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Review

Paediatric video laryngoscopy and airway management: What's the clinical evidence?

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A B S T R A C T

The major complications of paediatric airway management are uncommon, but the outcomes are often severe. Over the last decade, additions and advancements in the devices and technology have significantly improved our ability to manage difficult paediatric airways safely. Videolaryngoscopy involves the use of video and optical technology to facilitate indirect visualisation of the larynx during intubation and has been seen as an evolutionary step in intubation technology. Over the past few years, videolaryngoscopes have been receiving plenty of attention as new airway devices for use in paediatric patients. The objective of this narrative review is to specify the existing clinical evidence regarding the efficiency and safety of videolaryngoscopy in paediatric airway management.

1. Introduction

Management of difficult paediatric airways can be a challenge, especially when anaesthesia providers are non-paediatric anaesthesiologists [1]. The major complications of paediatric airway management are uncommon, but the outcomes are often severe. Thus, complications arising out of airway management still remain one of the main causes of perioperative morbidity in paediatric patients [2]. Recently, a multicentre study including 1018 children with difficult airways from 13 paediatric centres shows that tracheal intubation fails in 19 (2%) children and 204 (20%) children have at least one complication. Furthermore, the most common complication is transient hypoxemia. A most interesting finding of this study is that > 2 laryngoscopy attempts at securing the airway are associated with a high intubation failure rate and an increased incidence of severe complications [3]. All of these findings incite anaesthesia providers managing difficult paediatric airway to consider the following strategies: (a) minimise the number of direct laryngoscopy (DL) attempts, and early conversion to an indirect technique, such as fiberoptic bronchoscopy (FOB) and videolaryngoscopy (VL), when DL fails; (b) take a mean for ventilation or oxygenation of the lungs during intubation (apnoeic oxygenation or supraglottic airway) to decrease the risk of complications and improve patient safety [4].

VL involves the use of video and optical technology to facilitate indirect visualisation of the larynx during intubation and has been seen as an evolutionary step in intubation technology [5]. During the past five years, VL has been receiving plenty of attention as new airway device for use in the paediatric patients, with a great number of publications. This evidence-based narrative review aimed to specify the existing clinical evidence regarding efficiency and safety of VL in paediatric airway management.

2. Data sources and literature search

The Wan-Fang Data, CNKI, Pubmed, Embase, Cochrane library and Google Scholar were searched for relevant English and Chinese articles published up to July 1, 2017, using the keywords "video laryngoscope", "videolaryngoscope", "video laryngoscopy" and "videolaryngoscopy". No language restriction was implemented. Only case reports, case series, observational or comparative study and randomised controlled clinical trials in paediatric patients were included in our search. Manikin and cadaver studies were excluded. The results of the included studies and their reference lists were cross-referenced to identify a common theme.

3. The available paediatric videolaryngoscopes

Currently, several manufactures have provided the VLs that are specially designed for paediatric use; such as Storz VL (Karl Storz Endoscopy, Tuttlingen, Germany), Glidescope VL (Verathon Medi-

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Table 1
Features of available paediatric videolaryngoscopes.

	Blade shapes	Monitor	Portability	Disposability	Size range	Anti-fog	Video recording
Storz V- and C-MAC	Macintosh and Miller	Separate 7-inch or 2-in pocket LCD	Yes when using pocket monitor	RU	Macintosh: 2 and Miller: 0 and 1	Yes	Yes
Glidescope original	Angulated	Separate 7-inch LCD	No	RU	2 and 3	Yes	No
Glidescope Cobalt	Angulated	Separate 7-inch LCD	No	SU	0–3	Yes	Yes
Glidescope Ranger	Angulated	Separate 3.5-inch LCD	No	RU and SU	RU: 3 SU: 0–3	Yes	Yes
Glidescope Titanium	Angulated	Separate 3.5-inch LCD	No	SU	S1 and 2	Yes	Yes
Airtraq	Channelled	External monitor (when used as a VL)	Not when used as a VL	SU	0–2	Yes	No
Truview	Angulated	External monitor (when used as a VL)	Not when used as a VL	RU	0–3	Yes with oxygen insufflation	No
UEscope	Angulated and Miller	Integrated, 2.5 in. LCD	Yes	RU and SU	RU angulated; 1–3; RU Miller: 0 and 1 SU: 2	Yes	Yes
McGrath	Macintosh	Integrated 1.7-inch LCD	Yes	SU	1 and 2	No	No
Pentax-AWS	Channelled	Integrated 2.4-inch LCD	Yes	SU	Neonatal and paediatric	No	No
KingVision	Channelled and no-channelled	Integrated, 3.5 in. LCD	Yes	SU	Channelled: 1 No-channelled: 1 and 2	No	No

LCD: liquid crystal display; VL: videolaryngoscope; RU: reusable; SU: single-use.

