

An analysis of motor area activation sequence during swallowing in a tasting task using functional MRI

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ABSTRACT

Introduction: Previous research suggested that taste stimuli may increase neuromodulation in brain regions that controls swallowing, raising the possibility that specific taste stimuli may contribute to increase the primary motor cortex (M1) BOLD activity. Thus, we aimed to investigate the effects of concentration of saline on the brain activation of gustatory areas and motor areas by using time-resolved functional MRI. **Materials and Methods:** Ten neurologically normal subjects participated in this study. A sequence of 15 sec-tasting, 6 sec-rinse and 9 sec-rest periods in one trial was repeated for 20 times in a session. In the rinse period, subjects were instructed to swallow the intraoral liquid. At the beginning of the tasting period, NaCl solution of either a lower (0.9%, L-NaCl) or a higher concentration (9.0%, H-NaCl) was applied onto the subjects' tongue. Functional data were obtained using a T2* weighted gradient echo EPI sequence on a 1.5T MRI scanner and statistical tests were performed using SPM12. The temporal analysis was performed using a set of onsets for event-related analysis for each sampling point at every 3 sec. **Results:** In H-NaCl, the activation in the M1 were observed from OS-5 (left Precentral Gyrus (PG), BA4) to OS-7 (right PG, BA4). The activations in the premotor motor cortex (PMA) were observed at OS- 6 (bilateral PG BA6). The activation in the supplementary motor cortex (SMA) were observed at OS-7 (bilateral Superior Frontal Gyrus (SFG), BA6) and OS-10 (left SFG, BA6). In L-NaCl, the M1 activation was observed from OS-6 (left PG, BA4) to OS-7 (right PG, BA4). The PMA activations were observed from OS-5 to OS-6 (bilateral PG, BA6). The SMA activation was observed from OS-6 (left SFG, BA6, right PG, and BA6) and OS-7 (bilateral medial frontal gyrus, BA6). **Conclusion:** It was suggested that motor performance for swallowing may be different between the H and L-NaCl conditions depending on their influences on the subjects' behaviour. In the L-NaCl, the activation peak sequence PMA - M1 is the usual order in motor execution. In H -NaCl, the reversed sequence M1 - PMA may suggest more attempt to remove the NaCl with higher concentration toward the end of rinse period. The activation peak of SMA later than that of PMA and M1 may suggest its independency from the motor generation to rinse. One possible explanation may be preparation to form still status in the rest period. Its activity at OS-10 in H-NaCl may also represent preparation and tension for the next strong stimuli.