Can Hyperinflation Before and After Open Endotracheal Suctioning Improve Clinical Outcomes?

Endotracheal suctioning is among the most commonly performed interventions in ICUs around the world. It also falls under the scope of practice of many health care professionals, such as respiratory therapists, physiotherapists, kinesiologists, nurses, and physicians. Endotracheal suctioning is designed to maintain airway patency by applying negative pressure after a suction catheter is inserted through an artificial airway into the tracheal lumen to remove accumulated secretions. Although considered a relatively easy task, several of the components (eg, preoxygenation, hyperexpansion, suction depth, applied negative pressure, use of normal saline, chest physiotherapy between suction passes, target duration for suction, number of suction passes, patient position) are inconsistently performed, as demonstrated recently in several studies.[1-3] Endotracheal suctioning has also been associated with a number of adverse events such as airway bleeding (if deep suction technique is used), lung de-recruitment, hypoxemia, and cardiac dysrhythmias.[4] A decade ago, the American Association for Respiratory Care (AARC) updated the guidelines for endotracheal suction and made several evidence-based recommendations following the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) criteria as follows: (1) It is recommended that endotracheal suctioning should be performed only when secretions are present, and not routinely. (2) It is suggested that pre-oxygenation be considered if the patient demonstrates a clinically important reduction in oxygen saturation with suctioning. (3) Performing suctioning without disconnecting the patient from the ventilator is suggested. (4) Use of shallow suction is suggested instead of deep suction, based on evidence from infant and pediatric studies. (5) It is suggested that routine use of normal saline instillation prior to endotracheal suction should not be performed. (6) The use of closed suction is suggested for adults with high F_{IO_2} or PEEP or at risk for lung de-recruitment, and for neonates. (7) Avoidance of disconnection and use of lung recruitment maneuvers are suggested if suctioning-induced lung de-recruitment occurs in patients with acute lung injury.

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(8) It is suggested that a suction catheter is used that occludes $< 50\%$ of the lumen of the endotracheal tube in children and adults, and $< 70\%$ in infants. (9) It is suggested that the duration of the suctioning event be limited to < 15 s.[4]

In this issue of RESPIRATORY CARE, Rodrigues de Freitas Vianna and colleagues[5] report the effects on S_{pO_2} and P_{ETCO_2} when using a zero PEEP with baseline F_{IO_2} technique versus a zero PEEP plus hyperoxygenation of 20% above baseline F_{IO_2} before and after open endotracheal suctioning. While the AARC suggests using closed suction systems, the authors mentioned that open suction reflects the reality of Brazilian ICUs. Thirty-eight subjects were randomized in a crossover fashion. They excluded adults with high F_{IO_2} and high PEEP. Interestingly, the zero PEEP strategy was in fact a hyperinflation technique that consisted of a gradual increase of PEEP to 15 cm H_2O for 60 s followed by an abrupt PEEP reduction to zero in association with a manual bilateral compression to increase expiratory air flow and limiting the peak pressure to 40 cm H_2O. They intentionally avoided routine hyperoxygenation with F_{IO_2} of 1.0 and instead compared the effects of using baseline F_{IO_2} and baseline F_{IO_2} + 0.20 in both groups. They also used 5 deep suction events (ie, catheter introduced until resistance is met) with a negative pressure of $\sim$ 150 mm Hg for 15 s. They noted that S_{pO_2} was significantly higher using the F_{IO_2} + 0.20 during the first few minutes after suction, but this difference was not significant between groups after 30 min, and no significant changes were observed in P_{ETCO_2} at any point during the intervention. The authors concluded that, although there were not significant differences between groups, they recommend the hyperinflation technique with 20% above the baseline F_{IO_2} during open circuit suctioning.[5]

If endotracheal suctioning seems to be a straightforward technique, why does it seem that few studies follow the AARC guidelines as recommended? Maggiore

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and colleagues[6] clearly reported a 17% reduction in the incidence of complications associated with endotracheal suctioning events after studying almost 10,000 subjects prior to and after implementing the AARC guidelines. There are obvious differences between the endotracheal suctioning protocol reported by Rodrigues de Freitas Vianna and colleagues[7] reported and the one suggested by the AARC. The most significant are their use of an open technique, introduction of the suction catheter until resistance is met, and the routine use of a lung recruitment maneuver before and after the suction event. Despite these differences, their results suggest an interesting alternative to the endotracheal suctioning procedure. Schults and colleagues[3] recently described the perceived lack of evidence that causes the reported uncertainty regarding endotracheal suctioning best practice, which helps explain why Mwakanyanga and colleagues[2] reported that a majority of ICU nurses (80.6%) demonstrated undesirable knowledge of recommendations related to endotracheal suctioning. As a co-author of the AARC guideline, I ask myself if the fact that 9 of the 10 recommendations we made a decade ago are "suggestions" instead of strong-evidence "recommendations" could play a role in the inconsistency of endotracheal suctioning techniques published to date. For example, while the AARC has suggested a negative pressure not $\leq$ 150 mm Hg, a study last month evaluated negative pressures as high as 250 mm Hg without experiencing a significant difference in terms of oxygen desaturation, hypertension, bradycardia, or tracheal bleeding.[7] One thing is certain: endotracheal suctioning is not a single task, but a bundle of steps for which strong evidence is still lacking. Normal saline instillation or not? Hyperoxygenation or baseline F_{IO_2}? Shallow or deep suction technique? One, two, or how many passes? Should we include routine hyperinflation before and after endotracheal suctioning? Let evidence be the judge.

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