Table 2
Laryngoscopy and successful intubations with Storz videolaryngoscope in paediatric patients.

First author	Number of patients and study design	Operators' experience with VL	Laryngoscopy	Intubation outcomes	
			Improved laryngeal views with VL	Success rate (%)	Intubation time [s, median (range) or mean ± SD]
Macnair [12]	60 children aged 2–16 yrs with a normal airway; RCT	Anaesthetists, good experience	8/11 CL II to CL I (P = 0.02); 1 CL III to a CL II; 3 CL II remained unchanged	Overall: 30/30 (100) for DL and VL; $P > 0.05$	16.0 (14.0–20.0) and 22.5 (17.8–35.0) for DL and VL; $P < 0.001$
Vadi [13]	65 children < 2 yrs with a normal airway; a randomised evaluation study	Anaesthesiology trainees, only manikin training	–	Overall: 19/19(100.0) and 21/22 (95.5) for DL and VL; $P > 0.05$	42.1 (34.0–59.0) and 21.5 (17.0–34.3) for VL and DL; P = 0.002
Vadi [14]	93 children younger than 2 yrs with manual in-line stabilisation; RCT	Anaesthesiology trainees, no previous experience	21/31 (67.7%) CL I with DL and 29/31 (93.5%) CL I with VL; P = 0.006	Overall: 31/31 (100) and 30/31 (96.8) for DL and VL; $P > 0.05$	23.3 (20.7–26.5) and 33.3 (26.2–43.3) for DL and VL; P = 0.06
Vlatten [15]	56 children aged 4 yrs or younger with a normal airway; RCT	Anaesthetists; 10 mannequin intubations and 3 human intubations	POGO = 97.5% (10–100) with DL to 100% (80–100); $P < 0.05$	Overall: 28/28 (100) for DL and VL; $P > 0.05$	21 (17–29) and (22–37) for DL and VL; P = 0.006
Eisenberg [16]	430 children aged 0–18 yrs with emergency intubation; retrospective cohort study	ED trainees; Limited or no previous experience	–	Overall: 223/240 (92.9) and 187/190 (94) for DL and VL; $P > 0.05$	–
Patil [18]	60 children aged 8–18 yrs undergoing nasal intubation; comparative study	Anaesthetists; about 100 nasal intubations	26/30 (86.7%) CL I with DL and 29/30 (96.6%) CL I with VL; P = 0.35	Overall: 30/30 (100.0) and 30/30 (100.0) for DL and VL; $P > 0.05$	–

CL: Cormack–Lehane; POGO: percentage of glottis opening; DL: direct laryngoscopy; VL: videolaryngoscopy; RCT: randomised, controlled trial.

cal, Bothwell, WA, USA), Truview laryngoscope (Truphatek, Netanya, Israel), UEscope (UE Medical Co., Zhejiang, China), McGrath MAC VL (Aircraft Medical, Edinburgh, Scotland), Airtraq laryngoscope (Prodol, Vizcaya, Spain), KingVision VL (Kingsystems, Nobles-ville, IN, USA) and Pentax-Airwayscope (Hoya, Tokyo, Japan). These VLs can be classified into the four groups: Macintosh, Channelled, Angulated and Miller types (Table 1) [5–11]. Of these devices, Storz, Glidescope, Truview, Airtraq and UEscope are available for use across the entire spectrum of paediatric ages, from neonates to adolescents. In the available literature, there have been extensive clinical studies evaluating clinical performance of the 5 VLs by comparing quality of laryngeal view, intubation success rate, intubation time and the related adverse events with a DL in children (Tables 2–5). Moreover, many case reports and series have described clinical efficiency of these VLs for airway rescue when difficult or failed intubation with a DL or other devices occurs in paediatric patients with difficult airways. Thus, this review is mainly focused on these devices.