EDITORIAL

PREOXYGENATION-ROUTINE PREOXYGENATION DURING INDUCTION AND RECOVERY FROM ANESTHESIA IS RECOMMENDED AS A MINIMAL SAFETY PRECAUTION

With the introduction of the rapid sequence induction of anesthesia and tracheal intubation technique in the 1950s in patients who are at risk for aspiration of gastric contents, preoxygenation became an essential component of the technique[1]. In 1955, Hamilton and Eastwood showed that "denitrogenation" was 95% complete within 2 to 3 minutes in subjects breathing normally from a circle anesthesia system with 5 L/min oxygen[2].

Baraka et al 1999 reported that rapid and effective preoxygenation can be achieved by using eight deep breaths within 60 seconds, and an oxygen flow of 10 L/min. This technique can produce PaO2 values comparable to that achieved by the "traditional" preoxygenation technique. Also, it delays the onset of subsequent apnea-induced hemoglobin desaturation more significantly than following the other techniques of preoxygenation[3]. The mean times from the onset of apnea until hemoglobin desaturation from 100% to 99% was significantly longer following eight-deep breaths preoxygenation compared with the traditional 3 min of tidal volume breathing. The slower desaturation during apnea following the eight-deep breaths preoxygenation technique despite the comparable initial PaO2 values was unexpected. It is possible that deep breathing for 60 sec may open collapsed airways and/or lung alveoli with a consequent increase of the oxygen store in the functional residual capacity (FRC). Rapid preoxygenation with the eight deep breaths can be used as an alternative to the traditional 3-min tidal volume breathing technique[3].

In his Editorial, Benumof suggested that the report of Baraka et al[1] describes a new method of preoxygenation that may be best with regard to both efficacy and efficiency[4]. He also suggested that maximal preoxygenation is indicated not only during rapid sequence induction of anesthesia in patient with full stomach, but also in any patient with oxygen transport limitations (who desaturate the fastest), and in any patient in whom difficulty in managing the airway is suspected. Moreover, because the development of a cannot-ventilate, cannot-intubate situation is largely unpredictable, the desirability/need to maximally preoxygenate is theoretically present for all patients[4].

The original American Society of Anesthesiologists (ASA) difficult airway algorithm (1993) makes no mention of preoxygenation. In his editorial, Benumof 1999 recommended maximal preoxygenation in patients with oxygen transport limitations who desaturate the fastest, and in patients with a difficult airway[4]. Along this line of though, the ASA inserted 2003 a new statement in the updated difficult airway algorithm "Actively pursue opportunities to deliver supplemental oxygen throughout the period of difficult airway management"[5,6]. Moreover, because the development of the cannot-ventilate, cannot-intubate situation is largely unpredictable, the desirability/need to maximally preoxygenate is theoretically present for all patients. However, it must be noted that the safe period of apnea following preoxygenation, is still limited.

The SaO_2 may be misleading as a guide to alveolar denitrogenation and efficient preoxygenation. A saturation of 100% measured by pulse oximetry is not a reason to stop denitrogenation, and may occur well before the lungs are adequately denitrogenated. Conversely, failure of SpO_2 to increase substantially during denitrogenation does not necessarily indicate failure of preoxygenation. With normal lung function, the oxygen wash in and the nitrogen washout are exponential. The end tidal O_2 or N_2 can be used to monitor preoxygenation[7].

Preoxygenation followed by oxygen insufflations during subsequent apnea via a patent airway maintains SaO_2 by apneic diffusion oxygenation[7,8]. In the apneic adult, the VO_2 averages 230 ml/min, whereas the output of CO_2 to the alveoli is limited to about 21 ml/min only, and the remaining CO_2 production is buffered within the body tissues. Therefore, a pressure gradient is created between the upper airway and the alveoli resulting in a mass movement of O_2 down the trachea into the alveoli. Because of this mass movement of O_2 down the trachea, CO_2 is not exhaled, and hence the alveolar CO_2 concentration shows an initial rise of about 8-16 mmHg during the first minute and a subsequent fairly linear rise of about 3 mmHg/min. The increase in CO_2 during apneic mass-movement oxygenation and not hypoxemia becomes the limiting factor.

During apneic mass movement oxygenation via an open airway the increase in time to Hb desaturation achieved by increasing the FiO_2 from 0.9 to 1.0 is greater than that caused by increasing the FiO_2 from 0.21 to 0.9[9]. The technique of preoxygenation, followed by mass-movement oxygenation during the subsequent apnea is highly recommended in patients who may rapidly desaturate.

In conclusion, "Routine" preoxygenation before rapid-sequence induction of general anesthesia in patients with full stomach, is also recommended in patients with suspected difficult airway, as well as in patients with increased oxygen consumption associated with decreased functional residual capacity of the lungs such as children, the pregnant and the morbidly obese patients, as well as in all critically ill patients. The technique is also indicated not only during induction of anesthesia, but also during reversal of neuromuscular block and emergence from anesthesia[7]. Moreover, because the development of hypoxemia may be unpredictable, 'routine" preoxygenation during both induction of and recovery from anesthesia is recommended in all patients as a minimal safety precaution, similar to "fasten your seat belt" during takeoff and landing of planes.

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