J Anesth (2011) 25:415–417
DOI 10.1007/s00540-011-1112-9

CLINICAL REPORT

# Use of a laryngeal mask airway to stop a supraglottic air leak which prevented adequate ventilation via a tracheostomy in a patient with cerebral palsy and pneumonia

**Satoki Inoue · Ryuichi Abe · Masahiko Kawaguchi · Yasunobu Kawano · Hitoshi Furuya**

Received: 30 November 2010 / Accepted: 15 February 2011 / Published online: 13 March 2011


**Abstract** We report an adolescent developing ventilation failure due to supraglottic air leakage with the use of an uncuffed hand-made tracheal tube fit to her tracheobronchial deformity. To eliminate the supraglottic air leakage, a size 2.5 laryngeal mask airway (LMA) was inserted into the oral pharynx. Most of air leakage arose from the LMA. Supraglottic air leakage was not detected under mandatory mechanical ventilation following sealing of the 15-mm connector of the LMA with a piece of tape, and the respiratory condition of the patient gradually improved. The combination of a hand-made Y-shaped tube and the LMA was useful in restoring adequate ventilation. In conditions where air leaks through the glottis during mechanical ventilation interfere with adequate ventilation or the maintenance of airway pressure, the use of an LMA may be adequate to stop or significantly decrease the leak.

**Keywords** Laryngeal mask airway · Tracheostomy · Uncuffed tube · Air leakage · Scoliosis · Cerebral palsy

## Introduction

Bronchopulmonary dysplasia frequently occurs in extremely low birth weight infants, and it is occasionally accompanied by impairment of neuromuscular development, especially cerebral palsy [1]. It is also known that children with severe neurological impairment have a high incidence of pulmonary problems which are multifactorial in orgina and may be related to or dependent on the underlying disability [2]. Children with cerebral palsy have been reported to be particularly vulnerable to the development of contractures and postural deformity, including scoliosis, sometimes resulting in respiratory problems [2, 3]. The respiratory condition may worsen over time. As a result, they may need respiratory support, including a tracheostomy. However, pulmonary problems are based on multifactorial causes and may be complicated. Standard respiratory care might be ineffective in such patients.

Cuffed tracheostomy tubes allow for airway clearance, and positive pressure ventilation can be more effectively applied when the cuff is inflated [4]. Therefore, cuffed tubes are generally considered to be necessary to provide effective positive pressure ventilation. However, there may be situations in which the use of cuffed tubes is unsuitable due to factors specifically related to the patient. We report here the case of ventilation failure in an adolescent due to supraglottic air leakage involving the use of an uncuffed hand-made tracheal tube fit to her tracheobronchial deformity.

## Case history

The consent of patient's next of kin was obtained; however, institutional review board approval was exempted because there were no ethical concerns and the patient was de-identified. A 15-year-old girl (22 kg, 125 cm) who had been born at 27 weeks of gestation with severe hypoxia due to bronchopulmonary dysplasia resulting in developing cerebral palsy presented with pneumonia at our hospital. One year prior to presentation, she had already undergone

S. Inoue (✉) · R. Abe · M. Kawaguchi · H. Furuya
Department of Anesthesiology, Nara Medical University, 840 Shijo-cho, Kashihara, Nara 634-8522, Japan
e-mail: seninoue@naramed-u.ac.jp

Y. Kawano
Division of Intensive Care, Nara Medical University, Kashihara, Japan

tracheostomy but did not need support ventilation. After admission to the intensive care unit, positive pressure ventilation was started using a standard cuffed tracheostomy tube. Atelectasis of the left upper lobe was diagnosed based on radiology findings. With a short course of conventional ventilation, the atelectasis did not improve on the chest X-ray. Bronchoscopic examination revealed that the main bronchial orifices were almost occluded due to a severe bronchial wall deformity, edema, and secretions. The carina was nearly collapsed. In addition, the left upper orifice was completely occluded with secretions. During the bronchoscopic examination, secretions were suctioned as much as possible. A chest X-ray performed following the bronchoscopy revealed atelectasis in the right lobe. After discussion with pulmonologists, the placement of a hand-made Y-shaped tube to maintain the lumens using conventional reinforced endotracheal tubes was to be replaced with the cuffed tracheostomy tube through the tracheostoma. However, the cuff of the original tube could not be preserved when it was modified into a Y shape, which was made by cutting the end and attaching the end part with end-to-side anastomosis using nylon sutures (Fig. 1). A commercially available Y-shaped tracheobronchial stent was proposed as an alternative; however, it was withheld at this time because of the technical difficulties associated with its replacement or removal. Although the use of this tube was expected to improve the atelectasis, effective bilateral ventilation was not obtained because supraglottic air leakage occurred at an airway pressure of 10 $cmH_2O$. Effective positive end expiratory pressure (PEEP) was difficult to maintain. To eliminate the supraglottic air leakage, we initially attempted to pack around the glottis. However, effective sealing was not achieved and substantial air leakage continued. We then inserted a size 2.5 laryngeal mask airway (LMA) into the oral pharynx and inflated the cuff with 6 m of air. Most of the air leakage arose from the LMA. After sealing the 15-mm connector of the LMA with a piece of tape, supraglottic air leakage was not detected under mechanical ventilation at an airway pressure of 25 $cmH_2O$. The expiratory volume, which was 60–80 ml before the intervention, increased to 150–170 ml. Her respiratory condition gradually improved over the next few days during which she receiving assist control ventilation. The LMA was removed after almost 60 h of use, at which time pressure support ventilation was initiated. Further deterioration of the respiratory condition was not observed without the LMA under assisted spontaneous ventilation. Three days later, the hand-made tracheostomy tube was replaced with the conventional tracheostomy tube. Endoscopic examination after tube replacement revealed trachea and main bronchi patent with improvement of mucous membrane edema and decrease of mucopurulent sputum.

