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The Use of the Laryngeal Mask Airway in Children with Subglottic Stenosis

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Patients with tracheal stenosis have a high incidence of difficult or failed tracheal intubation. Airway management with the laryngeal mask airway during fibreoptic laryngoscopy was used in two children with acquired subglottic stenosis during spontaneous breathing. The laryngeal mask airway may be superior to tracheal intubation or use of a face mask during anaesthesia management in severe subglottic stenosis. Ventilation may be improved and the use of a laryngeal mask airway can reduce or eliminate some of the problems associated with the other methods of airway management, such as further damage to stenotic tissue and gastric distention.

KEY WORDS: Laryngeal mask airway; Subglottic stenosis; Airway management

Introduction

Tracheal stenosis is a serious complication of long-term endotracheal intubation, especially in the intensive care unit (ICU). It appears to result from an interaction of several elements, including individual susceptibility, movement and the size of the endotracheal tube, and the duration of intubation.[1] It is also well known that tracheal stenosis may lead to difficulty in airway management during anaesthesia.

Repeated attempts to intubate could aggravate any stenosis by producing oedema,[2] and the forced insertion of the endotracheal tube against the stenotic area might induce bleeding, shearing or even laceration of the stenotic tissue. Airway obstruction at, or below, the larynx is one of the relative contraindications to the use of the laryngeal mask airway (LMA).[3] There are, however, some reports that support the use of the LMA in subglottic stenosis,[4–7] and it may have a number of advantages in such cases over other methods of airway management. Gastric distention is also less likely to occur with an LMA than with a face mask[8] and the maintenance of spontaneous breathing can reduce air leakage.[5]

These case studies report the use of the laryngeal mask airway, during spontaneous breathing, for airway management in two anaesthetized children who had developed subglottic stenosis.

Case reports

CASE 1

A 5-year-old girl, with an American Society of Anesthesiologists' (ASA) physical status classification of II, weighing 20 kg, with a history of bronchial asthma, was scheduled for fibreoptic laryngoscopy and tracheostomy. On physical examination, she had nose breathing, inspiratory stridor and suffered from moderate retractions, even at rest. She had been hospitalized due to epidural haematoma and mechanically ventilated for 12 days with a 5-mm cuffed endotracheal tube. To investigate the presence of subglottic stenosis, fibreoptic laryngoscopy and tracheostomy were planned 10 days after extubation.

After the application of routine monitors and preoxygenation, anaesthesia was induced by the inhalation of 1.5 – 2.5% halothane and 100% oxygen via a face mask, and propofol 3 mg/kg intravenously. Ventilation was assisted with oxygen and halothane for 2 min with a face mask. Inspiratory stridor and chest-wall retraction evolved and gradually worsened, and ventilation via the face mask became difficult after deepening of the anaesthesia. Main stream end-tidal carbon dioxide monitoring showed a severe obstructive pattern, with peaks of 55 – 65 mmHg. A size-2 LMA was promptly inserted at the first attempt using the standard insertion technique and the cuff was inflated with 10 ml air without interruption of the spontaneous breathing. The correct position of the LMA was checked by auscultation of the breath sounds in both lungs and by adequate resistance to lung inflation. During assisted ventilation, a continuous leak was audible with peak inspiratory pressure of 30 – 40 cmH_2O. End-tidal carbon dioxide measurements were around 50 – 60 mmHg, and oxygen saturation by pulse oximetry remained above 95% throughout the procedure with spontaneous breathing.

Anaesthesia was maintained by 1.5% halothane and 100% oxygen, and bolus doses of propofol were given as required. Spontaneous breathing was maintained throughout the procedure. A fibreoptic scope (Karl Storz, external diameter 3.5 mm) was passed via a self-sealing mount down the shaft of the LMA to the level of the vocal cords. Photographic documentation (Karl Storz camera, model 576 A) of the subglottic area showed that there was a 90% stenosis at the subglottic area (Fig. 1).

Hypertension and any adverse cardiac events did not occur during the procedure, which lasted 30 min. Gastric distention was minimal. Fibreoptic laryngoscopy and tracheostomy were performed without complication. No problems were encountered during recovery from anaesthesia.

CASE 2

A 9-year-old boy, ASA I, weighing 27 kg, with a history of carbon monoxide intoxication was hospitalized in ICU for 10 days. He was mechanically ventilated by a 6-mm cuffed endotracheal tube for 2 days. He had inspiratory stridor 2 months after discharge and suffered from mild retractions, even at rest. Fibreoptic laryngoscopy was planned to investigate the presence of subglottic stenosis.

