Volume 2. Issue 1. 2019

ProClinS Anesthesiology and Pain Management

Mini Review

Open Access

Rethinking the Approach to Endotracheal Intubation in Children with Difficult Airways: The Role of Videolaryngoscope-Assisted Fibre Optic Intubating Videoendoscopic Tracheal Intubation

Author: Rajkumar Rajendram *

Department of Medicine, King Abdulaziz Medical City, Saudi Arabia

***Corresponding author:** Rajkumar Rajendram, Department of Medicine, King Abdulaziz Medical City, Ministry of National Guard-Health Affairs, Riyadh, Saudi Arabia, Email: rajkumarrajendram@doctors.org.uk

Received: December 07, 2019; **Accepted:** December 14, 2019; **Published:** December 16, 2019

ABSTRACT

In children, failed or difficult intubation is associated with complications, including desaturation and death. Whilst direct laryngoscopy is by far the most common technique used to guide endotracheal intubation, the associated incidence of failure is extremely high in children with difficult airways. Whilst videolaryngoscopy (VL) improves the view of the larynx during laryngoscopy; failure of endotracheal intubation with VL is well documented in children. However, the combination of a fibreoptic intubating videoendoscope (FIVE) with a VL eliminates the limitations of each individual device. The foresight, preparation, equipment and space required to implement this airway management strategy are usually prohibitive. However, this approach can be streamlined. The C-MAC VL (with any blade) and either a 2.85 mm external diameter 11301 BDXK FIVE (Karl Storz, Germany) or 4.1 mm external diameter 11302 BDXK FIVE (Karl Storz, Germany), if connected to a dual input 8403 ZX Screen (Karl Storz, Germany) attached to the 8401 YA stand (Karl Storz, Germany) is compact and portable. The combination of the improved visualization of the airway provided by the VL with the ability to use the FIVE as an introducer with a controllable tip greatly increases the maneuverability of an endotracheal tube with the airway. This emerging technique could therefore redefine the management of difficult airways in children.

KEYWORDS: Paediatric; Videolaryngoscope; Endotracheal intubation; Direct laryngoscopy; Fibreoptic bronchoscope; Fibreoptic intubating videoendoscope

INTRODUCTION

Experienced anesthetists rarely encounter difficulty with endotracheal tube (ETT) placement in children with normal anatomy. However, as children have limited cardiopulmonary reserves, high oxygen requirement, and developing nervous systems at risk from hypoxia; the consequence of difficulty or failure may be devastating [1]. Thus, in children multiple attempts at intubation are associated with increased complication rates [1,2]. Furthermore, the rate of complications is higher in children weighing less than 10 kg [1-3]. Extra caution is required for this extremely vulnerable group. Aiming to minimize the number of attempts at intubation is at least as important in children as it is in adults [1].

Unfortunately, the focus of research on airway management has been on adults. This has left the clinicians who treat children with 'toys' designed for adult airways that were simply shrunk down. It is critical to seek data and devices specific to the management of difficult airways in children. However, advancing our knowledge regarding the optimal airway management techniques in children is challenging. Randomized controlled trials (RCT) remain the gold standard of evidence-based medicine. However, the incidence of difficulty is low and enrolling children in clinical trials is fraught with difficulty. So, it is not feasible to conduct RCT to answer questions on pediatric difficult airways. Registry data collected from patient care by hundreds of anesthetists, in routine clinical practice, in several centers provide an accurate picture of airway management and outcomes in the 'real world'.

The pediatric difficult intubation registry

The Pediatric Difficult Intubation Registry (PeDI-R) has provided phenomenal insight into the management of the pediatric airway [2,3]. Park et al., 2017 [3] searched the PeDI-R and described the rate of successful intubation with various strategies for advanced airway management in children with anticipated difficult intubation. In the PeDI-R, the initial and ultimate success rate with direct laryngoscopy was shockingly poor (4%) [3]. Rates of successful tracheal intubation in children were much higher with other advanced airway management strategies. The success rates of some alternative strategies for advanced airway management in children are listed in Table 1 [3].

