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Comparative videolaryngoscope performance in children: data from the Pediatric Difficult Intubation Registry

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In 2003, the *British Journal of Anaesthesia* published a paper evaluating a novel device for tracheal intubation in cervical spine disease, the Glidescope.[1] Since then, evidence of the benefits of videolaryngoscopy over conventional direct laryngoscopy has gradually accumulated.[2] Videolaryngoscopy improves various measures related to tracheal intubation when compared with direct laryngoscopy in a wide range of contexts ranging from predicted difficulty, simulated difficulty, and even microgravity.[3] The accumulating evidence of improved success, improved visualisation (with its associated reduction in injury), reduced number of attempts, and even improved learning, has recently led to recommendations for the universal adoption of videoolaryngoscopy.[4] Certainly, the technique was firmly established in many countries even before the novel coronavirus disease 2019 (COVID-19) pandemic.[5] Guidelines on tracheal intubation in COVID-19 patients have included use of videolaryngoscopy, which allows clinicians to work further away from the open airway, thus reducing their exposure to aerosol and droplet material during tracheal intubation, and anecdotally there has been a significant expansion of videolaryngoscopy use as a result.[6,7] However, the choice between videoscopes remains unclear.

Multiple prospective studies have been conducted comparing different videolaryngoscopes in an attempt to find the 'best' device, often with conflicting results.[8] Generalisable evidence from prospective clinical trials in the area of airway management, including the assessment of devices, is certainly challenging. Such studies are difficult to control for confounding factors, the population of interest is typically small, the required sample size is large, and surrogate outcomes are typically required. These studies therefore require cautious interpretation, as the best choice is likely to be context-sensitive in terms of the patient group, the type of airway difficulty, and the clinician's experience and competence. Even with well-conducted studies with strong internal validity it is difficult to generalise. Meanwhile, the questions of which laryngoscope to use in a specific case or when purchasing

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remains important and unanswered. Children represent a large cohort in whom evidence on which to base choices between devices is even more sparse.

Peyton and colleagues[9] in this issue of the *British Journal of Anaesthesia* present their findings comparing the performance of videolaryngoscopes during tracheal intubation of children based on the shape of the laryngoscope blade. They performed a retrospective analysis of 1313 procedures from the Pediatric Difficult Intubation Registry (PeDI-R), which is maintained by an international collaborative group under the auspices of the Pediatric Anesthesia Society. The study period was 21 months, from March 2017 to January 2020. They categorised videolaryngoscopes into two groups based on blade shape, standard or non-standard, and compared the performance in a range of measures around tracheal intubation in a heterogeneous group of paediatric patients. The standard shape typically conforms with the usual Macintosh profile, whereas the non-standard is usually 'hyperangulated' or 'J-shaped', with the shape more closely resembling the upper airway anatomy at rest. Their main findings were that both types of devices performed similarly in most patients; however, standard blades performed better in the <5 kg patient category, and non-standard blades proved more successful in 'rescue' situations. They also observed that the risk of complications multiplied with more than one attempt, and difficulty passing the tube despite an adequate glottic view was more common with non-standard blades. Furthermore, non-standard blades were associated with more frequent significant complications, although this was not statistically significant after adjustment for multiple hypothesis testing. What conclusions are we justified in drawing from these results?

As clinical decision makers, and as purchasers, we are obliged to consider the limitations of these sorts of retrospective database analyses. The authors initially hypothesised that hyperangulated or 'J'-shaped blades would perform better than the standard blade profile, and lack of random group allocation is one of the important concerns in interpretation of retrospective studies. It is plausible, for example, to argue that clinicians might choose what they perceive to be a better device when they have significant concerns over anticipated difficulty. That situation, where the attending consultant believed difficulty was likely from the outset and elected to use videolaryngoscopy, represented about 70% of all the included cases, and was the fourth criterion for inclusion in this study by Peyton and colleagues.[9] The first three were more objective, and therefore less susceptible to operator bias: poor view on direct laryngoscopy; impossible direct laryngoscopy owing to severe anatomical issues; and previous failed direct laryngoscopy within 6 months. An elective decision on the part of the operator therefore to choose what they thought was a superior device for more difficult cases would potentially distort the allocation by assigning those cases to one type of device and consequently could result in apparently poorer performance of the 'better' device. Inspection of the patient characteristics data in each group in the study of Peyton and colleagues[9] appears to show that, if anything, the standard blade cohort might have been expected to be more difficult based on age, weight, and Americna Society of Anesthesiologists (ASA) physical status (Table 1). It is reassuring to note that despite lack of block randomisation, similar proportions of patients were found in each criterion, regardless of device used. The modelling may have reasonably adjusted for other confounding variables such as site. Data integrity is typically a concern in retrospective studies, and the authors do not comment on the completeness of data capture. In electronic health records, data are often either incomplete or of poor quality if they result from 'forced function' routines in the system which mandate field entry. However, we also have to recognise that data from large collections may be the best information available.

