Functional Mapping of the Human Visual and Sensorimotor Cortices Using Positron Emission Tomography

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Positron emission tomography (PET) has been used to localize cerebral cognitive or sensorimotor function by mapping the increase of regional cerebral blood flow (rCBF) during activation tasks. This preliminary study was performed to map the brain regions involved in visual and sensorimotor tasks.

Five right-handed volunteers who were psychiatrically, medically, and neurologically healthy were studied with $H_2{}^{15}O$ PET. Each subject underwent 6 PET scans within a single experimental session: 2 scans in the resting state (n=5), 2 scans during visual stimulation (visual stimulator, stimulating frequency 8 Hz) (n=4), 2 scans during motor task (sequential finger tapping) (n=3), and 2 scans during vibrotactile stimulation of hand (n=3). The tasks were alternated, randomized and counterbalanced to address potential order effects. Automated algorithms were used to align sequential PET images in each subject, transfer their PET images into the standard spatial coordinates of the Talairach atlas, investigate rCBF changes independent of variations in whole brain measurements, and generate normalized t-score (i.e., z-score) maps of significant rCBF increases during each task relative to resting state.

Visual stimulation identified the calcarine cortex in all of the subjects. Activation was clearly demonstrated in the postcentral gyrus during vibrotactile stimulation in all of the subjects. Two of the 3 subjects who received motor stimulation showed activation in the precentral gyrus and central sulcus.

PET measurements of rCBF changes during activation tasks may permit analysis of local changes in function brought about by cognitive or sensorimotor challenge and mapping of brain function. PET activation studies would be clinically useful for localizing eloquent cerebral cortex prior to surgical resection of brain lesions.