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# Laryngeal mask airway is useful for fiberoptic bronchoscopic evaluation of subglottic stenosis in children: a report of eleven cases

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## Introduction

Bronchoscopy under general anesthesia is often indicated to examine the upper airway in pediatric patients. Flexible bronchoscopy has been used for the majority of diagnostic procedures [1]. We report here the use of a laryngeal mask airway (LMA) to guide a fiberoptic bronchoscope while maintaining an adequate depth of anesthesia and effective ventilation during the procedure in small or premature infants who are suspected of having severe subglottic stenosis because of long-term intubation in early infancy.

## Case reports

Fiberoptic bronchoscopy was planned for 11 children. The patients were pretreated with oral atropine sulphate (0.02 mg·kg$^{-1}$) and nasal midazolam (0.2 mg·kg$^{-1}$) 30 min prior to the induction of anesthesia. Anesthesia was induced with intravenous lidocaine (2 mg·kg$^{-1}$), midazolam (0.2 mg·kg$^{-1}$), and slow infusion of aminophylline (4–5 mg·kg$^{-1}$), followed by inhalation of 50% nitrous oxide in oxygen, and 1–3% sevoflurane (Fig. 1a). Topical anesthesia of the upper airway was achieved with a 2% lidocaine spray (0.1 mg·kg$^{-1}$) by using an LTA kit (Abbott Ireland, Sligo, Ireland). A LMA was then inserted into the patients, either with and without tracheostomy (Fig. 1b). The size of the LMA was chosen based on the manufacturer's guidelines, with size No. 1 being used for children less than 6.5 kg and size No. 2 for children weighing 6.5–20 kg.

Endoexpiratory carbon dioxide concentration and blood oxygen saturation, by pulse oximetry, were monitored in all cases. Ventilation in patients without a tracheostomy was performed through the main entry of the Y-connector between the LMA and the anesthesia circuit, and through the tracheostomy in patients with a tracheostomy (Fig. 1b). Ventilation was usually spontaneous, but was supported by assisted ventilation when patients hypoventilated.

Next, a fiberoptic bronchoscope (FOB) with a diameter of 3.5 mm (3C10, Olympus Optical, Tokyo, Japan) was inserted through the side entry of the Y-connector in patients without a tracheostomy, and directly through the LMA in patients with a tracheostomy, and was advanced into the subglottic space (Fig. 1c). If the FOB was too large to pass through the stenotic portion of the subglottic space, a smaller FOB, 1.8 mm diameter (PF, Olympus Optical, Tokyo, Japan), was tried. Since the FOB does not have a movable tip, it was not possible to pass it through the slits of the LMA which was already in place, and the LMA had to be removed first. The LMA was then reinserted with the FOB through its slit. If this technique failed to allow the PF to be advanced into the subglottic space, we attempted to examine the subglottic area with the FOB positioned close the vocal cord. In patients with a tracheostomy, several other techniques were attempted after removal of the LMA, such as oral or nasal insertion of either size FOB, followed by an attempt to insert it through the vocal cords while holding it with Magill forceps.

Ease of insertion of the LMA was subjectively assessed as "good" if it was possible to insert it with a clear view of the vocal cord on the first attempt, "acceptable" if the first attempt failed, but changing the depth or angle by bronchoscopy yielded a clear view of the vocal cord in the middle of the slits of the LMA, "unacceptable" if, after several trials, no view of the vocal cord

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**Table 1.** Clinical findings and the ultimate methods of bronchoscopy in 11 children

| Patient No. | Age (years : months) | Weight (kg) | Indication | Tracheostomy | Size of LMA | Insertion condition of LMA | Level of stenosis | Final method of bronchoscopy |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 : 09 | 3.2 | Subglottic stenosis | − | 1 | Good | 1 | 3C10 through LMA |
| 2 | 0 : 07 | 3.2 | Subglottic stenosis | − | 1 | Good | 1 | 3C10 through LMA |
| 3 | 3 : 01 | 12.5 | Pneumonia | − | 2 | Good | 1 | 3C10 through LMA |
| 4 | 1 : 11 | 7.9 | Subglottic stenosis | − | (2) → 1 | Unacceptable | 2 | PF through LMA |
| 5 | 0 : 07 | 2.1 | Subglottic stenosis | − | 1 | Impossible | 3 | Nasal 3C10 through facial mask and supraglottic observation |
| 6 | 0 : 06 | 3.7 | Subglottic stenosis and tracheomalacia | − | 1 | Good | 1 | 3C10 through LMA |
| 7 | 2 : 09 | 11.1 | Tracheomalacia | + | 2 | Good | 1 | 3C10 through LMA |
| 8 | 2 : 10 | 9.8 | Subglottic stenosis | + | (2) | Unacceptable | 1 | Nasal 3C10 |
| 9 | 1 : 10 | 10.4 | Subglottic stenosis | + | 2 | Acceptable | 3 | Supraglottic observation using 3C10 through the LMA |
| 10 | 1 : 08 | 6.6 | Subglottic stenosis | + | (2) | Unacceptable | 3 | Supraglottic observation using 3C10 held by Magill forceps |
| 11 | 1 : 00 | 4.2 | Subglottic stenosis | + | 1 | Acceptable | 3 | Supraglottic observation using 3C10 through the LMA |

