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Anesthesia management in a pediatric patient with complicatedly difficult airway: A case report

Anesthesia management in pediatric difficult airway

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Abstract

BACKGROUND

Reports on perioperative anesthesia management in pediatric patients with difficult airways are scarce. In addition to relatively more difficulties in the technique of endotracheal intubation, the time for manipulation is restricted compared to adults. Securing the airways safely and avoiding the occurrence of hypoxemia in these patients is of significance.

CASE SUMMARY

A 9-year-old boy with spastic CP, severe malnutrition, thoracic scoliosis, thoracic and airway malformation, laryngomalacia, pneumonia, and epilepsy faced the risk of anesthesia during palliative surgery. After a thorough preoperative evaluation, a detailed scheme for anesthesia and a series of intubation tools were prepared by a team of anesthesiologists. Awake fiberoptic intubation is the widely accepted strategy for patients with anticipated difficult airways. Given the age and medical condition of the patient, we kept him sedated with spontaneous breathing during endotracheal intubation. The endotracheal intubation was completed on the second attempt after the

failure of the first effort. Fortunately, the surgery was successful without postoperative complications.

CONCLUSION

Dealing with the difficult airway in the pediatric population, the proper sedation allows time to intubate without interrupting spontaneous breathing. The appropriate endotracheal intubation method based on the patient's unique characteristics is the key factors in successful management of these rare case.

Key Words: Pediatric anesthesia; Difficult airway; Spastic cerebral palsy; Awake fiberoptic intubation; Case report

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Core Tip: A loss of control of the pediatric airway can result in catastrophic consequences if not addressed promptly. Spastic CP is often associated with complicated airways in pediatric patients, which can be classified as difficult intubations of anticipated difficult airways. Sedation with spontaneous breathing and fiberoptic bronchoscope (FOB)-guided endotracheal intubation is a valuable method for such patients. Herein, we describe the entire process of airway management and analyze the failure of the first intubation attempt.

INTRODUCTION

The pediatric difficult airway is a massive challenge for anesthesiologists and is one of the main causes of perioperative respiratory complications[1]. Cerebral palsy (CP) comprises a group of permanent disorders affecting the development of movement causing limited activity. Spasticity account for nearly 80% of pediatric CP, whereby comorbidities and functional limitations are prevalent and disabling[2]. Life-threatening

complications are primarily associated with recurrent chest infections, upper airway obstruction (UAO), and scoliosis leading to progressive lung disease, alone with complications of epilepsy[3]. These characteristic features are major risk assessments for anesthesiologists for predicting a difficult airway.

Cases of airway management in spastic CP are infrequently reported worldwide. Herein, we describe a case of anesthesia management in a pediatric case of a difficult airway caused by spastic CP, outlining the detailed process of airway management. We discuss the results of our literature review for evidence related to fiberoptic bronchoscope (FOB)-guided endotracheal intubation, the choice of sedation method, and other management strategies for the pediatric difficult airway, to encourage anesthesiologists to pay more attention to these patients.

CASE PRESENTATION

Chief complaints

A 9-year-old boy (14 kg) was admitted with feeding difficulties after birth caused by spastic CP.

History of present illness

After birth, the patient had persistent feeding difficulties, accompanied by repeated coughing and vomiting after eating. He was diagnosed with spastic CP alone with severe malnutrition, thoracic scoliosis, laryngomalacia, pneumonia, and multiple site deformities, including those of the airway, thorax, hip joint, and both hands and feet. In addition to epilepsy and taking Clonazepam 1 mg, Phenobarbital 25 mg, Levetiracetam 150 mg, and Sodium valproate oral liquid 5 mL twice daily, he had a history of aspiration pneumonia and copious purulent sputum, for which he was prescribed antibiotics for 9 days. He was scheduled to undergo implantation of an implantable venous access port (IVAP) and gastrostomy to improve feeding and nutrition. This was not a typical elective operation and was difficult to adjust to a conventionally safe state, because the pneumonia was protracted and nursing conditions were limited.

History of past illness

He was diagnosed with spastic CP alone with severe malnutrition, thoracic scoliosis, laryngomalacia, pneumonia, and multiple site deformities, including those of the airway, thorax, hip joint, and both hands and feet.

Personal and family history

He had been abandoned as a toddler, and his birth and family histories were uncertain

Physical examination

The patient's general physical examination revealed typical facial dysmorphism, thoracic deformities, scoliosis, oxycephaly, and hip dislocation. He showed a Mallampati Class IVairway with severely limited neck movement, thyromental distance of fewer than 3 fingers, and 20-mm-inter-incisor distance. Auscultation indicated an obvious UAO with distinct sputum sounds, and oxygen saturation (SpO_2) was 85-90% on 3 L/min of supplemental oxygen using a nasal oxygen cannula. Preoperative evaluation exhibited a Class III physical status of American Society of Anesthesiologists (ASA) with a difficult airway.

