Pharmaceutical Regulatory Affairs 2012: Does sleeping brain help consolidate associative conditioned memory in the rat - Hamdard University, New Delhi, India

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Abstract

Several studies suggest that sleep helps in the consolidation of certain memories but its role in the consolidation of trace and delay conditioned memories is not clearly known. Using the trace and delay conditioning paradigms in rats, we have found that consolidation of these memories is sleep-dependent as sleep deprivation impairs the consolidation of these memories. Further, it is believed that various sleep stages, possibly in part, provide an optimal condition to the brain for a range of distinct memory consolidation processes. For example, proficient learning of visual texture discrimination task augments total sleep, while the motor sequence task and motor adaptation task increase NREM sleep only. It is not known, however, if the change in sleep architecture after learning is a memory consolidation dependent phenomenon. Our data suggest that the altered sleep architecture after learning is indeed a memory consolidation dependent mechanism. The alteration in sleep architecture during the encoding of memory seems to be an essential procedural demand to fulfill the memory consolidation phenomenon. Additionally, we have reported that sleep potentiates in-vivo cortical synaptic plasticity by augmenting the neuronal firing rates, suggesting that it plays an instructive role for synaptic plasticity, which could be an underlying mechanism of memory consolidation. In this review we aim to comprehensively cover the field of "sleep and memory" research by providing a historical perspective on concepts and a discussion of more recent key findings. Whereas initial theories posed a passive role for sleep enhancing memories by protecting them from interfering stimuli, current theories highlight an active role for sleep in which memories undergo a process of system consolidation during sleep. Whereas older research concentrated on the role of rapid-eye-movement (REM) sleep, recent work has revealed the importance of slow-wave sleep (SWS) for memory consolidation and also enlightened some of the underlying electrophysiological, neurochemical, and genetic mechanisms, as well as developmental aspects in these processes. Specifically, newer findings characterize sleep as a brain state optimizing memory consolidation, in opposition to the waking brain being optimized for encoding of memories. Consolidation originates from reactivation of recently encoded neuronal memory representations, which occur during SWS and transform respective representations for integration into long-term memory. Ensuing REM sleep may stabilize transformed memories. While elaborated with respect to hippocampus-dependent memories, the concept of an active redistribution of memory representations from networks serving as temporary store into long-term stores might hold also for non-hippocampus-dependent memory, and even for nonneuronal, i.e., immunological memories, giving rise to the idea that the offline consolidation of memory during sleep represents a principle of long-term memory formation established in quite different physiological systems. Over more than a century of research has established the fact that sleep benefits the retention of memory.