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Case Report
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A Hybrid Technique Using Video Laryngoscope-assisted Flexible Bronchoscopy to Facilitate Endotracheal Intubation in Children with Anticipated Difficult Airway: A Case Series

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Abstract

We present a case series using a hybrid technique of video laryngoscope-assisted flexible bronchoscopy to facilitate endotracheal intubation in children with an anticipated difficult airway. This series describes the management of difficult airways in four pediatric cases using the hybrid technique: two cases of Apert syndrome scheduled for cranial remodeling with orbito-facial advancement, one case of an incomplete cleft palate and retrognathia scheduled for palatoplasty, and a case of Parry Romberg syndrome scheduled for reconstructive procedure. This case series aimed to highlight the value of the hybrid technique as a safe and effective intubation modality for difficult pediatric airways.

Keywords: Difficult airway, flexible bronchoscope, intubation, video laryngoscope

Main Points

- The hybrid intubation technique combines the advantages of a video laryngoscope and a flexible bronchoscope.
- The intubation is conducted by two anaesthesiologists: one inserts the video laryngoscope into the oral cavity to improve the visual field of the airway, and the other manipulates the endotracheal tube-loaded flexible bronchoscope through the vocal cords.
- This approach improves the success of tracheal intubation in children with difficult airways.

Introduction

Difficult airway can result in multiple intubation attempts, in addition to airway trauma and hypoxia.[1] Apart from direct laryngoscopy, laryngoscope blades of alternative design and size, adjuncts, video laryngoscopes (VLS), flexible intubation scopes, supraglottic airway (SGA), optical stylets, or rigid bronchoscopes could be used.[2,3] Fibreoptic-guided intubation is considered the gold standard for pediatric difficult airway, although manipulating the device may be difficult due to a smaller airway.[4]

We report a case series of four successful endotracheal intubations in children with difficult airways using VLS as a supplement for flexible bronchoscope navigation. This manuscript adheres to the Enhancing the Quality of and Transparency of Health Research-*EQUATOR* guidelines. Written consent was obtained from the parents or legal guardians of all patients prior to their publication of the case details.

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Case Presentation

Case 1

An 8-month-old female infant weighing 8 kg with Apert syndrome was scheduled for cranial remodeling with orbitofrontal advancement. She had a cleft palate, flat occiput, midfacial hypoplasia, and orbital proptosis. The airway examination using the Colorado Pediatric Airway Score (COPUR) was 12 (Table 1).[5] Computed tomography (CT) of the neck revealed an anteriorly positioned larynx (near C1 vertebra) and a small mandibular space.

Table 1. Colorado Paediatric Airway Score (COPUR)

Colorado Paediatric Airway Score (COPUR)		**Points**
C: Chin		
From the side view, is the chin:		
· Normal size?		1
· Small, moderately hypoplastic?		2
· Markedly recessive?		3
· Extremely hypoplastic?		4
O: Opening		
Interdental distance between the front teeth:		
· 40 mm		1
· 20-40 mm		2
· 10-20 mm		3
· <10 mm		4
P: Previous intubations, OSA (obstructive sleep apnoea)		
· Previous intubations without difficulty		1
· No past intubations, no evidence of OSA		2
· Previous difficult intubations, or symptoms of OSA		3
· Difficult intubation-extreme or unsuccessful; emergency tracheotomy; unable to sleep supine		4
U: Uvula Mouth open, tongue out, observe palate		
· Tip of uvula visible		1
· Uvula partially visible		2
· Uvula concealed, soft palate visible		3
· Soft palate not visible at all		4
R: range		
Observe line from ear to orbit, estimate range of movement, looking up and down		
· >120°		1
· 60°-120°		2
· 30°-60°		3
· <30°		4
Modifiers: add point for		
· Prominent front "buck" teeth		1
· Very large tongue, macroglossia		1
· Extreme obesity		1
· Mucopolysaccharidoses		2
Prediction points	**Intubation difficulty**	**Glottic view**
5-7	Easy, normal intubations	1
8-10	More difficult, laryngeal pressure may help	2
12	Difficult intubation, fibreoptic less traumatic	3
14	Difficult intubation, requires fibreoptic or other advanced methods	3
16	Dangerous airway, consider awake intubation, advanced methods, potential tracheotomy (Patients with hypercarbia	4
16+ scores	>16 are usually incompatible with life without an artificial airway	

Intravenous (IV) dexmedetomidine at 1 mg kg^{-1} h^{-1}, glycopyrrolate at 10 µg kg^{-1}, and dexamethasone 0.1 mg kg^{-1} were given, with intermittent IV ketamine at 0.5 mg kg^{-1} boluses. Nebulization, superior laryngeal nerve and transtracheal blocks with 2% lignocaine were administered.

