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MAIN ARTICLE

Endoscopic treatment of glottic stenosis: a report on the safety and efficacy of CO_2 laser

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Abstract

Background: Treatment of glottic stenosis is a considerable challenge to the otolaryngologist. Glottic airway patency can be compromised by bilateral vocal fold palsy, anterior webbing or a posterior segment scar, which may be significant enough to impair arytenoid movement.

Method: A retrospective analysis of a prospective database of patients ($n = 34$) treated by a specialist airway surgeon. All patients underwent endoscopic treatment with a CO_2 laser in an attempt to improve airway calibre and, in 12 patients, to decannulate tracheostomy tubes.

Results: Twenty-one patients had bilateral vocal fold palsy and 13 had predominantly posterior glottic stenosis. A variety of pathology-directed treatment approaches were used to achieve good functional results. Four patients required a second endoscopic procedure. The overall revision rate was 5 per cent for bilateral fold palsy and 23 per cent for posterior glottic stenosis ($p < 0.05$). All patients had an adequate functional airway calibre, and all 12 tracheotomised patients were decannulated.

Discussion: Pathology-directed endoscopic laser surgery is safe and effective treatment for glottic stenosis. Rather prescriptive use of unilateral or bilateral cordotomy or combined cordo-arytenoidectomy, clinicians must perform the procedure that will treat the lesion most adequately. Our success rate compared favourably with the best reported results.

Key words: Vocal Cord Paralysis; Cordotomy; Arytenoidectomy; Lasers, CO_2

Introduction

Glottic stenosis is a potentially life-threatening condition that often requires surgical intervention in order to prevent airway obstruction. The most commonly described cause of non-malignant acquired glottic stenosis is bilateral vocal fold palsy due to thyroid surgery; however, other aetiologies include trauma, intubation and laryngopharyngeal reflux (all causing posterior glottic stenosis), and neurological bulbar or pseudo-bulbar palsy.[1] In a small group of patients, no cause is ever found.[1]

A surgical tracheostomy is the 'gold-standard' technique of establishing an adequate airway and in the past was utilised as lifelong treatment.[2,3] The successful utilisation of the CO_2 laser for endoscopic laser cordotomy to treat bilateral vocal fold palsy was first described by Dennis and Kashima in 1989.[4] Since that time multiple modifications of the technique have been described to overcome the challenge of treatment of the primary stenosis as well as scarring-associated re-stenosis that occurs following laser treatment.[5,6]

We report our experience of treatment of glottic stenosis at the Royal North Shore Hospital and Westmead Hospital, tertiary referral centres in Sydney, Australia. We used a pathology-directed approach to perform either unilateral or bilateral cordotomy or cordo-arytenoidectomy, as required, as a primary procedure.

Methods

Patient selection

The presence of glottic stenosis was confirmed by a fibreoptic nasolaryngoscopy. All patients underwent a diagnostic microlaryngoscopy to assess arytenoid mobility and the presence of a posterior glottic scar or associated subglottic stenosis. In cases of post-thyroidectomy bilateral vocal fold palsy, patients who had tracheostomies performed prior to referral to our service were observed for six months to assess for any improvement of one or both recurrent laryngeal nerves, prior to any cordotomy being performed. No laryngeal electromyography was utilised.

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All patients also underwent a high-resolution computed tomography scan of the larynx to rule out any associated pathology of the paraglottic space. Where the aetiology was unclear, brainstem magnetic resonance imaging was also performed to assess for any likely neurological causes.

Patients selected for treatment were required to have adequate respiratory reserve in order to tolerate any micro-aspiration, which was a likely consequence of our treatment. A minimum forced expiratory volume in 1 second (FEV_1) of 1.5 l was required with no pre-existing airways disease.

Operative technique

Supraglottic jet ventilation was utilised in patients without tracheostomy tubes, with the laser procedure performed between 'breaths'. A laser-safe endolaryngeal laryngoscope was utilised with 400 mm focal length suspension microscopy. Standard laser precautions were always used, including covering of the patient's eyes and face with wet sponges, utilising 30 per cent oxygen ventilation, and ensuring adequate laser protection for staff.

Cordotomy and arytenoidectomy were performed with CO_2 laser at a 3 W continuous setting. During cordotomies, the excision was performed anterior to the vocal process of the arytenoid, proceeding laterally until the vocal ligament was divided. The arytenoidectomy was performed, when required after the cordotomy, by ablating the mucosa and cartilage of the arytenoid. Continuous smoke plume suction was utilised, and any laser eschar was cleaned with adrenaline and saline-soaked neurosurgical cottonoids.

Results

A total of 34 patients (11 males and 23 females) were treated over the study period. Of these, 21 patients had bilateral vocal fold palsy and 13 had predominantly posterior glottic stenosis. The commonest cause of bilateral vocal fold palsy was thyroid surgery (in 14 patients) followed by prolonged endotracheal intubation (in 3 patients). Posterior glottic stenosis was related to prolonged intubation in 10 patients. In three patients no cause was found although laryngopharyngeal reflux was considered to be contributory. No cases of neurological bilateral vocal fold palsy were treated. Patients with malignant stenosis or associated subglottic stenosis were excluded from analysis.

