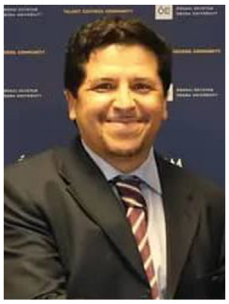
Preface

Innovations in Organ-Specific PET Instrumentation: Quo Vadis



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Editors

This is a thrilling time for innovative molecular imaging instrumentation in the era of precision medicine. The bulk of research to date in PET instrumentation focused on development of high-temporal-resolution detector modules to achieve the best performance from time-of-flight technology, improving the sensitivity through increasing the axial coverage, and integration of solid-state photodetectors (eg, Silicon photomultipliers) on (digital) clinical PET scanners. Significant research and development efforts were spent on improving the performance of dedicated systems during the last decade in both academic and corporate settings, resulting in the design of a number of systems suitable for clinical and research applications. Key examples include PET scanners dedicated to high-resolution imaging of the brain, breast, and prostate, in addition to preclinical systems intended for biomedical research.

In the current issue, we asked experts in the field to share their views, opinions, and experience with organ-specific PET scanners and their clinical applications. Prospects and suggestions for further research are also discussed. The contribution, by Lee and Lee, "Advancements in PET Detectors: From Silicon Photomultipliers Technology to Artificial Intelligence Applications," focuses on reviewing recent advances in PET detector modules and solid-state photodetectors, including the potential of artificial intelligence–powered algorithms in improving performance. The article by Allen and colleagues, "New Horizons in Brain PET Instrumentation," provides a comprehensive review of dedicated brain PET scanners developed in academic and corporate settings with particular emphasis on innovations in instrumentation and conceptual designs carried out during the last decade. The conceptual design of PET scanners constructed for imaging other organs, such as the breast and prostate, is comprehensively reviewed in the two articles, "Advances in Breast-PET Instrumentation," by Krishnamoorthy and Surti, and "Developments in Dedicated Prostate PET Instrumentation," by Gonzalez and Gonzalez-Montoro. The contribution by Lehnert and Miyaoka, "Innovations in Small-Animal PET Instrumentation," summarizes advances in high-resolution small-bore PET systems intended for small-animal imaging. A thorough appraisal of the potential of a virtual-pinhole PET insert in enhancing spatial resolution through zoom-in imaging capability implemented on existing commercial clinical whole-body PET scanners is provided in the article by Tai, "High-Resolution Imaging Using Virtual-Pinhole PET Concept." The basic concept of whole-gamma imaging that combines PET and Compton imaging and is expected to potentially provide a practical approach for clinical implementation of Compton imaging in nuclear medicine is reviewed in the article by Yamaya and colleagues, "Whole-Gamma Imaging: Challenges and Opportunities." Potential clinical applications of the above

PET Clin 19 (2024) xi–xii
https://doi.org/10.1016/j.cpet.2023.09.004
1556-8598/24/

reviewed dedicated systems (brain, breast, and prostate) are reviewed in the articles, "Transforming Neurology and Psychiatry: Organ-Specific PET Instrumentation and Clinical Applications," by by Taha and colleagues, "Clinical Applications of Dedicated Breast PET," by Fowler and colleagues, and "Potential Clinical Applications of Dedicated Prostate PET," by Castellucci and colleagues.

The development of advanced organ-specific PET instrumentation and related image reconstruction algorithms, as well as associated clinical applications, has been very fast and thrilling, and there is every reason to trust the field will move forward even more rapidly in the future. There is no scarcity of challenges and opportunities for advanced PET instrumentation and innovative clinical applications nowadays. We hope that, in this limited space, we were able to provide a flavor of recent advances in dedicated PET instrumentation and potential applications in clinical and research settings. We would like to thank the authors who contributed these articles and hope that the whole issue will be a valuable resource to readers.

CONFLICT OF INTEREST/DISCLOSURES

The editors have no conflicts of interest to disclose.

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