary:

PET, MRI and CT are imaging modalities routinely used for clinical and research applications. While PET/CT scanners have quickly become well-established clinical tools, development of combined PET and MRI has been much slower because of numerous technical challenges on both sides. Integrated scanners capable of acquiring PET and MRI data in the same imaging session, sequentially or simultaneously, have recently become available for human use. Given the complementary nature of each modality's strengths and weaknesses, integrating PET and MRI offers the opportunity to gain in a single examination many of the positive attributes of both, and mitigate some of their limitations. In addition, simultaneous PET/MR is expected to be a more quantitatively accurate tool than the two methods alone and this advantage alone could positively impact all clinical and research applications that require improved quantification.

Although PET/CT and stand-alone MR are independently useful imaging modalities, there are numerous unmet medical needs that may benefit from this new hybrid technology. Examples include applications where the advantages are obvious (e.g. patients where radiation exposure if a concern, area of the body where CT anatomy is suboptimal or where MRI offers improved tissue specificity), advanced applications that require improved quantification or multimodal biomarkers (e.g. therapy monitoring in oncology or clinical assessment of cardiovascular diseases) and future applications where PET/MR may change the way we practice (e.g. understanding the relationship between structural, chemical and functional changes in neuropsychiatric diseases, moving beyond FDG in oncology and quantification of "smart" MR probes).

Many factors will decide the ultimate role of PET/MR systems within our overall health care system, not the least of which is the cost of such systems, and the degree to which the benefits accrued match the resources required to perform and interpret these studies in the clinic. Training the next generation of interpreters in the art and science of both PET and MR is another challenge, which will have to be met if this tool is to have widespread impact outside a small group of academic sites. Nevertheless, if the future of clinical practice is precision medicine, where therapeutic decision are designed around specific molecular pathological events at the earliest possible stage, then PET/MR systems may be the first of the next generation of molecular imaging tools for that future.