Devices and Techniques	Patients (n)	Initial success n (%)	Eventual success n (%)	Attempts (n)
DL in combination with Rigid Bronchoscopy	24	19 (79%)	21 (88%)	29
GlideScope® in combination with FOB	48	29 (60%)	39 (81%)	65
DL in combination with FOB	5	3 (60%)	3 (60%)	6
C-MAC® VL	84	49 (58%)	63 (75%)	108
Otolaryngology Techniques (ORL)	72	40 (56%)	45 (63%)	94
Flexible FOB through an LMA	91	47 (52%)	66 (73%)	139
McGRATH™ MAC VL	34	17 (50%)	22 (65%)	42
Rigid Bronchoscope	19	9 (47%)	12 (63%)	29
Flexible FOB	166	77 (46%)	117 (70%)	268
Airtraq VL	11	5 (45%)	5 (45%)	13
GlideScope® VL	507	219 (43%)	346 (68%)	802
Truview VL	21	9 (43%)	14 (67%)	31
Direct Laryngoscopy Other Blade (ORL)	23	8 (35%)	8 (35%)	27
Direct Laryngoscopy (Multiple devices)	688	8 (1%)	36 (5%)	1348
Direct Laryngoscopy (Single device)	828	33(4%)	174 (21%)	1731

Table 1: *Rates of successful endotracheal intubation for various advanced airway management devices in the Pediatric Difficult Intubation Registry*

Rates of successful endotracheal intubation for various advanced airway management devices in the Pediatric Difficult Intubation Registry. The devices and techniques are listed in decreasing order of initial success rate. Data on direct laryngoscopy blades was recorded in the PeDI-R as: Miller, Macintosh, Wis-Hipple and 'other blade'. All techniques for which use in less than 10 patients was reported in the PEDI-R were excluded except DL in combination with FOB. The reported success rate of these techniques is unlikely to be representative. The techniques that were excluded are Blind Intubation through a Supraglottic Airway (n=2), Lighted Stylet (n=3), Anterior Commissure Scope (n=6), Direct Laryngoscopy with a Lighted Stylet in Combination (n=2), Blind Intubation (n=2), Tracheostomy (n=2), other device (n=41). Direct Laryngoscopy with an Optical Stylet in Combination (n=3). Bonfils Optical Stylet (n=1). Optical Stylet through a Supraglottic Airway (n=1). DL, direct laryngoscope; VL, Videolaryngoscope; FOB, fiberoptic bronchoscope; LMA, laryngeal mask airway. Data derived from Park et al., 2017

Use of devices for advanced airway management in children

The data shown in Table 1 have been derived from those presented by Park et al [3]. Analysis of these data from the PeDI-R suggested that a difficult paediatric airway is extremely difficult to manage [1]. For example, in adults with an airway that is anticipated to be difficult to manage, the GlideScope (Verathon Inc., USA) has success rates of up to 96% [4]. Unfortunately, in children, in the PeDI-R, the initial success rate was only 53% and the eventual success rate was only 82% [3].

The GlideScope has a hyperangulated blade and has a specifically designed stylet to facilitate endotracheal intubation. The success of endotracheal intubation with VL with hyperangulated blades is affected by the type of stylet used. For example, the Truflex articulating stylet (Truphatek International Ltd, Israel) improved first attempt success rates with the C-MAC D-blade in comparison to the Portex intubation stylet (Smiths Medical, USA) [5]. Videolaryngoscope-guided fibreoptic intubation is the natural evolution of the concept that the use of a stylet with a controllable tip with a facilitates tracheal intubation with a VL [6,7].

The performance of the fibreoptic bronchoscope (FOB) was similar to that of the GlideScope (initial success rate 46%, ultimate success rate 70%; Table 1) [3]. Interestingly, the performance of the GlideScope seemed to improve if used in combination with a FOB (initial success rate 60%, eventual success rate 81%; Table 1) [3]. Although the difference did not quite achieve statistical significance (GlideScope n=507; GlideScope with FOB n=48; χ^2 3.5; p=0.06); this airway management strategy requires further consideration as it is clearly better than DL.

Video laryngoscope-assisted fibreoptic intubating videoendoscopic tracheal intubation

This technique can obviously be performed using a VL and a fibreopticintubating videoendoscope (FIVE) with separate display screens for each device [6,7]. I have used a FIVE with a dedicated display screen successfully in clinical practice to rescue failed intubation with the Airtraq (ProdolMeditec SA, Spain), C-MAC (Macintosh and D-blades) and the A.P. Advance (Macintosh and Difficult Airway blades) VLs [7]. I have used similar techniques successfully with the GlideScope, McGrath and KingVision (Kingsystems, USA) blade 3 VLs in manikins with various FIVEs including the disposable a Scope 3 (Ambu, Denmark) [7].

The combination of the improved visualization of the airway provided by the VL with the ability to use the FIVE as an introducer with a controllable tip greatly increases the maneuverability of ETT within the airway [7]. Furthermore directly visualizing the ETT introducer reduces the risk of trauma from blind passage [7].

