

Laryngeal Mask Airway for the Interhospital Transport of Neonates

Daniele Trevisanuto, MD*; Chandy Verghese, MD‡; Nicoletta Doglioni, MD*; Paola Ferrarese, MD*; and Vincenzo Zanardo, MD*

ABSTRACT. Airway control during interhospital transport may present enormous management difficulties, even for experienced personnel. The laryngeal mask airway is an airway management device that has been established as a safe reliable tool in adult and pediatric practice. We describe 2 cases of successful interhospital transfer of infants with congenital airway malformations with the use of the laryngeal mask airway, and we review the literature. *Pediatrics* 2005;115:e109–e111. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2004-1468; *laryngeal mask airway, transport, neonates*.

ABBREVIATION. LMA, laryngeal mask airway.

The laryngeal mask airway (LMA) is a supraglottic device developed by Dr Archie Brain in 1981.¹ Since its introduction into clinical practice, the LMA has gained increasing popularity among medical and paramedical staff members, for anesthesia and resuscitation of adult and pediatric patients.²

For neonates, although education of personnel, competence, and use of this device remain low,³ the LMA has been used successfully for resuscitation,^{4,5} intrapulmonary administration of therapeutic agents,^{6,7} management of difficult airways,⁸ and respiratory support for prolonged periods.⁹ In addition, 2 previous reports showed that the LMA may be useful for neonatal transportation if other forms of airway management fail.^{10,11} We report the use of the LMA for 2 neonates during interhospital transfer, and we review the literature.

CASE REPORTS

Case 1

A male infant weighing 2.61 kg was born through elective caesarean section, performed because of polyhydramnios, at 36 weeks of gestation. Shortly after delivery, the patient developed signs of severe respiratory distress and required positive-pressure ventilation, but bag-and-mask ventilation was ineffective and tracheal intubation failed. External cardiac massage was performed and epinephrine and sodium bicarbonate were administered. Apgar scores were 3 and 3 at 1 and 5 minutes, respectively. Because

temporary respiratory improvement was noted when the child crying, the diagnosis of choanal atresia was suspected. Therefore, an oral airway was positioned and bag-and-mask ventilation was initiated. Despite this attempt, ventilation of the patient remained unsatisfactory. Ten minutes after birth, the transport service was alerted by the referring physician and, on the basis of clinical and laboratory data (pH 7.03; arterial carbon dioxide pressure: 88 mm Hg; arterial oxygen pressure: 71 mm Hg; HCO₃ concentration: 12 mmol/L), use of the LMA was suggested. A size 1 LMA was inserted, and effective ventilation was obtained. One hour later, at the time of transport team arrival, the infant was undergoing manual ventilation with the LMA, transcutaneous saturation was 98%, and the venous blood gas analysis indicated equilibration (pH 7.28; carbon dioxide pressure: 52 mm Hg; oxygen pressure: 54 mm Hg; HCO₃ concentration: 21 mmol/L). Orotracheal intubation was performed by the transport team physician, and the patient was transferred to our hospital for additional treatment. The diagnosis of isolated choanal atresia was confirmed; the patient underwent surgical treatment, after which he was discharged in good clinical condition.

Case 2

A female infant weighing 2.37 kg was born through emergency caesarean section, performed because of poor beat-to-beat variability, late decelerations, and meconium-stained amniotic fluid, at 41 weeks of gestation. The pregnancy had been complicated by intrauterine growth retardation and polyhydramnios. At birth, the infant presented with bradycardia (heart rate: 80–90 beats per minute), hypotonia, and respiratory distress associated with severe hypoplasia of the mandible (Fig 1). Resuscitation was initiated immediately (Apgar scores of 3 and 7 at 1 and 5 minutes,



Fig 1. LMA placement in case 2.

From the *Pediatric Department, Medical School, University of Padova, Padova, Italy; and ‡Department of Anaesthesia and Intensive Care, Royal Berkshire Hospital National Health Service Trust, Reading, United Kingdom.

Accepted for publication Sep 13, 2004.

doi:10.1542/peds.2004-1468

No conflict of interest declared.

