Cortical Representations of Taste -Positron Emission Tomography Studies-.

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There have been several neurophysiological studies in monkeys which investigate the cortical representations of taste stimuli. However, the functional anatomy of the human brain in relation to gustatory stimulation has not well known. The present study is the first human PET study which shows the changes in regional cerebral flow related to taste stimulation.

Material and Methods

The present study consisted of two different PET studies. One was a visual stimulation study, and the other was a taste stimulation study. In both studies, the same PET system (PT931/04, CTI Inc. USA) and the ^{15}O labelled CO_2 ($C^{15}O_2$) continuous inhalation method were used.

Visual Stimulation Study.

The purpose of this study was to validate the reliability of our PET technique. Five male normal volunteers (age 19 to 21) were participated. Subjects inhaled $C^{15}O_2$ continuously for 7 min to produce an equilibrium state. Then eight PET scans each of 2 min were obtained. During 1st to 4th scans, subjects were asked to close their eyes. During 5th to 8th scans, subjects were asked to open their eyes and to look at a small light. Relative changes in radioactivity during the course of PET scans were measured within regions of interest on the visual cortex.

Taste Stimulation Study.

Another eight male normal volunteers (age 18 to 23) were participated. Each subject had three different runs; a control state and two taste discrimination states. During the control state, 0.2 ml of pure water was injected into the subject's mouth through small tubes every 15 seconds. Subjects were asked to press a key after every 2 injections. During one of a discrimination state, either 0.2 ml of pure water or 0.2 ml of 0.18% saline was injected at the random order. Subjects were asked to press the key when saline injected. During the other discrimination state, 10% saline were used instead of 0.18% saline. The task was the same. The PET scan of 5 min was obtained during each state, after the equilibrium state. Subtraction image of each task minus control was calculated voxel-by-voxel for each subject. Then the voxels which had the relative changes in radioactivity more than 1.96 SD of mean were regarded as significant in each individual subtraction image. Thereafter, the spatial positions of these voxels were superimposed onto the MRI of the each subject.

Result

Visual Stimulation Study.

Increases in the relative radioactivity in the visual ROIs were measured after the 5th emission runs. The mean (SD) magnitude was 29.2 (12.0)%.

Taste Stimulation Study.

All subjects successfully performed two taste discrimination tasks. Fields in the thalamus, the insular cortex, the frontal cortex, the anterior cingulate cortex and the parahippocampal gyrus showed significant activations.

Conclusion

The result of the visual stimulation study indicates that our PET technique can validate the activity changes in individual PET image. The results of the taste stimulation study combined with above conclusion indicate that cortical and the subcortical fields listed in the result may be active in relation to the taste stimuli.