A variety of pathology-directed treatment approaches were utilised to achieve good functional results. These were: unilateral laser posterior cordotomy (in 12 patients), bilateral posterior cordotomy (eight patients), combined cordotomy and arytenoidectomy (nine patients) and excision of a posterior glottic scar (five patients). For patients with bilateral fold palsy, the choice of unilateral or bilateral excision depended on the lifestyle demands of the patient, as well as their respiratory status. Younger patients (i.e. aged less than 60 years) with more active lifestyles were treated with primary bilateral procedures, as they were felt more able to tolerate the micro-aspiration that may occur post-operatively. All patients were counselled about the possibility of worsened phonatory function after the procedure.

Four patients required a second (revision) endoscopic procedure: two underwent bilateral cordotomy and two combined cordo-arytenoidectomy. Of these four patients, only one had primary bilateral fold palsy (representing a 5 per cent revision rate), whereas the remaining three had posterior glottic stenosis as their primary pathology (a 23 per cent revision rate). This difference in outcome was statistically significant ($p < 0.05$, Fisher's exact test).

All patients had an adequate functional airway calibre, and all 12 tracheotomised patients were decannulated at the end of their treatment course. There were no major complications or deaths. Minor complications included lip injury in two patients and minor dental injury in one patient. No patient without a tracheostomy required an emergency intubation or tracheostomy post-procedure. Patients with a tracheotomy were re-assessed in an out-patient setting six weeks post-operatively; if the endoscopically visualised airway calibre was felt to be adequate, they were admitted for capped overnight oximetry prior to decannulation.

The median follow-up period was 24 months (range six to 60 months). No patient was lost to follow up.

Discussion

Potentially life-threatening airway obstruction from glottic stenosis can be treated with multiple techniques. In emergency situations or where proficiency with an endoscopic laser is not available, the safest treatment is tracheostomy. However, a tracheostomy tube places a significant burden on the patient's quality of life, due to activity limitation and cosmetic compromise. In our experience, no patient with a non-malignant stenosis chose to have a long-term tracheostomy tube. The literature demonstrates an evolution of techniques in the management of glottic stenosis, with historically important, open, tracheostomy-sparing procedures (e.g. external arytenoidectomy and vocal fold lateralisation) being gradually replaced by endoscopic laser techniques.[1–5] The CO_2 laser coupled with 400 mm microscopy permits a precise operative technique with minimal published morbidity.

Classical endoscopic partial posterior cordectomy was first described by Kashima.[4] Refinements of this technique were subsequently described, which aimed to reduce the overall revision rate of the procedure. These modifications involved more aggressive attempts to improve airway calibre, with the understanding that phonatory outcomes would be worse. The advantage of the original Kashima technique was its reported good voice outcomes; these have now been replicated by other groups performing more aggressive bilateral resections.[7,8]

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The incidence of dissatisfaction with a poor voice is low compared with the proportion of patients whose quality of life is improved due to tracheotomy decannulation. However, if patients find their poorer voice quality bothersome, ventricular and supraglottic phonatory techniques are easily taught by speech therapists. As a result, our treatment philosophy has relied less on fear of a worsened voice outcome, and more on a customised approach that would achieve the best airway for the individual patient's lifestyle at first attempt. Our revision rate of 12 per cent compares very favourably with previously published results, including original reports of re-stenosis rates as high as 50 per cent.[1,4] If one assesses bilateral fold palsy as an isolated entity, the results noted above are even more significant.

Posterior glottic stenosis is a different disease entity to bilateral fold palsy of neurogenic origin, whether due to central bulbar pathology or peripheral recurrent laryngeal nerve pathology.

Posterior glottic stenosis is caused by cicatrisation and ischaemia-associated fibrosis of the airway, commonly due to prolonged endotracheal intubation. This same pathological process occurs following laser surgery. The published methods of treating this problem have centred on more aggressive resections and the utilisation of mitomycin C, an antifibroblastic agent.[9,10] This is applied at a concentration of between 0.4 and 4 mg/ml for a duration of 3 to 4 minutes with the aid of a neurosurgical cottonoid. Although we have long-standing experience with the use of mitomycin in subglottic stenosis, it was not required for glottic stenosis in the current study. The airway calibre was improved by division of the posterior glottic scar, combined with cordectomy and arytenoidectomy as required.

- **The safest emergency treatment for bilateral vocal fold palsy is tracheostomy, but this may limit patients' quality of life**
- **Surgical approaches to glottic stenosis should reflect disease aetiology, patient factors and surgeon experience**
- **Adequate cardiopulmonary reserve is required to tolerate micro-aspiration after aggressive glottic widening**
- **Endoscopic outcomes are better for bilateral vocal fold palsy than for posterior glottic stenosis**
- **Surgeons should work with speech therapists to achieve good voice and swallowing**

The main risk in the more aggressive treatment technique of arytenoidectomy is troublesome bleeding from the arytenoid branch of the inferior laryngeal artery. In the current study, this was controlled with suction electrocautery when required. The other main complication is post-operative aspiration. It is therefore imperative to emphasise that patients selected to undergo more aggressive resection must have adequate respiratory reserve for the procedure. Almost all patients will have subtle micro-aspiration; however, in our study adequate clearance of secretions, as well as training in supraglottic swallow techniques, resulted in no significant respiratory sequelae.

Conclusion

Endoscopic techniques can be safely and effectively utilised for a variety of different presentations of glottic stenosis. If adequate precautions are taken, the complication rates are low. The sequelae of micro-aspiration and potentially worsened phonation can be managed by adjunctive supraglottic techniques.

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Dr F Riffat takes responsibility for the integrity of the content of the paper
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