Endoscopic laser management of bilateral abductor palsy

V. H. Oswal · S. S. Gandhi

Abstract

Objective To assess the results of endoscopic laser surgery in cases of bilateral abductor palsy on basis of respiration, preservation of voice (phonation) and swallowing.

Methods This retrospective study includes 48 patients (34 males and 14 females) from 5 years to 68 years of age at the time of intervention. 41 cases were operated with subtotal arytenoidectomy and 7 with unilateral posterior cordectomy. 32 patients were operated with tracheostomy and 16 with combination of intubation and jet ventilation.

Results 29 out of 32 tracheostomised patients were decannulated (91%). Respiration was adequate for daily routine activities in most of the operated patients. Phonation was normal to near normal in 32 cases out of the operated 34 adult patients (95%). Most of the patients had normal swallowing following surgery.

Conclusion Subtotal arytenoidectomy with endoscopic laser surgery in cases of bilateral abductor paralysis has established its place as a preferred surgical method to obtain good respiration, phonation and swallowing. It minimizes the surgical time, hospital stay and morbidity.

Keywords Vocal cord paralysis · Bilateral vocal cord paresis · Vocal cord palsy · Laser surgery · Voice quality · Airway obstruction

Introduction

Surgeons have long been searching for techniques to safely widen the glottic airway in patients with bilateral vocal cord paralysis without detracting from vocal quality and/or causing aspiration. Surgical methods were designed to attain good respiration, phonation and swallowing. For last 15 years the carbon dioxide (CO₂) laser endoscopic arytenoidectomy has become perhaps the most commonly used method for attaining these goals.

Historically, tracheostomy was the only option available to the surgeons to treat the patients with bilateral abductor paralysis. In 1922, [1] Chevalier Jackson introduced ventriculocordectomy, and excised the entire vocal cord and ventricle. This procedure created an excellent airway but resulted in breathy voice. In 1939, [2] King and in 1941 [3] Kelly proposed extra laryngeal arytenoidectomy. In 1948 [4] Thornell described endoscopic arytenoidectomy.

In 1968, [5] William L. Downey et al. described laryngo fissure approach for arytenoidectomy along with lateralization of the remaining vocal cord with stainless steel suture.

In 1976, [6] D.L. Zealer and H.H. Dedo reported a study to restore the natural function of a paralysed axial muscle such as the cricothyroid with electrical stimulation.

In 1979, [7] Fernando R. Kirchner described the series of 16 patients with direct lateralization of the vocal ligament after the removal of a pre-assessed amount of thyroarytenoid muscle with laryngeal micro-cautery.

Strong et al. in 1976, and Ossoff et al. in 1983 were mentioned the use of the CO₂ laser for endoscopic arytenoidectomy.

In 1985, Remsen et al. presented technique for unilateral endoscopic laser excision of the thyroarytenoid muscle combined with suture lateralization of the vocal ligament.

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In 1989, Dennis and Kashima introduced the modifications in technique of endoscopic laser cordectomy for good phonation.

Marc Remacle et al. in 1996 and Bikanis J G et al. in 2004 described their results of subtotal arytenoidectomy with CO₂ laser

Materials and methods

From February 2000 to February 2005, 48 patients of bilateral abductor paralysis were treated by endoscopic laser surgery. The group composed of 34 male and 14 female patients of age ranging from 5 years to 68 years at the time of intervention. The commonest etiological factor in this series was thyroid surgery. Other acquired causes included surgery for esophageal cancer, accidental neck trauma, carcinoma lung and pulmonary tuberculosis. 11 cases (23%) had been of Idiopathic origin and 10 (21%) had congenital origin.

Preoperative investigations

Patients were assessed with fiber optic flexible laryngoscopy, digital video stroboscopy, pulmonary function test and acoustic analysis. High resolution CT imaging was done to examine the complete respiratory tract and surrounding area.

Neurological tests were done to assess central or neuromuscular disorders in certain patients. Lab studies were undertaken to diagnose and treat any systemic disorder.

Management

Medical therapy: Medical management for patients with pulmonary tuberculosis and carcinoma lung was undertaken. Local steroid and mucolytic nebulisation was carried out before surgery. Anti Reflux management was started in all the patients 3 weeks before surgery.