Reprint requests to (D.T.) Pediatric Department, University of Padova, Via Giustiniani 3, 35128 Padova, Italy. E-mail: trevo@pediatria.unipd.it
PEDIATRICS (ISSN 0031 4005). Copyright © 2005 by the American Academy of Pediatrics.

respectively) but, after nasal and oropharyngeal suction, both bag-and-mask ventilation and tracheal intubation failed. In addition, placement of a nasopharyngeal tube was unsuccessful. Therefore, a size 1 LMA was inserted at postnatal age of 5 minutes. This procedure allowed effective oxygenation and ventilation of the patient (pH 7.19; carbon dioxide pressure: 62 mm Hg; oxygen pressure: 179 mm Hg; HCO₃ concentration: 24 mmol/L). The patient was referred to our institution at 20 minutes of age, for additional treatment. Eighty-five minutes later, after the arrival of the transport team, attempts were made to secure the infant's airway for transfer but tracheal intubation was impossible because of severe micrognathia and glossoptosis. In addition, an attempt at blind intubation through the LMA failed. Instead, the LMA was effective in allowing positive-pressure ventilation during the 3 intubation attempts. Because of the ease of LMA placement and the efficacy of positive-pressure ventilation, ground ambulance transfer (52 minutes) of the patient was successfully undertaken. Arterial blood gas analysis performed immediately before the transport indicated the following: pH 7.28; carbon dioxide pressure, 43 mm Hg; oxygen pressure, 244 mm Hg; HCO₃ concentration, 21 mmol/L. No difficulties were encountered during the transfer. The clinical parameters were stable (heart rate: 124–132 beats per minute; respiratory rate: 52–60 breaths per minute; transcutaneous saturation: 94–98%; mean arterial blood pressure: 48–51 mm Hg). After the patient's arrival at the tertiary center, the previously alerted pediatric otorhinolaryngologist passed an endotracheal tube (size 3.5) over a fiber-optic bronchoscope and through the nose of the patient, in the operating room. The next day, the patient underwent a mandibular distraction intervention. The time of treatment was 4 weeks. Chest radiographs also showed 10 ribs with gap defects between the dorsal ossified and ventral cartilaginous segments, bilaterally. The genetic diagnosis was cerebrocostomandibular syndrome. The patient was discharged 2.5 months later, in good clinical condition.

DISCUSSION

Previously, 3 case reports (2 infants with type 3 laryngotracheoesophageal clefts and 1 infected neonate) highlighted the use of the LMA during interhospital transport.^{10,11} Airway control during interhospital transport may present enormous management difficulties, even for experienced personnel.¹²

The transport process begins with telephone communication between the referring physicians and the transport team personnel. The receiving center is responsible for providing referring physicians with any information that may enhance understanding of the patient's needs.¹² In the first case, the suggestion for using the LMA was as a rescue device for ventilation of the patient in the period between the telephone call and the arrival of the transport team. Interestingly, the LMA was correctly positioned in the first attempt by a pediatrician inexperienced in its use, confirming the ease of placement by inexperienced personnel that was reported previously.^{2,4,5}

Case 2 involved an infant who could not be intubated by either the referring physicians or the transport team personnel, because of a severe congenital airway malformation. In this situation, the LMA allowed effective ventilation and oxygenation and permitted transfer to a safe setting.

In the literature, 5 cases (including these 2 cases) of LMA use during neonatal transport have been reported.^{10,11} Interestingly, in 4 of the 5 cases, the history was positive for polyhydramnios, which suggests that accurate prenatal diagnoses could facilitate the prediction of difficult airways in this group of patients. For these treated patients, the gestational age was ≥ 35 weeks and the birth weight was ≥ 2.37

kg. However, the LMA is effective in the resuscitation of smaller infants.^{5,6} Four patients required neonatal resuscitation, and the LMA provided an effective airway in a wide range of postnatal times (5 minutes to 24 hours). For all 5 patients, LMA use was determined by the failure of conventional modes of ventilation (facial mask and tracheal intubation). The size 1 LMA was effective in all cases; for 1 patient, size 2 LMA insertion failed. In 3 of 5 cases, no sedative and/or paralytic drugs were used for LMA insertion and placement, which suggests acceptance of this device for relatively long periods of time.

The LMA was positioned at the referral hospital in 4 cases; in 1 case, the LMA was positioned during interhospital helicopter transport because of an unexpected apneic episode that did not respond to stimulation and bag-and-mask ventilation.¹⁰ In 1 case, the LMA was used as a rescue device for 90 minutes, from the time of birth to the arrival of the transport team. These cases demonstrate that the LMA may play an important role in airway management in all phases of the transport process, ie, during stabilization at the referral hospital (before the arrival of the transport team), during the transfer, and after arrival at the tertiary center.

The duration of LMA use ranged from 5 minutes to 4 hours. No complications related to its use were reported, which suggests the safety of this device for both inexperienced and skilled personnel.² Different transport vehicles were used for the transportation of these patients; the LMA was always useful, particularly in situations in which access to the patient's airway was limited, such as in a helicopter.¹⁰ Placement of the LMA does not require manipulation of the patient's head, neck and jaw, is not influenced by anatomic factors, and does not require laryngoscopy.² All of these characteristics could be life-saving in the treatment of sick neonates, particularly during interhospital transport, which is considered a dangerous phase in the care of newborns.

