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How I do it:

A new technique for the management of inaccessible anterior glottic lesions

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Abstract
We describe a new technique for removing anterior vocal fold lesions, which cannot be visualized with conventional suspension laryngoscopy. These situations are rare and the only alternative surgeons have had previously is an open laryngeal procedure. The technique we describe involves the use of a laryngeal mask airway (LMA), a flexible bronchoscope with biopsy channel, a 400 μm laser fibre and KTP/532 nm laser. This method was used to treat two patients in whom conventional suspension laryngoscopy had previously been attempted and abandoned.

Key words: Bronchoscopes; Laser Surgery; Laryngeal Masks; Glottis

Introduction

Lesions in the anterior segment of the vocal fold are sometimes difficult to access by conventional suspension microlaryngoscopy. This is particularly so in patients with neck and oropharyngeal anatomy that makes glottic visualization and tracheal intubation difficult. In this distinct group of patients, vocal fold surgery poses a challenge to both surgeon and anaesthetist.

Anaesthetists use a method of assessment to predict difficult laryngoscopy at the time of intubation. This method was described by Mallampati and is based on the size of the tongue on oral inspection (see Table I).[1] The laryngoscopic view of the glottis at intubation has been graded by Cormack and Lehane (see Table II).[2] Mallampati Class I suggests ease of intubation and correlates with a grade I Cormack and Lehane laryngoscopic view. However, Mallampati Class IV suggests a poor Cormack and Lehane grade III.

Suspension laryngoscopy may allow the surgeon to improve the grade of laryngoscopic view obtained by the anaesthetist. Cricoid pressure by an assistant may further optimize the view. However, any view less adequate than a Cormack and Lehane grade II would make vocal fold surgery on an anterior lesion impossible.

The laryngeal mask airway (LMA) has revolutionized anaesthesia, and in particular, the management of difficult airways.[3] It is indispensable in maintaining the airway of patients in whom laryngoscopy cannot visualize the glottis, rendering visual tracheal intubation impossible. The LMA is placed blindly into the hypopharynx and forms an effective seal

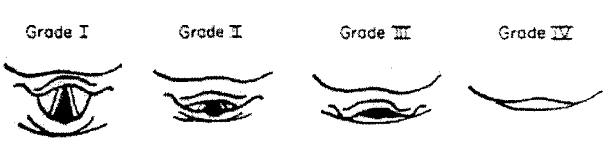
TABLE I
MALLAMPATI CLASSIFICATION[1]

The mallampati classification relates tongue size to pharyngeal size. This test is performed with the patient in the sitting position, the head held in a neutral position, the mouth wide open, and the tongue protruding to the maximum. The subsequent classification is assigned based upon the pharyngeal structures that are visible

Class	Structures visualized
I	Soft palate, fauces, uvula, anterior and posterior pillars
II	Soft palate, fauces and uvula
III	Soft palate, and base of uvula
IV	Soft palate not visible at all

TABLE II
CORMACK AND LEHANE GRADES OF LARYNGOSCOPIC VIEW[2]

Grade	Structures seen
I	Most of glottis
II	Posterior portion of glottis
III	Only epiglottis seen, none of glottis
IV	Neither glottis nor epiglottis seen



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around the larynx. The vocal folds are not traumatized during its introduction and lesions that the ENT surgeon may wish to address remain undisturbed.

A flexible bronchoscope may be passed through the LMA to visualize anterior vocal fold lesions and through the biopsy side channel in the bronchoscope, these lesions may be biopsied with flexible forceps.[4] This procedure can be performed with ease under general anaesthesia even by an inexperienced operator.[5] Unfortunately, the flexible bronchoscope has only one instrument channel and laryngeal surgery beyond simple biopsies with flexible forceps has not been possible.

Laser surgery was introduced into otolaryngology in the 1970s. Carbon dioxide (CO_2) lasers were the first to be used in laryngeal work and their use has become widespread.[6] The CO_2 laser is delivered by an articulated arm as a linear beam and therefore lacks manoeuvrability. In the 1980s, the Nd-Yag laser (yttrium-aluminium-garnet treated with neodymium ions pumped with a krypton arc lamp) was introduced and the main advantage over the CO_2 laser was delivery by means of a flexible fibre-optic light cable.[7] Whilst the Nd-Yag laser had greater coagulative properties it lacked the cutting ability of the CO_2 laser. The KTP laser introduced by Du Pont later in the 1980s, uses a Nd-Yag laser beam of 1064 nm wavelength that passes through a potassium titanyl phosphate (KTP) crystal to produce visible green light with a wavelength of 532 nm. This has superior cutting properties whilst maintaining Nd-Yag's coagulative properties when delivered as a divergent beam. In summary, the KTP/532 nm laser cuts better and faster than the Nd-Yag laser and coagulates better than the CO_2 laser.