Laboratory examinations

Routine blood tests showed a hemoglobin (Hb) level of 9.7 g/dL, hematocrit (Hct) of 33.3%, mean corpuscular volume of 73.9 fL, mean corpuscular Hb of 21.6 pg, and mean corpuscular Hb concentration of 29.2 g/dL. Other blood test results showed no significant abnormalities.

Imaging examinations

Chest radiography demonstrated pneumonia, scoliosis, and right deviation of the trachea (Figure 1). Computed tomography (CT) scans revealed scoliosis, osteoporosis of the spine, and significant atrophy of the muscles of the back of the bilateral

thoracolumbar with fat infiltration, and thoracic and tracheal malformation (Figure 2). Lateral cervical spine CT scans displayed laryngomalacia and malformations of the pharynx and cervical spine (Figure 3).

FINAL DIAGNOSIS

The final diagnosis of the present case was spastic CP, alone with feeding difficulties, severe malnutrition, laryngomalacia, epilepsy, severe pneumonia, anemia, congenital scoliosis, congenital thoracic deformity, congenital dislocation of hip bilateral, and ectrodactyly.

TREATMENT

A series of intubation tools including supraglottic airway devices, video laryngoscope, a fiberoptic bronchoscope (FOB), and invasive airway equipment (percutaneous tracheostomy) were utilized and a skilled anesthesiologist was present. In the operating room, the patient was in a supine position, and standard monitoring devices for measuring SpO_2, noninvasive blood pressure, and electrocardiogram were installed. Suction device and large suction tubes were ready for sudden regurgitation and aspiration. The patient's position was adjusted to 30~40° head height and oxygen flow rate was adjusted to 8 L/min. The mask was gently placed on his mouth and nose without additional pressure, and oxygen was continuously inhaled for 5min. After pre-oxygenation, gradual anesthesia was induced with penehyclidine hydrochloride 0.15 mg, esketamine 8 mg, and midazolam 1.4 mg. The patient was adequately sedated and showed spontaneous breathing. Due to the patient's limited neck motion, narrow inter-incisor distance, and malformed pharynx, we initially attempted a nasotracheal intubation guided by the FOB with a tip diameter of 2.8 mm. The procedure was performed by an anesthesiologist proficient in FOB intubation. Following intranasal administration of xylometazoline, the FOB passed from the nostril to the larynx. Even after making a few adjustments, no view of the epiglottis or the vocal cords was available. This was due to incorrect angles and copious secretions (Figure 4A). As a

result, the FOB was removed and pre-oxygenation and aspiration of secretions were immediately commenced. Subsequently, we again tried to pass the FOB from the oral cavity to the pharynx. The assistant gently used a jaw-thrust maneuver to expand the patient's pharyngeal cavity. The glottis could be seen clearly when the forepart advanced from the oropharynx to the pharynx (Figure 4B). Propofol and rocuronium were administrated after confirming that the forepart reached the mid-trachea and the endotracheal anterograde intubation was advanced with FOB view. A cuffed endotracheal tube of size 5.0 was used for the endotracheal intubation. After confirming that the endotracheal tube was in the trachea with a capnograph and auscultation, 20 mg of methylprednisolone was administered to the patient to alleviate airway stress reactions. Anesthesia was maintained with 2% sevoflurane and remifentanil 0.2 ug/kg.min. The operation lasted approximately 4 h and was successful without any incidents. The intraoperative fluid intake was 450 mL and the urine output was 80 mL. After the operation, the patient was sent to the intensive care unit (ICU) with a tracheal tube inserted for mechanical ventilator support. He was treated with aminomethylbenzoic acid, phenylethylamine for hemostasis, ceftriaxone for infection, and omeprazole for acid inhibition. The patient was successfully extubated after receiving assistance from a mechanical ventilator for two days.

OUTCOME AND FOLLOW-UP

The patient was transferred to the general ward on postoperative day 4 and discharged from the hospital 1 wk after surgery without any complications.

DISCUSSION

Spastic CP is the most common cause of upper motor neuron syndrome (UMN) among children, accounting for nearly 80% of cases[4]. In patients with spastic CP, motor impairments are often accompanied by seizures and secondary musculoskeletal issues, and abnormalities in sensation, perception, cognition, communication, and behavior[5,6]. The progressive nature of the disorder results in a combination of obstructive and

restrictive patterns of pulmonary diseases[7]. The main causes of UAO in patients are abnormal laryngeal structure and muscle hypertonia, tongue prolapsing posteriorly over the larynx, and excessive respiratory secretions, resulting in decreased tidal volume and carbon dioxide accumulation[8]. Moreover, musculoskeletal deformities of the neck result in a severe decrease in neck motion and limited mouth opening, making endotracheal intubation difficult[5]. The resulting pathophysiological alterations pose numerous difficulties for anesthesiologists.