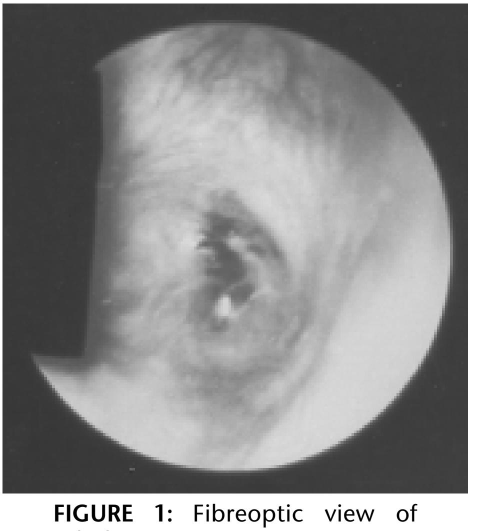

FIGURE 1: Fibreoptic view of subglottic area in case 1

Anaesthesia was induced with 8% sevoflurane and 100% oxygen via a face mask, and propofol 3 mg/kg intravenously. Mask ventilation was quite satisfactory throughout spontaneous breathing. A size-2.5 LMA was then inserted without interruption to spontaneous breathing. End-tidal carbon dioxide measurements were around 40 – 45 mmHg and oxygen saturation was constantly more than 96%.

Anaesthesia was maintained by 2.5% sevoflurane and 100% oxygen, and bolus doses of propofol were given as required. Spontaneous breathing was maintained throughout the procedure. According to the fibreoptic evaluation, there was a 75% stenosis at the subglottic area (Fig. 2). After an uneventful tracheostomy and steroid injection, anaesthesia was discontinued. There were no complications during the procedure, which lasted 40 min.

Discussion

Subglottic stenosis is frequently caused by long-term endotracheal intubation. The incidence reported by several authors varies between 0.9 and 3.0%.[9] This problem is common in children because the subglottis is the narrowest part of their upper airway and, consequently, the pressure exerted by an endotracheal tube inflicts the most damage to this area.

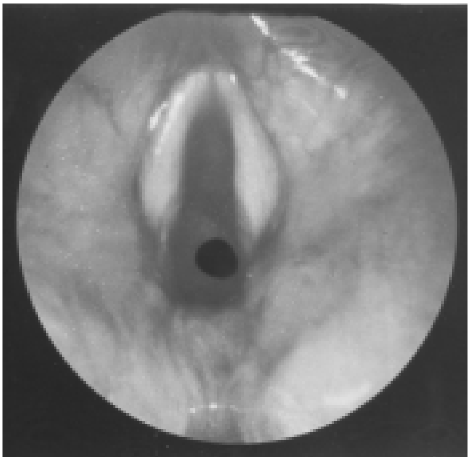

FIGURE 2: Fibreoptic view of subglottic area in case 2

The LMA was first described in 1983, and since then, it has been used for the administration of general anaesthesia, resuscitation and as an aid to bronchoscopy or intubation.[3] An LMA ensures better control of the airway than a face mask and does not have the disadvantages of an endotracheal tube. Moreover, it provides an effective, simple and proven solution to many problems of difficult intubation. Although airway obstruction at or below the larynx is one of the relative contraindications to the LMA,[3] it has been used both electively and for airway rescue in patients with laryngotracheal pathology.[10] The LMA may be more useful for rigid infraglottic pathologies and has been employed during elective surgery in children and adults with tracheal stenosis.[5,6] Unlike the tracheal tube, the LMA cannot bypass a laryngotracheal pathology, but it does allow the vocal cords and tracheobronchial tree to be observed fibreoptically while the patient is ventilated. The LMA also interferes minimally with the pathological process. Thus, the LMA has a role in both the diagnosis and management of laryngotracheal pathology.[11,12] An endotracheal tube can damage the trachea, leading to oedema of the airway and further obstruction of the lumen of the trachea.[2,13] The diameter of the tube of the LMA is much larger than the endotracheal tube, but the trachea is not intubated and the increase in airway resistance that occurs with the LMA is relatively low.

The conclusions from these cases are in agreement with other work that also suggests the importance of spontaneous breathing using an LMA in the management of patients with subglottic stenosis.[4,6] If ventilation is controlled in patients with severe tracheal stenosis, turbulent flow will occur distal to the stenosis, leading to inefficient ventilation. This is less likely to occur during spontaneous breathing. The smaller dead space volume of an LMA compared with that of a face mask means that ventilation must be improved. Kokkinis and Papageorgiou[14] reported two respiratory arrest cases with severe tracheal stenosis. They could not ventilate or intubate, even using small-sized tubes, and immediately inserted an LMA. However, they could not ventilate the lungs and neither patient could be resuscitated. This may also indicate the importance of spontaneous breathing during ventilation through an LMA in tracheal-stenosis patients.

The LMA cannot prevent air leakage at high-inflation pressure and, therefore, air could be introduced into the stomach with positive-pressure ventilation. However, because the LMA does not occlude the mouth and the nose, and partially obstructs the oesophagus, gastric distention is less likely to occur than when a face mask is used for ventilation. During the procedure, a small amount of gastric insufflation was observed in case 1; none was observed in the other patient because of the maintenance of spontaneous breathing. However, in spite of maintaining spontaneous breathing in case 1 for most of the time, high-peak inspiratory pressure was applied immediately after the insertion of the LMA in order to ventilate because the patient had bronchial asthma and 90% subglottic stenosis. During this intervention, the small amount of insufflation was observed.

The results suggest that the LMA provides suitable airway management in children with tracheal stenosis. It may be safer than other methods as it allows spontaneous breathing. In addition, further damage to the stenotic tissue is minimized and gastric distention is less likely to occur.

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