P806

Effects of cortical derivation on electroencephalogram power spectrum characteristics during sleep and wakefulness in mice

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Objectives: Cortical electroencephalogram (EEG) reflects both local synaptic activity as well as activities originating from distant areas. Since the contribution of local and distant sources into the cortical EEG is vigilance state- and frequency-specific, the recording configuration is essential. The aim of this study was to compare EEG power spectra obtained from three conventionally used electrode layouts in freely-moving mice during spontaneous waking and sleep.

Methods: Adult male C57BL/6J mice ($n = 9$) were used. EEG screws were placed in the frontal (F, AP +2 mm, ML +2 mm) and occipital (O, AP –3.5–4 mm, ML +2.5 mm) regions (reference above the cerebellum, C). EEG power spectra calculated from F-C, O-C and differential F-O signals were analysed during spontaneous waking and sleep in the light period.

Results: Absolute EEG power of slow frequencies (0.5–5 Hz) in NREM sleep was 1.4 $\pm$ 0.2 fold higher in F-C vs O-C ($P = 0.03$), but no differences were apparent between either F-C or O-C vs F-O spectra. In contrast, during REM sleep, EEG theta power (6–12 Hz) in O-C (168.9 $\pm$ 19.0 μV^2/0.25 Hz) was significantly greater as compared to both F-C and F-O (90.5 $\pm$ 6.1 and 90.5 $\pm$ 17.3 μV^2/0.25 Hz respectively, $P < 0.01$). Similarly, during wakefulness, a distinct peak was apparent in the EEG spectrum between 6–12 Hz only in O-C, resulting in this configuration having higher EEG power in this range (86.4 $\pm$ 6.7 μV^2/0.25 Hz), compared to both F-C and F-O configurations (65.3 $\pm$ 2.9 and 54.4 $\pm$ 6.7 μV^2/0.25 Hz, $P < 0.05$ and 0.01 respectively).

Conclusions: Our data suggest that recording configuration affects cortical EEG in a vigilance state- and frequency-specific manner.

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