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CASE REPORT

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Airway management in a two-year-old child with a tongue tumor using video laryngoscope-assisted flexible bronchoscopic nasotracheal intubation (hybrid technique)

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Key Clinical Message

Airway management in children can be challenging. A hybrid technique using a video laryngoscope-assisted flexible bronchoscopic nasotracheal intubation allowed a successful airway management in a two-year-old child with a large tongue tumor.

KEYWORDS

anesthesia, pediatrics and adolescent medicine

1 | INTRODUCTION

A difficult airway in children can be a potentially life-threatening event that affects perioperative outcome.[1–3] The NECTARINE network describes an incidence of difficult intubations in 5.8% of 4683 children.[1] In our own institution, in a retrospective analysis of 11,219 pediatric anesthetic procedures over a 5-year period, we found an incidence of difficult laryngoscopy of 1.35%.[3]

A difficult airway in children can be caused by a variety of factors, including anatomical anomalies, craniofacial dysmorphism, individual anatomical, functional and morphometric parameters such as a small mandibular space, an enlarged tongue or restricted head extension, and congenital syndromes such as Pierre Robin sequence, Goldenhar syndrome or Treacher-Collins syndrome.[4,5] Difficult intubation due to masses in the area of the tongue as a result of a thyroglossal duct cyst or hemangioma of the hypopharynx is a rare cause of difficult airway in children, whereas it is one of the more common reasons for the high rate of difficult intubation in adult patients in ear, nose and throat (ENT) surgery and maxillofacial surgery.[3,6,7]

The introduction of video laryngoscopes has greatly simplified the management of the difficult airway in children in recent years.[8,9]

Based on the video laryngoscope and the availability of flexible video bronchoscopes, a new method of difficult

airway management has been developed in recent years. This procedure is intended for cases where, despite the use of the video laryngoscope, intubation is difficult or impossible for anatomical or other reasons. This so-called hybrid technique allows video laryngoscope-assisted bronchoscopic intubation.

In this case report, we used such a video laryngoscope-assisted bronchoscopic nasotracheal intubation (hybrid technique) in a two-year-old child with an exophytic tumor in the middle of the tongue. The hybrid procedure allowed a no-touch technique with respect to the tumor in order to avoid the risk of lesion or perforation and subsequent bleeding from the highly vascularized tumor.

2 | CASE PRESENTATION

The patient was a two-year-old boy who presented with a 2.3 × 2.1 cm tumor on the dorsum of the tongue. The lesion existed since birth and was thought to be a hemangioma with vascularization from the right lingual artery. It had been monitored regularly through magnetic resonance imaging (MRI) and had shown very little to no growth, so a conservative approach with propranolol was chosen. The current MRI however showed significant growth compared to the previous one in July 2022, when the tumor was still measured 1.3 × 1.6 cm (Figure 1A,B).

Surgical resection under general anesthesia was therefore planned. The surgical colleagues requested a nasotracheal intubation in order to facilitate smooth surgical access to the tumor. The patient was otherwise healthy and developed normally for his age. The tumor did not cause him any breathing problems, nor did it prevent him from eating normally. However, the tumor did affect his speech and minor bleeding episodes were stated in the case history. The patient had been sedated with Propofol under spontaneous breathing for the MRIs, but had never before undergone general anesthesia with the need to secure the airway.

After the anesthesia information visit on the day before the operation, the MRI images were first examined by the responsible anesthesiologist to plan the airway management and then the securing of the airway was discussed in an interdisciplinary manner with the maxillofacial surgeons. Based on positive experiences with the video laryngoscopic-assisted flexible bronchoscopic nasotracheal intubation of children with Pierre Robin Sequence scheduled for surgical closure of a cleft palate, a modified hybrid technique was planned as primary airway protection. This procedure is routinely trained by the anesthetists involved in this case on an airway manikin with Pierre Robin Sequence (AirSim® Pierre Robin X, Trucorp Ltd., Lurgan, North Ireland). As a fallback, the use of tongue forceps or surgical spatula were planned to create enough space in the hypopharynx for nasal bronchoscopic intubation. As second fallback, two maxillofacial surgeons were present from the beginning of anesthesia induction ready to intervene in case of complications. Surgical material had been prepared to both stop a potential bleeding and establish a surgical airway by means of a tracheotomy if needed.

