Endoscopic Laser-Assisted Posterior Ventriculocordectomy Without Tracheostomy for Bilateral Vocal Cord Immobility

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Abstract

Background: Laryngeal obstruction due to bilateral vocal cord immobility in adduction may cause dyspnea, hoarseness and dysphagia and can lead to dependence on a tracheostomy. Treatment poses a challenge because of the opposing functions of the larynx and the risk of neck and laryngeal tissue damage.

Objectives: To describe our experience with endoscopic CO_2-laser-assisted posterior ventriculocordectomy without tracheostomy for the treatment of bilateral vocal cord immobility in adduction.

Method: The study group consisted of five male and five female patients aged 17–81 years. The procedure was performed with an endoscope and operating microscope connected to a CO_2 laser. A C-shaped incision was made, and the posterior third of one vocal cord, the vocal process of the arytenoid, and the posterior third of the false vocal cord were excised. Tracheostomy was not performed.

Results: The technique allowed for a convenient approach to the difficult-to-view areas of the larynx. The procedure was short and bloodless, with minimal damage to laryngeal tissue and no local edema. Hospitalization time was short. Postoperatively, patients had sufficient breathing and mostly fair to good voice quality. None of the patients had severe aspirations and only three patients had mild aspirations.

Conclusions: We recommend this procedure for patients with bilateral vocal cord immobility prior to tracheostomy. Delaying surgery beyond the time of possible re-innervation may place the patient at risk of decompensation, which requires tracheostomy.

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Bilateral vocal cord immobility in adduction occurs mainly as a consequence of surgery to the thyroid, parathyroid or mediastinum, or due to intubation. Other causes include radiotherapy and neurologic and rheumatologic disease [1,2]. Although an uncommon complication, it can lead to significant dyspnea, hoarseness and dysphagia. Left untreated, patients may become tracheostomy-dependent.

Most studies recommend surgery if there is no return of movement within 6 months [1]. Many techniques have been proposed to improve breathing without decreasing voice quality [1–16]. Currently the preferred option is laser endoscopy for unilateral arytenoid ablation or excision of the posterior part of one or both true vocal cords [1,2,3–6]. This permits voice production with the anterior part of the larynx and an adequate airway with the posterior part. Laser provides the advantage of precise endoscopic work in a difficult-to-approach anatomic area without substantial bleeding and with minimal injury to neck tissue. For these reasons, several groups of investigators, including ours, found it possible to perform the operation safely without securing the airway by tracheostomy [2–5]. We describe our experience with this technique at our center.

Materials and Methods

Between 1999 and 2003 we treated 10 patients with bilateral vocal cord immobility resulting in severe airway obstruction. None had a tracheostomy at the time of surgery. Other possible reasons for the vocal cord immobility, such as posterior vocal cord web or arytenoid dislocation, were ruled out. In view of findings that vocal cord function may return spontaneously up to 6 months from onset of palsy, all operations were performed after this period unless the surgeon was confident that the recurrent laryngeal nerves were transected.

Technique

Our department has adapted the technique first reported by Dennis and Kashima [3], with a few modifications. An endoscope, which allows for a convenient approach to the anterior commissure, was used together with an operating microscope connected to a CO_2 laser with 10 watt emission. After induction and intubation, neurosurgical pledgets moistened with lidocaine 1% and adrenaline 1:100,000 were placed at the subglottis to protect the trachea. The laryngoscope was used to push the ventilating tube anteriorly for good vision of the posterior commissure. A C-shaped incision was made, 3–4 mm long and laterally 4–5 mm wide, and the posterior third of one vocal cord, the vocal process and the posterior third of the false vocal cords were excised. Some of the fibers of the thyroarytenoid muscle and the vocal process of the arytenoids were included in the incision, yielding an opening of up to 7–8 mm [Figure 1]. Extubation was done within a half-hour of onset of surgery. Patients remained in the recovery room for 1 hour.

Outcome

The operation was considered successful if extubation was possible and the patient returned to activity without significant dyspnea and no need for tracheostomy or other surgery to alleviate symptoms.

