Intensive Care Med (1999) 25: 714–716

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The use of the laryngeal mask airway for inter-hospital transport of infants with type 3 laryngotracheo-oesophageal clefts

Received: 18 December 1998
Accepted: 19 April 1999

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Abstract Type 3 laryngotracheo-oesophageal clefts are rare congenital anomalies with a high mortality. In the past, transport of such infants to tertiary centres for surgical correction has proved extremely difficult, with the child's ventilatory status often deteriorating to such an extent that ultimate surgical intervention has not proved possible. We describe two cases of successful inter-hospital transfer of infants with type 3 laryngotracheo-oesophageal clefts using the laryngeal mask airway.

Key words Laryngeal mask airway · Laryngotracheo-oesophageal cleft · Inter-hospital transfers

Introduction

We describe two cases of successful inter-hospital transfer of infants with type 3 laryngotracheo-oesophageal clefts using the laryngeal mask airway.

Case reports

Case 1

A male infant weighing 2.9 kg was born by normal vaginal delivery at 35 weeks' gestation following a pregnancy complicated by polyhydramnios. Antenatal ultrasound scans had suggested congenital heart disease and possible oesophageal atresia. Shortly after delivery he developed signs of respiratory distress necessitating intubation and a trial of surfactant therapy. He was extubated following concerns regarding poor chest wall movement and subsequently proved impossible to reintubate; although some degree of stability was obtained firstly through bag and mask and then nasal continuous positive airway pressure (CPAP) ventilation. A chest X-ray showed hazy ground-glass lung fields with air bronchograms consistent with hyaline membrane disease. Rigid bronchoscopy revealed a type 3 laryngotracheo-oesophageal (LTE) cleft with a common tracheo-oesophagus extending as far as the carina. In addition, an echocardiogram showed multiple small atrial septal defects, a large patent ductus arteriosus and a coarctation of the aorta with a small aortic arch. In view of his complex congenital abnormalities, he was referred to our hospital at 24 h of age for further management.

Prior to the arrival of the transport team, the child's oxygen saturations had not been maintained despite continuous bag and mask ventilation. After gaseous induction with halothane, a size 2 laryngeal mask airway (LMA) was inserted. The larger LMA was chosen as it was thought that it would more effectively control the large air leak. However, it did not fit in the oropharynx easily and was electively changed to a size 1 LMA in order to achieve a better seal. Following partial inflation of the cuff, adequate chest wall

movement, air entry, and arterial oxygen saturations were obtained. The child was ventilated during the return journey via a T-piece and 100 % oxygen. No difficulties were encountered.

Unfortunately, within 12 h of arrival, it became increasingly difficult to oxygenate the infant despite paralysis, adequate chest movement, and surfactant therapy. Given the nature of his complex cardiac lesion, it was felt that complete surgical correction would have little chance of success, and at 2 days of age therapy was duly withdrawn.

Case 2

A male infant weighing 2.8 kg was born by normal vaginal delivery at 35 weeks' gestation following a pregnancy complicated by polyhydramnios. Resuscitation was required and endotracheal intubation was performed. This was complicated by a large leak, and bag and mask ventilation was found to be more effective. A contrast study was thought to show evidence of an H-type tracheo-oesophageal fistula. Bronchoscopy, however, revealed a type 3 LTE cleft extending from the larynx to the carina. Echocardiography demonstrated a coarctation of the aorta. He was referred to our institution at 18 h of age for further management.

On the arrival of the transport team, attempts were made to secure the infant's airway with increasing sizes of endotracheal tube up to a size 7.5 cuffed tube. Selective endobronchial intubation was also unsuccessful in providing adequate ventilation. A size 1 LMA was then inserted and by this method, with the patient sedated and paralysed, fixed wing transfer of the patient was successfully undertaken. On arrival at the tertiary centre he was conventionally ventilated with the laryngeal mask in situ.

After extensive discussion with the child's parents a complete surgical correction was attempted at 2 days of age. An end-to-end anastomosis of the coarctation, tracheobronchial reconstruction, and a left lingula and lower lobectomy was performed on cardiac bypass. At the end of a 7-h procedure, the patient returned to the Cardiac Intensive Care Unit in reasonable cardiorespiratory condition. However, during the next 9 days, following problems with dehiscence of the right main bronchus, it became impossible to ventilate the child and he subsequently died.