In the operating theater, the perioperative monitoring consisting of ECG, oxygen saturation and non-invasive blood pressure measurement (M540 from Dräger, Lübeck, Germany) and a peripheral venous access was established. After pre-oxygenation with a face mask, anesthesia was induced with a body weight-adjusted dose of 3 µg/kg fentanyl and 5 mg/kg propofol.

After the loss of consciousness, mask ventilation with the anesthesia ventilator (Perseus A500™, Fa. Dräger, Lübeck, Germany) was started without any problems and then 0.1 mg/kg of vecuronium was administered according to body weight.

3 | AIRWAY MANAGEMENT

Two minutes later, the first anesthesiologist performed a cautious indirect laryngoscopy using a GlideScope®

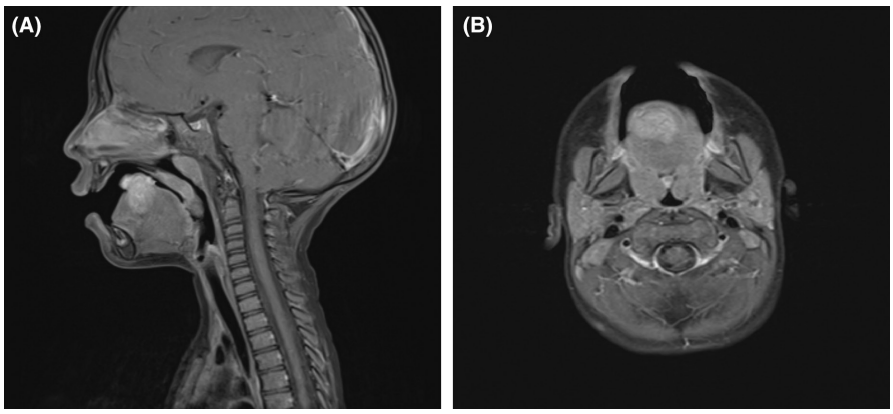

FIGURE 1 MRI of the tongue. Sagital T1-weighed postcontrast image. (B) MRI of the tongue. Axial T1-weighed postcontrast image. Sagittal (Figure 1A) and axial (Figure 1B) T1-weighted postcontrast images clearly show a 2.3 × 2.1 cm mass with an exophytic portion in the area of the posterior tongue.

Spectrum™ LoPro 2 blade with a GlideScope® Core™ video laryngoscopy system (Glidescope®, Verathon Medical Canada ULC, Burnaby, BC, Canada). A large exophytic tumor was found in the posterior tongue area, which was not touched by the blade to avoid injury to the tumor with the risk of bleeding or perforation (Figure 2). For this reason, the curved blade of the video laryngoscope was not inserted in the midline as usual. Instead, the curved blade was placed on the right edge of the tongue and carefully advanced under visual control past the tumor to lift the base of the tongue in the hypopharynx with minimal force

FIGURE 2 The mass presented with the video laryngoscope. In order not to injure the tumor, a no-touch technique was used. The curved GlideScope® Spectrum™ LoPro blade (Glidescope, Verathon Medical Canada ULC, Burnaby, BC, Canada) was guided past the side of the tumor in order to carefully lift the base of the tongue in the hypopharynx.

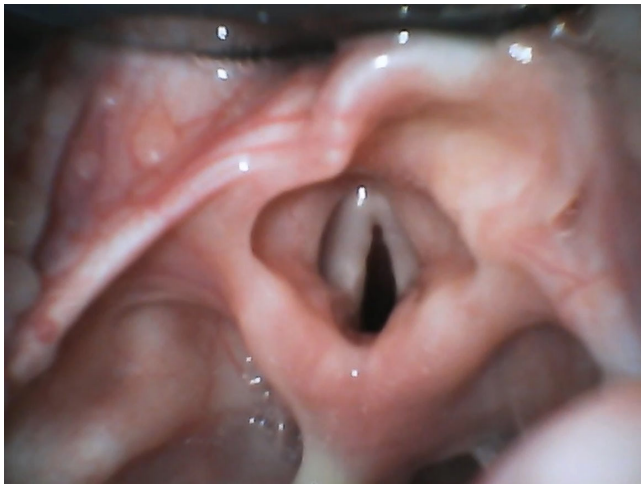

FIGURE 3 Videolaryngoscopic view of the larynx. The right tonsil can still be seen in the lower right corner of the image. The blade is inserted from the right edge of the tongue so as not to injure the tumor. Therefore, the view of the larynx is not completely symmetrical.

