

Continual-Activation Theories of Sudden Infant Death Syndrome

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Abstract: This paper hypothesizes that the sudden infant death syndrome is caused by the failure of activating the continual-activation mechanism during sleep.

Keywords: Continual activation theory, SIDS, REM, NREM, sleep, working memory.

Introduction

The sudden infant death syndrome (SIDS) remains a leading cause of death during the first year. SIDS has been defined as "the sudden and unexpected death of an infant under 1 year of age, with onset of the lethal episode apparently occurring during sleep, that remains unexplained after a thorough investigation including performance of a complete autopsy, and review of the circumstances of death and the clinical history" (Krous et al 2004). SIDS most commonly occurs in otherwise apparently healthy infants from 1 month to 1 year of age, with the greatest number taking place between the ages of 2 and 4 months. Death is often the first sign of any potential problem for SIDS victim. SIDS deaths occur quickly, with no signs of suffering, and are associated with sleep. However, despite decades of research, the exact causes of SIDS are still unknown.

The theory presented here is a direct extension of Zhang's memory model and the continual-activation theory (Zhang, 2004, 2005a, 2005b). Readers are encouraged to read these articles first.

Continual-Activation Theory of Sudden Infant Death Syndrome (SIDS)

Hypothesis: The cause of sudden infant death syndrome is due to the failure of activating the continual-activation mechanism during sleep.

The continual-activation theory proposes that both the conscious and non-conscious subsidiary systems of working memory of human brain have to be continually activated throughout a person's lifetime. This requirement of continual activation can be easily met during waking time, since the five senses continuously pass information to both conscious and non-conscious working memories for processing. However, this is not the case during sleep time, when the sensing rates of all the sensors are slowed, and the arousal thresholds are increased. Zhang (2004) hypothesized that sleep has two stages: non-rapid eye movement (NREM) sleep for processing the declarative memory in the conscious subsidiary system of working memory; and rapid eye movement (REM) sleep for processing the procedural memory in the non-conscious subsidiary system of working memory. The questions are how the brain maintains the continual-

activation in non-conscious subsidiary system of working memory in NREM sleep, and conscious subsidiary system of working memory in REM sleep.

To answer these questions, Zhang (2005a) proposed that there is a continual-activation mechanism in each subsidiary system of working memory to carry out this task. When the activation level of either subsidiary system descends to a certain threshold, the corresponding continual-activation mechanism in the brain will be triggered to generate a data stream from memory stores to flow through the subsidiary system in order to maintain brain continual activation. Therefore, the existence of the continual-activation mechanisms provides a safeguard for life to go on during sleep time, and also a necessary condition for animal hibernation. Based on above assumptions, the author further hypothesize that failure of activating either continual-activation mechanisms during sleep is the root cause of the sudden infant death syndrome.

The continual-activation mechanism may fail in one of two ways: first, failure of activating the continual-activation mechanism in the non-conscious subsidiary system of working memory during the NREM sleep period; second, failure of activating the continual-activation mechanism in the conscious subsidiary system of working memory during the REM sleep period. In the first situation, without brain continual activation in the non-conscious subsidiary system longer than a certain time period will lead the overall nervous system failure, since this subsidiary system regulates and monitors many critical systems such as heart rate, respiratory rate and blood pressure. This explains why sudden infant death occurs quickly, with no signs of suffering during sleep. In the second situation, loss of brain continual activation in the conscious subsidiary system during the REM sleep period, will lead to an unconscious (coma like) condition. This will create a condition from which a baby cannot awake in response to potentially dangerous situations, such as apnea or any respiratory problem. "Back to sleep campaign" and other health promotion program for reducing the risk of SIDS can only reduce the SIDS cases that are caused by this later type of situation, but not the first type. This explains why SIDS cannot be eliminated, even when all the known risk factors have been reduced.

The continual-activation theory of SIDS can also explain why most SIDS deaths occur between the ages of 2 and 4 months. According to study results of sleep-wakefulness rhythm in infants (Dement, 1999), infant sleep, at birth, is distributed evenly over six to seven brief sleep periods. These short sleep and night waking in the first few months have survival benefits. When a failure of activating the continual-activation mechanism occurs, short sleep can reduce the risk of reaching a life threatening condition. This sleep pattern changes significantly between 2 and 4 months. After 4 months, most babies can sleep through the night. This longer and deeper sleep pattern creates a situation that could jeopardize survival if either of the continual-activation mechanisms failed to activate when needed.

Conclusion

This paper hypothesizes that the sudden infant death syndrome is due to the failure of activating the continual-activation mechanism during sleep.

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