BJA

British Journal of Anaesthesia, 119 (5): 984–92 (2017)

doi: 10.1093/bja/aex344
Advance Access Publication Date: 3 October 2017
Respiration and the Airway

RESPIRATION AND THE AIRWAY

The efficacy of GlideScope® videolaryngoscopy compared with direct laryngoscopy in children who are difficult to intubate: an analysis from the paediatric difficult intubation registry

R. Park[1,2,†], J. M. Peyton[1,2,†,*], J. E. Fiadjoe[3], A. I. Hunyady[4], T. Kimball[1], D. Zurakowski[1,2] and P. G. Kovatsis[1,2] for the PeDI Collaborative Investigators[‡]

[1]Department of Anesthesiology, Perioperative and Pain Medicine, Boston Children's Hospital, Boston, MA, USA, [2]Department of Anaesthesiology, Harvard Medical School, Boston, MA, USA, [3]Department of Anesthesiology and Critical Care, Children's Hospital of Philadelphia, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA and [4]Department of Anesthesiology and Pain Medicine, Seattle Children's Hospital, University of Washington School of Medicine, Seattle, WA, USA

*Corresponding author. E-mail: James.Peyton@childrens.harvard.edu
[†]Both authors contributed equally to the manuscript and are considered joint first authors.
[‡]PeDI Collaborative Investigators are listed in Appendix.

Abstract

Background. We analysed data from the Paediatric Difficult Intubation Registry examining the use of direct laryngoscopy and GlideScope® videolaryngoscopy.
Methods. Data collected by a multicentre, paediatric difficult intubation registry from 1295 patients were analysed. Rates of success and complications between direct laryngoscopy and GlideScope videolaryngoscopy were analysed.
Results. Initial (464/877 = 53% *vs* 33/828 = 4%, Z-test = 22.2, $P < 0.001$) and eventual (720/877 = 82% *vs*. 174/828 = 21%, Z-test = 25.2, $P < 0.001$) success rates for GlideScope were significantly higher than direct laryngoscopy. Children weighing <10 kg had lower success rates with the GlideScope than the group as a whole. There were no differences in complication rates per attempt between direct laryngoscopy and GlideScope. The direct laryngoscopy group had more complications associated with the greater number of attempts needed to intubate. There were no increased risks of hypoxia or trauma with GlideScope use. Each additional attempt at intubation with either device resulted in a two-fold increase in complications (odds ratio: 2.0, 95% confidence interval: 1.5–2.5, $P < 0.001$).
Conclusions. During difficult tracheal intubation in children, direct laryngoscopy is an overly used technique with a low chance of success. GlideScope use was associated with a higher chance of success with no increased risk of complications. GlideScope use in children with difficult tracheal intubation has a lower success rate than in adults with difficult tracheal intubation. Children weighing less than 10 kilograms had lower success rates with either device. Attempts should be minimized with either device to decrease complications.

Key words: airway management; intratracheal intubation; children; difficult intubation; videolaryngoscopy

Editorial decision: August 26, 2017; **Accepted:** August 28, 2017

Editor's key points

- Efficacy of the use of a direct laryngoscope or a videolaryngoscope (Glidescope) was assessed, in 1295 children who were anticipated, or were discovered on initial attempt at direct laryngoscopy, to be difficult to intubate.
- The success rate of tracheal intubation using a direct laryngoscope was quite low.
- The Glidescope provided a higher success rate of tracheal intubation, but the success rate of intubation at the first attempt was not low (merely approximately 50%), in particular, in children weighing<10 kg.

Multiple studies have demonstrated significant morbidity and mortality related to repeated intubation attempts and intubation failure.[1–4] In an analysis of airway management complications in children with difficult tracheal intubation, significant hypoxia occurred in 9% and cardiac arrest in nearly 2% of patients.[5] Identifying techniques that have high levels of first pass success can reduce intubation attempts and may decrease life-threatening complications.

Many different techniques are used to intubate the trachea. Direct laryngoscopy is the most commonly used technique chosen to perform tracheal intubation in children. Direct laryngoscopy was the initial technique used for tracheal intubation in nearly half the patients in a 2016 study of children who experienced difficult tracheal intubation.[5] Direct laryngoscopy was also the technique of choice in nearly 90% of tracheal intubations in a study published in 2017 analysing airway management in paediatric intensive care units (PICU).[6] However, limited information is available on the efficacy of direct laryngoscopy in children with difficult airways. In children with difficult tracheal intubation, first attempt success rates as low as 3% have been reported when direct laryngoscopy is used.[5] This demonstrates the need for further studies examining the continued use of direct laryngoscopy in paediatric difficult airways.

