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Monotremes and the evolution of sleep

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Summary

Sleep is an active process that requires the engagement of brainstem, hypothalamic, thalamic and cortical neural systems for the full physiological expression of the different sleep states. In mammals and birds, sleep involves cycling between slow wave sleep and paradoxical or rapid eye movement (REM) sleep states. The sleep physiology of monotremes is especially important for understanding the evolution of REM sleep among mammals in particular and amniotes in general. The presence of therian-like REM sleep in monotremes would imply that REM sleep (or at least some variant of it) was present in the common ancestor for therians and prototherians. If some variant of REM sleep is present not just in birds and mammals but in all amniotes, then the emergence of some form of REM sleep may have predated the common ancestor of all extant amniotes. Nevertheless, the nature or even existence of paradoxical sleep among the monotremes remains controversial, with some reporting that the monotremes exhibit a sleep state that has the brainstem, but not forebrain, components of paradoxical or REM sleep; whereas other reports find that echidnas have entirely typical features of therian REM sleep.

What is sleep? What is wakefulness?

Sleep is an active process and is found in a wide variety of vertebrates from fish through to amphibians, reptiles, birds and mammals, although features of sleep differ between vertebrates. Sleep differs from coma in that the sleeper can be aroused from sleep, and sleep plays an important part in normal brain function, particularly in learning and memory. Nevertheless, sleep is still a poorly understood type of brain activity.

Sleep is composed of behavioural, physiological/metabolic and electrophysiological (i.e.