to create an air space proximal to the laryngeal opening (Figure 3). This approach allowed sufficient space and visibility for bronchoscopic intubation.

At the same time, a second anesthesiologist performed nasal bronchoscopy using an Ambu® aScope™ 5 Broncho 2.7 mm disposable bronchoscope connected to an Ambu® aView™ II video monitor (Ambu®, Ballerup, Denmark) with a Woodbridge tube ID 4.0 mm (Rüschflex™, Rüsch®, Teleflex Medical Europe, Athlone, Ireland) threaded onto it. After passing the vocal cords with the flexible bronchoscope (Figure 4), the Woodbridge tube was easily and atraumatically advanced over the bronchoscope into the trachea (Figure 5).

After intubation, mechanical pressure-controlled ventilation was performed with an end-expiratory target CO_2

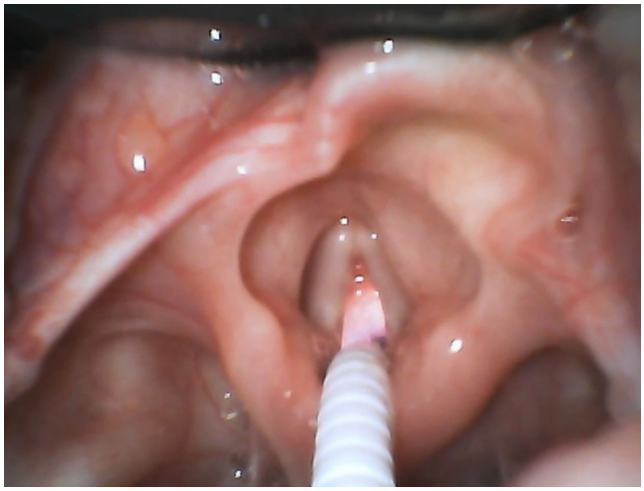

FIGURE 4 The disposable nasal bronchoscope (Ambu® aScope™ 5 Broncho, Ambu®, Bad Nauheim, Germany) passed through the vocal cords atraumatically.

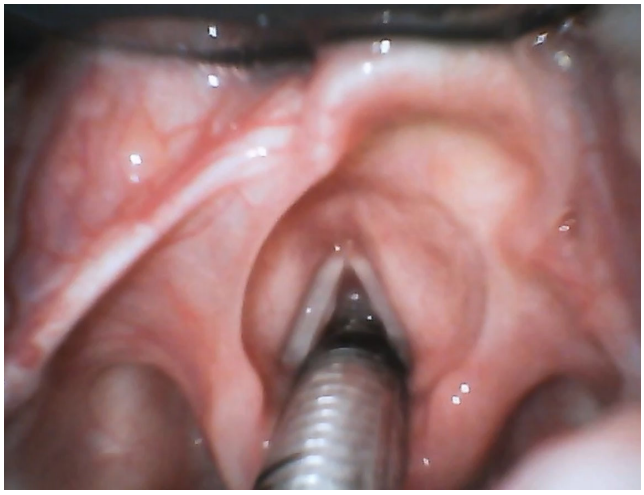

FIGURE 5 The ID 4 mm Woodbridge tube is placed using the Seldinger technique over the disposable bronchoscope (Ambu® aScope™ 5 Broncho, Ambu®, Bad Nauheim, Germany).

