

CORRESPONDENCE

References

1. Benumof JL: Preoxygenation: Best method for both efficacy and efficiency? *ANESTHESIOLOGY* 1999; 91:603-5
2. Patel R, Lenczyck M, Hannallah RS, McGill WA: Age and onset of desaturation in apnoeic children. *Canadian J Anaesth* 1994; 41:771-4

3. Videira RLR, Neto PPR, Amaral RVG, Freeman JA: Preoxygenation in children: For how long? *Acta Anaesthesiol Scand* 1992; 36:109-11

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Preoxygenation: Comparison of Maximal Breathing and Tidal Volume Techniques

To the Editor:—Baraka *et al.*¹ recently demonstrated that preoxygenation using eight deep breaths within 60 s (8 DB/60 s) at an oxygen flow of 10 L/min can produce arterial oxygen tension ($P_{a_{O_2}}$) values comparable to those obtained using normal tidal volume breathing (TVB) for 3 min. In addition, they showed that this technique significantly delayed the onset of apnea-induced hemoglobin desaturation.

Before this new method becomes widely accepted, several issues need to be clarified. First, we wonder what role the baseline values for $P_{a_{O_2}}$ played in the delayed hemoglobin desaturation after 8 DB/60 s. For this portion of their study, Baraka *et al.* used a separate group of subjects, group B, in whom baseline $P_{a_{O_2}}$ values were 407 ± 53 mmHg after 3 min of TVB and 434 ± 45 mmHg after 8 DB/60 s. Both values were higher than those of subjects in group A, in whom 3 min of TVB yielded a $P_{a_{O_2}}$ higher than 392 ± 72 mmHg versus 369 ± 69 mmHg after 8 DB/60 s. It cannot be ruled out that the higher $P_{a_{O_2}}$ values observed in group B after 8 DB/60 s contributed to the delay in hemoglobin desaturation. If subjects from group A were subjected to apnea, the benefit of 8 DB/60 s may not have been evident, or at least may not have been as dramatic.

Second, we think that reporting this technique as eight breaths in 60 s underestimates the number of breaths and the time of preoxygenation. If we understand the protocol correctly, after the eight breaths, a rapid-sequence induction of anesthesia was carried out. During this period, face-mask oxygenation was continued until apnea ensued, a period described as 15 to 30 s during which an additional 2 to 4 deep breaths occurred. Thus, it appears that Baraka *et al.* actually evaluated the efficacy of 10 to 12 breaths during a 75 to 90 s period rather than eight deep breaths in 60 s. The authors proposed two possible mechanisms for the delayed decrease in hemoglobin saturation during 8 DB/60 s: (1) that the extra 15 to 30 s provided more alveolar oxygenation in patients breathing deeply for 60 s than during TVB; and (2) that continued deep breathing during this extra time may have opened collapsed airways or lung tissue, with a consequent increase in oxygen store in the functional residual capacity. In his editorial, Benumof² proposed other explanations, including a leftward shift of oxyhemoglobin dissociation curve secondary to hyperventilation-induced reductions in $P_{a_{CO_2}}$. We propose that by extending the duration of deep breathing beyond 60 s (*i.e.*, to 75-90 s) may have enhanced the potential influence of this factor. A delay in desaturation caused by a leftward shift of the oxyhemoglobin dissociation curve would not necessarily favor improved oxygen transport. Because the authors presented only values for $P_{a_{O_2}}$, the role of changes in arterial carbon dioxide tension and arterial pH must remain speculative.

Third, Baraka *et al.* state that using the technique of four deep breaths in 30 s (4DB/30 s), $P_{a_{O_2}}$ values increased exponentially as oxygen flow is increased from 5 to 10 to 20 L/min. Although this description may accurately describe the increase from baseline values, the mean values for $P_{a_{O_2}}$ at 5, 10, and 20 L/min oxygen flow all decrease within the linear, essentially flat portion of the curve. The differences appear minimal, and the authors make no statement concerning the significance of the differences among the values for $P_{a_{O_2}}$ at the three fresh gas flows. Recently, Nimmagadda *et al.*³ demonstrated that increasing fresh gas flows from 5 to 7 to 10 L/min had no significant effect on end-tidal oxygen or nitrogen during preoxygenation using 4DB/30 s or 2-min TVB techniques in healthy volunteers. Although Nimmagadda *et al.*³ did not test 20 L/min, this value is probably not encountered in most circumstances in the operating room. Although interesting and provocative, the study of Baraka *et al.* is far from conclusive. More studies are required to ascertain if the 8 DB/60 s method actually delays hemoglobin desaturation, and whether this method is more beneficial than the traditional TVB. It is clearly premature to anoint the 8 DB/60 s technique as the method of choice for preoxygenation.

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References

1. Baraka AS, Taha SK, Aouad MT, El-Khatib MF, Kawkabani NI: Preoxygenation: Comparison of maximal breathing and tidal volume breathing techniques. *ANESTHESIOLOGY* 1999; 91:612
2. Benumof JL: Preoxygenation: Best method for both efficacy and efficiency (editorial). *ANESTHESIOLOGY* 1999; 91:603
3. Nimmagadda UN, Megally M, Salem MR, Joseph NJ, Wafai Y: Preoxygenation with four maximal breaths vs. tidal volume breathing: Impact of fresh gas flow (abstract). *ANESTHESIOLOGY* 1998; 89:A1213

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