Preface


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Guest Editors

For those individuals who were in the medical and scientific fields during the early 1970s, it was an exciting time to be alive. In 1973, the first clinically available computed tomography (CT) scanner was introduced due to the groundbreaking efforts of Drs. Godfrey Hounsfield and Allan Cormack in years prior.[1,2] The first magnetic resonance (MR) image was published by Dr. Paul Lauterbur in 1973 following the introduction of the use of gradients in the magnetic field to create images, and in 1977 the first human magnetic resonance imaging (MRI) scan was performed. CT and MRI have revolutionized structural tomographic imaging. Also in 1973, the concept of ^{18}F-fluorodeoxyglucose (FDG) for purposes of in vivo positron emission tomography (PET) imaging was born via the combined efforts of Drs. Abass Alavi, David Kuhl, and Martin Reivich at the University of Pennsylvania, which has revolutionized nuclear medicine and molecular imaging.[3] Simultaneously, Drs. Michael Ter-Pogossian, Michael Phelps, and Edward Hoffman at Washington University and Dr. Gerd Muehllehner at Searle Radiographics successfully assembled instrumentation for optimal in vivo PET imaging of positron-emitting radionuclides in humans.[4,5] In 1976, the first human brain and whole body FDG scintigraphic images were acquired on a single photon emission CT instrument at the University of Pennsylvania.

Subsequently, in 1998, PET/CT was introduced by Drs. Townsend and co-workers at the University of Pittsburgh, which allowed for the optimal combination of structural and functional assessment of human patients in vivo.[6,7] As a result, PET instrument sales have markedly decreased whereas PET/CT instrument sales have markedly increased. PET/MRI prototype instruments have recently been assembled in recent years and offer many advantages compared with PET/CT.[8] These include a lack of additional ionizing radiation, superior soft tissue contrast resolution, and an ability to provide additional gross functional imaging data using diffusion-weighted imaging, dynamic perfusion imaging, MR elastography, or MR spectroscopy.[9] However, CT generally remains superior to MRI for evaluation of the lungs, tracheobronchial tree, bowel, and cortical bone, and challenges still remain with regards to attenuation correction using MR images. It is conceivable that hybrid PET/CT/MRI instruments may therefore be assembled to become the standard imaging platform in the future for optimal structural and functional evaluation of all parts of the body.

It is now clear in retrospect how the natural evolution of these originally separate and now frequently combined imaging modalities progressed over the years. There is a natural synergy between PET and CT/MRI, allowing one to obtain the maximal amount of information per imaging session. Hybrid structural and functional imaging provides for partial volume correction of standardized uptake values from PET images via volumetric measurements on CT/MRI examinations, improved anatomical localization of radiotracer uptake seen on PET via coregistration with CT/MRI images, improved sensitivity, specificity, and accuracy of disease assessment, and combination of quantitative structural data from CT/MRI with quantitative molecular data from PET into single integrated quantitative parameters of global disease assessment that are easy to use and take into account structural and functional components of a disease process.[10,11] As such, the future of standalone CT, MRI, or PET

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instrumentation may be in question except for use in particular niche applications.

In this issue of *PET Clinics*, we provide a series of articles regarding the application of combined PET, CT, and MRI to small animal preclinical imaging and clinical imaging, brain tumors, non-neoplastic neurologic disorders, the head and neck, breast cancer, thoracic malignancy, the cardiovascular system, abdominopelvic disorders, musculoskeletal disorders, and the endocrine system. It is our hope that the readers of these articles will learn much and therefore apply much to the future practice of combined structural-functional quantitative PET/CT/MR imaging in the 21st century.

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