Oral intubation with an H-SteriScope (Vathin Medical Instrument Co. Ltd, Hunan, China), a pediatric fibreoptic bronchoscope (FOB), with an outer diameter of 2.2 mm was attempted, with oxygen supplementation through nasal prongs to prevent desaturation. Owing to the narrowing of the oral cavity, the FOB had little room, and intubation was unsuccessful. A second attempt was made using a McGrath minimum alveolar concentration (MAC) VLS (Aircraft Medical Ltd., Edinburgh, UK) with a 1 blade size. Due to the anterior larynx and inadequate angulation of the stylet or bougie, maneuvering the endotracheal tube (ETT) or bougie into the trachea was unsuccessful, despite a percentage of glottic opening score of 25% (Figure 1). A patient experienced a fall in saturation, and the attempt was abandoned. The patient was ventilated.

Finally, FOB and VLS were used simultaneously by anaesthesiologists who were experienced in this technique. Intubation was performed by two anaesthesiologists: one inserted the VLS into the oral cavity to improve the visual field of the airway, and the other manipulated the FOB (Figure 2). The tip of the bronchoscope, as visualized on the VLS, could be maneuvered and passed through the vocal cords, followed by smooth railroading of the 3.5-mm ETT. After confirming adequate ventilation via capnography, the ETT was fixed.

IV fentanyl (2 µg kg^{-1}) and atracurium 0.5 mg kg^{-1} were given. Anaesthesia was maintained with dexmedetomidine at 0.5 µg kg^{-1} h^{-1} and 0.8-1.0 MAC isoflurane. After the procedure, the patient was transferred to the pediatric intensive care unit (PICU) and extubated the next day.

Case 2

A 9-year-old child weighing 19 kg with Parry Romberg syndrome comprising right progressive hemifacial atrophy with en coup de sabre deformity, was scheduled for free anterolateral-thigh adipofascial flap. Difficult intubation was anticipated again when the COPUR score was 13. CT revealed hypoplasia of the right mandible. After securing IV access, IV fentanyl (2 µg kg^{-1}), propofol 2 mg kg^{-1} and after confirming adequate mask ventilation, atracurium (0.5 mg kg^{-1}) was administered. A C-MAC VLS (Karl Storz GmbH, Tuttlingen, Germany) with a Macintosh blade 2 was inserted. Following this H-SteriScope, a flexible video bronchoscope with an outer diameter of 3.2 mm, loaded with 5 mm cuffed armored ETT, was passed under VLS guidance through the vocal cords, and intubation was accomplished successfully in the first attempt (Figure 3). Upon completion of the surgery, the patient was transferred to the PICU and extubated the next day.

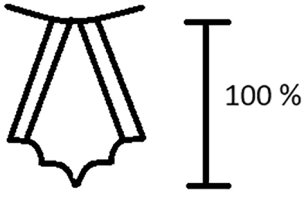

Figure 1. Percentage of glottic opening (POGO) score for laryngeal grading. The POGO score represents the linear span from the anterior commissure to the interarytenoid notch.

Figure 2. In the first case of Apert syndrome, a video laryngoscope is introduced into the oral cavity by one anaesthesiologist to improve visualization of the airway, and the second anaesthesiologist simultaneously manipulated the fiberoptic bronchoscope loaded with an endotracheal tube into the vocal cords.

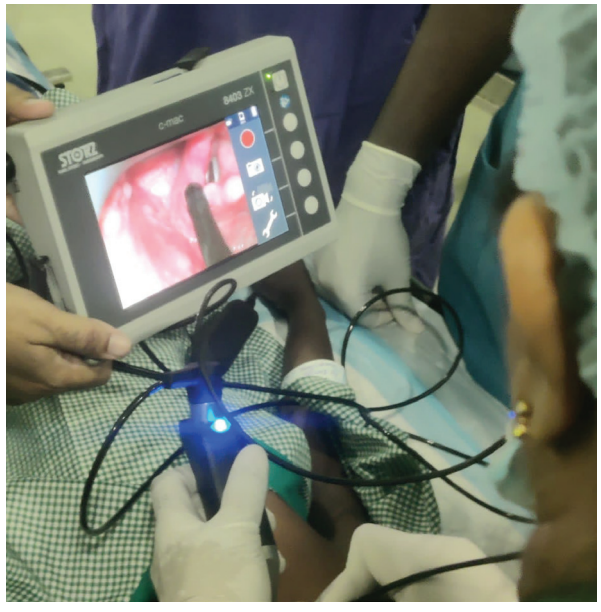

Figure 3. In case 2 with Parry-Romberg syndrome, the fibreoptic bronchoscope is manipulated into the vocal cords after visualization under the C-MAC video laryngoscope.

