British Journal of Anaesthesia 1993; 70: 30–33

COMPARISON OF THE REINFORCED LARYNGEAL MASK AIRWAY AND TRACHEAL INTUBATION FOR ADENOTONSILLECTOMY

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SUMMARY

One hundred and four patients were allocated randomly to receive anaesthesia for adenotonsillectomy via either a reinforced laryngeal mask airway or a tracheal tube. Airway maintenance and protection were assessed during and after operation. The reinforced laryngeal mask did not interfere with surgical access; it resisted compression and protected the lower airway from contamination with blood. Four patients were withdrawn from the laryngeal mask airway group: two because of difficulty with placement, and two because the laryngeal mask was obstructed distally when the Boyle Davis gag was opened fully. In children, recovery was less eventful in the laryngeal mask airway group, with less airway obstruction ($P < 0.001$) and better airway acceptance ($P < 0.05$). The reinforced laryngeal mask airway provided a clear, secure airway until recovery of protective reflexes. (Br. J. Anaesth. 1993; **70**: 30–33)

KEY WORDS

Anaesthesia: otorhinolaryngological. Equipment: laryngeal mask airway.

The laryngeal mask airway is made of silicone but, although the tube portion is relatively stiff, it is compressed or kinked easily and thereby obstructed. A modified laryngeal mask airway has been produced, with a reinforced tube portion which is suitable for use with a Boyle Davies gag, and its use in anaesthesia for adenotonsillectomy was described in 1990 [1].

Anaesthesia for adenotonsillectomy with tracheal intubation may be compromised by tracheal tube compression or displacement [2]. It subjects the patient to the complications of tracheal intubation [3], bronchial intubation with preformed tracheal tubes [4] and aspiration of blood past uncuffed tubes. Extubation at the end of surgery is performed either under deep anaesthesia, leaving an unprotected, insecure airway, or awake, risking excessive coughing and postoperative haemorrhage.

These problems might be avoided by using the modified laryngeal mask airway, as the tube portion is reinforced and resistant to compression and kinking. A correctly positioned laryngeal mask attains a gas-tight seal of up to 2 kPa [5] and has been shown to protect the larynx from dye placed in the pharynx [6].

The aim of this study was to compare the reinforced laryngeal mask airway with tracheal intubation for adenotonsillectomy.

PATIENTS AND METHODS

The study was approved by the Hospital Ethics Committee. Patients of ASA grades I and II, undergoing elective tonsillectomy and or adenoidectomy were allocated randomly (by the toss of a coin) to receive either a reinforced laryngeal mask airway or an RAE preformed orotracheal tube. Patients were not studied if there were any contraindications [5] to the use of a laryngeal mask airway, or if they weighed less than 15 kg. Patients were withdrawn if the quality of anaesthesia jeopardized either the patient or the success of surgery.

Children were premedicated with trimeprazine 2 mg kg^{-1} and atropine 0.02 mg kg^{-1} orally and EMLA cream was applied to the dorsum of both hands 1.5 h before operation. Adults received papaveretum 0.2 mg kg^{-1} i.m. and hyoscine 0.004 mg kg^{-1} 1 h before operation.

Anaesthesia was induced with thiopentone 5 mg kg^{-1} or halothane in 50% nitrous oxide and oxygen. Tracheal intubation was facilitated by administration of suxamethonium 1 mg kg^{-1} i.v. and, in children, the correct tube size was confirmed by demonstration of a small leak with positive pressure ventilation. The laryngeal mask was inserted without the use of a neuromuscular blocker when the patient did not respond to jaw lift, and correct placement was confirmed by the presence of a clinically clear airway and the ability to inflate the patient's lungs manually with no audible gas leak.

Anaesthesia was maintained by spontaneous breathing of 66% nitrous oxide in oxygen and 1–1.5% halothane. Patients were placed supine with a shoulder bar and pillow removed to extend the neck. Monitoring comprised pulse oximetry, capnography, ECG and automated non-invasive arterial pressure.