3C10, BF 3C10 bronchoscope with 3.5 mm diameter (Olympus, Japan)
PF, PFTM bronchoscope with 1.8 mm diameter (Olympus, Japan)
LMA, laryngeal mask airway
( ), size of LMA tried but failed

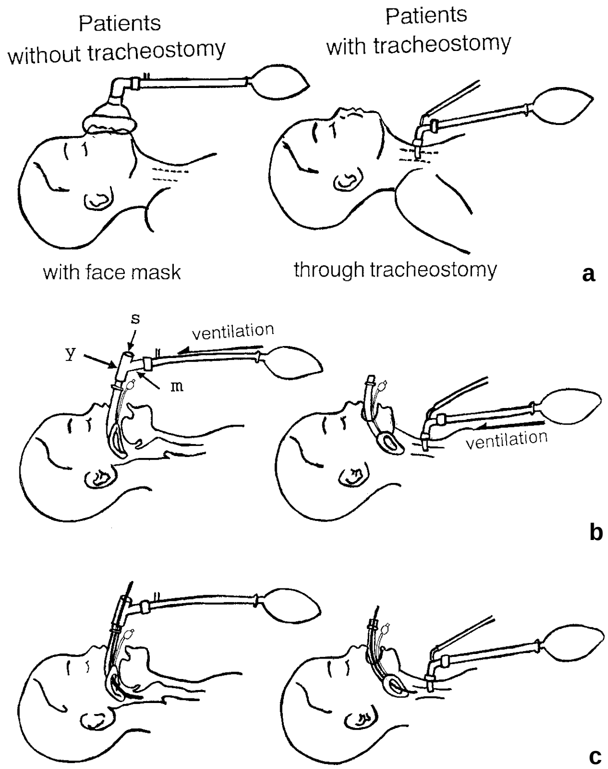


**Fig. 1.** **a** Induction of anesthesia. **b** Insertion of laryngeal mask. *m*, main entry; *s*, side entry; *y*, Y-connector. **c** Insertion of a fiberoptic bronchoscope

was achieved by bronchoscopy even though ventilation was possible, and "impossible" if the LMA could not be inserted at all (Table 1). The severity of the subglottic stenosis was evaluated on a scale of one to three, as follows: 1, the 3C10 (3.5 mm diameter) could pass through the stenotic area; 2, the PF (1.8 mm diameter) was needed to pass through the stenotic area; 3, the attempt to pass it had to be abandoned (Table 1).

The 11 patients ranged in age from 6 months to 3 years. The diagnosis was subglottic stenosis in nine of the patients (82%), and pneumonia or tracheomalacia in the others. Five patients (45%) had a tracheostomy (Table 1). Ease of insertion of the LMA was rated "good" in four of the six patients (67%) without a tracheostomy, as opposed to only one of the five patients (20%) with a tracheostomy. Insertion was assessed as "impossible" in only one (9%) of 11 patients. That patient weighed 2.1 kg, had been intubated at birth, and did not have a tracheostomy. Among the patients without a tracheostomy, the severity of the stenosis was rated grade 2 in one patient, grade 3 in one patient (17%), and grade 1 in the others (67%). Two (40%) of the five patients with a tracheostomy had grade 1 stenosis, and the other three (60%) had grade 3.

Two patients (Nos. 5 and 11) developed hypoxemia during the induction of anesthesia, but none became hypoxemic during the examination. We tried to insert a size No. 1 LMA twice in case No. 5, but both times the patient developed bradycardia, even though ventilation through the LMA was possible. We therefore abandoned attempts to insert the LMA into this patient and substituted facial mask ventilation, and inserted the 3C10 through the side entry of an adapter connected between the facial mask and the anesthesia circuit. This allowed examination of the subglottic stenosis outside the vocal cord.

## Discussion

Bronchoscopy to examination subglottic stenosis under local anesthesia is difficult and hazardous in small children. Although a rigid bronchoscope is suitable for examing the larynx under general anesthesia, it is more hazardous to tissues around the larynx than fiberscopic procedures. By contrast, fiberoptic examination through an endotracheal tube under general anesthesia is a safe procedure, but the supra- and subglottic area cannot be visualized. Thus, fiberoptic bronchoscopy with the LMA should fulfill both the requirements of diagnosis and of safety for children [2–4].

Although ventilation can be performed through a tracheostomy, the LMA is useful not as a device for ventilation, but because of the following features. (1) The LMA can be used as a guide for inserting the PF, which has no provision for angulation at the tip and is too soft to advance to the examination area without support. (2) The LMA can guide the thin fiberscope close to the vocal cords, in spite of abnormal pharyngeal anatomy, without being deflected by obstacles in the airway. (3) The LMA avoids the risk of damage to the nasal mucosa. For these reasons, the LMA is a useful and indispensable instrument for examination of the vocal and subglottic area in patients either with and without a tracheostomy.

Small children born as low-weight infants who undergo long-term endotracheal intubation may have delayed development inside the oral cavity, as in our cases. Moreover, the patients in our study who were evaluated as having grade 2 or 3 stenosis were evaluated as less than "good" with regard to ease of insertion. In other words, it tends to be difficult to insert the LMA in children who have severe subglottic stenosis.

In conclusion, the LMA is useful for fiberoptic bronchoscopy of children with severe subglottic stenosis either with and without tracheostomy.

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