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PRIMARY SOMATOSENSORY EVOKED MAGNETIC FIELDS BY DORSAL PENILE NERVE STIMULATION

Hypothesis / aims of study

The aim of this study was to investigate the primary somatosensory cortex of the penis in the human brain using magnetoencephalography (MEG). MEG, the magnetic counterpart of electroencephalography (EEG), has similar high time resolution and higher spatial resolution than EEG because of the negligible effect of the inhomogeneous head conductivity. Somatosensory evoked magnetic fields (SEFs) are the MEG responses to various types of stimulation of the peripheral nerves and skin.

Study design, materials and methods

The subjects were seven healthy male volunteers aged 30-40 (mean: 33.9) years old, with heights of 166-171 cm. SEF for the stimuli were measured with a helmet-shaped MEG system. Electrical stimuli were applied unilaterally to the dorsal penile nerve (DPN) at an intensity just below the pain threshold. Electrical square pulses with duration and frequency of 0.3 ms at 2.8 Hz, respectively, were delivered and signals were averaged over 1000 stimuli. SEFs for the median (MN) and posterior tibial nerves (PTN) were also measured for comparison. Sources of the early SEF peaks were superimposed on individual magnetic resonance images. The first peak of the DPN originated from the primary somatosensory cortex, and the source strength was estimated by an equivalent current dipole (ECD) model (Figure).

Results

The first peak latency for the DPN stimulus was 39.2 ± 4.7 ms (mean ± standard deviation, N=14), which was similar to the latency for the PTN stimulus (39.3 ± 1.3 ms, N=14) and longer than the latency for the MN stimulus (21.0 ± 0.8 ms, N=14) ($p<0.001$). The source strengths of first peak latency for DPN were 3.8 ± 3.5 nAm, which were smaller than those for PTN (19.1 ± 6.1 nAm; $p<0.001$) and those for MN (25.5 ± 8.3 nAm; $p<0.001$) (Table). The ECDs of the DPN stimuli were located near the medial end of the contralateral central sulcus facing the interhemispheric surface (Figure).

Interpretation of results

There have been few previous reports of MEG investigations for DPN[1)2)]. The previous reports described that the first peak latency for the DPN was from 50 to 63.8 ms. In this study, the first peak latency for the DPN stimulus was 39.2ms, which was shorter than the previous reports[1)2)].

Concluding message

We were able to measure the SEF for the DPN stimuli using MEG, and clearly identified the location of the penis in the primary somatosensory cortex. MEG can be used to evaluate brain cortical response to the urogenital organs. This non-invasive technique promises further brain functional mapping for the urogenital organs.

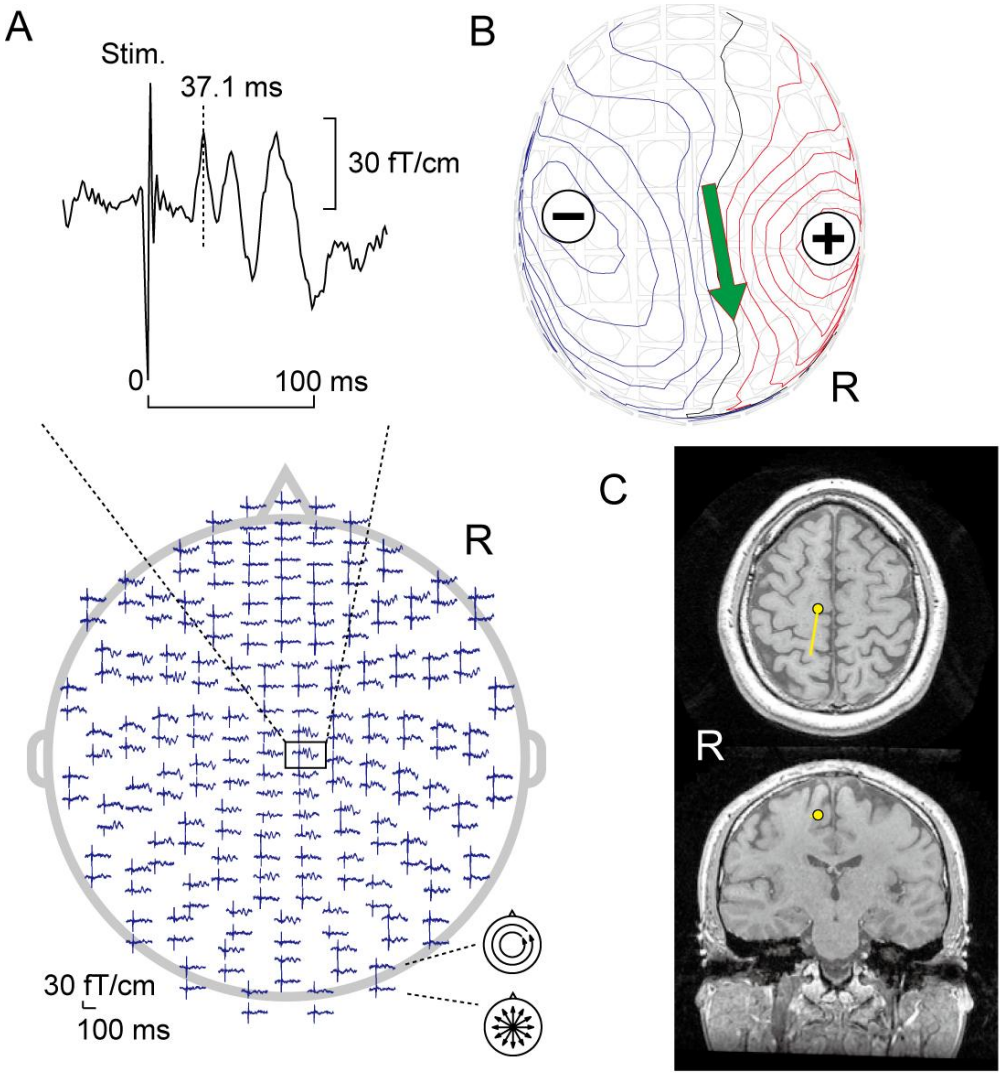
Table

Latency and source strength of DPN, MN and PTN

	DPN	MN	PTN
Latency (ms)	39.2 ± 4.7	21.0 ± 0.8*	39.3 ± 1.3
Source strength (nAm)	3.8 ± 3.5	25.5 ± 8.3*	19.1 ± 6.1*

Mean ± standard deviation
*p<0.001 compared with DPN

Figure



Somatosensory evoked magnetic fields for the left dorsal penile nerve (DPN) stimulus in a normal male subject.
A. The first peak of the DPN stimulus (37.1ms) was defined from a typical waveform (upper) obtained from 204 gradiometer sensors recording from 50 ms before and 150 ms after the stimulus onset (bottom). The latitudinal and longitudinal derivatives of the magnetic field (upper and lower curves in each pair, respectively) are shown at each measurement site. B. Isofield map at the first peak latency of the DPN indicates a single dipole pattern over the vertex with posterior orientation. C. Equivalent current dipole (ECD) of the DPN is superimposed on magnetic resonance images of the subject. Circles and bars indicate the ECD location and orientation, respectively.

References

1. Electroencephalogr Clin Neurophysiol (1998) 108; 57-61
2. Hum Brain Mapp (2003) 18; 90-99

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Is this a clinical trial?	**Yes**
Is this study registered in a public clinical trials registry?	**No**
What were the subjects in the study?	**HUMAN**
Was this study approved by an ethics committee?	**Yes**
Specify Name of Ethics Committee	**The ethical committees of Tohoku University Graduate School of Medicine and of Kohnan Hospital**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**