PET/CT and molecular imaging in neurological disorders

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ABSTRACT

In recent years, positron emission tomography-computed tomography (PET-CT) and molecular imaging techniques have revolutionized the diagnosis and management of neurological disorders. Molecular imaging offers two key advantages: first, it detects biological processes at the underlying molecular level, rather than simply at the tissue level; and second, compared with conventional anatomic imaging, it provides diagnostic information at an earlier time point during a disease onset or repair process. PET-CT enables the visualization and quantification of metabolic processes and receptor densities in the brain, offering valuable insights into the pathophysiology of neurological disorders. By utilizing radiotracers specific to neurotransmitter systems and metabolic pathways, PET CT and molecular imaging facilitate the identification of aberrant molecular signatures associated with conditions such as Alzheimer's disease, Parkinson's disease, epilepsy, and encephalitis. Molecular imaging techniques, including amyloid and tau PET imaging, have emerged as promising tools for early detection and differential diagnosis of neurodegenerative diseases. PET-CT and molecular imaging also play a pivotal role in the development and evaluation of novel therapeutic interventions for neurological disorders. One significant advancement for F18 FDG PET brain interpretation is the widespread use of statistical mapping for image interpretation and analysis. This approach not only improves overall diagnostic accuracy but also quantitative information on the significance level of detected abnormalities, helps to standardize interpretation, allows cross-institutional comparisons and helps support consistent scan interpretation by physicians with different levels of experience. By enabling the precise localization of disease pathology and monitoring treatment response, these imaging modalities facilitate personalized medicine approaches, leading to improved patient outcomes and therapeutic efficacy. In conclusion, PET-CT and molecular imaging represent invaluable tools in the diagnosis, management and research of neurological disorders. As technology continues to evolve and new radiotracers are developed, the potential of PET-CT and molecular imaging to transform our understanding and treatment of neurological conditions hold great promise for the future of neurology.