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At the end of surgery, the pharynx was cleared of blood under direct vision and, in the tracheal tube group, the larynx was viewed to detect any blood on the vocal chords. Patients then breathed 100% oxygen with halothane for 3 min, after which an Olympus LE1 fibreoptic bronchoscope was passed down either the laryngeal mask, to inspect the larynx and interior of the mask, or the tracheal tube, to view the trachea. The bronchoscope was not passed beyond the end of the tracheal tube.

All patients were placed in the left lateral position with a pillow under the shoulder during recovery. The laryngeal mask was left *in situ*, while the tracheal tube was removed and a Guedel airway used to aid airway maintenance. All patients were monitored with pulse oximetry and received 40% oxygen until awake.

All anaesthetics were given by the authors and surgery was performed by surgeons of all grades who were familiar with the procedure. Neither the anaesthetist nor the surgeon was randomized.

Data were analysed using Student's t test and χ^2 test for 2×2 contingency tables with Yates' correction.

RESULTS

Patient characteristics and surgical procedure for the two groups are shown in tables I and II. Although the tracheal group appear younger and lighter, the difference is not significant statistically.

One hundred and four patients were recruited, but four patients were withdrawn from the laryngeal mask group (table III): two because of difficulty with laryngeal mask insertion, and two because the laryngeal mask airway became obstructed when the Boyle Davis gag was opened fully. In one of the last two, surgical access was inadequate.

In the remaining patients, surgical access (table IV) was good or adequate, with the laryngeal mask airway being hidden from view when the Boyle Davis gag was opened fully.

There were no episodes of airway obstruction in either group in the remaining patients.

One laryngeal mask airway was displaced by the laryngoscope during pharyngeal toilet at the end of surgery. It was repositioned easily while *in situ* and no aspiration of blood occurred.

Laryngeal spasm occurred in three patients — once on tracheal extubation, which was treated with 100% oxygen; no desaturation occurred. In the laryngeal mask group, insertion of the Boyle Davis gag induced laryngeal spasm in one patient because of inadequate depth of anaesthesia. This was treated by deepening anaesthesia with i.v. thiopentone and manual ventilation; desaturation was prevented. The third episode resulted from accidental laryngeal stimulation during fibreoptic inspection of the inside of the laryngeal mask and larynx. This was the only case of oxygen desaturation (to 75%) during operation and it was treated with i.v. suxamethonium 50 mg and manual ventilation with 100% oxygen via the laryngeal mask.

Where there were statistically significant differences between the groups, we have analysed the results according to age because the incidence of perioperative aspiration and postoperative airway obstruction, in particular, varied with age in the tracheal tube group. Aspiration of blood into the lower airway occurred frequently in the intubation group (table V), particularly in children, extending past the carina in three children. However, in the laryngeal mask airway group, there were no cases of aspiration of blood into the larynx ($P < 0.001$) and only one instance when a small amount of blood entered a laryngeal mask. The presence of blood in the lower airway of children (table VI) was associated

TABLE I. *Patient characteristics (mean (SD) [range])*

	Laryngeal mask airway ($n = 48$)	Tracheal tube ($n = 52$)	P
Age (yr)	11.2 [3–31]	9.3 [3–37]	> 0.1
Sex (M/F)	24/24	25/27	
Weight (kg)	39.4 (20.9) [15–90]	32.3 (18.7) [15–88]	> 0.05

TABLE II. *Surgical procedure*

	Laryngeal mask airway ($n = 48$)	Tracheal tube ($n = 52$)
Tonsillectomy	25	18
Adenotonsillectomy	12	16
Adenoidectomy	1	0
Myringotomy + adenotonsillectomy	7	11
Myringotomy + adenoidectomy	3	4
Submucosal diathermy + adenoidectomy	0	1
Cautery to turbinate + adenotonsillectomy	0	1
Antral washout + adenotonsillectomy	0	1

