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IPR PRESENTATIONS

Molecular imaging in pediatrics

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Medical imaging technology has experienced rapid development over the past several decades, and these innovative developments have transformed radiology, making it an essential "guiding hand" of medical practice. In parallel, the rapid pace of biological advances have made this the age of molecular medicine. Thanks to the emerging field of molecular imaging, the radiology community has the opportunity to help lead a revolution in modern medicine toward optimized diagnosis and therapy in individual patients.

Molecular imaging is the in vivo characterization and quantification of biological processes that occur at cellular and molecular level, at a macroscopic level of resolution. This is in contrast to current conventional, anatomically based radiology. Molecular imaging will play a major role in the near future, not only within the scope of basic research, but also in clinical diagnosis and monitoring of therapy. Molecular imaging will not only provide the exact localization of a disease or lesion, but also show the expression and activity of specific molecules (proteases, kinases, etc.) and biological processes (apoptosis, angiogenesis, metastasis, etc.), the behavior of diseases and/or response to therapies. This information is expected to have a major impact on early diagnosis, individualized treatment and the development of new therapies, as well as on the general understanding of how diseases arise. Imaging techniques that fit this description have been in use for a number of years, and include contrast-enhanced magnetic resonance imaging, magnetic resonance spectroscopy, single photon emission computed tomography, positron emission tomography, optical imaging, and various combinations of these techniques using multimodality and multiparametric imaging. The clinical use of more specific molecular imaging probes, along with high-throughput serum screening and biologically targeted biopsies, will make it possible to apply a growing array of imaging techniques, including serum and tissue biomarkers, to detect and characterize disease in humans. These will include predictive biomarkers for identifying the relative sensitivity or resistance of a disease to a specific therapy, or for identifying disease that does not require treatment; biomarkers for assessing treatment response earlier than is possible with conventional means; and prognostic biomarkers that provide information about the likely outcome, regardless of the specific treatment applied. In addition, molecular imaging will allow the increasing use of theranostics, i.e. combinations of targeted diagnostic and therapeutic agents that work sequentially or in tandem. Emerging genomic and proteomic technologies have the potential to transform the way in which these diseases are managed clinically.

The direction for radiology, as for almost all of modern medicine, is to begin thinking at the molecular level. Although most molecular imaging techniques are used in preclinical or early clinical phases, pediatric radiology will benefit greatly from these methods. Many diseases, especially those with specific molecular fingerprints, including many pediatric diseases, could reap the future advantages that these new techniques will provide, including better detection, characterization, diagnosis, targeted therapies, and the ability to monitor results at molecular level. Molecular imaging is the key technology for accomplishing these goals. Although the challenges are significant, the potential for molecular imaging is enormous. These techniques represent the future of imaging.

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