EDITORIAL

"ROUTINE" PREOXYGENATION BEFORE INDUCTION OF AND RECOVERY FROM ANESTHESIA (A SAFETY PRECAUTION)

Whenever you travel by air "fasten your seat belt" is the "minimum safety precaution" during take off and landing. Similar to air flying, the risk to patients undergoing general anesthesia is highest at induction (take off) and recovery (landing) and hence "routine" preoxygenation during these two critical periods, can be considered a "safety precaution"[1-3].

The potential for oxygen desaturation in otherwise smooth induction of anesthesia in healthy patients has led to previous calls for "routine" preoxygenation. Although it can be argued that such desaturation does not necessarily generate mortality or morbidity, there appears to be an overall weight of benefit favoring this practice[1-3].

Since the inception of the ASA Closed Claims project, adverse respiratory events have constituted the single largest source of injury[4]. Just three mechanisms of injury accounted for nearly three fourths of all claims for adverse respiratory events. These mechanisms are inadequate ventilation (38%), esophageal intubation (18%) and difficult tracheal intubation (17%). Most of these adverse respiratory events (72%) are readily diagnosed by pulse oximetry and end-tidal capnography. Also, the consequent hypoxemia can be ameliorated by the "routine" preoxygenation.

Recent investigations have highlighted risk factors for the rapid development of hypoxemia during apneic episodes. These risk factors are additive. It included reduced functional residual capacity (FRC), increased oxygen consumption and/or airway obstruction. It also includes hypoventilation prior to apnea or inadequate preoxygenation. Patients with a combination of these factors are liable to develop rapid desaturation during apnea[5].

Preoxygenation will always be mandatory in the context of "rapid-sequence induction" of general anesthesia in patients with full stomach, and arguably so in an additional range of scenarios as the predictable "difficult airway". Imperative preoxygenation exists for those patients who will not tolerate a fall in PO_2 such as ischemic heart disease or atopic individuals. "Routine" preoxygenation would also be strongly advisable when FRC is low and oxygen consumption is high (the pregnant, the obese and children), as well as in patients with already low PO_2 such as lung disease or right-to-left shunt[2].

In the absence of any of the above factors, "routine" preoxygenation offers identifiable "safety benefits" during induction of general anesthesia[1-3], since many conditions may be unpredictable such as the "difficult intubation-difficult ventilation scenario". Also, many adverse drug reactions can follow induction of anesthesia such as drug-induced anaphylaxis, hypotension and hypoventilation. Thus, the recommendation of "routine" preoxygenation will be in line with the promotion of patient safety. However, "routine" preoxygenation must be used as an adjunct rather than an alternative to a sequence of fundamental preoperative precautions than minimize adverse sequalae[2].

Recovery from anesthesia and tracheal extubation have received limited critical safety measures compared with attention to the identification and management of potentially difficult intubation, despite the observation that airway complications are more likely to be associated with tracheal extubation than intubation[6,7]. The American Society of Anesthesiologists (ASA) Task Force on Management of the Difficult Airway recommended that each anesthesiologist must have a pre-formulated strategy for extubation of the difficult airway, and an airway management plan for dealing with post extubation hypoventilation[8]. "High-risk" extubation is defined as a situation where in re-establishing a lost airway, be it due to failure of oxygenation, ventilation or loss of airway patency is likely to be difficult or incomplete without significant risk.

Even routine discontinuation of anesthesia, reversal of neuromuscular block and tracheal extubation can be complicated with hypoxemia, hypoventilation and loss of airway patency. Hypoventilation and hypoxemia can result from the residual effects of anesthetics as well as the incomplete reversal of neuromuscular block[9]. Residual anesthesia and neuromuscular block can decrease the functional activity of the pharyngeal muscles resulting in upper airway obstruction and in fourfold to fivefold increase in the risk of aspiration[10]. The residual effects of anesthesia and relaxants can also decrease the contractions of the respiratory muscles resulting in hypoventilation, as well as inability of deep breathing and effective coughing which predispose to atelectasis. It can also obtund the hypoxic drive by the peripheral chemoreceptors[11]. In addition, Baraka has shown that adequate oxygenation must be ensured before reversal of neuromuscular block by neostigmine in order to achieve safe reversal and minimize neostigmine-induced cardiac arrhythmia[12,13]. Jacoby et al have shown that cardiac response to vagal stimulation is more frequent and serious in the presence of hypoxia[14].

There is evidence that "routine" preoxygenation with 100% oxygen prior to reversal of neuromuscular block and tracheal extubation is recommended not only to ensure safe reversal of neuromuscular block by neostigmine[12,13] but also to improve the margin of safety, given the potential of unpredictable airway and ventilation problems.

Preoxygenation of the awake patient before induction of general anesthesia increases the alveolar oxygen and decreases the alveolar nitrogen in a parallel fashion. "Denitrogenation" of the functional residual capacity (FRC) of the lungs is 95% complete within 3 minutes when the subject is breathing a normal tidal volume from a circle absorber system using a fresh gas flow equals to the alveolar ventilation volume about 5 L/min[15]. A higher oxygen flow up to 10 L/min is required whenever the alveolar ventilation volume is high as observed during pregnancy. Also, a high oxygen flow is required whenever "rapid" preoxygenation is achieved by the 8 deep breaths' technique within 60 seconds[16,17]. In the anesthetized patient on intermittent positive pressure ventilation, preoxygenation during recovery from anesthesia can be also achieved by either the normal tidal volume ventilation for 3 minutes, or by the 8 deep breath technique for 60 seconds.

The effectiveness of preoxygenation (denitrogenation) can be checked by an end-tidal oxygen >80%. The achievement of SpO2 100% is not a reason to stop denitrogenation and may occur before the lungs are adequately denitrogenated. Conversely, failure of SpO2 to increase substantially does not necessarily indicate failure of denitrogenation[18].

In conclusion, "routine" preoxygenation with 100% oxygen can be considered as a "safety" measure during induction of and recovery from general anesthesia. However, it must be used as an adjunct rather than an alternative to a sequence of fundamental precautions that minimized adverse sequalae.

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