We report the case of a pediatric patient with tetralogy of Fallot (TOF) and cleft palate deformity with difficult intubation in which a laryngeal mask airway (LMA) was used and converted into an endotracheal tube through retrograde intubation. The patient with TOF was scheduled for repair of the congenital bilateral cleft lip and palate. Inhalational induction with 4% sevoflurane was started. Conventional tracheal intubation was impossible because the patient had a difficult airway, and the procedure could cause severe cyanosis and respiratory distress. An LMA was inserted to maintain ventilation and anesthesia and to facilitate intubation. Retrograde intubation and a catheter mount were used to convert the LMA into a conventional endotracheal tube without difficulty. Airway management for patients with TOF and cleft palate deformity is not clear. Retrograde intubation permits replacing an LMA with an endotracheal tube. This method enables maintaining the airway until the LMA is exchanged with an endotracheal tube. This technique seems useful to facilitate difficult airway intubation in pediatric patients with TOF and cleft palate deformity.

Introduction

Orofacial cleft deformities are among the most common birth anomalies. Congenital heart diseases (CHD) have been reported in 9.5% of patients with orofacial cleft deformities. In a study, tetralogy of Fallot (TOF) was detected in 0.9% of patients with orofacial cleft deformity. There is limited information regarding airway management in these patients.

Patients with TOF have severe cyanosis and frequently develop respiratory distress. They can become severely cyanotic, hyperpneic and lethargic. A hypercyanotic spell presents with rapidly falling oxygen saturation in response to surgical or other stimulation. Inherent anatomical characteristics of the pediatric airway include cleft alveolus, protruding premaxilla and a high vaulted arch, which make airway management difficult. The cleft lip and palate and related CHDs might increase difficulty in laryngoscopy and intubation. Depending on the skill and experience of the anesthesiologist and the availability of equipment, various airway management strategies have been used for similar pediatric patients.

We report the case of a pediatric patient with TOF and a cleft palate deformity with difficult intubation in which a laryngeal mask airway (LMA) was used and converted into an endotracheal tube through retrograde intubation.

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Case report

A 7-month-old male infant weighing 6.1 kg with TOF was admitted for repair of congenital bilateral cleft lip and palate (Figure 1). However, the patient did not undergo yet the TOF surgery. The patient’s failure to thrive was attributed to feeding difficulties due to the cleft palate. He only rarely experienced cyanotic crises. Preoperative echocardiography showed anatomy consistent with Fallot-type ventricular septal defect. An echocardiogram showed a ventricular septal defect (the size of the VSD was 6 mm), supravalvar pulmonary stenosis with a gradient of 90 mmHg over the outflow tract, and overriding of the aorta (50%).

The main pulmonary artery was of adequate size.

The patient’s baseline blood pressure and heart rate were 81/57 mmHg and 127 bpm, respectively. Peripheral oxygen saturation before induction of anesthesia was 86% on room air. The patient was induced with sevoflurane in oxygen. The inspired concentrations delivered via a mask were increased from 2% to 8% gradually. Anesthesia was induced with 8% sevoflurane in oxygen and a # 2 LMA was inserted successfully. Subsequently the lungs were ventilated without difficulty. Rocuronium 0.6 mg/kg was given as a slow intravenous bolus to facilitate tracheal intubation, followed by 2 mcg/kg fentanyl. The end tidal concentration of sevoflurane was maintained at approximately 3%.

Local infiltration of lignocaine (2%) was administered over the subcricoid region in the midline, and a puncture needle was introduced into the trachea by piercing the cricotracheal ligament in the cephalic plane at a 45° angle. After aspiration of free flow air, a 0.035 inch guidewire was introduced through the puncture needle and passed rostrally to emerge through the LMA. Then a 3.5-mm ID tracheal tube was introduced via the LMA over the retrograde guidewire (Figure 2). Tracheal intubation was confirmed by detecting exhaled CO₂. The connector of the introducing tube was removed, and the LMA was withdrawn, leaving the 3.5-mm tracheal tube in situ with the help of another intubation tube. When breathing sounds and CO₂ exhalation were reaffirmed, the guidewire was removed. Oxygen saturation remained satisfactory throughout intubation, ranging from 90% to 96%. Reconstructive surgery was performed without incident, and at the end of the procedure, the trachea was extubated following reversal of neuromuscular relaxation. The trachea was extubated when the patient was fully awake. The patient was then taken to the recovery room.

Discussion

Unsuccessful or difficult tracheal intubation remains an important cause of mortality and morbidity during anesthesia. Difficulties are more frequent in pediatric patients because of their anatomical variations. Anesthesiologists treating a patient with a difficult airway can use the following techniques: 1) awake fibreoptic intubation; 2) LMA; and 3) placing...
an alternative airway, such as an endotracheal tube\textsuperscript{11}. Appropriate airway management in patients with TOF and cleft palate deformity is not clear. Awake fibreoptic intubation might be unpleasant due to severe cyanosis and the development of respiratory distress in such pediatric patients. Using a LMA to repair congenital bilateral cleft lip and palate is difficult due to the risk of aspiration and blockage of the surgical site. Direct laryngoscopy has been avoided in such cases to prevent severe cyanosis and respiratory distress during airway management. Most anesthetic morbidity related to cleft lip repair procedures is due to difficult laryngoscopy and intubation or postoperative airway obstruction.