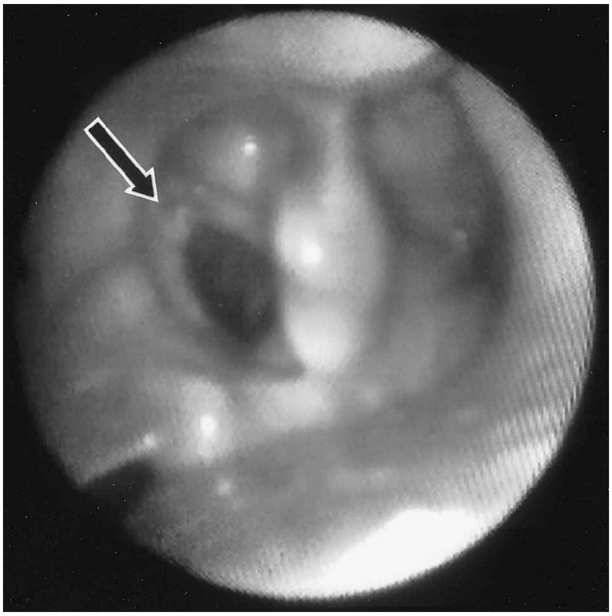

FIG. 1

Case 1 pre-operative photo of lesion taken via bronchoscope. Arrow indicates lesion.

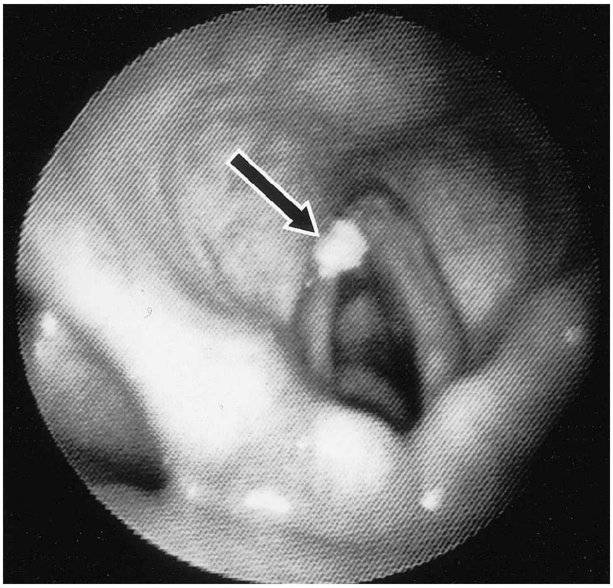

FIG. 2

Case 2 pre-operative photo of lesion taken via bronchoscope. Arrow indicates lesion.

Laser treatment via a flexible bronchoscope has been used to treat lesions in the subglottis and tracheobronchial tree. Yamaguchi *et al.* have used Nd-YAG lasers in the subglottis and tracheobronchial tree.[8] We describe the first use of the KTP/532 nm laser to treat vocal fold lesions in the anterior glottis in patients who have failed conventional suspension laryngoscopy due to anatomical reasons.

Case reports

Case 1

A 41-year-old gentleman presented to the ENT department with variable dysphonia. Fibre-optic laryngoscopy in the voice clinic revealed a pedunculated anterior vocal fold polyp (see Figure 1). He was subsequently admitted for microlaryngoscopy and removal of this lesion, but the procedure was abandoned due to an inability to visualize the lesion despite strong suspension and cricoid pressure. He had a body mass index (BMI) of 30 (weight 106 kg; height 1.88 m), a short neck but good jaw protrusion and was assessed to have a Mallampati grade 3 airway. He also had a full set of teeth.

The patient subsequently underwent flexible bronchoscopy under general anaesthesia with a laryngeal mask airway and KTP/532 laser vaporization of the lesion.

At follow-up, following speech therapy, the patient's voice had improved considerably, and he remained well.

