Sevoflurane-Based General Anesthesia Induction via Nasopharyngeal Endotracheal Tube Prior to Definitive Airway Control in Pediatric Oral Tumors

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Airway-related tumors in pediatrics are always challenging for anesthesiologists. We present 2 cases of friable, bleeding large tumors in the oral cavity where conventional methods of securing the airway were not possible. Induction of general anesthesia could potentially lead to complete airway collapse and catastrophic obstruction in such cases. Awake fibrotic intubation is limited in pediatric patients. We describe the innovative use of an endotracheal tube inserted blindly as a nasopharyngeal airway guided by end-tidal carbon dioxide trace. This allowed us to bypass the anatomical obstruction and induce anesthesia using sevoflurane in high-flow oxygen. By the described technique, we were able to maintain and assist the spontaneous breathing of the child as well. We also highlight limitations of the use of a conventional nasopharyngeal airway in such situations.

Key words: Oral tumors pediatric anesthesia; Pediatric difficult airway.

Oral tumors limiting access to the airway have always been a challenge to the anesthesiologist. Exacerbation of obstruction and the loss of airway on anesthesia induction is the most feared complication. Understanding the mechanism of breathing in a patient with an obstructed airway and changes that anesthesia induction can bring about are critical in the management of these patients. Characteristics of the lesion (relative size to oral cavity, friability, ability to bleed) and the patient's age and clinical condition determine the anesthetic plan. The pediatric airway itself is more demanding than that of adults, and intraoral masses add to the complexity of this situation. We describe 2 such cases of intraoral tumors where airway access was not possible using conventional

management protocols. We describe the innovative use of a prewarmed, softened polyvinyl chloride (PVC) endotracheal tube (ETT) inserted nasally like a nasopharyngeal airway to bypass the oral obstruction prior to the induction of anesthesia.

CASE 1

A 4-year-old, 14-kg male child diagnosed with neuroblastoma with skull metastasis presented to the emergency with increasing difficulty in breathing for the previous 24 hours. Three months prior he had been diagnosed with retro-orbital and intraoral metastases, for which he had received 20 cycles of chemotherapy (cyclophosphamide and doxorubicin). The intraoral mass had grown in size over the preceding 4 days and was now associated with occasional hemorrhage. Increasing mass size resulted in gradually progressive respiratory

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Figure 1. Oral metastasis of neuroblastoma with super added mucormycosis.

distress and inability to eat. On evaluation, the mass was found to be a large metastatic deposit almost completely occupying the oral cavity with superficial mucormycosis, which was causing it to bleed (Figure 1). The child was forced to keep his mouth open. A tracheostomy was planned to relieve the respiratory obstruction and prevent any likelihood of aspiration.

Preoperative hemogram revealed hemoglobin of 8.1 g/dL and a platelet count of $3.7 \times 10^3/\mu\text{L}$. A unit of single-donor platelets was transfused, increasing the platelet count to $52 \times 10^3/\mu\text{L}$, and the child was transferred to the operating room on an urgent basis. Computed tomography scan showed that the mass was mainly limited to the oropharynx, sparing the nasopharynx.

Although appearing obtunded, the child responded by moans and movement to stimuli like application of the pulse oximeter probe and blood pressure cuff. Respiratory obstruction did not seem to be postural, and it was possible to place the child supine with the head elevated. Oral inspection revealed a large hemorrhagic mass occupying almost the entire oral cavity. Conventional laryngoscopy did not seem practical because of the

