

NEUROLOGIC APPLICATIONS OF PET

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Positron Emission Tomography of the Brain

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Homer A. Macapinlac

Positron emission tomography (PET) is a technique that allows imaging of the temporal and spatial distribution of positron-emitting radionuclides. The purpose of this article is to outline the current clinical use for PET imaging in the brain and other radiopharmaceuticals used for assessing various physiologic parameters pertaining to tumor metabolism.

Neuroimaging in Dementia

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Jennifer L. Whitwell and Clifford R. Jack

Neuroimaging has become increasingly important in the clinical assessment and diagnosis of dementia. Structural imaging with MRI and functional imaging techniques, such as positron emission tomography and single photon emission CT, increasingly are used to aid in the differential diagnosis and early detection of dementia. Imaging techniques also can track disease progression over time and may be useful to monitor treatment effects. The most important development in the field over the past decade is the ability to image amyloid in the brain. This technique will revolutionize patient management and care.

Positron Emission Tomography Diagnosis of Alzheimer's Disease

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R. Edward Coleman

Positron emission tomography (PET) imaging of [18F]-2-fluoro-2-deoxy-D-glucose (FDG) is accurate in the early detection of Alzheimer's disease (AD) and in the differentiation of AD from the other causes of dementia. FDG-PET imaging is available widely and performed easily. Different patterns of abnormality with the various causes of dementia are well described. Semiquantitative methods of image interpretation are available. Medicare covers FDG-PET imaging for the narrow indication of differentiation of possible AD from frontotemporal dementia.

Positron Emission Tomography Imaging of Cerebral Ischemia

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Colin P. Derdeyn

Positron emission tomography (PET) uniquely allows the in vivo regional measurement of several important physiologic parameters in living humans, including cerebral blood flow and oxygen metabolism. PET studies have advanced our understanding of normal

human brain physiology and, as detailed in this article, our understanding of human cerebrovascular pathophysiology. This article focuses on knowledge gained from PET regarding acute ischemic stroke and chronic oligemia from arterial occlusive disease. Knowledge of the responses of the brain and its vasculature to ischemia and oligemia is growing more important with the increasing availability of CT and MR perfusion techniques.

Applications of Clinical Dopamine Imaging

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Kimberly P. Lindsey and S. John Gatley

Recent technologic advances make it increasingly possible to image neurotransmitter systems in living human brain. The dopamine system has been most intensively studied owing to its involvement in several brain disorders, including motor disorders such as Parkinson's disease and Huntington's disease, as well as psychiatric disorders such as schizophrenia, depression, and compulsive behavioral disorders of multiple types. A variety of aspects of dopamine receptor density, function, and dopaminergic terminal status can now be assessed using the minimally invasive neuroimaging techniques of positron emission tomography and single-photon emission computed tomography. Although these techniques are currently used most often in the context of research, clinical applications are rapidly emerging.

Opioid Imaging

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Alexander Hammers and Anne Lingford-Hughes

Many breakthrough scientific discoveries have been made using opioid imaging. Developments include the application of ever higher resolution whole-brain positron emission tomography (PET) scanners, the availability of several radioligands, the combination of PET with advanced structural imaging, advances in modeling macroparameters of PET ligand binding, and large-scale statistical analysis of imaging datasets. Suitable single-photon emission computed tomography (SPECT) tracers are lacking, but with the increase in the number of available PET (or PET/CT) cameras and cyclotrons thanks to the clinical successes of PET in oncology, PET may become widespread enough to overcome this. In the coming decade, there should be a more widespread application of the available techniques to patients and an impact in clinical medicine.

Cutting-Edge Brain Imaging with Positron Emission Tomography

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Vesna Sossi

A review of recent advances in brain imaging using positron emission tomography (PET) is presented in this article. Some properties of the high-resolution research tomograph are described as examples of state-of-the-art PET instrumentation. A summary of current research topics in image reconstruction and quantification is given, with emphasis on the requirements of brain dynamic imaging. A brief overview of image analysis methods is presented, together with some examples of the contributions of quantitative PET imaging to the current understanding of brain function and disease. PET findings must be evaluated in the context of clinical observations and complemented by other imaging modalities whenever possible to ensure a proper interpretation of the data.

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