Although they may not tell us much with confidence about why one device behaves better, or even if all other things being controlled one device appears superior, they are revealing with respect to what happens in practice: a crude form of empiricism over a more strictly rational approach. Such studies present very strong observational evidence.

Many anaesthetists are taught that the first attempt at intubation should be their best, and this was reiterated in COVID-19 guidance. In paediatric anaesthesia, such considerations assume even greater importance as children are generally more difficult to assess in a preoperative setting. A great many of the airway assessment tools used in adult practice are difficult or impossible to apply when assessing children, especially young children, in whom cooperation with assessment may be minimal. Unfortunately, multiple studies have shown that difficulties in management of paediatric airways are a leading cause of perioperative morbidity and mortality.[10–13] This emphasises the need for a technique with a high first pass success rate.

Evidence from a recent analysis of the PeDI registry[14] suggests that we are still not making the right choice for paediatric airway management. In this analysis of children with difficult airways, 46% of anaesthetists chose direct laryngoscopy as their first-choice airway technique. The success rate with this technique was 3%. Fibreoptic bronchoscopy was chosen as the first technique by 28% of anaesthetists, and only 18% chose videolaryngoscopy. The success rates for these two techniques were 54% and 55%, respectively. That study did not seek to differentiate between different types of videolaryngoscope used in each case, but the principle of their use in paediatric cases is clear. The use of awake fibreoptic bronchoscopy, long the staple of difficult cases in adult practice, is a much more limited option in paediatrics, especially in young children. This leads to the implication that videolaryngoscopy should be the go-to technique in paediatric practice.

Although derived from retrospective analysis, these findings of Peyton and colleagues[9] make a useful contribution to our understanding of device performance across paediatric patients. Correct choice first time is particularly important in younger children, who are more prone to rapid hypoxaemia during apnoea because of low functional residual capacity and high oxygen demand, and has the potential to significantly reduce perioperative morbidity and mortality. Analysis from the PeDI registry[14] identifies four independent risk factors for increased risk of complications: more than two tracheal intubation attempts; weight <10 kg; short thyromental distance; and three direct laryngoscopy attempts before an indirect attempt. These independent risk factors are interesting because they suggest that an in-depth assessment of the child's airway beyond looking at the thyromental distance does not actually help in assessing difficulty.

In future, ever more data will become available, enabling us to measure our performance and understand our practice with greater confidence and to pose new questions. The videolaryngoscope is an early example in anaesthetic practice of taking a dumb device and making it smarter by embedding technology within an old design, especially in the case of the standard blade profiles. We have seen the significant benefits this approach has brought. However, what is lacking so far in the videolaryngoscope industry is the ability of the device itself to

capture and analyse key data on laryngoscopy and intubation, and to incorporate this into the electronic health record. Such a development would transform the laryngoscope from a device into a service and provide a vast wealth of information on intubation performance. If robotic or robotically assisted tracheal intubation becomes a reality, validation of its performance will rely on automated collection of such data.[15]

Meanwhile, the construction of databases such as the PeDI-R requires considerable collaboration and effort to develop and maintain, and it is often some time before the rewards may be seen. The authors and colleagues in Peyton's group deserve our recognition and thanks for their work to date and in future.

Authors' contributions

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Writing, editing, and submission of manuscript: AN
Review, drafting, revision of the manuscript: JA

Declarations of interest

The authors declare that they have no conflict of interests.

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Ultrasound identification of the cricothyroid membrane: the new standard in preparing for front-of-neck airway access

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