Case 3

A 1-year-old child weighing 9 kg with incomplete cleft palate and retrognathia was scheduled for palatoplasty. The patient had a history of difficult intubation in the past. The COPUR score was 14. IV access was secured after inhalation with oxygen and sevoflurane. IV fentanyl (2 µg kg^{-1}) and atracurium (0.5 mg kg^{-1}) were administered after adequate mask ventilation. A McGrath MAC VLS with a 1-blade was inserted, and the arytenoids were visualized. An H-SteriScope, a flexible bronchoscope with an outer diameter of 2.2 mm, loaded with 3.5 mm cuffed armored ETT, was passed, and the child was intubated without any untoward complications. The child was extubated at the end of the surgery.

Case 4

A 1-year-old child with Apert syndrome and craniosynostosis weighing 7 kg was scheduled for bilateral fronto-orbital advancement. The child had a cleft palate. The COPUR score was 13. CT scan of the neck revealed an anteriorly placed larynx and a small mandibular space. After premedication with oral midazolam (0.5 mg kg^{-1}), inhalation induction was performed with oxygen and sevoflurane. Following IV cannulation, fentanyl (2 µg kg^{-1}) and atracurium (0.5 mg kg^{-1}) were administered after adequate mask ventilation. Following visualization of the arytenoids under a McGrath MAC VLS with a size 1 blade, an H-SteriScope, a pediatric flexible bronchoscope with an outer diameter of 2.2 mm, loaded with 3.5 mm cuffed armored ETT was passed. Anaesthesia was maintained with oxygen, air, and isoflurane (MAC 0.8-1). The child was extubated on the table.

Discussion

Ours is a tertiary center catering to all specialties, and our pediatric cases comprise primarily cleft repair or neurosurgical and abdominal cases. In children with a difficult airway, alternative techniques are imperative to ensure successful intubation.[6] We ensured the availability of various sizes of Mackintosh and Miller laryngoscope blades, adjuncts like bougies and stylets, VLS with different sized blades, flexible bronchoscopes, and invasive access. SGAs were available in all cases as a backup plan, except for the first case in which there was a leak in the 1.5 ProSeal size on the day of the procedure.

SGAs allow effective oxygenation and ventilation by relieving upper airway obstruction by displacing the tongue and soft tissue in the posterior pharynx. SGAs can be used as primary devices for recognized difficult airways.[7] However, considering limited access in head and neck procedures or the duration of the case, we decided to intubate our cases.

Intubation through a SGA is a suitable option in difficult airways by acting as a conduit for the passage of the FOB loaded with an ETT. While restoring oxygenation and ventilation, caution should be maintained to avoid inadvertent extubation while removing the SGA, as the ETT may extend for only a short distance beyond the distal tip of the SGA.[7]

VLS is associated with better glottic visualization, higher success rate (92%), and a faster learning curve.[8] However, despite a good glottic view, it does not always aid in the easy passage of an ETT, as happened in our first case, due to the different axes between the optical visualization of the vocal cords and ETT introduction.[8] The failure rate of VLS as a primary technique is 2%, and as a rescue technique is 8%.[9]

Flexible bronchoscopy is the gold standard for elective difficult intubation.[10] It is associated with a higher success rate of intubation compared with VLS in patients with difficult airways.[11] On the downside, manipulating the device could be difficult due to the smaller airway in children, resulting in poor visualisation.[4] H-SteriScope is a new single-use flexible video-bronchoscope (Vathin Medical Instrument Co. Ltd, Hunan, China) with an outer diameter of 2.2-6.2 mm. Except for the 2.2 mm bronchoscope, the others have working channels with diameters ranging from 1.2 to 3.2 mm.[12]

We have described a hybrid technique using VLS to assist flexible bronchoscopy for endotracheal intubation. The VLS is inserted by one anaesthesiologist which improves visualization of the glottis, while the flexible bronchoscope with a mounted ETT is inserted orally and manipulated through the vocal cords by a second anaesthesiologist. In a simulated study, it was shown that a single anaesthesiologist can introduce the laryngoscope, which can be held in place by a second person without airway training.[13]

The hybrid technique had a greater first-attempt intubation success rate in adult patients compared with the individual technique.[13,14] The hybrid technique can facilitate easier and quicker intubation, thereby minimizing desaturation episodes. In this case series, we did not observe any significant oxygen desaturation or bradycardia events. By choosing this technique, we were able to intubate the children safely in a much shorter time (average 60 seconds). A proper communication between team members is of primary importance for this method to be effective.

Since ventilation with a face mask was adequate, we paralyzed a few of the patients before intubation was attempted. Due to the non-availability of sugammadex in this region at the time of conducting the cases and to avoid possible bradycardia with succinylcholine, we used atracurium. When available, rocuronium and sugammadex are better alternatives to succinylcholine and atracurium in patients with difficult airways.[15]

Conclusion

The hybrid technique of VLS-assisted flexible bronchoscopy facilitates safe and successful tracheal intubation in children with difficult airways and can be used electively or as a rescue measure.

Ethics

Informed Consent: Written consent was obtained from the parents or legal guardians of all patients prior to their publication of the case details.

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Footnotes

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