Airway congenital malformations were reported for 4 patients, which suggests that the role of the LMA is particularly important for this group of neonates; however, the use of this device should also be considered for patients with normal airways.¹⁰ The LMA has been recommended by the American Heart Association and the European Resuscitation Council for use in adult resuscitation.¹³ In road traffic accidents, paramedics have used the LMA to provide emergency airway control for victims when limited access to the patient has made laryngoscopy impossible.²

Recently published International Guidelines for Neonatal Resuscitation suggested that "the LMA may serve as an effective alternative for establishing an airway if bag-mask ventilation is ineffective or attempts at intubation have failed."^{14(p9)} However, routine use of the LMA cannot be recommended at this time.^{14,15}

Standard equipment listed for interhospital care of perinatal patients includes a variety of devices, such as tracheal tubes, facial masks, and oral airways.^{12,16} We recommend that the list should include the LMA, for situations in which airway management is diffi-

cult or cannot be achieved with a facial mask or tracheal tube. Rescue personnel must be trained in the use of the LMA before this modality is added to all protocols.

REFERENCES

1. Brain AI. The laryngeal mask: a new concept in airway management. *Br J Anaesth*. 1983;55:801–805
2. Berry AM, Brimacombe JR, Verghese C. The laryngeal mask airway in emergency medicine, neonatal resuscitation, and intensive care medicine. *Int Anesthesiol Clin*. 1998;36:91–109
3. Trevisanuto D, Ferrarese P, Zanardo V, Chiandetti L. Laryngeal mask airway in neonatal resuscitation: a survey of current practice and perceived role by anaesthesiologists and paediatricians. *Resuscitation*. 2004;60:291–296
4. Paterson SJ, Byrne PJ, Molesky MG, Seal RF, Finucane BT. Neonatal resuscitation using the laryngeal mask airway. *Anesthesiology*. 1994;80:1248–1253
5. Trevisanuto D, Micaglio M, Pitton M, Magarotto M, Piva D, Zanardo V. Laryngeal mask airway: is the management of neonates requiring positive pressure ventilation changing? *Resuscitation*. 2004;62:151–157
6. Brimacombe J. Airway rescue and drug delivery in an 800 g neonate with the laryngeal mask airway. *Paediatr Anaesth*. 1999;9:178–179
7. Brimacombe J, Gandini D, Keller C. Laryngeal mask airway for administration of surfactant in two neonates with respiratory distress syndrome. *Paediatr Anaesth*. 2004;14:188–190
8. Johr M, Berger TM, Ruppen W, Schlegel C. Congenital laryngotracheo-oesophageal cleft: successful ventilation with laryngeal mask airway. *Paediatr Anaesth*. 2003;13:68–71
9. Bucx MJL, Grolman W, Krusinga FH, Lindeboom JAH, Van Kempen AAMW. The prolonged use of the laryngeal mask airway in a neonate with airway obstruction and Treacher Collins syndrome. *Paediatr Anaesth*. 2003;13:530–533
10. Brimacombe JR, De Maio B. Emergency use of the laryngeal mask airway during helicopter transfer of a neonate [letter]. *J Clin Anesth*. 1995;7:689–690
11. Fraser J, Hill C, McDonald D, Jones C, Petros A. The use of the laryngeal mask airway for inter-hospital transport of infants with type 3 laryngotracheo-oesophageal clefts. *Intensive Care Med*. 1999;25:714–716
12. American Academy of Pediatrics. *Guidelines for Air and Ground Transport of Neonatal and Pediatric Patients*. Elk Grove Village, IL: American Academy of Pediatrics; 1999
13. American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology*. 2003;98:1269–1277
14. Niermeyer S, Kattwinkel J, Van Reempts P, et al. International Guidelines for Neonatal Resuscitation: an excerpt from the Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: International Consensus on Science. *Pediatrics*. 2000;106(3). Available at: www.pediatrics.org/cgi/content/full/106/3/e29
15. Kattwinkel J, Niermeyer S, Nadkarni V, et al. An advisory statement from the Pediatric Working Group of the International Liaison Committee on Resuscitation. *Pediatrics*. 1999;103(4). Available at: www.pediatrics.org/cgi/content/full/103/4/e56
16. Insoft RM. Neonatal transport. In: Cloherty JP, Eichenwald EC, Stark AR. *Manual of Neonatal Care*. 4th ed. Baltimore, MD: Lippincott Williams & Wilkins; 2004:151–157