CANCELLED - Temporal variation of medial olivocochlear reflex during sleep and its relation to electroencephalographic activity

Sho Otsuka*†[1], Yuto Suzuki[1], and Seiji Nakagawa[1]

[1]Chiba University – Japan

Abstract

The medial olivocochlear reflex (MOCR) is a feedback response that controls the gain of the outer hair cells. It has been reported that the MOCR becomes weaker during sleep. However, it remains unclear how early in sleep stages the MOCR reduction begins. In this study, we evaluated stages from awakening to sleep using electroencephalogram (EEG) and electrooculogram (EOG) and investigated the relationship with MOCR strength.

The amplitude of β (13-30 Hz), α (8-13 Hz),
theta (4-8 Hz) and δ wave (0.5-4 Hz), which reflects each stage from wakefulness to deep sleep, were monitored during the two-hours measurement session. Simultaneously, we assessed MOCR in terms of the suppression of click-evoked otoacoustic emissions (CEOAEs) induced by noise presented to the contralateral ear. Click trains were played into the right ear canal to generate CEOAEs from within the cochlea. Each click had a duration of 100 μs. Clicks were presented at a 55-dB peak-equivalent sound pressure level (SPL) and at a rate of 50 times per second. The MOCR was elicited by a noise presented to the left ear, referred to as the MOCR elicitor, during the CEOAE recording. The noise was band-pass filtered between 100 and 10,000 Hz, with a duration of 0.5 s, including a 10-ms raised-cosine ramp. The noise was presented at 60-dB SPL and at intervals of 5 s. The relatively long intervals were aimed to differentiate neural oscillations from event-related potentials evoked by the MOCR elicitors. The CEOAE waveforms measured from one minute before and one minute after each time point were extracted, and then the waveforms measured in the interval with and without contralateral noise were averaged, respectively. The pressure levels of the CEOAEs for each condition were defined as RMS values in the region of 8–18 ms and are denoted as Pwith and Pwithout (in Pa). MOCR strength was defined as 20log10(Pwith/Pwithout).

The amount of OAE suppression (MOCR strength) had a statistically significant positive correlation with the time variation of α waves (appearing mainly from awakening to sleep onset), but not with other EEG components and with the time variation of slow eye movement (appearing in the sleep onset period), which was calculated from EOG. This result indicates that MOCR strength becomes weaker at a relatively early stage of sleep onset, which has a large change in awareness level, regardless of the depth of sleep. Further, no correlation was found between the auditory brainstem response and the α waves. This result indicates that the reduction of MOCR strength at sleep onset cannot be attributed to the changes of activities from the inner ear to brainstem.

*Speaker
†Corresponding author: otsuka.s@chiba-u.jp