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Original article

Use of the laryngeal mask airway in thyroid and parathyroid surgery as an aid to the identification and preservation of the recurrent laryngeal nerves

EF Shah[1], JG Allen[2], RA Greatorex[1]

Departments of [1]General Surgery and [2]Anaesthetics, The Queen Elizabeth Hospital, King's Lynn, Norfolk, UK

A prospective study was carried out in patients undergoing thyroid and parathyroid surgery using a laryngeal mask airway (LMA) and electrical nerve stimulation to identify the recurrent laryngeal nerves. A total of 150 consecutive patients undergoing thyroid and parathyroid surgery by a single surgeon were assessed for suitability of anaesthesia via the LMA. Peroperatively, a fibre-optic laryngoscope was passed through the LMA to enable the anaesthetist to visualise the vocal cords while adduction of the cords was elicited by applying a nerve stimulator in the operative field. In all, 144 patients were selected for anaesthesia via the LMA. Fibre-optic laryngoscopy and nerve stimulation were performed in 64 patients (42.7%). The trachea was deviated in 51 (34.0%) and narrowed in 33 (22.0%). The recurrent laryngeal nerves were identified in all patients. There were no cases of vocal cord dysfunction resulting from surgery. The LMA can be safely used for thyroid and parathyroid surgery even in the presence of a deviated or narrowed trachea. It can assist in identification and preservation of the recurrent laryngeal nerve and is, therefore, of benefit to both patient and surgeon.

Key words: Thyroidectomy – Laryngeal mask airway – Recurrent laryngeal nerve – Laryngoscopy

We report our experience in identification of the recurrent laryngeal nerve during thyroid and parathyroid surgery by a technique combining the use of a laryngeal mask airway (LMA), fibre-optic laryngoscopy and electrical nerve stimulation. Damage to the recurrent laryngeal nerve should occur in less than 1% of patients undergoing thyroidectomy.[1] However, the actual figures are probably higher in cases of thyroid malignancy and

Correspondence to: Miss EF Shah, 9 Alma Square, London NW8 9QD, UK

Figure 1 A sterile adhesive 'U' drape was applied to the inferior border of the mandible and superior border of the trapezius muscles

Figure 2 The 'U' drape was used to separate the operative field from the face, leaving easy access to the patient's head for the anaesthetist

re-explorations, even in the most experienced hands.[2] In 1991, we published a pilot study from this hospital suggesting use of the LMA as the method of choice for anaesthetising patients undergoing thyroid surgery.[3] Five years later a larger series, describing the anaesthetic technique involved, was reported.[4] The present article demonstrates the value of this procedure from the surgeon's perspective, as an aid to identification of the recurrent laryngeal nerves, especially in large goitres, malignancies and secondary procedures where the anatomy may be distorted, and as a useful teaching tool for surgical trainees. This is now the procedure of choice in our hospital for anaesthetising patients for both thyroid and parathyroid surgery.

Patients and Methods

Between January 1990 and February 1999, 150 consecutive patients with a mean age of 49.5 years (range, 20–87 years) underwent surgery for thyroid and parathyroid disease. All patients had their vocal cords checked pre-operatively by an experienced otolaryngologist using indirect laryngoscopy. On the day before surgery, a senior anaesthetist assessed each patient's suitability for the LMA and a total of 144 patients were selected.

Cardiac monitoring and pulse oximetry measurements were commenced before induction of anaesthesia. In all cases selected for the LMA technique, midazolam, fentanyl, propofol and vecuronium were used for induction, and a propofol infusion for maintenance of anaesthesia. If the anaesthetist failed to achieve satisfactory seal with the laryngeal mask after induction, it was abandoned in favour of tracheal intubation.

Positioning of the patient was carried out using a traditional head ring and a sandbag under the shoulders. A screen bar was placed to separate the surgeon's field from the anaesthetist's and traditional head towelling was dispensed with. A sterile adhesive 'U' drape was applied to the inferior border of the mandible and superior border of the trapezius muscles (Fig. 1) to separate the operative field from the face, leaving easy access to the patient's head for the anaesthetist (Fig. 2), should intubation become necessary intra-operatively.