Discussion

Congenital laryngeal and laryngotracheo-oesphageal clefts are extremely rare disorders with an incidence of less than 0.1 % [1]. Evans has classified such defects into 3 types. In the type 1 cleft, the posterior defect is confined to the supraglottic larynx; in the type 2 cleft the defect involves the cricoid lamina and may extend downwards to involve the cervical trachea; in the type 3 cleft the thoracic trachea is involved and there may be a common tracheo-oesophageal tube [2]. Associated cardiac and other lesions are common. Infants with type 3 clefts present with severe aspiration, cyanosis and respiratory distress in the newborn period. The overall mortality for all patients with laryngeal clefts is 48 %, but with the type 3 cleft mortality approaches 100 %, there being only three reported survivors in the literature [3]. Morbidity often arises from late diagnosis and from the inevitable complications of respiratory embarrassment associated with ventilation through a common tracheo-oesophageal tube. Early closure of the cleft together with an antireflux surgical procedure is vital to prevent the irreversible damage which occurs with ongoing aspiration.

Table 1 Size selection for laryngeal mask airway

Mask size	Patient weight (kg)	Internal diameter (mm)	Cuff volume (ml)
1	< 5	5.25	< 4
1.5	5–10	6.1	< 7
2	10–20	7	< 10
2.5	20–30	8.4	< 14
3	30–50	10	< 20
4	50–70	10	< 30
5	> 70	11.5	< 40

The transport of the infant with a type 3 LTE cleft presents one of the most challenging scenarios to the intensive care team. All too often in the past, stabilisation of the airway has proved to be precarious and worsening respiratory failure has militated against later surgical correction. If the patient cannot be supported with either nasopharyngeal CPAP or conventional endotracheal intubation, then the LMA now provides an alternative method of airway management. There are two reasons why the LMA may be more effective than conventional endotracheal intubation in the management of these difficult airways. Firstly, the large diameter of the common tracheo-oesophagus results in a large air leak which renders effective ventilation impossible. The design of the LMA allows it to sit in the hypopharynx over the laryngeal inlet, where it forms a circumferential seal around the glottis, which markedly reduces any leak. Secondly, with a large cleft it is probable that the endotracheal tube falls posteriorly into the oesophagus resulting in hypoventilation. This problem does not arise with use of the LMA, although it is likely that some gas will still pass from the trachea to the oesophagus.

The LMA was originally developed as an airway adjunct by the British anaesthetist Dr. Archie Brain and colleagues in 1981. It is inserted blindly into the pharynx and studies have shown that relatively inexperienced personnel can achieve successful insertion at the first attempt. Sufficient depth of anaesthesia is essential for correct placement, and it appears that the degree of anaesthesia required is greater than that for insertion of an oropharyngeal airway but less than that for tracheal intubation [4]. Inhalational or intravenous induction usually provides adequate conditions for insertion. The choice of LMA size in children is primarily based on weight, and guidelines are shown (see Table 1).

The merits and complications of the LMA in conventional anaesthesia and in the management of difficult airways in children have now been widely described

[5]. However, there are now increasing reports of the LMA being used in alternative roles outside the operating theatre. In neonatal resuscitation, the size 1 LMA has been successfully demonstrated as an effective and easily learned method of airway management [6]. In road traffic accidents, paramedics have used LMAs to provide emergency airway control in victims where limited access to the patient has made laryngoscopy impossible [7]. In helicopter transports, the use of LMAs has been recommended as an alternative airway in an environment where noise and restricted space would make intubation difficult [8].

Our case reports highlight the use of the LMA during inter-hospital transport. Improved survival of infants with type 3 LTE clefts will depend on multiple factors, including adequate resuscitation and successful transfer to specialist centres for surgical repair. Although we recommend that the LMA should be considered as an alternative airway adjunct in the management of these complicated patients, we stress that conventional endotracheal intubation remains the standard and safest method of airway support for the transport of ventilated infants.

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