

Arousal from Sleep

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Question 2

Arousal from sleep is a frequent occurrence in patients with obstructive sleep apnea syndromes and plays a significant role in the adverse clinical consequences of untreated sleep apnea. Which of the following respiratory stimuli most consistently predicts arousal from sleep?

- a. The degree of inspiratory resistance.
- b. The arterial carbon dioxide tension.
- c. The pH of arterial blood.
- d. The degree of inspiratory effort.
- e. The arterial oxygen tension.

Disclosure Statement

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IT DOESN'T SOUND LIKE SNORING

ANSWER 1: C

DISCUSSION

This patient was experiencing stridor due to vocal cord paralysis. Vocal cord paralysis was evident during fiberoptic endoscopy and the patient underwent immediate tracheostomy with resolution of excessive sleepiness and breathing difficulties. Vocal cord paralysis and recurrence of symptoms after decompression surgery have both been described in patients with Arnold Chiari malformation.^{1,2} Patients with Arnold-Chiari malformation can develop both obstructive and central apneas (see figure).^{3,4} Such apneas may be due to depression of respiratory centers, depression of ascending reticular activating system, or paralysis of upper airway muscles and vocal cords.^{4,6} Bilateral vocal cord paralysis with stridor can be life threatening, and may be one mechanism for sudden death known to occur in these patients.⁷ As in this patient, nocturnal hypoventilation may persist despite tracheostomy due to depression of respiratory centers and/or diaphragm paralysis.^{4,6,8} Such patients may require nocturnal assisted ventilation until resolution of such hypoventilation with time.

In this patient, the history, physical examination, and sleep technicians report are more suggestive of vocal cord paralysis than heart failure, adenoidal hypertrophy, or bronchospasm (response A, B, and D). Although the exact prevalence of sleep-disordered breathing in these patients is unclear, a high degree of suspicion for sleep-disordered breathing should be entertained and polysomnogram performed when appropriate. As always, anxiety as a cause of dyspnea should be a diagnosis of exclusion (response E).

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AROUSAL FROM SLEEP

ANSWER 2: D

DISCUSSION

The preponderance of scientific evidence indicates that while changes in arterial carbon dioxide tension, arterial oxygen tension, arterial pH and mechanical factors are important in altering the time course of inspiratory effort, arousal from respiratory stimuli is triggered at a consistent level of inspiratory effort independent of the combination of individual respiratory stimuli contributing to the inspiratory effort.^{1,2} The notion that inspiratory effort best predicts arousal from sleep is supported by investigations in normal humans^{1,2,3,4} and in patients with obstructive sleep disordered breathing.^{1,5}

The majority of investigations into the nature of respiratory arousal from sleep have focused on normal individuals and obstructive sleep disordered breathing. The mechanisms leading to arousal in central sleep disordered breathing have not been well elucidated. The observation that arousal from sleep in Cheyne-Stokes respiration occurs during hyperpnoea,⁶ a time in which inspiratory effort is theoretically maximal, is consistent with the notion that inspiratory effort triggers arousal in this form of central sleep disordered breathing. The mechanism by which inspiratory effort prompts arousals occurring with the resumption of ventilatory effort, as occur with idiopathic central sleep apnea, has not been clearly defined.

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