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Paediatric difficult airway management: what every anaesthetist should know!

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Airway management remains a significant cause of morbidity and mortality in anaesthetized children. Children with difficult direct laryngoscopy are an especially vulnerable group. However, most paediatric anaesthetics are administered by generalists without advanced paediatric training. This editorial is aimed at all practitioners who care for children, particularly those without advanced paediatric anaesthesia training. Our goal is to convey three important points: (i) the contributing factors for severe complications in this population; (ii) the important role of the supraglottic airway (SGA) in managing these patients; and (iii) the ideal method of invasive airway access when oxygenation is compromised. We hope this editorial enhances the care and outcomes in this vulnerable patient population.

The paediatric difficult airway is associated with a high risk for complications during airway management

A multicentre study of 1018 children with difficult airways in 13 paediatric centres (Pediatric Difficult Intubation registry) demonstrated that more than two direct laryngoscopy attempts in children with difficult tracheal intubation is associated with high failure rates and an increased incidence of severe complications.[1] In fact, every additional attempt beyond the first increased the proportion of patients with complications. This extensive study was the first to confirm that airway management in a paediatric difficult airway population cared for mostly by paediatric anaesthetists is associated with significant complication rates. In these children, tracheal intubation failed in 19 (2%) patients, and 204 (20%) children had at least one complication. The most common severe complication was cardiac arrest, which occurred in 2% of these children. The most common complication overall was transient hypoxaemia (oxygen saturation <85%). The results of this study should prompt anaesthetists caring for children to consider the following strategies: (i) minimize the number of direct laryngoscopy attempts, and transition to an indirect technique (videolaryngoscope/fibreoptic bronchoscope) when direct laryngoscopy fails; and (ii) consider a means for oxygenation of the lungs during tracheal intubation attempts (nasal cannula or supraglottic airway) to reduce the risk of complications and enhance patient safety. Lastly, this study also identified the following four independent risk factors that are associated with the increased risk of complications: more than two tracheal intubation attempts; weight less than 10 kg; short thyromental distance (micrognathia); and three direct laryngoscopy attempts before an indirect technique.[1]

Supraglottic airways for the difficult airway: what is the evidence?

Use of an SGA is a distinctive step in many airway management algorithms.[2–4] An SGA may be used in situations where difficult ventilation, failed intubation, or both occur. The paediatric airway guidelines published by the Difficult Airway Society/Association of Paediatric Anaesthetists of Great Britain and Ireland suggests the use of an SGA, if feasible, when failed tracheal intubation occurs in children with difficult airways.[5] In the paediatric practice, general anaesthesia is often required for brief procedures (e.g. radiology, ophthalmological, or general surgery) which would typically not need any form of anaesthesia in adults. For these procedures, it may not always be necessary to intubate the trachea. In children with difficult airways, an SGA alone can be used to provide an adequate airway with low failure rates and should be considered for airway maintenance in this population.[6] Additionally, in the paediatric population, the SGA failure rate is lower than in the adult population (0.86[7] *vs* 1.1%[8]). Supraglottic airway failure in children is more likely in the presence of the following risk factors: ear/nose/throat surgery, inpatient procedures, prolonged surgical duration, congenital/acquired airway abnormalities, and patient transport.[7] Although these risk factors for failure have been identified, clinicians should have sufficient experience with the routine use of these devices and know how to recognize and troubleshoot causes for inadequate ventilation of the lungs, such as improper position or fit, and should remain vigilant for subtle signs of poor device performance.[9] Additionally, all equipment necessary to perform tracheal intubation should be readily on hand and checked in the unlikely event that tracheal intubation is needed. Supraglottic airways have been very useful as a conduit for tracheal intubation in children with difficult airways.[10 11] Future analysis of the multicentre Pediatric Difficult Intubation registry may help to answer questions about the efficacy of SGAs in specific difficult airway populations; for instance, is fibre-optic tracheal intubation through an SGA superior to using a videolaryngoscope in the Pierre Robin infant?

'Cannot intubate, cannot oxygenate' in an infant: invasive airway access in children

The need for an emergency surgical airway in infants is very rare. Most anaesthetists may never even encounter this clinical situation in their career, especially in smaller children. There is a dearth of literature regarding invasive airway techniques in this patient population, and very little equipment development in this area. Most studies to date incorporate the use of rabbit[12 13] or pig models.[14 15] Moreover, the cricothyroid membrane is difficult to identify in this age group, and expeditious performance of a surgical airway is challenging even for a skilled paediatric otolaryngologist. In a crisis, therefore, the fastest option to oxygenate the lungs is most likely to be through a needle cricothyroidotomy. However, the use of 14, 16, or 18 gauge angiocatheters for needle cricothyroidotomy is not without risk. Animal studies demonstrate that, although invasive tracheal access may be successful on the first attempt in about 60–70%, placement of the needle is associated with perforation of the posterior tracheal wall.[13 14]

Once a needle cricothyroidotomy is appropriately placed in the trachea (pig model), adequate oxygenation has been demonstrated with a low-pressure oxygen supply (e.g. wall oxygen at 1–15 litres min^{-1}) attached to an Enk Oxygen Flow Regulator (Cook Medical, Bloomington, IN, USA). This technique has been shown to provide effective oxygenation for at least 15 min[16] when oxygen is administered through an 18 gauge or larger diameter angiocatheter.[17]

In the event of complete upper airway obstruction, it has been shown that the Ventrain device (Dolphys Medical, Eindhoven, The Netherlands) may provide adequate oxygenation and ventilation through a small-bore transtracheal catheter.[15] This device may be of use in the 'cannot intubate, cannot oxygenate' situation in an infant but has yet to be studied in the infant animal model.

Lastly, although scalpel cricothyroidotomy is the recommended surgical airway technique in the new Difficult Airway Society airway algorithm for adults,[4] the evidence in children is lacking. One rabbit study demonstrated that the first attempt success rate was 100% but was associated with significant complication rates (posterior tracheal wall damage).[12] More studies on both techniques are still needed to help determine the best practice for smaller children, but currently, needle cricothyroidotomy remains the technique of choice in the 'cannot intubate, cannot oxygenate' situation in infants.[5]

In conclusion, although airway management strategies for children have come a long way during the past few years, with improvements in technique and equipment, management of the difficult paediatric airway still remains a problem associated with significant risks and complications. Future multicentre studies in this high-risk group may help us to determine the best airway practices for these children.

Authors' contributions

Conception and design of the editorial, drafting the article, and final approval of the version to be published: N.J., L.S., J.E.F.

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Airway management in the critically ill: the same, but different

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Airway management has had a central role in intensive care medicine even from its origins. When Danish Anaesthetist Björn Ibsen applied his airway skills to victims of the 1952–3 Copenhagen poliomyelitis epidemic, the era of Critical Care Medicine was born.[1] The