Case 2

A 78-year-old male presented with a hoarse voice to the ENT department of another hospital. On examination he had a keratotic lesion of his left anterior vocal fold (Figure 2). He was otherwise fit

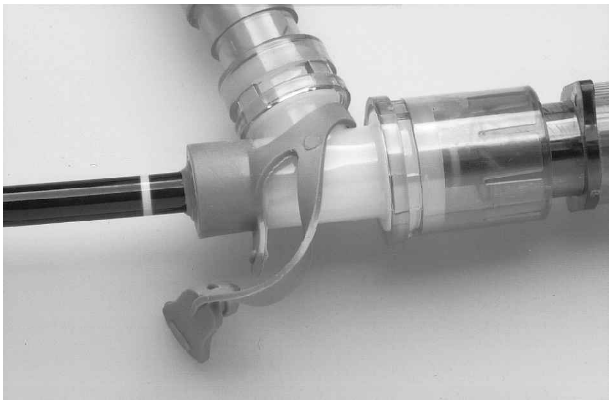

FIG. 3
Swivel catheter mount and self-sealing port allows passage of the bronchoscope without an air leak and repositioning of ventilator tubing.

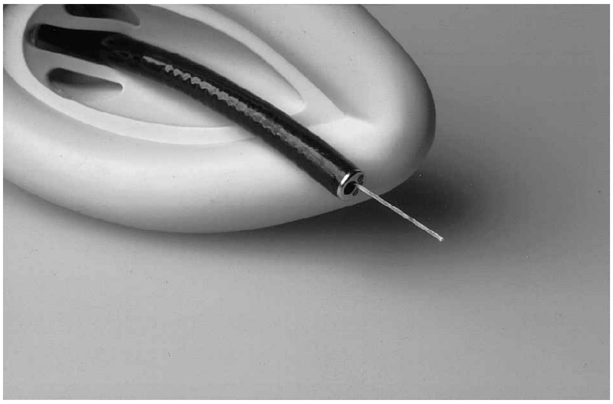

FIG. 5
Close-up of the 400 μm laser fibre emerging from the tip of the bronchoscope.

and well, but had poor dentition. Microlaryngoscopy was unsuccessful in visualizing the lesion due to his short, thick and inflexible neck. He had a BMI of 27 (weight 86 kg; height 1.78 m), poor jaw protrusion and Mallampati grade 3 airway. He subsequently had a biopsy of this lesion with a flexible bronchoscope and biopsy forceps. Histologically, this lesion proved to be a granuloma with no atypical or malignant features.

He was then referred to our unit where the lesion was debulked with the KTP/532 laser via a flexible bronchoscope. Biopsies performed prior to debulking once again confirmed the benign nature of this lesion. Complete removal of this lesion was not undertaken as it was not possible to accurately aim the laser beam to the lateral margin of the lesion despite repositioning of the patient, LMA and a flexible bronchoscope. Given the benign nature of this lesion, we elected not to proceed to complete removal, as this would involve laser damage to adjacent normal vocal fold epithelium.

At follow-up, he still had a small remnant of the lesion, but improved voice quality.

FIG. 4
The bronchoscope passes through the saline-filled LMA.

Technique

Following five minutes of pre-oxygenation, general anaesthesia was induced with intravenous propofol and fentanyl. Bag mask ventilation was manually confirmed prior to administration of the muscle relaxant, atracurium, and anaesthesia was maintained with air, oxygen and sevofluorane.

Cormack and Lehanne laryngoscopy grade 2 was obtained with cricoid pressure, in *Case 1* with a short-bladed McCoy laryngoscope and in *Case 2* with a long Mackintosh blade. The vocal folds were sprayed with 4 ml of four per cent lignocaine. A size 5 laryngeal mask airway (LMA) was inserted in the standard way and the cuff inflated with 20 ml of normal saline dyed with methylene blue.

The lungs were ventilated with air, oxygen and sevofluorane in a volume controlled mode with airway pressure maintained below 20 cm H_2O by reducing tidal volume and increasing respiratory rate. A swivel catheter mount was inserted between the LMA and the ventilator tubing to allow the tubing to be moved during the procedure either by an anaesthetist or surgeon for manipulation of the bronchoscope with minimal disturbance of the LMA. A self-sealing port was placed on top of the mount to allow the passage of the bronchoscope directly into the LMA with no leakage of air (Figure 3).

An adult flexible bronchoscope (Olympus GIF-PQ20) was introduced via the self-sealing port and passed through the LMA grill to visualize the glottis (Figures 4 and 5). Images were viewed on a television screen, and anaesthetist, scrub nurse and other theatre personnel were aware of the surgeon's manoeuvres. Flexible forceps were inserted via the instrumentation channel in the bronchoscope to take biopsies of the lesion whilst intermittent suction was maintained. The entire bronchoscope was then removed to allow passage of a 400 μm bare laser fibre through the instrument channel. The laser fibre was introduced whilst keeping the scope straight to ensure that the fibre did not fracture within the bronchoscope. The fibre was then stripped of its outer coating, and the quality of the laser beam checked.