friability of the mass and its large size relative to the oral cavity. After topical anesthesia of the nasal cavity with 10% lidocaine spray (3 puffs in the right nostril only), a softened and lubricated PVC ETT, 4.5 mm ID, was inserted blindly into the right nostril using a technique similar to the one practiced while inserting a conventional nasopharyngeal airway. It was gently advanced into the nasopharynx till a good trace of end-tidal carbon dioxide could be obtained via a sampling line connected to the ETT using a standard sampling angle connector. This angle connector was further connected a Jackson Rees breathing circuit (modified Mapleson F circuit). The Jackson Rees circuit was connected to a fresh gas outlet of an anesthesia workstation, which simultaneously allowed inflow of both high-flow oxygen and sevoflurane. (The connection assembly is seen in Figure 2.) As the nasally inserted ETT ostensibly bypassed the obstruction at the oropharynx, the reservoir bag movement became more pronounced with breathing (Figure 2). Anesthesia was induced and maintained with sevoflurane in oxygen. It was possible to assist spontaneous breaths because of optimal (supraglottic) placement of the ETT. We were also able to improve the oxygenation by providing a small degree of continuous positive airway pressure by manually closing the other nostril and partially occluding the opening of the reservoir bag.

Surgical tracheostomy was performed after local anesthetic infiltration and a 4.5-mm tracheostomy tube inserted. After an uneventful course in the postanesthesia care unit the child was shifted to the ward.

CASE 2

A 3-month-old, 5-kg male child with tongue hemangioma was scheduled for magnetic resonance imaging (MRI) to determine the posterior extent of the tumor. The hemangioma, present since birth, had been increasing in size with age. It was associated with snoring while sleeping in a supine position. There were no obstructive features when the infant was awake. Because of the large extent of the tumor, only the hard palate was barely visible when the child cried. There was a history of an occasional small amount of bleeding from the mass.

Elective tracheal intubation was planned prior to MRI to facilitate safe sedation and avoid airway-related complication during the procedure. The hemangioma was very large relative to the oral cavity and was likely to bleed on laryngoscopy or insertion of any oral device (Figure 3). Flexible fiber-optic-guided nasal intubation was planned. After topical anesthesia of the nasal cavity using 10% lidocaine spray (2 puffs in the left nostril) a lubricated, prewarmed, and softened PVC ETT (4 mm ID) was introduced via the left naris. The tube was gently

Figure 2. Nasal endotracheal tube—breath transmission to bag.

advanced blindly like a conventional nasopharyngeal airway into the supraglottic region till a good end-tidal carbon dioxide trace could be obtained from the sampling line attached to a standard sampling angle connector (Figure 4). Upon fixing of the ETT at this position, anesthesia was induced and maintained with sevoflurane in air and oxygen.

Subsequently, a pediatric flexible fiber-optic scope was used in the right naris to intubate the trachea with a 4-mm ID PVC ETT (Figure 4). The infant was then shifted to the MRI suite on a propofol infusion. MRI lasted 1 hour, 40 minutes. The baby was observed in the pediatric intensive care unit and the trachea was extubated once he was fully awake.

DISCUSSION

Most difficult-airway situations in adults can be dealt with by using awake fiber-optic intubation. Securing the airway in an awake child is not a very practical option.^{1,2} Another approach that has been tried with limited success for awake intubation in the pediatric patient is the use of videolaryngoscopes.³ However, a prerequisite of successful video laryngoscopy is the presence of adequate mouth opening.⁴ The likelihood of active bleeding that could obscure the airway view was a real concern in these cases. Bleeding could also eliminate any further possibility of the use of optics-based devices for securing the airway. Both our cases had the above-mentioned limitations, which prevented the use of these modern rescue devices for securing the airway.

Classically in children with airway tumors leading to either anticipated or unanticipated difficult airway, the role of a rigid fiber-optic scope and laryngeal mask airway is

Figure 3. Nasal endotracheal tube—postinduction bypassing the obstruction in tongue hemangioma.

well established. In the presented cases these options were also not possible because of limited access due to a tumor-filled oropharynx. Tracheostomy is another option in adults, but performing this procedure under local anesthesia in young awake children is also limited.

