Magnetoencephalography (MEG)

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Introduction

Magnetoencephalography (MEG) is a noninvasive test recording faint magnetic fields that are caused by neuronal activity.

Testing

The subject's head is surrounded by a vacuum insulated flask also referred to as Dewar, it contains hundreds of very sensitive magnetic field detectors. Electroencephalography (EEG) and MEG signals are very closely related; in case of the EEG, different conductivities of various tissues lead to lateral spread and distortion, while the magnetic fields that are recorded in MEG are unaffected by different tissues. However, complex software using anatomic and physiologic assumptions is needed to identify signal generators.Pain signals reach first the primary somatosensory cortex (SI) in the contralateral sulcus centralis with an >20 ms latency and then the bilateral secondary somatosensory cortices (80–150 ms) which are located along the lateral sulcus in the parietal operculum, with somatotopy (representation of body parts over this cortical area) demonstrated in animal studies. Positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) demonstrate that the next affected area is the cingulum, both anterior and posterior parts; the posterior parts can be timed by concurrent MEG/EEG measurements as vertex positivity at 200–350 ms. As mentioned above, functional imaging and MEG/EEG can be combined, but extra scrutiny is warranted due to major differences in the methods (for instance, MEG signal decreases with increasing stimulus intensity, the opposite is the case with fMRI) [1, 2].

High Yield Point

- MEG is a noninvasive but highly complex research tool for central pain processing, with excellent time resolution.

Questions

1. Magnetoencephalography (MEG) is defined as:
   A. Noninvasive test recording faint magnetic fields that are caused by neuronal activity
   B. Refers to magnetic stimulation of brain cells
   C. Mode of therapy for patients with Epilepsy
   D. None of the above
   Answer: A

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2. Magnetoencephalography (MEG) is useful in experimental pain research because MEG:
   A. is a low cost exam
   B. can measure responses without delay, in real time
   C. allows for straightforward anatomic identification with high precision
   D. electrodes are minimally invasive and cause only mild discomfort
   E. is particularly helpful measuring spinal cord and cortical responses in the same setting
   Answer: B
3. The following statements about central pain processing are correct except:
   A. The primary sensorimotor cortex (SI) response can be recorded at the contralateral postcentral gyrus
   B. The response of the secondary somatosensory cortices (SII) is noted afterwards
   C. The SII response is one-sided/contralateral as well
   D. The anterior and posterior cingulate gyrus are also involved in nociception
   E. The primary sensorimotor cortex is thought to be much less receptive to opioid analgesia than other central structures
   Answer: C

References

1. Hari R, Puce A. MEG-EEG primer. New York: Oxford University Press; 2017.
2. Bromm B. Brain images of pain. News Physiol Sci. 2001;16:244–9.