However, this technique is too cumbersome to use regularly in routine practice, even if a difficult airway is expected. Substantial foresight, preparation, equipment and space are required [7]. I have therefore refined and optimized this technique. I now recommend connecting a C-MACVL (with any blade)and either a11302 BDXK(Karl Storz, Germany) or a 11301 BDXK FIVE (Karl Storz, Germany), within a clear plastic scope holder, to a dual input 8403 ZX Screen(Karl Storz, Germany) attached to the 8401 YA stand (Karl Storz, Germany) [7].

Note that the outer diameter of the distal tip of the 11302 BDXK FIVE set 4.0 x 65 is 4.1 mm. It is therefore suitable for the placement of ETT greater than 4.5 mm internal diameter (ID). The outer diameter of the distal tip of the 11301 BDXK FIVE set 3.0 x 52 is 2.85 mm; suitable for ETT greater than 3.5 mm ID.

This configuration has several advantages. The 8403 ZX screen has a dual camera input so both the VL and FIVE can remain connected simultaneously [7]. Only one device input can be displayed on the screen and the screen is blank when switching between the devices. However, switching between devices takes less than four seconds and the C-MAC blade can still be used for direct laryngoscopy [7]. The 8401 YA stand holds the VL and FIVE together with the 8403 ZX screen [7]. As the 11302 BDXK FIVE the 11301 BDXK FIVE have an integrated tube holder an ETT can easily be preloaded [7]. This configuration of devices can be moved by a single person and is extremely compact [7]. It can be used to manage unexpected difficult airways almost anywhere in the hospital if kept 'ready to go' [7].

An algorithm for airway management that combines the use of a FIVE with the GlideScope has been described previously [8]. I have adapted this for use with a C-MACVL and a FIVE simultaneously connected to a dual input 8403 ZX screen [7]. The FIVE can be used as a stylet with a controllable flexible tip if Cormack-Lehane (CL) grades one or two views are seen with the C-MAC VL [7]. The FIVE is guided into the glottis solely under the view of the C-MAC. If use of the C-MAC can only achieve CL grades three or four views, the FIVE should be guided to the point at which it is most likely to be able to view the glottis [7]. The 8403 ZX screen can then be used to display the view from the FIVE whilst the C-MAC is used like a DL to retract the oropharyngeal tissues [7]. The FIVE should then be passed through the glottis to allow ETT placement [7]. If the C-MAC pocket monitor (Karl Storz, Germany) is available then the C-MAC can continue to be used as a VL. This would better assist optimal positioning of the five and identify any cause of resistance to passage of the tracheal tube [7].

CONCLUSIONS

Strategies for advanced airway management are still evolving. Whilst the use of VLs is increasing they are associated with an alarmingly high rate of failure [6,7] particularly in children [1-3]. Using a FIVE and a VL together eliminates the limitations of each individual device [7]. Whilst further data is clearly required and the PeDI-R is perfectly positioned to provide this; it is likely that this strategy could improve the rate of successful endotracheal intubation in children [7]. Videolaryngoscope guided FIVE intubation is an emerging technique that could therefore redefine airway management in children [7].

REFERENCES

1. Aziz M. Big data, small airways, big problems. Br J Anaesth. 2017; 119: 864-866.
2. Fiadjoe JE, Nishisaki A, Jagannathan N, Hunyady AI, Greenberg RS, Reynolds PI, 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.
3. Park R, Peyton JM, Fiadjoe JE, Hunyady AI, Kimball T, Zurakowski D, et al. for the PeDI Collaborative Investigators. The efficacy of GlideScope® 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: 984-992.
4. Jungbauer A, Schumann M, Brunkhorst V, Borgers A, Groeben H. Expected difficult tracheal intubation: a prospective comparison of direct laryngoscopy and video laryngoscopy in 200 patients. Br J Anaesth. 2009; 102: 546-550.
5. Al-Qasmi A, Al-Alawi W, Malik AM, Manzoor Khan R, Kaul N. Comparison of Tracheal Intubation Using the Storz's C-Mac D-blade(TM) Video-Laryngoscope Aided by Truflex(TM) Articulating Stylet and the Portex(TM) Intubating Stylet. Anesth Pain Med. 2015; 5: e32299.
6. Rajendram R. Videolaryngoscopy is not a panacea for difficult airway management. Br J Anaesth. 2017; 118: 470-471.
7. Rajendram R. Videolaryngoscope guided fibreoptic endotracheal intubation with the C-MAC and a dual camera input screen. Br J Anaesth. 2016; 116.
8. Sukernik MR, Bezinover D, Stahlman B, Vaida S, Pott L. Combination of GlideScope with fiberoptic bronchoscope for the optimization of difficult endotracheal intubation: a case series of three patients. 2009.