Both our patients needed a satisfactory airway conduit to avoid airway obstruction during induction of general anesthesia. A concern in oral or pharyngeal tumors is loss of airway patency that in the awake state is maintained by the tone of the airway. An obstruction often at the velopharyngeal level can be further precipitated by anesthesia, resulting in loss of the ability to ventilate.⁵ It is of utmost importance in such cases to preserve spontaneous breathing, adequate airway patency, and muscle tone to prevent a partial obstruction from turning into a complete one. In both our cases a

Figure 4. Ventilation via nasal endotracheal tube and fiber-optic-guided intubation via other naris.

warmed (therefore soft) and lubricated ETT was inserted under topical anesthesia before the beginning of induction. Although the ETT remained above the larynx, it bypassed the tumor-related anatomical site of airway obstruction (the oropharynx).

The ideal method for airway topicalization in young uncooperative pediatric patients also faces practical challenges. Nebulization using 4% lidocaine can be tried, but success is likely to be limited. Most awake children would not allow a face mask to be held for nebulization, causing failure of the technique. Additionally, as in our scenario with a child in respiratory distress needing immediate intervention, use of nebulization requiring time is also questionable. Gargling with a viscous solution of lidocaine as in adults cannot be carried out in children. With our present technique, we only needed to anesthetize the nasal mucosa, allowing placement of a supraglottic ETT, following which general anesthesia could be induced. Use of intranasal 10% lidocaine spray emerged as a rapid and convenient solution. Concerns exist, however, for the maximum allowable safe dose of lidocaine being used via this route. The British Thoracic Society's published guidelines limit the total dose of topical lidocaine to no more than 8.2 mg/kg in adults.⁶ Although no such guidelines are available for pediatric patients, comparable values have been used in the literature. Our technique of nasal spray remained fairly well below possible toxic doses. It is estimated that a single puff of 10% lidocaine spray delivers nearly 10 mg of drug; thus, the total drug used was fairly below toxic level in both patients. From our previous experiences, 2–3 puffs in children proved to be fairly effective to anesthetize the nasal passage, and the present cases demonstrated the same.

We made sure that respiration could be assisted after anesthetic induction by optimally positioning the ETT in the supraglottic region. This ability to effectively assist ventilation also adds to safety, as positive pressure can help to splint the airway open once the anesthesia is induced.⁷ The additional of small continuous positive airway pressure also can aid in improving oxygenation in hypoxemic children. Anesthesia was induced in both these patients with careful titration of sevoflurane in oxygen to maintain spontaneous respiration. In the first child it was evident from the computed tomography that a narrow passage was present in the nasopharynx that was free of metastatic mass; hence, it was logical to use a conduit to bypass the oropharynx, which was the cause of obstruction. In our second case a similar logic could be applied, as hemangiomas are benign lesions and hence the mass was likely to be limited to the tongue⁸ even though its posterior aspect was not known because of the absence of any imaging available. Lidocaine 10% spray was used as topical anesthesia to prevent

responses while inserting a nasal ETT to bypass the obstruction at oropharyngeal level. The longer length of the ETT facilitated manipulation and optimal positioning close to the laryngeal inlet compared to a shorter nasopharyngeal airway. All available nasopharyngeal airways are made such that their length decreases with decreasing diameter, so in our case the smaller length of the nasopharyngeal airway would have become a limiting factor to effectively bypass obstruction. The extra length of ETT available outside also makes it more convenient to fix the tube at the correct point. Also, a standard universal connector can more conveniently fit into the external end of an ETT (compared to a nasopharyngeal airway), which can be used to effectively connect to a breathing circuit. Both our patients were predisposed to airway bleeding, so we planned to use smaller-diameter tubes to avoid trauma. In the first case, ventilation could be assisted via the nasal ETT simultaneously while tracheostomy was done. In the second case, we continued to assist ventilation while a pediatric flexible fiber-optic bronchoscope was used to nasally guide an ETT from the right nostril into the trachea.

We therefore recommend that a lubricated, warmed, PVC ETT inserted under topical anesthesia, guided by end-tidal carbon dioxide waveform for optimal placement, can be effectively used to replace the limitations of a nasopharyngeal airway for anesthetic induction in pediatric patients presenting with oral tumors that negate oral approaches to intubation.

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