British Journal of Anaesthesia, 126 (6): 1086–1088 (2021)
doi: 10.1016/j.bja.2021.03.012
Advance Access Publication Date: 16 April 2021

Difficult airway management: children are different from adults, and neonates are different from children!

Narasimhan Jagannathan[1,*] and Takashi Asai[2]

[1]Department of Pediatric Anesthesiology, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, USA and [2]Department of Anesthesiology, Dokkyo Medical University Saitama Medical Centre, Koshigaya, Saitama, Japan

*Corresponding author. E-mail: simjag2000@gmail.com

This editorial accompanies: Difficult tracheal intubation in neonates and infants. NEonate and Children audiT of Anaesthesia pRactice IN Europe (NECTARINE): a prospective European multicentre observational study by Disma et al., *Br J Anaesth* 2021:126:1173–1181, doi: 10.1016/j.bja.2021.02.021

Keywords: airway management; complications; difficult airway; neonate; paediatric anaesthesia; videolaryngoscopy

Children are different from adults in many aspects of airway management. For example, it is generally believed that the incidence of unexpected difficult airway management in children is low, and that most children who have difficult to manage airways can be identified in advance.[1] In this issue of the *British Journal of Anaesthesia*, Disma and colleagues[2] report that neonates (and infants) are also quite different from older children when it comes to difficult airway management.

Disma and colleagues[2] present an analysis of difficult tracheal intubation in neonates and infants derived from a European multicentre observational cohort study of critical events in paediatric anaesthesia (the NEonate-Children sTudy of Anaesthesia pRactice IN Europe [NECTARINE] study).[3] Neonates and infants up to 60 weeks postconceptual age undergoing anaesthesia for surgical and non-surgical procedures were recruited during a 3-month period between March 2016 and January 2017. The resulting cohort is perhaps the best available snapshot of difficult airway management in the youngest patient populations.

Difficult tracheal intubation, defined as two failed attempts of direct laryngoscopy, occurred at an incidence of 5.8% (95% confidence interval 5.1–6.5%). In two-thirds of those patients, difficult intubation was unexpected. The most frequent interventions used to achieve a successful tracheal intubation were changing the laryngoscope blade and calling for experienced help. Advanced alternative indirect techniques such as use of a videolaryngoscope or fibreoptic bronchoscope were only utilised in a limited number of cases where difficult intubation was expected. Successful intubation was achieved in 98% of cases within an average of three attempts, with no patients requiring a surgical airway. Bradycardia occurred in 8% of cases with difficult intubation, while a significant decrease in oxygen saturation (SpO_2<90% for 60 s or longer) occurred in 40%. Difficult tracheal intubation did not lead to a significant increase in 30- and 90-day morbidity or mortality.

Possible differences in neonates

Recent evidence indicates that there are differences between neonates and older children. First, the incidence of difficult tracheal intubation is higher in neonates and infants than in older children.[2,4] Second, unexpected difficult intubation may occur more frequently in neonates and infants than in older children.[2,5] So the generally accepted belief that 'most children who have airways that are difficult to manage can be identified in advance' may not be applicable to neonates and infants. Third, the incidence of hypoxaemia associated with tracheal intubation is higher in neonates and infants than in older children.[5] Finally, when a conventional direct laryngoscope is used in neonates and infants with difficult airways, the success rate of tracheal intubation for the first attempt is extremely low.[2,6]

Difficult airway management in neonates

So, what should we do when we encounter a neonate with an unexpected difficult airway? Disma and colleagues[2] report that experienced help was frequently sought, a practice that is in accordance with guidelines.[1] They also report that, in neonates and infants with difficult airways, the success rate of intubation at the first attempt with a direct laryngoscope was merely 3% when a conventional laryngoscope was used. Such a low success rate (4%) with direct laryngoscopy has also been reported by Park and colleagues.[6] Therefore, when difficult intubation is predicted, or intubation has failed twice, there is no reason to attempt to intubate the trachea using direct laryngoscopy.