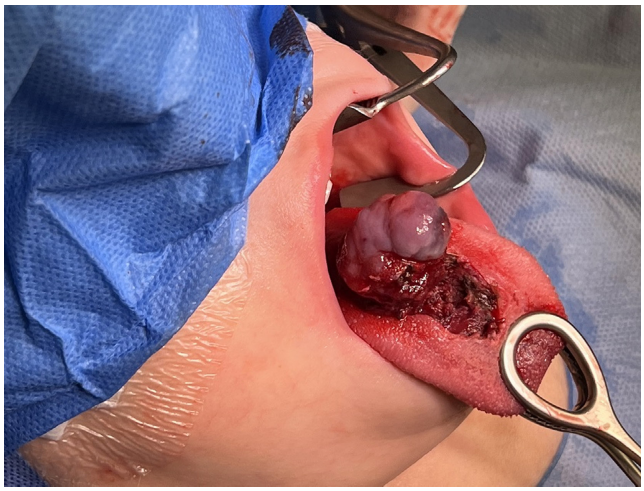

FIGURE 6 Intraoperative site shortly before the complete removal of the tumor.

of 36–38 mmHg. Anesthesia was maintained by continuous body weight-adjusted administration of 6 mg/kg/h propofol and 0.5 μg/kg/min remifentanil. At the request of the surgical colleagues, perioperative antibiotic prophylaxis was given with 40 mg/kg ampicillin and 20 mg/kg sulbactam, and 5 mg/kg prednisolone was administered to prevent tongue swelling caused by the surgical trauma.

The perioperative course of anesthesia and surgery was uneventful. The tumor was completely removed after an operation time of 55 min (Figure 6). For post-operative pain management, 20 mg/kg Metamizol was administered according to body weight. The young patient was easily extubated in a lateral position 7 minutes after the end of surgery. The patient was initially transferred to the pediatric intensive care unit for 4 hours for post-operative monitoring. As there was no swelling of the tongue or post-operative bleeding, he was then transferred to the regular ward.

4 | DISCUSSION

This case report described the airway management of a 2-year-old child with an exophytic mass in the posterior middle part of the tongue. Bleeding episodes were reported in the history. Based on the imaging and clinical picture, a hemangioma was considered. The aim of the airway management in this specific case was therefore to avoid touching the tumor with the laryngoscope blade to avoid perforation and bleeding.

Nakanishi and colleagues described lower tongue forces (16 N versus 7 N) when using a Storz® C-MAC™ video laryngoscope with a curved D-blade compared to direct laryngoscopy with a Macintosh blade on the intubation manikin with normal airway.[10] Similar results were obtained by Russell and co-workers. They found that GlideScope® intubations had equal or better views of the glottis with lower median peak, average and impulse forces applied to the base of the tongue when compared to direct laryngoscopy with Macintosh blades in an airway manikin. They concluded, that the GlideScope® required less force to obtain similar or better laryngoscopic views.[11] Irouschek and colleagues, found in a study using a Pierre Robin Manikin, that curved video laryngoscope blades provided a significantly faster and better view of the vocal cords and reduced oral soft tissue trauma compared to standard video and conventional blades.[12]

Our young patient's tumor was so unfavorably located that direct laryngoscopy would have put pressure on the tumor. Even a video laryngoscope with a standard straight blade would have been likely to cause pressure injury to the tumor. In order to have easy surgical access to the tumor, the surgical colleagues requested nasotracheal intubation. We therefore used a curved GlideScope® Spectrum™ LoPro blade, which, in contrast to the routine procedure, we did not insert over the middle of the tongue but at an angle on the right edge of the tongue. This maneuver was performed carefully, first under direct vision and then under camera view, to avoid damaging the right tonsil or mucosa. The video screen therefore showed a slightly unsymmetrical image (Figure 2). With minimal force, the base of the tongue was lifted to create an airway space for the flexible bronchoscope inserted nasally by the second anesthesiologist. After passing the vocal cords with the bronchoscope, the tube threaded onto the bronchoscope was advanced atraumatically through the vocal cords using the Seldinger technique.

