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Use of the Laryngeal Mask in a Child with Tracheal Stenosis

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The laryngeal mask was developed by Brain in 1983 as an apparatus for maintaining the airway.[1] The laryngeal mask can be used during either spontaneous respiration or controlled ventilation. It has been successfully used both in normal patients and patients with abnormal airways, in whom conventional tracheal intubation would be difficult.[1–5]

Airway management of the child with tracheal stenosis is a challenge to the anesthesiologist.[6,7] Although traditional techniques of managing the airway of these patients have required the use of a face mask or an endotracheal tube, we evaluated whether a laryngeal mask could be used safely and effectively for a patient with this lesion.

CASE REPORT

A 5-yr-old girl, height 94 cm, weight 15 kg, was scheduled for canthoplasty. At 2 yr of age she had severe respiratory distress that required tracheal intubation. The intubation was difficult, and fiberoptic bronchoscopy revealed tracheal stenosis.

Preoperatively, the child was alert and cheerful. The lateral chest roentgenogram showed a segmental tracheal stenosis, starting about 1.5 cm below the vocal cords and extending for 3 cm. The narrowest caliber was about 2 mm. She also had other anomalies, including kyphoscoliosis, macroglossia, and high arched palate. Blood chemistry and complete blood counts were within normal limits. Stridor and chest wall retraction were present during crying.

Atropine 0.15 mg was given orally 90 min before the induction of anesthesia. Upon arrival in the operating room, the patient was awake and calm and had no stridor or chest wall retraction. After application of routine monitors, anesthesia was induced by inhalation of nitrous oxide 50% and increasing concentration of sevoflurane up to 4%. With deepening of the anesthetic depth, stridor and chest wall retraction appeared and gradually worsened. Ventilation *via* a face mask became difficult but improved with intravenous vecuronium 0.8 mg.

A size-2 laryngeal mask was easily inserted without using a laryngoscope. The correct position of the laryngeal mask was checked by the auscultation of breath sounds in both lungs and by adequate resistance to lung inflation. The lungs were successfully ventilated using airway pressure up to 20 cmH_2O. A humidifier (Humid-Vent 1®) and a capnometer were placed in the anesthesia circuit. Anesthesia was maintained with 2% sevoflurane and 50% nitrous oxide in oxygen. Analysis of arterial blood gases taken 15 min after the insertion of the laryngeal mask revealed oxygen tension 205 mmHg, carbon dioxide tension 39 mmHg, and hemoglobin oxygen saturation 99% with an inspired oxygen fraction of 0.5.

After 70 min of uneventful anesthesia, ventilation became difficult and airway pressure began to increase. Chest auscultation revealed expiratory wheezing. End-tidal carbon dioxide pressure increased to 59 mmHg. Analysis of arterial blood gases taken at this time confirmed the presence of hypercapnia (carbon dioxide tension 63 mmHg, oxygen tension 200 mmHg, and *p*H 7.23). The wheezing subsided within 15 min by deepening the anesthesia. The remainder of the operation proceeded without difficulty.

At the end of the surgery, fiberoptic bronchoscopy confirmed the correct position of the laryngeal mask, which indicated that the wheezing was not due to an improperly placed laryngeal mask. Neuromuscular blockade was reversed with neostigmine and atropine while the laryngeal mask was left in place. Chest wall retraction and stridor, which were similar to those that occurred during crying, reappeared with a return to spontaneous respiration. Endotracheal suctioning was not performed. The laryngeal mask was removed when the patient attempted to expel it.

The patient was transferred to the recovery room where respiration became normal within 1 h. Her postoperative course was uneventful, and she was discharged from the hospital 2 weeks later.

DISCUSSION

The laryngeal mask has several advantages over the endotracheal intubation in the airway management of patients with tracheal stenosis.

An endotracheal tube can injure the trachea, leading to edema of the airway. When injury occurs, the lumen of the trachea is further obstructed.[6,7] In our case, since the patient could not breathe adequately during crying, injury of the stenotic segment could have led to serious respiratory disturbance.

The laryngeal mask has a blunt edge and does not touch the vocal cords and trachea. Although pharyngeal trauma has been reported with the laryngeal mask, damage to the airway is unlikely to occur.

Insertion of an endotracheal tube narrows the diameter of the airway and induces reflex airway constriction, resulting in more resistance to ventilation.[8] In contrast, since the diameter of the tube of the laryngeal mask is much larger than the endotracheal tube and the trachea is not intubated, the increase in airway resistance that occurs with the laryngeal mask is relatively low.

In some patients with tracheal stenosis, airway control might be achieved by the use of an endotracheal tube positioned above the stenosis. However, if the stenotic segment is in the proximal trachea, proper fixation of the

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tube is difficult. In contrast, the laryngeal mask can be used regardless of the location of the stenotic segment.

The laryngeal mask is not able to prevent air leakage at high inflation pressure and also is not designed as an esophageal blocker. Air can therefore be introduced into the stomach with positive pressure ventilation. However, because the laryngeal mask does not occlude the mouth and nose, and instead partially obstructs the esophagus, gastric distention is less likely to occur than when a face mask is used for ventilation.

Bronchospasm appeared during anesthesia in our case, and was relieved by increasing depth of anesthesia, demonstrating the laryngeal mask should be used in a deep plane of anesthesia. Brain recommends that the laryngeal mask should not be removed during a light plane of anesthesia, since this may worsen the situation by increasing the stimulus.[9]

One of the disadvantages of the laryngeal mask is air leakage. Air leakage usually occurs at airway pressure greater than about 20 cmH_2O. Although successful airway management at peak pressure of 60 cmH_2O with pressure on the thyroid cartilage has been reported, the efficacy of the laryngeal mask at high airway pressure has not been confirmed; therefore, we consider that tracheal intubation is currently a better choice in patients who require high inflation pressure. If in our case the airway problem during the induction of anesthesia or the bronchospasm during the surgery had worsened despite deepening of the anesthesia, we would have intubated the patient's trachea.

Patients with mechanically obstructed trachea, such as tracheomalacia or external compression of the trachea, cannot be managed with a laryngeal mask, because the laryngeal mask cannot prevent collapse of the trachea.

In summary, we used the laryngeal mask in a child with congenital tracheal stenosis. We believe that the laryngeal mask is a useful alternative to endotracheal intubation in this population.

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Protamine-induced Right-to-left Intracardiac Shunting

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Right-to-left intracardiac shunting through a patent foramen ovale (PFO) is not usually observed in the resting state, but certain physiologic conditions during anesthesia that increase right atrial pressure and/or decrease left atrial pressure may increase interatrial shunting.[1–6] This report describes a case of acute right-to-left interatrial shunting provoked by protamine-induced pulmonary vasoconstriction in a patient with a PFO.

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Key words: Blood, coagulation: protamine. Complications: embolism. Heart: atrial septal defect. Lungs, circulation: hypertension. Monitoring: transesophageal echocardiography.

Case Report

A 64-yr-old 80-kg man was admitted for elective coronary revascularization and closure of a perimembranous ventricular septal defect (VSD). His past history included a recent non–Q-wave myocardial infarction, pneumonia, and mild glucose intolerance.

A preoperative transthoracic echocardiogram showed a perimembraneous VSD with left-to-right shunting, increased pulmonary artery