Videolaryngoscopy is potentially useful for tracheal intubation, and many studies have shown that videolaryngoscopy increases first pass success in tracheal intubation in children (including neonates and infants) with difficult airways.[5–9] These reports suggest that there should be a greater proscriptive emphasis of the use of videolaryngoscopy in

DOIs of original article: 10.1016/j.bja.2021.02.021, 10.1016/j.bja.2021.02.016.

paediatric airway management algorithms, particularly for the first attempt at tracheal intubation.

The use of fibreoptic bronchoscopy is another reliable method to intubate the trachea. The bronchoscope can directly be inserted into the trachea, or can be guided through an already inserted supraglottic airway, to achieve tracheal intubation.[7,10] The success rate of insertion of a supraglottic airway is high in children with difficult airways,[11] and successful insertion of which facilitates oxygenation.

Possible barriers in difficult airway management strategies

Overall, difficult airway management strategies in neonates and infants seem to be similar to the strategies in adults or older children, but there are some differences. Neonates and infants are at increased risk of oxygen desaturation, which often forces the clinician to abandon intubation attempts and then to multiple intubation attempts, thereby increasing the risk of additional complications. Many small children exhibit features of physiologic difficult airways given that multiple intubation attempts are reported despite reasonable glottic views.[2,5,12,13] Apnoeic oxygenation by insufflating oxygen delays onset of hypoxaemia during attempts at tracheal intubation, and experts continue to advocate apnoeic oxygenation to minimise interruption of intubation attempts.[14–18] By incorporating this practice as standard of care whenever tracheal intubation is attempted in all neonates and infants, we can reduce multiple attempts at tracheal intubation, thereby reducing complications associated with repeated attempts.

Videolaryngoscopy may not be as effective in small children as in older children or adults.[19] In adults with expected or unexpected difficult airways, the success rate of videolaryngoscope-aided tracheal intubation at the first attempt is high (90–99%).[20,21] In contrast, the first-attempt success rate of intubation in small children may be much lower than in large children, and one study has indicated a success rate of only 30% at the first attempt, with 70% eventual success.[6] The reason for this lower success rate is not clear, but a possibility is that currently available videolaryngoscope blades in practice may not be consistently effective in exposing the glottis in small children. Additionally, tracheal tube delivery also may be difficult despite an adequate view of the glottis. These findings were confirmed by a study[7] that reported a significantly lower first pass success for tracheal intubation when a videolaryngoscope was used compared with fibreoptic intubation via a supraglottic airway in neonates and infants with difficult airways, whereas no such difference was observed in older children. Similar problems may be associated with fibreoptic bronchoscopy in neonates, as a fibreoptic bronchoscope with a small external diameter (<3 mm) may not be readily available.

If both tracheal intubation and ventilation via a facemask have failed, a supraglottic airway is regarded as a rescue device. Insertion of a supraglottic airway is usually easy in children with difficult airways,[10,11] but ventilation via a supraglottic airway may also fail. In adults, some factors are known to be risk factors for difficult ventilation via a supraglottic airway,[22] but risk factors may well be different in neonates. If ventilation via a supraglottic airway has failed, invasive front of neck airway access is indicated as the last resort. Emergency front of neck access may not be suitable in infants because it can be difficult to locate the cricothyroid membrane which is frequently <3 mm in size.[23]

Current and future goals

What we can learn from the findings reported in this multicentre study,[2] and what are our current and future goals? We should first be aware that, unlike in older children, unexpected difficult tracheal intubation occurs frequently in small children, and that the chance of successful intubation is quite low with direct laryngoscopy. Therefore, when tracheal intubation is unexpectedly difficult, we should maintain a clear airway without repeated attempts at intubation, call for help, and call for alternative intubation equipment (e.g. videolaryngoscope, fibreoptic bronchoscope, supraglottic airway) of suitable size and means to provide apnoeic oxygenation. We should then start apnoeic oxygenation and attempt to intubate the trachea either with a videolaryngoscope (with a stylet or a bougie readily available) or a fibreoptic bronchoscope.