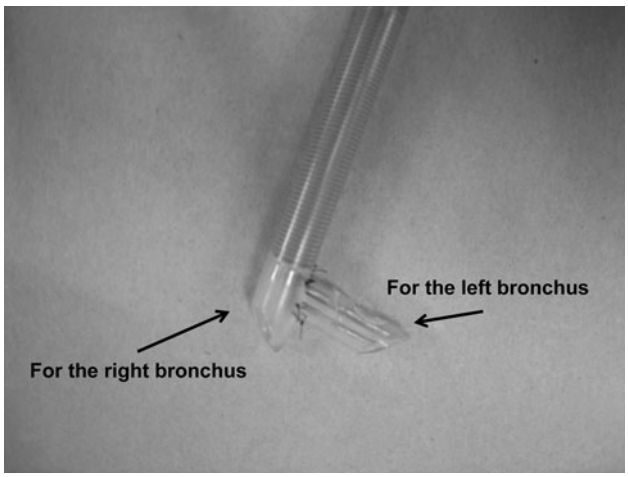


**Fig. 1** A hand-made Y-shaped tracheostomy tube. The cuff was peeled off when the side orifice was constructed for the end-to-side anastomosis of the tubes

## Discussion

Laryngeal mask airway (LMA) devices have been used to control subgrottic leakage in an endotracheal tube with a broken cuff or uncuffed cricothyroidotomy tube in critical situations [5–7]. They have also been used to prevent a leak during ventilation via a microlaryngeal tube or a Montgomery T-tube which was inserted through the tracheostoma during anesthetic management [8, 9]. In all of these reported cases, the LMA devices were used for short periods of time, until either extubation or replacement of the airway device. In our patient, the combination of the hand-made Y-shaped tube and the LMA was useful as it allowed ventilation for a long period of time.

Reintubation or a cuffed tracheostomy tube is often required in the intensive care unit setting when substantial subgrottic air leakage occurs during respiratory management. However, a cuffed tracheostomy tube initially failed in the respiratory management of our patient, and we therefore used a hand-made Y-shaped tube in an attempt to overcome the airway obstruction caused by edema and secretions. Unfortunately, this tube did not allow for a cuff. When this Y-shaped tube did not alleviate the problem and the supraglottic leak continued, we considered replacing it with another hand-made tube, ultimately did not do so for two reasons: (1) we were uncertain how to determine the best size to seal the leak, and (2) it would have taken too much time to construct such a tube. Thus, we concluded that immediate sealing of the leak was the best alternative and therefore used the LMA.

In our case, LMA-related complications, such as laryngeal or lingual edema, were not observed [10, 11]. These complications may be related either to the prolonged usage or the placement of an oversized LMA [10, 11]. The LMA

in our case was placed for a considerably prolonged time compared to times reported in previous studies. One possible, perhaps better, alternative approach may have been to have deflated the LMA intermittently to avoid a prolonged continuous pressure on the oropharynx.

In summary, we were presented with the case of an adolescent patient who developed ventilatory failure because of supraglottic air leakage during the usage of an uncuffed hand-made tracheal tube fit to her tracheobronchial deformity. The combination of the hand-made Y-shaped tube and the LMA was useful in restoring adequate ventilation. In conditions where air leaks through the glottis during mechanical ventilation interfere with ventilation or the maintenance of airway pressure, the use of an LMA may stop or significantly decrease the leak.

**Conflict of interest** This case report does not include any conflict of interest. Financial support was solely from a departmental source.

## References

1. Walsh MC, Szefler S, Davis J, Allen M, Van Marter L, Abman S, Blackmon L, Jobe A. Summary proceedings from the bronchopulmonary dysplasia group. Pediatrics. 2006;117:S52–6.
2. Seddon PC, Khan Y. Respiratory problems in children with neurological impairment. Arch Dis Child. 2003;88:75–8.
3. Porter D, Michael S, Kirkwood C. Patterns of postural deformity in non-ambulant people with cerebral palsy: what is the relationship between the direction of scoliosis, direction of pelvic obliquity, direction of windswept hip deformity and side of hip dislocation? Clin Rehabil. 2007;21:1087–96.
4. Hess DR. Tracheostomy tubes and related appliances. Respir Care. 2005;50:497–510.
5. Miyazaki H, Asai T, Kambara T, Nagata A, Shingu K. Use of the laryngeal mask airway prevents gas leak around a tracheal tube (in Japanese with English abstract). Masui (Jpn J Anesthesiol). 2009;58:193–4.
6. Asai T, Murao K, Shingu K. Laryngeal mask airway to prevent a gas leak around a tracheal tube. Anaesthesia. 2005;60:102.
7. Wong DT, Kumar A, Prabhu A. The laryngeal mask airway prevents supraglottic leak during ventilation through an uncuffed cricothyroidotomy. Can J Anaesth. 2007;54:151–4.
8. Guha A, Mostafa SM, Kendall JB. The Montgomery T-tube: anaesthetic problems and solutions. Br J Anaesth. 2001;87:787–90.
9. Agrawal S, Payal YS, Sharma JP, Meher R, Varshney S. Montgomery T-tube: anesthetic management. J Clin Anesth. 2007;19:135–7.
10. Endo K, Okabe Y, Maruyama Y, Tsukatani T, Furukawa M. Bilateral vocal cord paralysis caused by laryngeal mask airway. Am J Otolaryngol. 2007;28:126–9.
11. Stillman PC. Lingual oedema associated with the prolonged use of an inappropriately large laryngeal mask airway (LMATM) in an infant. Paediatr Anaesth. 2003;13:637–9.