LMA is indicated for airway establishment in patients whose tracheas are difficult to intubate or whose lungs cannot be ventilated or oxygenated before progressing to cricothyroidotomy. The LMA creates a conduit that can provide better conditions for intubation\textsuperscript{14}.

Intubation via LMA using the fibreoptic bronchoscope to convert the LMA into an endotracheal tube has been described\textsuperscript{11}. In this technique, a 3.0-mm ID PVC tracheal tube is connected to the tip of another 2.5-mm tube to extend its length. The tracheal tube is introduced blindly via the bronchoscope adapter concave anteriorly. A major hazard of this technique is that, during advancement, the endotracheal tube can telescope blindly through the LMA, causing the tube to go into the esophagus\textsuperscript{15}. The retrograde guidewire allows placing the tracheal tube in the trachea. Another study indicated that a similar technique is possible in adult patients using retrograde intubation and a pediatric bronchoscope under direct visualisation\textsuperscript{12}. However, to the best of our knowledge, intubation via LMA using retrograde intubation in pediatric patients with TOF and cleft palate deformity has not been described.

In this case, a standard catheter mount was placed between the LMA connector and the anesthesia circuit. The retrograde wire was then advanced up to the tubular portion of the LMA while ventilating the lungs using the reservoir bag of the anesthesia machine.

A disadvantage of our case is the lack of the inclusion of a pediatric bronchoscope. The retrograde wire was advanced blindly through the LMA. However, in this case, desaturation did not occur during intubation because the laryngeal mask created a conduit that provided good conditions for intubation.

The LMA ventilates the lungs using the reservoir bag of the anesthesia machine, which can provide sufficient oxygen saturation during retrograde intubation. The LMA provides a conduit to relieve soft tissue obstruction, allow instrumentation of the airway and maintain oxygenation, ventilation and delivery of anesthetic gases. Retrograde intubation provides an improved guidewire method to convert an LMA into an endotracheal tube.

In conclusion, intubation via LMA using retrograde intubation was performed successfully for intubation of difficult airways in a pediatric patient with TOF and cleft palate deformity. This technique might be recommended to perform difficult airway intubation in pediatric patients with TOF and cleft palate deformity.
References

BRIDION— for optimal neuromuscular blockade management and improved recovery

Predictable and complete reversal

- 98% of BRIDION patients recovered to a TOF\(^+\) ratio of 0.9 from reappearance of T\(_2\)\(^+\) within 5 minutes\(^1\)
- 97% of BRIDION patients recovered to a TOF\(^+\) ratio of 0.9 from 1 to 2 PTCs\(^+\) within 5 minutes\(^1\)

Rapid reversal

- BRIDION rapidly reversed patients from reappearance of T\(_1\)\(^+\) in 1.4 minutes\(^2\)
- BRIDION rapidly reversed patients from 1 to 2 PTCs\(^+\) in 2.7 minutes\(^3\)

BRIDION is indicated for the reversal of neuromuscular blockade induced by rocuronium or vecuronium. In children and adolescents (aged 2-17 years), BRIDION is only recommended for routine reversal of moderate rocuronium-induced neuromuscular blockade\(^1\)

Important safety information

BRIDION is not recommended in patients with severe renal impairment. Studies in patients with hepatic impairment have not been conducted and, therefore, patients with severe hepatic impairment should be treated with great caution. Caution should be exercised when administering BRIDION to pregnant women as no clinical data on exposed pregnancies are available.

Neuromuscular blockade is reversed within 24 hours of administration, a non-reversal neuromuscular blocking agent should be used instead of rocuronium or vecuronium. The most commonly reported adverse reactions were dyspnea (oral or bitter taste) and anesthetic complications (movement, coughing, grimacing, or rattling on the endotracheal tube). In patients treated with BRIDION, a few cases of awareness were reported. The relation to BRIDION was uncertain. In a few individuals, allergic-like reactions (e.g., flushing, erythrohormus rash) following BRIDION were reported. Children should be prepared for the possibility of allergic reactions and have the necessary precautions. In a trial of patients with a history of paroxysmal complications, intravenous anaphylaxis was reported in 2 patients and a causal relationship could not be fully excluded.

Volunteer studies have demonstrated a slight (19%-23%) prolongation of the phenylochrome time between tissue time (T\(_1\)C) with BRIDION, however, clinical studies have demonstrated no clinically relevant effect on postsurgical bleeding complications with BRIDION alone or in combination with anticoagulants. As BRIDION has demonstrated an in vitro pharmacodynamic interaction with anticoagulants, caution should be exercised in patients on anticoagulants for a pre-existing or current condition. This pharmacodynamic interaction is not clinically relevant for patients receiving routine postsurgical prophylactic anticoagulation. Although formal interaction studies have not been conducted, no drug interactions were observed in clinical trials. Preclinical data suggest that clinically significant drug interactions are unlikely with the possible exceptions of borenine, fadacid, and the oral contraceptives.

\(^1\) Data of four
\(^2\) Data of two
\(^3\) Second Switch

REFERENCES: 1. BRIDION Summary of Product Characteristics (SPC).

Please see summary of product characteristics for full prescribing information.

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- **Spray geometry**: Spray cone with a wide 62.7° average spray angle and a 36.5mm average plume width.²

References:
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