To carry out these steps efficiently and effectively, a policy based on current knowledge and resources available at each hospital should establish whether or not apnoeic oxygenation can be incorporated as standard of care, videolaryngoscopy should be regarded as the first choice for tracheal intubation in small children, and personnel with sufficient skills to manage the difficult airway in neonates should always be readily available. This would allow a structured checklist in the form of an airway 'time out' focusing on plans for appropriate device use, oxygenation, and experienced help beforehand to ensure that key steps and approaches are not overlooked.

It is clear that airway management methods in small children are still not optimal. Therefore, it is time to carry out studies to assess the efficacy of each procedure, to develop suitable sizes of airway devices for neonates, and to establish more proscriptive recommendations and formal education for clinicians to minimise complications during difficult airway management, since neonates are quite different from children.

Declarations of interest

NJ serves on the editorial boards of the *Anesthesia and Analgesia*, *Pediatric Anesthesia*, *Journal of Clinical Anesthesia*, and *Journal of Anaesthesia*. He has received products free of charge from Ambu and Teleflex corporations. He has received travel support for meetings involving future developments for upcoming airway devices from Teleflex, Vyaire Medical, and Mercury Medical. He has received stock options from Spiro. TA is an editor of the *British Journal of Anaesthesia* and the *Journal of Anesthesia*.

References

1. Black AE, Flynn PE, Smith HL, Thomas ML, Wilkinson KA. Development of a guideline for the management of the unanticipated difficult airway in pediatric practice. *Paediatr Anaesth* 2015; **25**: 346–62
2. Disma N, Virag K, Riva T, Kaufmann J, Engelhardt T, Walid Habre W. Difficult tracheal intubation in neonates and infants. NECTARINE: a prospective European multicentre observational study. *Br J Anaesth* 2021 Mar 30. https://doi.org/10.1016/j.bja.2021.02.021. S0007-0912(21)00116-1; Online ahead of print. PMID: 33812665r
3. Disma N, Veyckemans F, Virag K, Kaufmann J, et al. Morbidity and mortality following anaesthesia in early life: results of the European prospective multicentre observational study, NECTARINE. *Br J Anaesth* 2021 Mar 31. https://doi.org/10.1016/j.bja.2021.02.016. S0007-0912(21)00111-2; Online ahead of print. PMID: 33812668