TABLE III. *Details of four patients withdrawn from laryngeal mask group*

Patient No.	Age (yr)	Weight (kg)	Reason for withdrawal
1	8	32	Inadequate surgical access
2	6	25	Obstructed by Boyle Davis gag
3	3	15	Unsuccessful placement
4	6	23	Unsuccessful placement

TABLE IV. *Peroperative observations. *Patient is one of the two with laryngeal spasm*

	Laryngeal mask airway ($n = 48$)	Tracheal tube ($n = 52$)	P
Surgical access			
Good	44	51	
Adequate	4	1	> 0.1
Complications			
Obstruction	0	0	
Displacement	1	0	> 0.5
Bronchospasm	0	0	
Laryngeal spasm	2	1	> 0.5
Oxygen desaturation (< 94%)	1*	0	> 0.5

TABLE V. *Perioperative observations. Analysis of laryngeal and tracheal contamination*

Blood in larynx	Laryngeal mask airway	Tracheal tube	*P*
Children (< 14 yr)	(*n* = 34)	(*n* = 39)	
None	34	18	
Larynx	0	13	
Larynx and trachea	—	5	≪0.001
Larynx and carina	—	3	
Adults	(*n* = 14)	(*n* = 13)	
None	14	11	
Larynx	0	1	> 0.1
Larynx and trachea	—	1	

TABLE VI. *Perioperative aspiration of blood in the intubation group of children (< 14 yr) and postoperative sequelae*

	Aspiration of blood		
	Yes (*n* = 21)	No (*n* = 18)	*P*
Coughing			
Yes	6	0	
No	15	18	< 0.05
Biting			
Yes	0	1	
No	21	17	> 0.5
Laryngeal spasm			
Yes	3	1	
No	18	17	> 0.5
Desaturation (< 94%)			
Yes	1	2	
No	20	16	> 0.5

TABLE VII. *Recovery observations in children (< 14 yr). Mandibular support was used when there was partial or complete airway obstruction despite the use of an airway*

	Laryngeal mask airway (*n* = 34)	Guedel airway (*n* = 39)	*P* (95% CI)
Airway maintenance			
Easy	33	23	< 0.001
Mandibular support	1	16	(0.21–0.54)
Airway acceptance			
Good	33	30	< 0.05
			(0.06–0.34)
Coughing	0	6	> 0.05
Biting	0	1	> 0.5
Laryngeal spasm	1	4	> 0.1
Suction			
Easy	30	25	> 0.5
Difficult	1	1	
Not required	3	13	< 0.05
			(0.07–0.42)
Desaturation (< 94%)	0	3	> 0.1
Blood staining			
Outer surface	34		
Inner surface	6		

with an increase in coughing during recovery ($P < 0.05$). There were no cases of perioperative blood loss requiring i.v. fluid replacement (i.e. loss greater than 10% of calculated blood volume) and no episodes of postoperative haemorrhage.

In children, maintenance of an unobstructed airway during recovery (table VII) was much easier with the laryngeal mask airway than with the Guedel airway ($P < 0.001$) and airway acceptance was better ($P < 0.05$). Suction to clear secretions and blood was easy in both groups, but was required less in the tracheal intubation group ($P < 0.05$). In adults, a similar pattern was observed for airway maintenance and acceptance and the need for suction during recovery, but the number of adults studied was too small to show a statistically significant difference.

Oxygen desaturation to 92%, 90% and 88% occurred in three children in the intubation group; two cases resulted from laryngeal spasm and one from upper airway obstruction. One patient required further surgery to control bleeding detected while the laryngeal mask was still in place. Anaesthesia was deepened and haemostasis achieved.

DISCUSSION

Our results show that the reinforced laryngeal mask airway may be used in place of tracheal intubation during anaesthesia for adenotonsillectomy.

