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Bird-like propagating brain activity in anesthetized Nile crocodiles

Ryan K Tisdale, John A Lesku, Gabriel J L Beckers, Niels C Rattenborg

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Abstract

Study Objectives

The changes in electroencephalogram (EEG) activity that characterize sleep and its sub-states—slow-wave sleep (SWS) and rapid eye movement (REM) sleep—are similar in mammals and birds. SWS is characterized by EEG slow waves resulting from the synchronous alternation of neuronal membrane potentials between hyperpolarized down-states with neuronal quiescence and depolarized up-states associated with action potentials. By contrast, studies of non-avian reptiles report the presence of high-voltage sharp waves (HShW) during sleep. How HShW relate to EEG phenomena occurring during mammalian and avian sleep is unclear. We investigated the spatiotemporal patterns of electrophysiological phenomena in Nile crocodiles (*Crocodylus niloticus*) anesthetized with isoflurane to determine whether they share similar spatiotemporal patterns to mammalian and avian slow waves.

Methods

Recordings of anesthetized crocodiles were made using 64-channel penetrating arrays with electrodes arranged in an 8 × 8 equally spaced grid. The arrays were placed in the dorsal ventricular ridge (DVR), a region implicated in the genesis of HShW. Various aspects of the spatiotemporal distribution of recorded signals were investigated.

Results

Recorded signals revealed the presence of HShW resembling those reported in earlier studies of naturally sleeping reptiles. HShW propagated in complex and variable patterns across the DVR.

Conclusions

We demonstrate that HShW within the DVR propagate in complex patterns similar to those observed for avian slow waves recorded from homologous brain regions. Consequently, sleep with HShW may represent an ancestral form of SWS, characterized by up-states occurring less often and for a shorter duration than in mammals and birds.

Crocodylus niloticus, dorsal ventricular ridge, evolution, high-voltage sharp waves, slow waves, traveling, propagating, isoflurane

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