4. Heinrich S, Birkholz T, Ihmsen H, Irouschek A, Ackermann A, Schmidt J. Incidence and predictors of difficult laryngoscopy in 11.219 pediatric anesthesia procedures. *Paediatr Anaesth* 2012; **22**: 729–36
5. Fiadjoe JE, Nishisaki A, Jagannathan N, et al. Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) registry: a prospective cohort analysis. *Lancet Respir Med* 2016; **4**: 37–48
6. Park R, Peyton JM, Fiadjoe JE, et al. The efficacy of GlideScope(R) videolaryngoscopy compared with direct laryngoscopy in children who are difficult to intubate: an analysis from the paediatric difficult intubation registry. *Br J Anaesth* 2017; **119**: 984–92
7. Burjek NE, Nishisaki A, Fiadjoe JE, et al. Videolaryngoscopy versus fiber-optic intubation through a supraglottic airway in children with a difficult airway: an analysis from the Multicenter Pediatric Difficult Intubation Registry. *Anesthesiology* 2017; **127**: 432–40
8. Garcia-Marcinkiewicz AG, Kovatsis PG, Hunyady AI, et al. First-attempt success rate of video laryngoscopy in small infants (VISI): a multicentre, randomised controlled trial. *Lancet* 2020; **396**: 1905–13
9. Peyton J, Park R, Staffa SJ, et al. A comparison of videolaryngoscopy using standard blades or non-standard blades in children in the Paediatric Difficult Intubation Registry. *Br J Anaesth* 2021; **126**: 331–9
10. Asai T, Nagata A, Shingu K. Awake tracheal intubation through the laryngeal mask in neonates with upper airway obstruction. *Paediatr Anaesth* 2008; **18**: 77–80
11. Jagannathan N, Sequera-Ramos L, Sohn I, Wallis B, Shertzer A, Scjaldenbrand K. Elective use of supraglottic airway devices for primary airway management in children with difficult airways. *Br J Anaesth* 2014; **112**: 742–8
12. Engelhardt T, Virag K, Veyckemans F, Habre W. Airway management in paediatric anaesthesia in Europe – insights from APRICOT (Anaesthesia PRactice in Children Observational Trial): a prospective multicentre observational study in 261 hospitals in Europe. *Br J Anaesth* 2018; **121**: 66–75
13. Habre W, Disma N, Virag K, et al. Incidence of severe critical events in paediatric anaesthesia (APRICOT): a prospective multicentre observational study in 261 hospitals in Europe. *Lancet Respir Med* 2017; **5**: 412–25
14. Fiadjoe JE, Litman RS. Oxygen supplementation during prolonged tracheal intubation should be the standard of care. *Br J Anaesth* 2016; **117**: 417–8
15. Jagannathan N, Burjek N. Transnasal humidified rapid-insufflation ventilatory exchange (THRIVE) in children: a step forward in apnoeic oxygenation, paradigm-shift in ventilation, or both? *Br J Anaesth* 2017; **118**: 150–2
16. King MR, Jagannathan N. Best practice recommendations for difficult airway management in children – is it time for an update? *Br J Anaesth* 2018; **121**: 4–7
17. Riva T, Pedersen TH, Seiler S, et al. Transnasal humidified rapid insufflation ventilatory exchange for oxygenation of children during apnoea: a prospective randomised controlled trial. *Br J Anaesth* 2018; **120**: 592–9
18. Humphreys S, Lee-Archer P, Reyne G, Long D, Williams T, Schibler A. Transnasal humidified rapid-insufflation ventilatory exchange (THRIVE) in children: a randomized controlled trial. *Br J Anaesth* 2017; **118**: 232–8
19. Lingappan K, Arnold JL, Fernandes CJ, Pammi M. Videolaryngoscopy versus direct laryngoscopy for tracheal intubation in neonates. *Cochrane Database Sys Rev* 2018; **6**, CD009975
20. Aziz M, Dilman D, Fu R, Barmbrink A. Comparative effectiveness of the C-MAC video laryngoscope versus direct laryngoscopy in the setting of the predicted difficult airway. *Anesthesiology* 2012; **116**: 629–36
21. Asai T, Liu EH, Matsumoto S, et al. Use of the Pentax-AWS in 293 patients with difficult airways. *Anesthesiology* 2009; **110**: 898–904
22. Saito T, Chew STH, Liu WL, Thinn KK, Asai T, Ti LK. A proposal for a new scoring system to predict difficult ventilation through a supraglottic airway. *Br J Anaesth* 2016; **117**(Suppl): i83–6
23. Navsa N, Tossel G, Boon JM. Dimensions of the neonatal cricothyroid membrane - how feasible is a surgical cricothyroidotomy? *Paediatr Anaesth* 2005; **15**: 402–6

British Journal of Anaesthesia, 126 (6): 1088–1092 (2021)
doi: 10.1016/j.bja.2021.02.003
Advance Access Publication Date: 9 March 2021

Surgery and opioids: some cracks in an enduring romance

Devjit Srivastava[1,*] and Paul Wilkinson[2,*]

[1]Anaesthesia and Pain Medicine, Raigmore Hospital, Inverness, UK and [2]Department of Anaesthesia, Newcastle Pain Management Unit, Royal Victoria Infirmary, Queen Victoria Road, Newcastle upon Tyne, UK

*Corresponding author. E-mails: dev.srivastava@nhs.scot, paul.wilkinson@nuth.nhs.uk

This editorial accompanies: Surgery and opioids: evidence-based expert consensus guidelines on the perioperative use of opioids in the United Kingdom by Srivastava et al., *Br J Anaesth* 2021:126:1208–1216, doi: 10.1016/j.bja.2021.02.030

DOI of original article: 10.1016/j.bja.2021.02.030.