Surgical therapy: In this series we performed posterior cordectomy or subtotal arytenoidectomy as the initial procedure. These procedures were undertaken only after spontaneous improvement had failed. (for 12 months) (Table 1)

Table 1 Aetiology – 48 cases

Causes of bap	Number of cases
Congenital	10 (21%)
Post thyroid surgery	15 (31%)
Surgery for esophageal cancer	2 (04%)
Accidental neck trauma	7 (15%)
Idiopathic	11 (23%)
Carcinoma lung	1 (02%)
Inflammatory pulmonary tuberculosis	2 (04%)
Total	48

Surgical management

The surgery was done with microlaryngoscopy under GA. A metal cuffed tube was used for ventilation by intubation. In tracheostomised patients no.6 to no.8 portex tracheal tube was used for ventilation.

Neurosurgical cottonoid moistened with saline was kept in the subglottis in order to protect the endotracheal tube cuff. The cuff was inflated with normal saline tinted with methylene blue in order to detect any possible damage during the course of surgery. The patient's face was protected by large, moist gamgee.

We used the CO₂ laser with micromanipulator. We used micro surgical instrument set with suction and cautery attachments. Diode laser was used as a complementary laser system in cases of bleeding in posterior glottis.

A) Subtotal arytenoidectomy (41 cases – 85%)

The surgery starts with incision between the vocal process and the membranous part of vocal fold. It extends laterally on to the ventricular fold and posteriorly encircling the anteromedial part of the arytenoid cartilage. (Fig. 1a, b). The posterior 1/3 of vocal fold, 2–3 mm of ventricular fold and anteromedial part of body of arytenoid is removed by vaporization with laser in super pulse mode.

CO₂ laser with acublade mode was used. The incision length can range between 0.5–3.5 mm and depth between 0.5–2.0 mm. 5 watts of power was used. Laser application was done in continuous mode with super-pulse. Flash scanner mode with 0.7 mm diameter and 2–2.5 watts of power was used in continuous mode for vaporization and reduction of the posterior shelf of the arytenoids to minimize or prevent aspiration.

A 2 mm posterior shell of the arytenoid cartilage was preserved. In doing so, the muscular process is also respected. If necessary, haemostasis of the arytenoid artery is achieved by electrocoagulation by the monopolar cautery attachment of microforceps. The inter-arytenoid area was protected with neurosurgical cottonoid during the application of laser in the posterior glottis.

The surgical procedure lasts for 25–30 minutes. Following resection of the arytenoid the surgical site is covered with neurosurgical cottonoid with 2 ml of mitomycin-C (1 mg/ml) for 2 minutes. The bed is then covered with fibrin glue to prevent formation of granuloma. During surgery antibiotics and steroids are administered intravenously. Upon awaking, non-tracheostomy patients are extubated in the Operation Theatre.

B) Unilateral posterior cordectomy (7 cases – 15%)

CO₂ laser with acublade mode was used. 3.5–4 mm C shaped wedge of posterior vocal cord is excised from the free border of the membranous cord, anterior to vocal

Fig. 1 Right subtotal arytenoidectomy. (a) Surgical incision for right subtotal arytenoidectomy (b) Completion of right subtotal arytenoidectomy

Fig. 2 Left posterior cordectomy. (a) Surgical incision for left posterior cordectomy (b) Completion of left posterior cordectomy

process, extending 4 mm laterally over ventricular band. The excision begins anterior to the vocal process without exposing cartilage. This excision creates a 6–7 mm transverse opening at the posterior larynx. The laserised area is cleaned with moistened pledgets to remove char and mitomycin-C is applied as described before.

C) Three cases who had undergone subtotal arytenoidectomy in the past required minimum removal of contralateral arytenoid to improve respiration.

Postoperative management

The patient is kept in intensive care unit for 24 hours to observe respiratory difficulties due to surgical edema. No

patient had respiratory difficulty which required re-intubation. All patients received post operative therapy including broad spectrum antibiotics for 7 days, nebulisation with steroid and mucolytic agents. Antireflux treatment was given for 12 weeks. Speech therapy was undertaken after 21 days. Most of the tracheostomised patients were decannulated between 10 days to 3 months after the test weaning. The patient is admitted in the hospital for test weaning and decannulation.

