Swaddling and Sudden Infant Death Syndrome: A Selected Annotated Bibliography


Influence of swaddling on sleep and arousal characteristics of healthy infants.

Objective: Swaddling is an old infant care practice. It was reported to favor sleep and to reduce crying among irritable infants. There are few data on the physiologic effects of swaddling on infants' sleep-wake characteristics. This study was conducted to evaluate whether swaddling influences infants' arousal thresholds for environmental auditory stress. Design: Sixteen healthy infants, with a median age of 10 weeks (range: 6-16 weeks), underwent polygraphic recording in their usual supine position during one night. The infants were successively recorded swaddled and nonswaddled, or vice versa. In both conditions, the infants were exposed to white noise of increasing intensity, from 50 to 100 dB(A), during rapid eye movement sleep, to determine their arousal thresholds. Results: Swaddling was associated with increases in the infants' sleep efficiency and in the time spent in non-rapid eye movement sleep. When swaddled, the infants awakened spontaneously less often. However, significantly less-intense auditory stimuli were needed during rapid eye movement sleep to induce cortical arousals when swaddled than when not swaddled. Conclusions: Swaddling promotes more-sustained sleep and reduces the frequency of spontaneous awakenings, whereas induced cortical arousals are elicited by less-intense stimuli. These findings could indicate that, although swaddling favors sleep continuity, it is associated with increased responsiveness to environmental auditory stress.

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Franco P, Scaillet S, Groswasser J, Kahn A.

Increased cardiac autonomic responses to auditory challenges in swaddled infants.

Study Objectives: When infants have been swaddled and sleep supine, their risk of dying from sudden infant death syndrome (SIDS) is reduced with an odds ratio of 0.64 to 0.69. Alternatively, the risk for SIDS in swaddled infants shows a 3-fold increase in the prone position. The protective role of swaddling during supine sleep has remained unexplained. This study was designed to evaluate the effects of swaddling on cardiac reactivity to auditory stimuli during sleep in both the prone and the supine position. Design: Thirty healthy infants with a median age of 11 weeks (range 8 to 15 weeks) were studied polygraphically for 1 night while sleeping successively prone and supine, or vice versa. The infants were studied while swaddled and nonswaddled in both positions. Heart rates were studied during rapid eye movement sleep, before and after exposure to 90 dB(A) of white-noise. Results: Ten infants were excluded from the study because they woke up during the position change or the auditory challenge. Before the administration of the...
noise stimulus, swaddling decreased values of basal heart rates in the supine position only (P = .049). Following swaddling, the values of basal heart rate were significantly lower in the supine than in the prone position (P = .003). Auditory challenges were followed by a greater increase in heart rate when the supine sleeping infants were swaddled than when not swaddled (P = .018). When swaddled, beat-to-beat heart-rate variability increased following auditory stimulation in the supine position only (P = .012). Conclusion: When sleeping supine, swaddled infants had greater cardiac autonomic changes in response to noise challenges than when they were not swaddled.

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Gerard CM, Harris KA, Thach BT.
**Physiologic studies on swaddling: an ancient child care practice, which may promote the supine position for infant sleep.**
J Pediatr. 2002 Sep; 141(3):398-403

Objective: The calming effects of swaddling may help infants accept back sleeping and so reduce the risk of sudden infant death syndrome. We hypothesized that swaddling, with minimal leg restraint, would be accepted by postneonatal infants with minimal respiratory effects. Study design: Postneonatal infants (n = 37) were studied for the introduction of swaddling. Four infants were studied by using traditional swaddling techniques. Swaddle tightness was increased in 13 infants, simulating traditional swaddles. Respiratory variables-respiratory rate, tidal volume, oxygen saturation, heart rate, sigh rate, and "grunting"-were measured. Results: Hips were flexed and abducted in the swaddle. The majority of infants accepted swaddling while supine, including 78% of infants who slept prone at home. Acceptance decreased with increasing age. With increased swaddle pressure, respiratory rate increased during quiet sleep (P <.05). In rapid eye movement sleep, a slight effect on heart rate was observed (P <.05). Other variables did not change. Conclusions: Older infants including usual prone sleepers generally accept a form of swaddling that has minimal respiratory effects. The reintroduction of swaddling, without restricting hip movement or chest wall excursion, combined with supine sleeping, may promote further sudden infant death syndrome reduction.

Full-text available at: http://journals.elsevierhealth.com (not a U.S. Government site)

Gerard CM, Harris KA, Thach BT.
**Spontaneous arousals in supine infants while swaddled and unwaddled during rapid eye movement and quiet sleep.**
Pediatrics 2002 Dec; 110(6):e70

Objective: Supine sleep is recommended for infants to decrease the risk of sudden infant death syndrome, but many parents report that their infants seem uncomfortable supine. Many cultures swaddle infants for sleep in the supine position. Swaddled infants are said to "sleep better"; presumably they sleep longer or with fewer arousals. However, there have been no studies of the effect of swaddling on spontaneous arousals during sleep. Arousal is initiated in brainstem centers and manifests as a sequence of reflexes: from
sighs to startles and then to thrashing movements. Such "brainstem arousals" may progress to full arousal, but most do not. Methods: Twenty-six healthy infants, aged 80 +/- 7 days, were studied during normal nap times. Swaddled (cotton spandex swaddle) and unswaddled trials were alternated for each infant. Sleep state (rapid eye movement [REM] or quiet sleep [QS]) was determined by behavioral criteria (breathing pattern, eye movements) and electroencephalogram/electrooculogram (10 infants). Respitrace, submental and biceps electromyogram, and video recording were used to detect startles and sighs (augmented breaths). Full arousals were classified by eye opening and/or crying. Frequencies of sighs, startles, and full arousals per hour were calculated. Progression of events was calculated as percentages in each sleep state, as was duration of sleep state. Results: Swaddling decreased startles in QS and REM, full arousal in QS, and progression of startle to arousal in QS. It resulted in shorter arousal duration during REM sleep and more REM sleep. Conclusions: Swaddling has a significant inhibitory effect on progression of arousals from brainstem to full arousals involving the cortex in QS. Swaddling decreases spontaneous arousals in QS and increases the duration of REM sleep, perhaps by helping infants return to sleep spontaneously, which may limit parental intervention. For these reasons, a safe form of swaddling that allows hip flexion/abduction and chest wall excursion may help parents keep their infants in the supine sleep position and thereby prevent the sudden infant death syndrome risks associated with the prone sleep position.