Studying ApOx in the ED: forget associations, the truth is in the design

Nicholas Caputo

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Emergency Medicine, NYC Health+Hospitals/Lincoln, Bronx, New York, USA

Correspondence to
Dr Nicholas Caputo, Emergency Medicine, NYC Health+Hospitals/Lincoln, Bronx, NY 10451, USA; ncaputo.md@gmail.com

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Apnoeic oxygenation (ApOx) is an adjunctive airway technique that has been used over the decades to prevent desaturation during the apnoea period of rapid sequence intubation (RSI). The technique has made its way from the operating room to the prehospital environment to the emergency room (ER). Many studies, mostly observational, have looked at the efficacy of ApOx in delaying desaturation with a consensus that it does so and even a misunderstanding that it prevents it. This is despite the conflicting evidence of true efficacy (ie, reduction of not only desaturation rates, but morbidity and mortality). When looking back at the original study that laid the foundation for the physiological basis of ApOx, a question must be asked of the current technique used to perform the physiological manoeuvre at present: have we extrapolated the technique of that study to the point that we are actually performing something less efficacious?

The original study by Frumin *et al* of ApOx used significant preoxygenation periods (around 30 min), followed by induction, then endotracheal intubation, then subsequent paralysis to initiate apnoea.[1] The findings of this study made clear the physiologically sound concept when performed with the proper technique. A distinction between the ED and the operating room in terms of the patient population served (undifferentiated patients in or close to extremis) and the expediency in which these patients require treatment (eg, inability to provide thorough preoxygenation) must be considered. However, this being recognised, the technique itself has been extrapolated to practice in the ED to the point of the use of nasal cannula (NC) at 15 L/min or flush rate without solid evidentiary basis for such. There have been few randomised control trials showing patient benefit from such technique and two larger trials (one in theintensive care unit (ICU) and one in the ER) that showed no effect at all.[2 3] This is likely due to the generalisation of the technique to a broad cohort when really the type of technique used and the particular patient in front of the provider really need to be taken into consideration. Observational studies, such as those offered by Perera *et al* and Wimalasena *et al* as examples, offer no real insight into who could benefit from the technique due to lack of proper methodology and design.[4 5] Data collection and analytics should be more granular in order to tease out which technique works and who it works on.

The nature of these observational study designs does not allow for anything to be determined from these studies other than a possible correlation (which has already been soundly based in the literature). We need more randomised control trials on this subject in order to determine whether the technique they deployed (the use of NC at 15 L/min) truly offers any benefit to patients undergoing RSI. This is especially important considering the technique used does not have a sound physiological basis when compared with the original study of ApOx. We know that 15 L/min by NC only supplies around 67% end tidal oxygen (ETO_2) when combined with a non-rebreather for preoxygenation.[6] This is far below the recommended 85% ETO_2 recommended by the Difficult Airway Society.[7] Though these observational studies mention this briefly in their limitations, the gravity of its impact on a patient's ability to maintain their saturation during the apnoeic period is not addressed.

Again, the original Frumin *et al* study supplied 100% fractional inspired oxygen (FiO_2) by means of an endotracheal tube (ETT) to its subjects in order to prevent desaturation placing the foundation for the use of ApOx. These nuances play a role in how one should approach the study of ApOx. The majority of patients here were preoxygenated with a bag valve mask or non-rebreather without mention of the quality of the preoxygenation (ie, the amount of time, the level of FiO_2 achieved, the oxygena saturation (SpO_2) achieved at induction). Also lacking is the time to desaturation, which is generally overlooked in observational studies though very important to analysis. This is a crucial variable that can confound results greatly in this type of study. Not knowing whether or not a patient will be a 'rapid desaturator' (eg, the critically ill, the obese, the paediatric) is also a major confounder as this can have major implications when studying the efficacy of a technique such as ApOx using NC at 15 L/min as these patients generally may still require positive pressure ventilation (PPV) despite the presence of ApOx. This may have implications on the impact non-invasive ventilation may have on the patients who receive ApOx long with PPV as the use of a non-collapsible tubing for the NC can cause air leak on bilevel positive airway pressure (BiPAP)/continuous positive airway pressure (CPAP) face masks reducing the FiO_2 supplied.

RSI is an invasive procedure and all care must be taken when deciding to perform such. The patient, as an individual, needs to be taken into consideration in order to prevent unnecessary and inadvertent harm. ApOx in itself likely has no potential for harm, but generally not discussed is the human factors aspect of its use. We know from prior studies that physician perception of time to intubation is inaccurate.[8] This can become compounded if one

believes they have more time than they actually do because they have supplied ApOx (especially an inferior form of ApOx such as via NC at relatively low rates). This is why knowing the times to intubation is also crucial to the study of the efficacy any technique using ApOx, be it by NC or high-flow NC. These studies generally make no mention of such.

These observational studies do lay a foundation of signal in terms of clinical effect ApOx by NC has on saturation during RSI. This is purely by correlation however. Though I commend the authors of these studies for investigating this important topic, it would be more encouraging to see future collaborative efforts to pursue well-designed randomised control trials to help us truly determine the utility of ApOx by NC.

Twitter Nicholas Caputo @nickmd1980

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ORCID iD

Nicholas Caputo http://orcid.org/0000-0001-5583-0712

REFERENCES

1 Frumin MJ, Epstein RM, Cohen G. Apneic oxygenation in man. *Anesthesiology* 1959;20:789–98.
2 Caputo N, Azan B, Domingues R, *et al*. Emergency department use of apneic oxygenation versus usual care during rapid sequence intubation: a randomized controlled trial (the ENDAO trial). *Acad Emerg Med* 2017;24:1387–94.
3 Semler MW, Janz DR, Lentz RJ, *et al*. Pragmatic critical care research Group. randomized trial of apneic oxygenation during endotracheal intubation of the critically ill. *Am J Respir Crit Care Med* 2016;193:273–80.
4 Perera A, Alkhouri H, Fogg T, *et al*. Apnoeic oxygenation was associated with decreased desaturation rates during rapid sequence intubation in multiple Australian and New Zealand emergency departments. *Emerg Med J* 2021;38:118–24.
5 Wimalasena Y, Burns B, Reid C, *et al*. Apneic oxygenation was associated with decreased desaturation rates during rapid sequence intubation by an Australian helicopter emergency medicine service. *Ann Emerg Med* 2015;65:371–6.
6 Hayes-Bradley C, Lewis A, Burns B, *et al*. Efficacy of Nasal Cannula Oxygen as a Preoxygenation Adjunct in Emergency Airway Management. *Ann Emerg Med* 2016;68:174–80.
7 Frerk C, Mitchell VS, McNarry AF, *et al*. Difficult airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *Br J Anaesth* 2015;115:827–48.
8 Cemalovic N, Scoccimarro A, Arslan A, *et al*. Human factors in the emergency department: is physician perception of time to intubation and desaturation rate accurate? *Emerg Med Australas* 2016;28:295–9.