Annals of Nuclear Medicine Vol. 17, No. 2, 79–89, 2003

PET studies in dementia

Karl HERHOLZ

Neurologische Universitätsklinik and Max-Planck-Institut für neurologische Forschung, Köln, Germany

Measurement of local cerebral glucose metabolism (lCMRGlc) by positron emission tomography (PET) and ^{18}F-2-fluoro-2-deoxy-D-glucose (FDG) has become a standard technique during the past 20 years and is now available at many university hospitals in all highly developed countries. Many studies have documented a close relation between lCMRGlc and localized cognitive functions, such as language and visuoconstructive abilities. Alzheimer's disease (AD) is characterized by regional impairment of cerebral glucose metabolism in neocortical association areas (posterior cingulate, temporoparietal and frontal multimodal association cortex), whereas primary visual and sensorimotor cortex, basal ganglia, and cerebellum are relatively well preserved. In a multicenter study comprising 10 PET centers (Network for Efficiency and Standardisation of Dementia Diagnosis, NEST-DD) that employed an automated voxel-based analysis of FDG PET images, the distinction between controls and AD patients was 93% sensitive and 93% specific, and even in very mild dementia (at MMSE 24 or higher) sensitivity was still 84% at 93% specificity. Significantly abnormal metabolism in mild cognitive deficit (MCI) indicates a high risk to develop dementia within the next two years. Reduced neocortical glucose metabolism can probably be detected with FDG PET in AD on average one year before onset of subjective cognitive impairment. In addition to glucose metabolism, specific tracers for dopamine synthesis (^{18}F-F-DOPA) and for (^{11}C-MP4A) are of interest for differentiation among dementia subtypes. Cortical acetylcholine esterase activity (AChE) activity is significantly lower in patients with AD or with dementia with Lewy bodies (DLB) than in age-matched normal controls. In LBD there is also impairment of dopamine synthesis, similar to Parkinson disease.

Key words: PET, dementia, multicenter study, automated image analysis, Alzheimer disease, glucose metabolism, acetylcholine, dopamine