Anesthesia

32 cases (66.67%) were referred with tracheostomy. 16 patients (33.33%) were anesthetized with combination of intubation and jet ventilation. The intubation tube was removed towards the end of the surgery to clear up the posterior-most

part of the vocal cord and arytenoid. Jet ventilation was used during this part of the surgery.

Follow-up

47 patients were followed up in last five years. One patient was lost to follow up.

Results

We followed up our cases and recorded the surgical results under 4 parameters.

1. Decannulation
2. Respiration
3. Phonation
4. Swallowing

Decannulation

29 patients (90.48) patients were successfully decannulated. Immediate postoperative decannulation was possible in four (12%) patients. The time frame for decannulation for 25 patients ranged from ten days to three months. Two patients have T tube insertion due to concomitant subglottic stenosis. One patient was lost to follow up.

Respiration

We performed pulmonary function test pre and post (3 weeks) surgery for non-tracheostomised patients. Respiratory function was adequate for daily routine activities such as walking and climbing flight of stairs. However, it was found inadequate for more strenuous activities like swimming or playing games.

Phonation

Phonatory evaluation was undertaken in patients over ten years old. (36 pts.-1 lost to follow up, 1 with 'T' tube)

Phonation was recorded 12 weeks after surgery. Post operative voice analysis was done twice, after 1 week and

after 12 weeks with Maximum Phonation Duration, Noise to Harmonics ratio, Frequency and Amplitude.

However, the results were based on clinical history elicited from the patient. Subjective parameters were studied under five headings. (One-to-one conversation, Telephone conversation, Group discussion, Lectures, Conversation in noisy surroundings). 19 patients reported 'normal' quality of phonation, 13 had 'near normal' and 2 had 'fair' quality.

Swallowing

One patient had post operative aspiration for liquids for up to 3 weeks with full recovery.

Risk factors

One patient developed granuloma at the site of vocal process which resolved with a combination of local and systemic steroids. Three cases had recurrence of fibrosis in the interarytenoid region. Revision surgery was carried out and part of the contralateral arytenoid cartilage was excised. One patient had aspiration which lasted for three weeks, with full recovery of swallowing.

Discussion

Unilateral posterior cordectomy has the advantage of a shorter operating time of around 10–15 minutes. This is carried out in elderly patients and patients associated with other systemic illness. In our series none of the patients who have undergone unilateral posterior cordectomy required further surgical invention for airway insufficiency

Table 2 Phonation results based on clinical evaluation of patients

Phonation	Number of patients
Normal	19 (55.88 %)
Near normal	13 (38.24 %)
Fair	02 (5.88 %)
Total	34

Fig. 3 Risk Factors. (a) Granuloma (b) Interarytenoid fibrosis (c) Aspiration

on follow-up. However, some articles report that the improvement in respiratory airway may be inadequate especially during moderate activity. This may be due to fibrosis at the site of incision or neo cord formation. Some articles describe this surgery to be performed on both vocal cords. Surgical re-intervention for early (6–8 weeks) airway insufficiency or for post cicatrisation fibrosis has indeed been reported by Dennis and Kashima [8].

The superpulse mode increases the cutting effect and reduces the heat generation, thus minimizing edema and a need for postoperative tracheostomy [9] (Marc Remacle et al. 1996).

Protection of interarytenoid mucosa, use of mitomycin-C and slough removal undertaken three to five days after the surgery minimizes the risk of fibrosis. Submucosal dissection of arytenoid had also been described to further minimize the fibrosis. Application of fibrin glue [10] (V Oswal, Marc Remacle) to the surgical bed prevents the formation of post operative granuloma.

Endoscopic approach provides adequate anatomical exposure of the field. Haemostatic property of the laser surgery provides bloodless field and facilitates precise controlled widening of the posterior glottis. Laser surgery results in formation of coagulum covering the surgical field and minimizes any possibility of infection.

Subtotal arytenoidectomy results in preservation of vibrating portion of the glottis to a large extent and thus results in good phonation.

In conclusion, subtotal arytenoidectomy offers good airway for patients with bilateral abductor palsy. Due to minimal removal of tissue, offers a potential to achieve a better and more acceptable quality of voice [11]. (Wani, et al. 1994).

Inadequate airway due to interarytenoid fibrosis remains the major risk factor. The endoscopic laser surgery makes hospitalization shorter and results in minimum post operative morbidity.

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