Videolaryngoscopy is an alternative tracheal intubation technique to direct laryngoscopy. When used as a rescue device after failed direct laryngoscopy in adults, videolaryngoscopy results in successful intubation rates exceeding 90%.[7–11] Unfortunately, data regarding the use of videolaryngoscopy in children is limited and the heterogeneity between existing studies creates difficulty in interpreting their findings. In the general paediatric population, videolaryngoscopy may improve glottic visualization,[12–14] but may not increase intubation success rates when compared with direct laryngoscopy.[15–17] A 2017 Cochrane review of videolaryngoscopy in children suggested that videolaryngoscopy 'leads to prolonged intubation time with an increased rate of intubation failure when compared with direct laryngoscopy'.[18] Two small studies in children with difficult intubations have demonstrated an improved view of the larynx with videolaryngoscopy but no increase in rates of intubation success,[12 19] whilst a recent study looking at a small number of children predicted to have difficult airways demonstrated an improved glottic view and high levels of successful intubation using the GlideScope® videolaryngoscopy compared with direct laryngoscopy.[20] A large multinational study of videolaryngoscopy *vs* direct laryngoscopy use in PICU demonstrated that videolaryngoscopy is associated with a lower occurrence of complications, but did not show any difference in success rates or number of attempts in either group.[6] Another recent Cochrane review comparing videolaryngoscopy *vs* direct laryngoscopy in neonates concluded that there is not enough evidence to recommend videolaryngoscopy in neonates.[21]

The Paediatric Difficult Intubation Registry (PeDI-R) collects data on children who experience difficult tracheal intubation. To date, two studies have been published using data derived from the PeDI-R. The first detailed the formation and structure of the registry, and offered a general overview of the complications occurring during intubation.[5] The second examined the comparative success rates of videolaryngoscopy *vs* intubation using fibreoptic bronchoscopy through a supraglottic airway device.[22] These studies also revealed children weighing less than 10 kilograms (kg) or less than one yr of age had lower success rates and more complications.

We focused our analysis on the two most common techniques utilized in the PeDI-R, direct laryngoscopy and GlideScope videolaryngoscopy. We designed an a priori analysis to examine our primary aims of comparative success and complication rates between direct laryngoscopy and GlideScope videolaryngoscopy within the database. We hypothesize that the GlideScope is associated with a higher success rate and an equal or lower complication rate than direct laryngoscopy in children with difficult tracheal intubation. As secondary aims, we evaluated the effect of weight on intubation success and the success of direct laryngoscopy with poor visualization of the laryngeal inlet.

Methods

Study design

The PeDI-R is a collaborative, multicentre registry, created under the auspices of the Society for Paediatric Anaesthesia to collect prospective, non-randomized, observational data on the airway management of children who meet specific criteria for difficult intubation.[5] Our study included data from 20 hospitals in the United States, Canada, Mexico and Australia on attempts at intubation using either direct laryngoscopy or the GlideScope, from August 2012 through April 2017. The following categories of direct laryngoscopy blades were included for analysis: Miller, Mac, Wis-Hipple and "other blade". When used by anaesthetists the "other blade' category was included in our overall direct laryngoscopy analysis. Each centre's Institutional Review Board granted approval for the collection of data with the requirement for written informed consent waived. The inclusion criteria for this cohort were as follows:[5] Children under 18 yr of age, intubation attempts supervised or performed by an attending anaesthetist, difficult intubation as defined by one of the following 4 criteria:[5]

1. Children with difficult laryngeal exposure as directly assessed by the attending anaesthetist with direct laryngoscopy (Cormack and Lehane Classification $\geq$ 3).[23]
2. Children in whom direct laryngoscopy was physically impossible because of anatomical reasons (e.g. severely limited mouth opening).
3. Children who had failed direct laryngoscopy within the preceding six months.
4. Children in whom the attending anaesthetist deferred direct laryngoscopy as a result of a perceived poor chance of success.

We used the following definitions:

Initial Success: The number of patients on which the technique was initially successful divided by the number of initial attempts with the technique.