During dissection, if identification of the recurrent laryngeal nerve proved difficult or impossible, or if an identified structure needed to be confirmed as the nerve, electrical stimulation was used to localise it in the following manner. First, the anaesthetist confirmed decay of the neuromuscular block using a peripheral nerve stimulator. Then a fibre-optic laryngoscope was passed into the lumen of the LMA by the anaesthetist to visualise the vocal cords. The surgeon then applied a nerve stimulator in the operative field at the presumed site of the nerve while the anaesthetist observed adduction of the ipsilateral vocal cord, thereby confirming both identity and integrity of the recurrent laryngeal nerve.

A pulsed constant nerve stimulator (Xomed, USA) was used in all cases. This device delivers 80 pulses/s, with a maximum current intensity of 0.7 mA, and is designed specifically for the identification of exposed motor nerves during surgical procedures.

Table 1 Indications for surgery

Indications	Number
Multinodular goitre causing pressure symptoms	45
Solitary benign nodule	43
Thyroid malignancy	26
Recurrent thyrotoxicosis	20
Cosmesis	3
Primary hyperparathyroidism	13

Table 2 Reasons for elective endotracheal intubation

Reasons	Number
Myotonic dystrophy diagnosed 6 years previously	1
Massive retrosternal goitre	1
Hiatus hernia with proven gastro-oesophageal reflux	2
Rheumatoid neck deformity with odontoid peg erosion and a massive retrosternal goitre	1
Previously diagnosed poor lung compliance	1

Table 3 Range of surgical procedures

Procedures	Number
Thyroid lobectomy	67
Subtotal thyroidectomy	59
Total thyroidectomy	7
Excision of thyroid isthmus	4
Parathyroidectomy	13

3 of the subtotal thyroidectomies were secondary procedures.

Table 4 Postoperative complications

Complications		Number
General		
	Wound infection	1
	Cerebrovascular accident	1
Specific		
	Hypothyroidism	2
	Transient hypoparathyroidism	3
	Transient surgical emphysema	1
	Pulmonary oedema	1

Results

There were 150 consecutive patients who required surgery for thyroid and parathyroid disease (Table 1). Those with suspected malignancy pre-operatively but which turned out to be benign on histopathological examination have been placed in the benign group for greater clarity. Six patients were deemed unsuitable for a laryngeal mask airway at pre-operative assessment (Table 2) and they underwent elective tracheal intubation. Of the remaining 144 patients who were anaesthetised via the LMA, three had to be intubated after induction due to technical difficulties with the LMA and one patient who had been anaesthetised using the LMA was intubated in the recovery room due to laryngospasm on emergence from anaesthesia. Another two patients were intubated intra-operatively due to irretrievable loss of the mask seal during mobilisation of the thyroid gland; this was carried out uneventfully and at no stage did either patient become hypoxaemic. In this consecutive series there were three patients with massive retrosternal goitres, of whom two were successfully anaesthetised via the LMA.

Pre-operative imaging revealed a deviated trachea in 51 patients (34.0%), and narrowing in 33 (22.0%). Of the latter, only three patients were in the group that needed elective tracheal intubation and one in the group that required intra-operative intubation.

A wide range of surgical procedures was carried out (Table 3). There were three secondary procedures for recurrent thyroid disease, one of which was a large retrosternal goitre which necessitated elective intubation as shown before in Table 2; the other two re-explorations, including one case of thyroid malignancy, were anaesthetised successfully using the LMA.

Fibre-optic laryngoscopy combined with nerve stimulation was carried out in 64 patients (42.7%); in 13 cases (8.7%) solely for purposes of identification of the recurrent laryngeal nerve (two of which were non-recurrent nerves) and in the other 51 (34.0%) for confirmation of identity and for teaching. There were no postoperative complications relating to nerve damage (Table 4). Pre-operative screening discovered vocal cord dysfunction in four patients and, of these, three remained symptomatic after surgery. Postoperative cord screening did not reveal any cases of recurrent laryngeal nerve dysfunction arising from surgery.

Discussion

Riddell was concerned about the medicolegal implications of recurrent laryngeal nerve damage as far back as 1956, when he studied the rates of nerve injury in a series of patients undergoing thyroid surgery.[5] He found no statistically significant difference in nerve injury rates between the group in which the nerves were identified and the group in which they were not. In 1970, he described a technique of electrical stimulation to test for nerve integrity,[6] but as the LMA did not exist at that time, it necessitated exchange of the endotracheal tube for the laryngoscope during the operation. The LMA has enabled this process to be carried out more simply and safely.