The use of video laryngoscope-assisted flexible bronchoscopic intubation has been described in several case reports for both nasal and oral intubation method in adult patients.[13–20] All these reports describe the hybrid technique as a safe method with only few side effects.[13–20] There are also some reports of its use in pediatric anesthesia. Stein and colleagues reviewed observational data from the International Pediatric Difficult Intubation Registry from 2017 to 2021, and compared in a retrospective 4:1-mixed propensity score observation 140 patients who underwent 180 hybrid attempts with 560 patients who underwent 800 attempts with a flexible bronchoscope. They found no significant differences with a first attempt success rate of 70% in the hybrid group and 63% in the flexible bronchoscope group ($p = 0.1$). However, the hybrid technique was used more often as a rescue technique when other methods had failed. Severe complications occured in <1% of attempts.[9]

The hybrid technique has several advantages over videolaryngoscopy or flexible bronchoscopy alone.[9,18,20] This technique combines the best elements of airway management[18]: The video laryngoscope displaces the tongue and

surrounding tissues allowing the flexible bronchoscope a clear view and an unobstructed path to the glottis. If an adequate view is obtained with video laryngoscopy, but the tracheal tube cannot be successfully maneuvered through the glottic opening, the flexible bronchoscope can be used as a steerable stylet to facilitate tracheal intubation.[9] This situation can occur during video laryngoscopy especially with hyperangulated blades, where the view is usually better, but the intubation is sometimes technically more difficult.[9,12,20] In these cases, the flexible bronchoscope could be a rescue option.[9] Another advantage of the hybrid technique are the two different cameras. If the bronchoscopic view is obstructed by mucus or blood, the flexible bronchoscope can also be guided to the glottis via the often better image of the video laryngoscope camera. If the view through the video laryngoscope to the vocal cords is impaired or impossible (e.g., Cormack Lehane 4 classification), the view through the flexible bronchoscope often allows the glottis to be located and the trachea to be successfully intubated.

While initially separate monitors had to be used for video laryngoscopy and flexible bronchoscopy, systems are now available that allow the video laryngoscope and bronchoscope to be displayed as a split image on the monitor.[21] However, the range of thin video bronchoscopes is very limited, so that in the case of pediatric patients, as in the case presented, two different monitor systems have to be used.

The hybrid technique also has a disadvantage. Two anesthesiologists familiar with the technique are required to perform the hybrid technique.[9] Certainly, this limitation is of modest importance, as the management of an anticipated difficult airway usually requires two operators.[13] Ideally, the procedure should previously be practiced in a team using an airway manikin.

In our case, the tumor was not touched during the entire hybrid intubation procedure. With the usual blade insertion method, nasal intubation without blade contact with the tumor would not have been possible with either standard or curved video laryngoscope blades due to the central location of the tumor. In addition, the blade pressure for the required nasal intubation would have been significantly higher in order to create space in the pharynx for the Magill forceps to guide the tube to the glottis.

The only alternative procedure that would have also ruled out contact with the tumor with certainty would have been flexible bronchoscopic intubation under sedation. However, flexible bronchoscopic intubation is difficult to perform in children, because of two extremes. Either the sedation is so shallow that spontaneous breathing is maintained, but the thin bronchoscope is often deviated by the epiglottis toward the esophagus, or with deeper sedation there is a risk of respiratory arrest with the need for intermediate ventilation.

5 | CONCLUSION

Video laryngoscope-assisted flexible bronchoscopic nasotracheal intubation is a well-suited procedure with few side effects for securing the airway in children with anatomical intubation difficulties, such as a tongue tumor. However, two experienced anesthesiologists familiar with the procedure are required to successfully apply the hybrid procedure. Ideally, the procedure should previously be practiced in a team using an airway manikin.

AUTHOR CONTRIBUTIONS

Anne-Sophie Senger: Conceptualization; data curation; investigation; writing – original draft; writing – review and editing. **Andrea Irouschek:** Conceptualization; writing – original draft; writing – review and editing. **Manuel Weber:** Investigation; writing – review and editing. **Rainer Lutz:** Writing – review and editing. **Oliver Rompel:** Data curation; writing – review and editing. **Marco Kesting:** Investigation; writing – review and editing. **Joachim Schmidt:** Conceptualization; data curation; investigation; writing – original draft; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no financial or personal conflicts of interest associated with this case report.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The ethical approval was not required for the case report.

CONSENT

Written informed consent was obtained from the patient's parents for publication of this case report.

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