When facing such a case of a pediatric difficult airway, a comprehensive preoperative evaluation is anesthesia management's first and most crucial step. Unfortunately, no specific scales or suggested measurements for pediatric airway evaluation exist[1]. Despite these limitations, we can evaluate the airway based on previous medical records, facial and jaw features, and anatomical and ultrasonographic measurements[9,10].

An experienced and competent specialist needs to lead the team to formulate an anesthesia plan and discuss alternative strategies before any intervention. Flexible FOB-guided endotracheal intubation is a highly reliable solution for pediatric difficult airways, particularly for difficult or impossible ventilation[11,12]. Studies with observational findings for FOB-guided intubation indicated success rates ranging from 78-100%[13]. Moreover, FOB-assisted anterograde intubation is almost noninvasive[14]. Unlike adults who can receive FOB-guided endotracheal intubation in the awake state, children require sedation or general anesthesia. Pediatric patients have lower oxygen reserve and higher oxygen consumption during apnea compared to adults[15], so it is better to use appropriate sedation with spontaneous breathing during elective pediatric FOB-aided difficult endotracheal intubation. In this case, we chose the esketamine 0.5 mg/kg and midazolam 0.1 mg/kg for sedation, which allowed suitable sedation without interrupting spontaneous breathing. Midazolam provided proper sedation and prevented seizures during the procedure[16]. Esketamine induces a state of dissociative sedation, resulting in strong analgesia, sedation, immobilization, and amnesia whilst maintaining spontaneous respiration and cardiopulmonary stability[17]. Esketamine

relatively preserves the protective airway reflexes of patients[18], and is a comparatively safe and effective sedative. However, there is no relevant report on the use of esketamine in the management of pediatric difficult airways. Esketamine produced a good sedative effect that facilitated subsequent procedures in this case. Dexmedetomidine, propofol, fentanyl, and inhalational anesthetic agents are classic sedatives for the management of a difficult airway. Their combinations and dosages need to be adjusted individually to prevent interruption of breathing. If the induction of anesthesia is inappropriate, the airway may turn into a difficult mask ventilation airway or even an emergency airway. Therefore, anesthesiologists should choose the appropriate sedation method according to their experience and the specific patient's situation. Before the procedure began, we also pretreated the nasal cavity with xylometazoline and penehyclidine hydrochloride. Xylometazoline is a topical vasoconstrictor that can reduce nasal bleeding during procedures which may affect the visual field[19]; penehyclidine hydrochloride can inhibit salivary gland and airway gland secretions.

The anesthesiologists' team analyzed the reasons for the failure of the first attempt at intubation. Fiberoptic nasotracheal intubation was the first choice owing to the cervical deformity and restricted mouth opening of the patient. However, in the process, despite the use of anticholinergics and full secretion suction before the procedure, the patient had severe respiratory inflammation and constant copious secretions, which severely affected the visual field. Furthermore, the longer and more curved path from the nasal cavity to the glottis, combined with structural abnormalities in the pharynx, made the adjustment of the anterior end of the FOB more difficult. On the second attempt, we opted for transoral FOB-guided intubation and a jaw-thrust maneuver was performed by the assistant. When the mandible was displaced forward, it pulled the tongue outward, thereby enlarging the pharyngeal cavity and offering more space for the adjustment of the FOB's forepart. There were no adverse events like decreased oxygen saturation, blood pressure, and heart rate during the whole process.

Managing different difficult airways depends on the patient's condition and the individual abilities and habits of the anesthesiologist. A visual laryngoscope can help complete most common intubations, and FOB is a standard protocol for patients who have difficulty with laryngoscope exposure. Awake intubation can be used in adults with difficult airway, but it is difficult for children to cooperate awake intubation. In the pediatric difficult airway, we need the child to keep sedation with spontaneous breathing to create a suitable operating environment. Midazolam combined with esketamine may be an effective induction regimen.

CONCLUSION

There are only a few articles on the anesthetic management of children with spastic CP. However, patients with spastic CP present several challenges during anesthetic management that may even be fatal on some occasions. When confronted with a pediatric difficult airway, it is essential to have both an experienced specialist and a coordinated team to conduct a complete preoperative evaluation and implement various appropriate management strategies. Under sedation with spontaneous breathing, FOB-guided endotracheal intubation is a standard treatment for a pediatric difficult airway. Anesthesiologists need to individually select the sedation protocol and FOB approach according to the specific patient's situation to reduce the occurrence of respiratory interruption, hypoxemia, drop in blood pressure, and/or other adverse events.

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