Sensory Speech Area Investigated by Magnetoencephalography

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INTRODUCTION

If brain lesions are situated in the temporo parietal area and surgical treatment is necessary, it is important to know where the functional speech areas of the patient are, to avoid damage during surgical treatment. In 96% of right handed and in 70% of left handed humans the speech areas are located exclusively in the left hemisphere. In 15% of the left handed people and 4% of the right handed ones the speech areas are located in the right hemisphere alone (Wada et al. 1969). We investigated whether stimulation with cognitive tasks involving speech processing evokes brain activity, which can be used to localize the speech area.

METHODS

We recorded in 13 subjects (9 right handed, 4 left handed) the magnetic brain activity with the 37 channel biomagnetic system KRENIKON (Siemens). The volunteers were asked to create in their mind the word describing an object presented to them on a screen. Another task was to read a word on the screen and imagine the object. In both cases the task was performed about 800 times and we measured the activity of the left and the right hemisphere. In order to avoid the influence of the auditory response in the Heschl gyrus, which is neighbouring the speech areas, we stimulated visually. The screen was observed using a glass fibre optic with 10000 fibres and an angle of vision of about 10 degrees. The 100 different stimuli were presented randomized. The displayed pictures were known to the subject. The interstimulus intervall was between 1500ms and 1900ms. The presentation of the stimulus had a duration of 500ms. The trials of each task and each hemisphere were averaged. The data were filtered from 1 to 48 Hz. Only the data of two right handed subjects were included in detailed further evaluation, because of the quality of the data. The time course of left and right measurements were compared to each other and sources were localized using a single dipole fit (Marquardt algorithm). Additionally the Current Localization using the Spatial Filtering (CLSF) was applied, which shows the region of most probable current flow (Grummich et al. 1992). The results were inserted into MR-slices using a coordinate transformation obtained by a head contour fit (Kober et al. 1993).

RESULTS

The time courses show, that activity in the lateral brain areas starts about 250ms after stimulus onset. The first three waves marked in the figure by A,B,C have mainly a monopolar field distribution, indicating that this activity originates from occipital areas. Remarkable is a wave having its maximum at about 350ms after stimulus onset (marked by D) and a wave starting at about 500ms. The waves originating from the left hemisphere of the right handed subjects are up to two times stronger than the ones from the right hemisphere. The inter subject variability of the time course is high, but each subject shows always similar results, when the experiment is repeated. The responses to the stimulation with words (second task) are shown in figure 1. The responses following the presentation of objects are shown for the second subject (lower two traces) as hatched lines as well. These time courses are remarkably similar.

The localizations of the first subject determined at 386ms after stimulus onset are situated in the fissure between gyrus temporalis superior and gyrus temporalis medius. This area is known as the sensory speech area (Wernicke’s area; Kretschmann et al. 1991, Vignolo et al. 1988). Sometimes the localizations are situated up to 5 millimeters medial of it in the backside of the insula. We assume, that the deeper location is caused by a modelling error. The experience shows, that the results are always to deep, if a distributed source is approximated by a single dipole.

DISCUSSION

We found, that stimulation with speech tasks evokes activity in the temporal area. Furthermore, we found differences between the responses measured above the left and the right hemisphere. Localizations were found in or less than 5mm apart from the sensory speech area. A problem is, that only a few subjects have a good signal. The distortion may be caused by breathing and muscle artifacts, by the difficult viewing condition, by not performing constantly the task or
by an interference of several activities of the brain. It remains to be studied, whether an alternative task may evoke a stronger signal in more subjects or whether additional data processing may improve the signal.

REFERENCES


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