It is noteworthy that the laryngeal mask airway did not obstruct the surgical field and, when the Boyle Davis gag was opened fully, the surgeon could not distinguish between it and a tracheal tube. Adequate, rather than good, surgical access occurred in children in both groups. In addition, the laryngeal mask airway protected the lower airway from aspiration of blood during operation; in contrast, in the intubation group, aspiration of blood occurred in 54% of children and 15% of adults.

Although we did not see the trachea in the laryngeal mask group, we have assumed the trachea was not contaminated because there were no cases of laryngeal contamination and only one case of blood entering the laryngeal mask airway by the end of surgery.

Four children had to be withdrawn from the laryngeal mask group, two because the laryngeal mask became obstructed and two because it proved impossible to place the reinforced laryngeal mask correctly. This was caused by very large tonsils causing the mask portion to rotate on the flexible tube of the laryngeal mask airway.

The airway was compromised in three patients in the laryngeal mask group. One patient developed mild laryngeal spasm on insertion of the Boyle Davis gag, and this highlights the need to ensure adequate depth of anaesthesia. In two children with small, narrow, long mouths and restricted mouth opening, the reinforced laryngeal mask airway was obstructed distally when the Boyle Davis gag was opened fully. This was probably a result of the gag pushing the laryngeal mask anteriorly, causing the aperture to be occluded by the epiglottis, which may also have been down-folded. Such cases, when identified, require tracheal intubation, but it must be remembered that occasionally, in patients with severely limited surgical access, the Boyle Davis gag must be inserted asymmetrically to avoid tracheal tube compression, and one tonsil removed before repositioning the gag to remove the other tonsil.

With the exception of the above three patients and the iatrogenic case of laryngeal spasm, the laryngeal mask airway provided as clear an airway as the RAE

tube. It is of note that while the Boyle Davis gag is *in situ* the laryngeal mask airway (or the RAE tube) is held firmly in place by the gag and displacement is unlikely to occur.

One laryngeal mask airway was displaced during pharyngeal toilet. This occurred because the laryngoscope blade elevated the tongue base, allowing the laryngeal mask airway to slip up over it. This can be avoided if care is taken to elevate the mask portion of the laryngeal mask airway and the tongue base together.

It is advocated that the laryngeal mask airway be left in place to ensure a clear airway until recovery of protective reflexes [5]. Our results support this view, as only two patients had problems during recovery. One child developed mild laryngeal spasm and required mandibular support, and one adult coughed on the laryngeal mask, without ill effect. This compares with frequent airway obstruction and coughing and occasional laryngeal spasm and oxygen desaturation when a Guedel airway was used to aid airway maintenance. The cause of upper airway obstruction during anaesthesia is complex [7] and the Guedel airway itself has been associated with causing airway obstruction [8]. These problems can be overcome by leaving the laryngeal mask *in situ* for recovery from anaesthesia.

Suction to clear excessive amounts of blood and secretions pooling in the mouth was required more often in the laryngeal mask group, especially in children, and may be necessitated by the laryngeal mask preventing these fluids from being swallowed or aspirated.

On removal, all laryngeal mask airways were blood-stained on their outer surfaces and in masks from eight patients there was blood staining on the inner surface. We cannot know if this occurred while the laryngeal mask airway was still in place, or during its removal. Of these eight patients, only one child developed mild laryngeal spasm and in the others there were no signs of aspiration of blood. In the Guedel airway group, nine patients coughed, five developed laryngospasm and three suffered oxygen desaturation, possibly suggesting laryngeal contamination during recovery.

The reinforced laryngeal mask airway has been used previously for adenotonsillectomy anaesthesia [1], but there was no direct assessment of laryngeal protection. When 10 ml of methylene blue was placed in the oropharynx [6] there were no cases of laryngeal contamination with dye, although the site of surgery was not specified. We have shown that the laryngeal mask airway did protect the larynx from contamination with blood during surgery on the upper airway.

The laryngeal mask airway is contraindicated in non-fasted patients, in whom there is risk of regurgitation of stomach contents, and in patients with low lung compliance [5]. However, patients with these problems rarely present for elective adenotonsillectomy.

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