The laser fibre was connected to the KTP laser (Laserscope Aura XP) and retracted flush with the end of the scope prior to passage through the LMA for the second time. Fume extraction tubing was fitted to the suction port of the scope to ensure good visibility during the procedure. A power of 10W was used in continuous mode to vaporize the lesion and the average exposure was 127J in the two cases we describe.

Airway control and ventilation were easily and safely maintained throughout the procedures, which lasted 35 and 55 minutes respectively.

Discussion

In patients with short, stout and inflexible necks, laryngoscopy may be difficult. In such patients who have glottic lesions, the anaesthetist and surgeon are faced with the dual dilemma of adequate vision of, and access to, the surgical field and ventilation during anaesthesia. The situation is further compounded if the lesion is situated in the anterior glottis where visualization may be impossible. The two cases we describe are exceedingly rare even in our institution where over 700 microlaryngoscopic procedures are performed annually.

One previous alternative to this dilemma was an open neck procedure such as laryngofissure. In several centres in Europe, indirect microlaryngostroboscopic surgery of the vocal folds is practised, and this could conceivably address small anterior glottic lesions where bimanual instrumentation is not necessary.[9] Some authors have advocated the deliberate extraction or the extraction and re-implantation of incisors to improve laryngoscopic view of the anterior commissure.[10,11] We do not believe that this alternative would be widely acceptable to patients.

The procedures we describe were both performed following failure of conventional suspension laryngoscopy to visualize and treat the lesion. This new technique allowed access for diagnosis and treatment of these anterior glottic lesions whilst maintaining good airway control and ventilation.

The technique builds and refines on methods described by others. Brimacombe *et al.* describe the use of the LMA and a flexible bronchoscope for biopsy of vocal fold lesions without the use of laser.[4] This technique has two major limitations. Firstly, surgery beyond simple biopsy is not possible as the bronchoscope only has a single instrumentation channel. Secondly, the control of haemorrhage may be difficult as even the application of an adrenaline-soaked 'patty' is impossible. Yamaguchi *et al.* used the Nd-YAG laser for treating subglottic and tracheobronchial lesions.[8] This laser may be passed through a laser fibre via a flexible scope and has good coagulating properties. Technically, access to the subglottis and tracheobronchial tree is easier via an LMA. The Nd-YAG laser has poor cutting properties and is therefore less suitable for the treatment of larger lesions.

Our technique allows the flexible bronchoscope to access the anterior glottis via the LMA grill and precise removal of lesions in this area by accurate laser vaporization. This employs the KTP/532 laser, which has good cutting properties in addition to the coagulative properties of Nd-YAG, from which it is derived. Haemostasis can be quickly and effectively ensured.

Although the KTP laser is used within the body cavity, necessary precautions should still be taken in theatre as stray laser beams may escape from fractured fibres. An air-filled LMA cuff can be penetrated by a KTP/532 laser at 10W at 10 mm ($1.22\ Wmm^{-2}$) in one to three seconds, but filling with saline takes five to 11 seconds of exposure to produce cuff penetration.[12] The use of a saline-filled LMA has been shown in a randomized study to produce satisfactory results with reliable positioning and similar oropharyngeal leak pressures to air-filled cuffs.[13] Normal saline with methylene blue dye, as described by Keller *et al.*, allows the surgeon to recognize cuff penetration immediately, and if the cuff is accidentally penetrated, the saline released would douse the flames.[14] The risk of an airway fire is further minimized by the use of air or the lowest inspired O_2 concentration (FiO_2) to maintain adequate O_2 saturations.

We recommend that this technique be limited to lesions which can be vaporized with the loss of vocal fold epithelium. There will undoubtedly be scarring following laser treatment, and the risk of this against those of an open procedure must be weighed up carefully.

This technique is easy to master for surgeons who are already familiar with the use of laser and flexible bronchoscopes.

Summary

The use of a laryngeal mask airway (LMA), a flexible bronchoscope with biopsy channel and a 400 μm laser fibre and KTP/532 laser offers an attractive alternative to open laryngeal surgery for diagnosis and treatment of anterior glottic lesions but would otherwise be impossible to visualize using conventional suspension laryngoscopy. The saline-filled LMA enables safe ventilation and laser use, and is easy to use. The coagulative and cutting properties of the KTP/532 laser allows for effective surgery and haemostasis. Surgeons familiar with the use of lasers may easily master the procedure.

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