Elevated Body Position Early after Delivery Increased Airway Size during Wakefulness, and Decreased Apnea Hypopnea Index in a Woman with Pregnancy Related Sleep Apnea

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CASE REPORTS

We report a patient with pregnancy related obstructive sleep apnea ([OSA]; apnea hypopnea index [AHI] 18/h) early after delivery, with improvement of AHI by 87% following 45-degree elevation in body position compared with the non-elevated position. Improvement associated with this position may be explained, at least in part, by an increased upper airway diameter (as measured during wakefulness). Sleep apnea in this patient resolved at 9 months postpartum. This observation suggests that 45-degree elevated body position may be

an effective treatment of pregnancy related OSA during the postpartum period.

Keywords: pregnancy, polysomnography, sleep apnea, positional therapy, post-partum

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Hormonal changes during pregnancy cause water retention leading to increased upper airway (UA) resistance and pregnancy related obstructive sleep apnea (OSA). The incidence of sleep apnea is high and associated with adverse pregnancy outcomes. Depending on method used for assessment and population studied, symptoms of sleep apnea occurred in up to 85% in a cohort of women with preeclampsia.¹⁻³ During the postpartum period, airway obstructions are a main cause of anesthesia related maternal death in North America,⁴ and increased vulnerability to airway obstruction may be successfully treated with adequate body position, as elevated posture has been shown to improve UA size accessed by acoustic pharyngometry⁵ and collapsibility during anesthesia⁶ and sleep, as well as during wakefulness in pregnant women.^{7,8} Nevertheless, the effect of elevated upper body position on airway size and pregnancy associated OSA is currently unknown. We evaluated the effects of elevated upper body position on nocturnal breathing in a woman during her second night after delivery.

REPORT OF CASE

A 43-year-old woman was admitted to the labor floor at term for induction of labor. The patient's medical history was unremarkable except for a previous diagnosis of endometriosis and a smoking history. HELLP syndrome, preeclampsia, eclampsia, anemia, or gestational diabetes mellitus had not been diagnosed during her pregnancy, and blood glucose level was 85 mg/dL prior to delivery. The sleep focused interview revealed typical OSA symptoms, which had started during late pregnancy: severe snoring, frequent nocturnal awakening due to her own

snoring or with choking sensation, and severe daytime sleepiness (Epworth Sleepiness Scale score of 16/24).

Her body mass index (BMI) was 35.2 kg/m² prior to pregnancy and 40.1 kg/m² at time of vaginal delivery. The patient had an uncomplicated 20-h induction of labor including epidural analgesia and delivery of a male infant with Apgar scores of 7 and 9.

As part of an ongoing institutional review board approved research protocol, whole night polysomnography (PSG) was performed during the second night after delivery on the postpartum floor (22:30 to 04:00) using an out-of-center PSG monitoring device (Alice PDx, Respiromics, Murrysville, PA, USA) during sleep in non-elevated and 45-degree elevated body position (3 h each). Apnea hypopnea index (AHI) in the non-elevated body position averaged 18.0/h and decreased to normal levels (AHI of 2.4/h) following transition to 45-degree elevation. At the same time, sleep architecture was improved (i.e., percentage of total sleep time spent in NREM and REM sleep) to values similar to those seen during the follow-up PSG performed 9 months after delivery at the patient's home (**Table 1**).

The following morning, we evaluated the effects of changes in upper body position on airway anatomy using acoustical pharyngometry (Eccovision Acoustic Pharyngometry, Sleep Group Solutions, Miami, FL).^{5,7} UA diameter during wakefulness increased from non-elevated (supine) to sitting (0.43 cm² in supine body position to 0.46 cm² at 45 degrees elevation and 0.49 cm² during sitting body posture). We speculate that the increase in UA diameter from non-elevated to the elevated back position may explain some of the improvement in UA patency during sleep.

Table 1—Obstructive sleep apnea OSA symptoms and BMI data for the time prior to, at the end of, and nine months after pregnancy, as well as PSG data during non-elevated and 45-degree elevated body posture early after delivery and at 9 months follow-up

	Prior to pregnancy	End of pregnancy		9 months after pregnancy
		Supine	45° elevated	
Demographics and symptoms				
BMI (kg/m ²)	35.2		40.1	34.6
Snoring (primary)	+		–	+
Snoring (severe)	–		+	–
Nocturnal awaking due to snoring or respiratory distress	–		+	–
Morning headache	–		–	–
Daytime sleepiness				
Subjective	–		+	–
ESS-score	n. a.		16 of 24	1 of 24
Polysomnographic data				
AHI (/h)	n. a.	18.0	2.4	2.2
ODI (/h)	n. a.	15.8	2.2	5.1
TST (min)	n. a.	83.5	74.0	305.5
NREM 1 (% of TST)	n. a.	12	8.8	3.8
NREM 2 (% of TST)	n. a.	70.1	41.2	49.1
NREM 3 (% of TST)	n. a.	3	16.9	27.7
REM (% of TST)	n. a.	15	33.1	19.5

While multiple symptoms and daytime sleepiness (increased Epworth Sleepiness Scale [ESS] score) indicative of OSA and moderate daytime sleepiness were reported during pregnancy no symptoms except for primary snoring (no severe snoring i.e. occurring during the majority of the night, most nights of the week¹³) were reported neither prior nor nine months after pregnancy. In line with this PSG confirmed moderate OSA (elevated apnea hypopnea index [AHI] and oxygen desaturation index [ODI]) early after delivery, were abolished by elevation of the upper body, while follow-up PSG was unremarkable for OSA. TST, total sleep time.

A PSG follow-up study conducted 9 months after delivery showed primary snoring without signs of sleep disordered breathing in this patient (AHI 2.2/h), while she reported full resolution of her symptoms of OSA during the first months postpartum (**Table 1**).

DISCUSSION

Three main factors which promote OSA during pregnancy are higher extraluminal pressure generated by structures surrounding the pharyngeal airway, increased negative airway pressure generated by respiratory pump muscles due to a higher ventilatory drive, and smaller end-expiratory lung volume due to increased abdominal volume during pregnancy.^{1,9} We here present a noninvasive, low-technology treatment alternative for pregnancy-related OSA during the early post-partum period: elevated body position. The underlying mechanism may include beneficial effects on pharyngeal tissue edema and rostral fluid shift similar to those observed in patients with heart failure¹⁰ and an increase in functional residual capacity and end-expiratory lung volume.⁹ Thus elevated body posture may be an effective, inexpensive, and easy treatment for pregnancy-related OSA and should be the subject of further investigation. Our report emphasizes the effects of elevated body position on sleep disordered breathing after delivery. It is important to mention that our results do not have direct implications on OSA in pregnancy, where the supine position with elevated upper body may affect uterine perfusion and cardiac output.¹¹

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