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Poster presentation

The role of Tc-99m-HMPAO SPET perfusion neuroimaging and cerebrovascular reactivity to acetazolamide in patients with mild cognitive impairment

Konstantinos Petsanis*[1], Pavlos Markou[2], Dimitrios Chatzopoulos[2] and Magda Tsolaki[1]

Address: [1]3rd Neurological Department, General Hospital G. "Papanikolaou", Aristotle University of Thessaloniki, Greece and [2]Nuclear Medicine Department, General Hospital "G. Papageorgiou", Thessaloniki, Greece

* Corresponding author

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Background

In contrast to the physiological age related decline of cognitive functions, mild cognitive impairment (MCI) is considered an early stage of dementia. In the presence of vascular risk factors, it is difficult to differentiate early stages of Alzheimer's disease (AD) from those of vascular dementia (VD), solely on the basis of clinical and neuroimaging (CT, MRI) findings. Single photon emission tomography (SPET) is a technique to obtain functional tomographic images of the 3-dimensional distribution of a radiopharmaceutical. One of the most widely used radiopharmaceutical for regional Cerebral Blood Flow (CBF) SPET is Technetium-99m (Tc-99m) labelled compound with HMPAO (Ceretec; Nycomed Amersham). After intravenous injection the Tc-99m-HMPAO lipophilic compound cross the intact blood brain barrier, distribute in the brain proportional to local blood flow and is retained in the brain with a fixed regional distribution for a sufficient time period to permit image acquisition. The peak brain activity is reached within 2 min post-injection. Since there is no redistribution, the initial tracer uptake and distribution remains almost unchanged for several hours and are independent of rCBF variations occurring after the fixation time (frozen images, which represent the rCBF at the time of injection). Acetazolamide (Diamox) is known to increase Cerebral Blood Flow (CBF) without changing the cerebral metabolic rate of oxygen. Patients with compromised circulation and resultant reduced CBF due to reduced perfusion pressure does not respond to acetazolamide. However, little is known about the cerebrovascular reactivity (CVR) in patients with MCI due to degenerative or perfusion related memory disturbances.

Materials and methods

This study included 18 patients with demonstrated (clinic and neuropsychologic findings) MCI. There were ten men and eight women (age range 52–82 years, mean 69 years) with neurological clinical examination including Hachinski scale score. Computerized tomography (CT) scanning and Magnetic resonance (MR) imaging was performed in all patients. SPET brain perfusion imaging was performed after the intravenous injection of a typical dose of 740 MBq Tc-99m-HMPAO in two different days before and after the intravenous administration of 1 gr Diamox. All SPET scans were interpreted visually.

Results

In 16 of the 18 patients, structural neuroimaging (CT/MRI) demonstrated the presence of cortical atrophy, and only two patients presented with relevant signs of ischaemic microangiopathy. In contrast, SPET scanning disclosed the presence of focal hypoperfusion, indicating the presence of vascular lesions, in 5 out of 18 patients presumptive VD group). 12 patients showed the characteristic findings of degenerative dementia (AD), and one patient was diagnosed as having both signs of focal ischaemic and global degenerative disease. In the 12 patients with presumptive AD, the mean HS value was 3.5, with a mean HS value of 7.6 in the presumptive VD group. In the patient with mixed findings, the HS was 6.

Discussion

Applied to the brain, SPET imaging can be used to assess various functions, among those cerebral perfusion plays a predominant role. This information is often complemen-

tary to the anatomic detail provided by structural neuroimaging techniques such as CT scanning or MR imagining. However, brain perfusion SPET has clinical value itself, because functional impairment in cerebral diseases often precedes structural changes. Further, functional abnormalities can be present in several neurologic and psychiatric disorders without the presence of a structural defect. SPET images are often useful in the clinical management of patients providing new and additional information that cannot be obtained from other techniques. Brain perfusion SPET has a role in the diagnosis, therapeutic management, and follow-up of patients. In addition it is a useful tool for research, because it is widely available and provides non invasive in vivo assessment of human brain function. In patients with MCI, structural neuroimaging using CT or MRI does not contribute to the differential diagnosis of presumptive degenerative from vascular dementia. In contrast, functional imaging of brain perfusion (and indirectly, metabolism) with 99mTc-HMPAO-SPET detected in all patients the presumptive underlying disease, either AD, VD or mixed dementia. SPET findings had a tendency to correlate with the HS, but the sample size was too small to detect statistical significance. As SP *Et al*. lows the semi-quantitive assessment of disease severity (spatial extent and degree of hypoperfusion), a larger study might allow the correlation of SPET clinical findings, expressed with neuro-psychological tests, such as the HS.