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Tc-99m HMPAO SPECT CEREBRAL BLOOD FLOW STUDY IN CHILDREN WITH TOURETTE'S SYNDROME

Tourette's syndrome (TS) is a chronic neuropsychiatric disorder of childhood onset, characterized by fluctuating involuntary motor and vocal tics. To date, the results of functional brain SPECT studies in TS patients are controversial, and few focus on children. Using HMPAO SPECT, we conducted this study to explore the incidence rate and location of cerebral perfusion abnormalities in children with TS.

Materials and Methods: High-resolution brain SPECT with Tc-99m HMPAO were performed on eighteen unmedicated children with TS (17 boys, 1 girl) at a mean age of 9.5 years (ranged from 5 to 14 years). To identify abnormalities, in addition to view all the slices on a color monitor, we generated regions of interest over cerebral cortex, basal ganglia and thalamus for semi-quantitative analysis.

Results: Fifteen of the eighteen (83.3%) TS children showed abnormally hypoperfused areas. The majority (22/25, 88%) of the abnormalities was on the left side. Left frontal cortex was most frequently (12/18, 66.7%) involved. Other involved areas included 5 in left temporal cortex, 5 in left basal ganglia, 2 in right basal ganglia and one in right temporal cortex.

Conclusions: Our findings suggest a high incidence rate of cerebral hypoperfusion in children with TS. Most of them involve left cerebral hemisphere, especially over left frontal cortex. The results are compatible with the current hypothesis of cortico-striatal circuit dysfunction in TS.

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MEASUREMENT OF BRAIN SEROTONIN SYNTHESIS IN LINING BRAIN

Dysfunction of the brain serotonergic system has been implicated in many brain disorders. With advances in brain imaging methodologies, particularly with the study of different brain receptors, it becomes rather important to fully understand the biological bases of brain disorders in order to measure *in vivo* the rate at which neurotransmitter serotonin is synthesized in humans. We have developed a method which uses α-[11C] methyl-L-tryptophan [α-[11C]MTrp] as a tracer with positron emission tomography (PET) for imaging 5-HT synthesis in living brain. This methodology will be exemplified by the measurement of 5-HT synthesis in normal human and dog brains. A multivariate discriminate analysis was used to identify the brain structures contributing the most to the separation of the male (n=11) and female (n=14) subjects. This analysis was carried out on the log-transformed data, because the synthesis rate in some structures were not normally distributed. By entering selective brain structures into the calculation (frontal and occipital cortex, putamen, globus palidus, hypothalamus, midbrain and amygdala) the difference between the two groups was significant ($p<0.05$).

The influence of MDMA (3,4-dimethylenedioxymethamphetamine) on brain serotonin synthesis in dog brain was also studied. Since MDMA is a rather common drug, often misused at parties, and since there is some evidence to suggest it is neurotoxic in rat and non-human primate brains, we investigated its effects on brain serotonin synthesis immediately and several hours after injection. Serotonin synthesis was measured before MDMA injection (base line), 1 h after and 5 h after MDMA using α-[11C]MTrp and PET. It was found that 5-HT synthesis is increased about 9 times one hour, and reduced about 3 times 5 h after MDMA, when compared to the baseline. This result suggests that there is a large increase in 5-HT synthesis 1 h after MDMA, likely as a result of an attempt by serotonergic neurons to replenish MDMA released 5-HT. This increase in the 5-HT synthesis probably explains the euphoric effect reported by humans who use MDMA. Similarly, reduction in brain 5-HT synthesis 5 h after MDMA would explain the need for a "booster" dose several hours after the original ingestion. This reduction could also be related to reports of depressive feelings reported by users of MDMA. The method used, as well as its potential for the study of brain 5-HT synthesis, will be discussed. In addition, the use of stepwise multivariate discriminant analysis will explained. The research presented has been supported in part by the US Public Health Service (R01-NS-29629)and the Medical Research Council of Canada (MT-13368).

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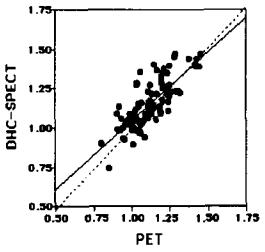
BRAIN FDG-SPECT WITH DUAL HEAD COINCIDENCE DETECTION SYSTEM: COMPARISON WITH PET IN PERFORMANCE CHARACTERISTICS AND CLINICAL APPLICATION

The clinical utility of FDG-PET imaging for the evaluation of patients with neurological diseases is well documented, however, the disadvantages of PET have limited availability with expensive maintenance. Recently, SPECT with dual head coincidence detection system (DHC) have been proposed to offer an another alternative to FDG-PET. The purpose of this study including: (1) measurement the physical imaging characteristics of DHC-SPECT system and comparison with conventional FDG-PET; and (2) comparison the images of DHC-SPECT with those of PET directly and quantitatively in human brain F-18 FDG studies. **Methods:** (1) Physical imaging characteristics, including system resolution and sensitivity, of DHC-SPECT (VERTEX PLUS MCD, ADAC Labo.) and PET (ECAT EXACT47, Siemens), were measured and compared. (2) Both brain DHC-SPECT and PET with F-18 FDG were performed in six patients with various cerebral disorders and three normal volunteers. Both DHC-SPECT and PET image were evaluated using the mean cortical-to-cerebellar ratio, semiquatitatively. **Results:** (1) System resolution and system volume sensitivity of DHC-SPECT were comparable to those of PET, respectively. (2) In human FDG imaging, the mean cortical-to-cerebellar ratio of DHC-SPECT were correlated well with that of FDG ($Y = 0.87x + 0.18$, $r=0.79$, $p<0.001$). **Conclusions:** FDG-SPECT with DHC has a comparable performance as a dedicated PET camera. It enable us to visualized metabolic parameter of brain which will dedicate to clinical usefulness in terms of cost and availability.



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INCREASED BRAIN PERFUSION BY GLYCEROL INFUSION IN ONE DAY PROTOCOL STUDY WITH 99mTECHNETIUM-ECD

The purpose of this study was to examine whether glycerol increases brain perfusion and to develop a convenient and reliable method to measure both base line and drug-induced increase of brain perfusion in a sequential study (one day protocol). Basically CBF in the base line study was measured by the method of Matsuda with 370MBq of 99m-Tc ECD. A drip infusion of 500ml of 10% glycerol and the acquisition of first SPECT images was started at 10min after injection of ECD. After the end of infusion (about 60min later), the second dynamic images were achieved with 740MBq of ECD. After the background counts on the brain and aortic arch were subtracted from the second dynamic curve, the second study was also analyzed by the method of Matsuda. The second SPECT images were taken from 9min after the second ECD injection and reconstructed after subtraction of the first images. The stability of this method was verified by studies without glycerol infusion in 19 patients with no definite abnormality on CT or MRI and the average change in hemispheric CBF between the first and second CBF was 0.69% (n=38). However, the average change after glycerol infusion in the patients with metastatic brain tumor was +17% (n=18), which was statistically significant($p=0.0011$). Average regional CBF in 16 ROIs defined semiautomatically in each patient on the cortex, basal ganglia, cerebellum, tumor core and peritumoral edema was significantly higher in glycerol treatment(44.87 and 53.05 ml/100g/min in base line and glycerol administration, respectively)($p<0.0001$). These results suggest that glycerol can increase CBF.