The concept of direct visualisation of the vocal cords and electrical stimulation of the recurrent laryngeal nerve at operation is, therefore, not a new one. Other workers have described various techniques to aid identification of the nerve. Davis *et al.* described a

system for intra-operative monitoring of nerve function by an electrode placed in the vocal cord musculature,[7] while another group demonstrated nerve function by using electrodes inserted through the cricothyroid membrane into the vocal muscle to record action potentials.[8]

Tanigawa *et al.* described a method similar to that in the present study, but used inhalational agents before insertion of the LMA; they reported 2 cases of laryngospasm during anaesthesia.[9] Charters *et al.*, in turn, argued that this method had serious drawbacks.[10]

There are several key differences in the technique employed in the current study. Based on previous studies that have shown significant advantages in using propofol as the induction agent for LMA insertion,[11,12] all the patients were induced with propofol and then maintained on a propofol infusion, the benefits of which, are reflected in the results. Positioning and draping of the patient are also important factors. In the 2 patients who needed intra-operative intubation in this series, there was no difficulty in the anaesthetist obtaining access to the patient's airway in view of the use of the 'U' drape and screen bar.

Patients with gastro-oesophageal reflux are at risk of aspiration of gastric contents during LMA anaesthesia,[13] but in selecting out these patients this potential complication is avoided.

In 1983, Brain described the use of the laryngeal mask in cases of difficult tracheal intubation.[14] Milner *et al.* have reported its use in a case of severe respiratory tract obstruction.[15] Similarly, the present study demonstrates that the LMA may be used where the trachea is deviated or narrowed.

Safe and successful use of the LMA in thyroid and parathyroid surgery requires co-operation between surgeon and anaesthetist. We advocate its application as the method of choice in this type of surgery, especially where difficulty in identification of the recurrent laryngeal nerve is anticipated.

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References

1. Farrar WB. Complications of thyroidectomy. *Surg Clin North Am* 1983; **63**: 1353–61.
2. Ready AR, Barnes AD. Complications of thyroidectomy. *Br J Surg* 1994; **81**: 1555–6.
3. Greatorex RA, Denny NM. Application of the laryngeal mask airway to thyroid surgery and the preservation of the recurrent laryngeal nerve. *Ann R Coll Surg Engl* 1991; **73**: 352–4.
4. Hobbiger HE, Allen JG, Greatorex RA, Denny NM. The laryngeal mask airway for thyroid and parathyroid surgery. *Anaesthesia* 1996; **51**: 972–4.
5. Riddell VH. Injury to recurrent laryngeal nerves during thyroidectomy. *Lancet* 1956; **ii**: 638–41.
6. Riddell V. Thyroidectomy: prevention of bilateral recurrent nerve palsy. *Br J Surg* 1970; **57**: 1–11.
7. Davis WE, Rea JL, Templer J. Recurrent laryngeal nerve localization using a microlaryngeal electrode. *Otolaryngol Head Neck Surg* 1979; **87**: 330–3.
8. Flisberg K, Lindholm T. Electrical stimulation of the human recurrent laryngeal nerve during thyroid operation. *Acta Otolaryngol* 1970; **263**: 63–7.
9. Tanigawa K, Inoue Y, Iwata S. Protection of recurrent laryngeal nerve during neck surgery: a new combination of neutracer, laryngeal mask airway, and fiberoptic bronchoscope. *Anesthesiology* 1991; **74**: 966–7.
10. Charters P, Cave-Bigley D, Roysam CS. Should a laryngeal mask be routinely used in patients undergoing thyroid surgery? *Anesthesiology* 1991; **75**: 918–9.
11. Brown GW, Patel N, Ellis FR. Comparison of propofol and thiopentone for laryngeal mask insertion. *Anaesthesia* 1991; **46**: 771–2.
12. Smith I, White PF, Nathanson M, Gouldson R. Propofol – an update on its clinical use. *Anesthesiology* 1994; **81**: 1005–43.
13. Payne J. The use of the fibreoptic laryngoscope to confirm the position of the laryngeal mask. *Anaesthesia* 1989; **44**: 865.
14. Brain AIJ. The laryngeal mask – a new concept in airway management. *Br J Anaesth* 1983; **55**: 801–5.
15. Milner QJW, Abdy S, Allen JG. Management of severe tracheal obstruction with helium/oxygen and a laryngeal mask airway. *Anaesthesia* 1997; **52**: 1084–9.