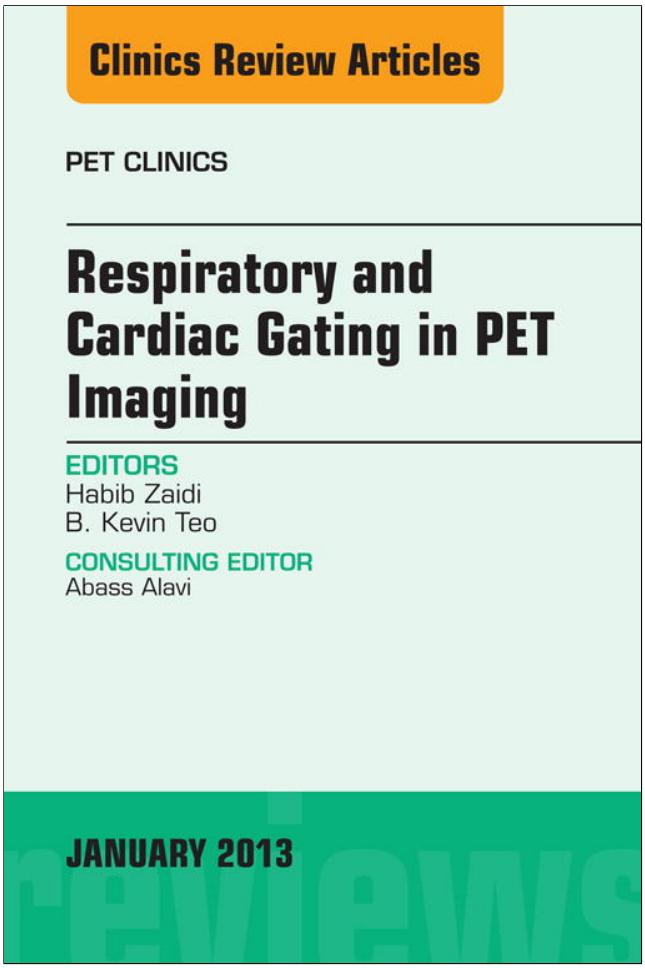

Preface

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Guest Editors

In the era of molecular imaging,[1] positron emission tomography (PET) and single-photon emission computed tomography using highly specific probes have enabled biomedical researchers to study biochemical processes at the molecular level. The rapid pace in the development of emission tomography imaging technology has been motivated by the desire of clinicians and biomedical imaging researchers to produce ever more detailed and quantitatively accurate images for diagnosis, staging, therapy response monitoring, and radiation therapy treatment planning. This drive has led the academic community as well as commercial vendors to develop new molecular agents, detector technologies, image reconstruction algorithms, and data processing software. The integration of PET and CT in a single gantry has enabled better localization of metabolic abnormalities, which in turn spurred the need to further improve PET sensitivity, image resolution, and quantification. While PET scanner sensitivity and image resolution can be improved by new detector technologies, correcting for motion blurring requires a fundamentally different approach.

Motion is a particularly challenging problem in PET. Respiratory motion in the thoracic and abdominal regions can be up to several centimeters and results in a smeared image with reduced quantification accuracy. The effect of motion can be further compounded by errors in attenuation correction that may lead to a wrong diagnosis. For cardiac applications, both respiratory and cardiac motion lead to image artefacts that affect diagnosis. In recent years, gating techniques were developed for PET/CT imaging to reduce motion artefacts. While some level of success has been achieved with these gating techniques, there is still room for further improvement. In particular, the issue of reduced signal-to-noise ratio, irregular breathing motion, and accuracy of external motion surrogate must be addressed. With the development of PET/MRI systems[2,3] capable of simultaneous acquisition, highly advanced non-rigid motion correction strategies are becoming possible.[4] While this technology is still in its infancy, it is a promising development that seems to have the potential to overcome all the deficiencies with current gating techniques. Further exciting developments in technology to address motion lie ahead for researchers in this field.

This issue of *PET Clinics* addresses the subject of gating in PET as a method to reduce motion artefacts and discusses the hardware and software tools available. As the use of gating becomes more widespread, its role and limitations in the clinical setting for clinical oncology and cardiology applications are being debated. Advanced topics related to gating, such as computer modeling and simulation, are also discussed. It is hoped that this collection of comprehensive topics in gating will serve as instructional information for readers interested in understanding current gating technology and its applications.

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