

Report of three cases of infants with pyloric stenosis using apneic oxygenation via nasal cannula technique, who did not have significant desaturation during intubation despite apnea for more than a minute.

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Introduction

Infants with pyloric stenosis are at risk of critical desaturation due to small FRC, high metabolic rate, and possible aspiration at baseline. These infants are considered full stomachs, so mask ventilation during failed intubation attempts might increase their risk of aspirating gastric contents. Techniques that prolong the time to desaturation may increase the intubation safety window.

We present three cases where apneic oxygenation via nasal cannula prevented desaturation during intubation attempts that took longer than one minute in infants with pyloric stenosis. We defined time to intubation as the interval between removal of the mask from the face and confirmation of intubation by auscultation of breath sounds.



Discussion

Apneic oxygenation refers to oxygen uptake in the lungs in a non-ventilated state. The lungs will absorb a greater volume of O₂ than the released volume of CO₂ (approximately 250 mL/min O₂ absorbed in adults and 5-8 mL/kg/min O₂ absorbed in neonates, and 8-20 mL/min of CO₂ released in adults). Most of the CO₂ is buffered in the blood during apnea. With imbalanced volumes of absorbed and released gases, pressure in the lungs is reduced relative to the atmosphere, creating passive gas movement from pharynx to alveoli. If the gas in the pharynx is oxygen enriched, oxygen can be delivered passively to the lungs for absorption, prolonging the time to hemoglobin desaturation.²

Hypercapnia and acidemia limit apneic oxygenation duration in adults, but one study

found that hypoxia precedes clinically significant hypercapnia in infants.³ This study examined intubated pediatric patients undergoing cardiac catheterization. It showed that apneic oxygenation may be safe in children for a period of up to 10 minutes before hypoxia would occur. The same study found that infants may become hypoxic after only 2 minutes.³

Similarly, our three pediatric patients did not experience significant desaturation despite prolonged intubation times.

Apneic oxygenation is a documented effective technique that prolongs the time to critical desaturation in the adult population.^{2,5,6}

Several pediatric studies support these results.^{1,3,4} Larger clinical trials of apneic oxygenation in the pediatric population are in progress.

Case Presentations

Demographics	Room air SpO ₂	Preox SpO ₂	Preox exhaled O ₂	Induction medications	Intubation time (min:sec)	Min SpO ₂
5 wk male 3.85 kg, 53.3 cm	92%	100%	92%	15 mg propofol 3 mg rocuronium	1:37	97%
8 wk male 4.13 kg, 62 cm	96%	100%	90%	12 mg propofol 3 mg rocuronium	1:17	100%
3 wk male 2.9 kg, 49.5 cm	100%	100%	90%	12 mg propofol 3 mg rocuronium	1:32	99%

References

1. Bhagwan SD. Levitan's no desat with nasal cannula for infants with pyloric stenosis requiring intubation. *Paediatr Anaesth* 2013;23:297-8.
2. Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med* 2012;59:165-75.
3. Cook TM et al. Changes in blood-gas tensions during apnoeic oxygenation in paediatric patients. *Br J Anaesth* 1998;81:338-42.
4. Kernisan G et al. Apneic oxygenation in pediatric patients. *Anesthesiology* 1987;3:A521.
5. Ramachandran SK et al. Apneic oxygenation during prolonged laryngoscopy in obese patients: a randomized, controlled trial of nasal oxygen administration. *J Clin Anesth* 2010;22:164-8.
6. Taha SK et al. Nasopharyngeal oxygen insufflation following pre-oxygenation using the four deep breath technique. *Anaesthesia* 2006;61:427-30.