Body PET-MRI:

Target Audience: Radiologists within the academic and private practice setting interested in the burgeoning field of hybrid PET-MRI.

How was the problem determined and examples of how this issue has been addressed: – Analogous to hybrid PET/CT imaging, which has become a powerful multi-modality imaging tool, there are many reasons for performing combined PET and MRI examinations within the abdomen. PET/MRI allows the combination of functional PET information with the unparalleled soft tissue contrast of MRI and potentially with advanced functional techniques such as diffusion/perfusion imaging and MR spectroscopy, which are already widely implemented in oncologic and body imaging The combination of high-resolution morphologic and functional MR combined with metabolic information provided by the integrated PET system seems to have great potential therein. Moreover, in contrast to PET/CT, PET/MRI does not increase radiation exposure, a particularly important factor with respect to patients receiving multiple followup examinations.

With the recent advent of novel targeted agents that have resulted from a rapid and profound increase in genomic and proteomic technology, concomitant with an improved understanding of the unique, but occasionally redundant signal transduction pathways involved in many malignancies, the practice of medical oncology has been revolutionized by the development, introduction and implementation into practice of novel targeted agents. As these agents have come to fruition, however, there has been a lag in the development and validation of robust serum or imaging methods for the assessment of anti-cancer treatment activity. The RECIST criteria are based on unidimensional measurement criteria, and although providing a statistically robust measure of drug efficacy for clinical trials, these measures suffer from their delayed measure of therapeutic efficacy and are an unlikely solution to the granular early needs of precision medicine. The development of new combined, targeted/morphological/functional/physiologic measures and methods for evaluating the efficacy of these novel targeted agents is of paramount importance in oncology in order to not only evaluate therapeutic efficacy, but more so to select patients who are likely to benefit from targeted therapy, and gather early response indicators so as to modulate therapies efficaciously. This is the only path forward as we progress to hopeful precise and personalized medicine. Molecular imaging may offer a solution to many of these problems by potentially providing an in vivo and non-invasive evaluation of molecular background expression thus differentiating patients. An early glimpse into this potential has been noted in the routine utilization of 18F-FDG, a radiotracer that measures metabolism, and is able to differentiate metabolically active tumors. FDG has also been shown to be efficacious as a predictive biomarker of some targeted oncologic treatment strategies. A number of new compounds that interrogate various unique properties of signal transduction, or ligands that may

be up-regulated in specific malignancies are also currently available or under development. The aim of this talk is to analyze the role of molecular imaging with positron emission tomography (PET), MRI, and further explore the benefits and potential of hybrid PET-MRI using conventional and innovative radiotracers in clinical practice and to explore the promising new perspectives in body imaging and cancer research. The session will follow the outline below and be divided into novel tracers, and the role and promise of PET-MRI with FDG and other tracers in oncologic grading and staging[1-12] At the end of the session, the participants will have a better understanding of PET-MRI as it applies to body imaging within inflammatory and oncologic conditions and the role that PET-MRI may have in precisely diagnosing and continuously monitoring the progression of their disease.

I. Tracers
   a. Novel compounds
      i. ^{18}F
         1. ^{18}F-FLT
         2. ^{18}F-NaF
         3. ^{18}F-DHT
         4. ^{18}F-DOPA
      ii. ^{11}C
         1. ^{11}C-Choline
         2. ^{11}C-Acetate
         3. ^{11}C-Methionine
      iii. ^{68}Ga-DOTATOC and ^{68}Ga-DOTANOC
   b. Imaging of labeled chemotherapeutic agents
   c. EGFR
   d. HER-2
   e. C-KIT
   f. Gene expression

II. PET-MRI
   a. Basic technology
   b. MR-based attenuation correction
   c. Clinical application with FDG in inflammatory and oncologic conditions
   d. Multi-parametric evaluation
      i. Diffusion
      ii. DCE-MRI
      iii. Perfusion
         1. DSC
         2. ASL
      iv. MRS

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