Postoperative airway obstruction was measured with a subjective scale, as follows: 0 = no airway problem, 1 = difficulty breathing on exertion, 2 = mild dyspnea during activities of daily living, 3 = significant dyspnea limiting activities of daily living, and 4 = dyspnea at rest. Swallowing was graded according to the scale of

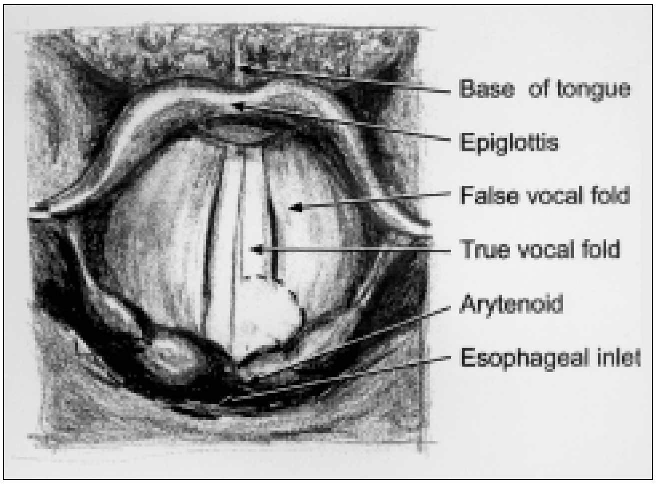

Figure 1. Illustration of posterior ventriculocordectomy with resection of vocal process. Dotted line indicates the incision boundaries.

Pearson [17]: 0 = no problem swallowing, 1 = occasional cough during eating (not clinically significant), 2 = constant cough that worsens during eating, and 3 = aspirations causing pulmonary complications. Voice quality was rated on a 4-point scale as follows: 0 = normal, 1 = mild hoarseness, 2 = breathy, 3 = whisper.

Results

The patients' characteristics and outcome of treatment are shown in Table 1. The study group consisted of five male and five female patients aged 17–81 years (average 61). The duration of follow-up ranged from 4 months to 6 years.

All 10 patients underwent posterior ventriculocordectomy in one vocal cord; none required a second procedure. Operating time ranged from 20 to 40 minutes. Seven patients were released 1 day after surgery and three patients after 2 days. Dyspnea improved from grade 3-4 before surgery to grade 0 after surgery in 3 patients (60%), grade 1 (dyspnea on exertion) in 5, and grade 2 (mild dyspnea during daily activities) in 2. Voice quality improved to grade 1 in five patients and grade 2 (breathy) in two; it remained weak (grade 3) in three patients. None of the patients had severe aspiration, but 3 patients (30%) had mild aspiration (grade 1).

None of the patients died during surgery or from airway obstruction.

Table 1. Patient and clinical characteristics and outcome of surgery

	Sex	Age (yr)	Cause of immobility	Voice grade	Aspiration grade	Dyspnea grade
1	M	17	Brain surgery	3	0	2
2	F	41	Thyroidectomy	1	0	1
3*	F	55	Prolonged intubation	3	0	0
4	M	63	Heart surgery	1	0	1
5	M	65	Heart surgery	1	1	1
6	F	70	Parathyroidectomy	2	0	0
7	F	72	Neurologic disorder	3	1	1
8	M	72	Unknown	1	1	1
9	M	76	Chest surgery	1	0	2
10	F	81	Thyroidectomy	2	0	0

Lower grades indicate better subjective outcome.

* Patient 3 was tracheotomy-dependent on admission, after prolonged intubation. We excised the adhesions in the posterior commissure followed by decannulation, but the larynx remained dysfunctional. Therefore, laser endoscopy was performed. The patient was included in the study because she had no tracheotomy at the time of the final operation.

Discussion

The treatment of bilateral vocal cord palsy poses a challenge to clinicians, and its history is rife with innovative ideas but little to show by way of successful cure. Normally, the larynx closes during eating and vocalizing and opens during breathing. Therefore, for treatment to be effective, it needs to account for both these opposite functions.

In the early 1900s, the only treatment option for bilateral vocal cord palsy was tracheostomy. In 1922, Jackson [7] described the unilateral excision of the false and true vocal folds, which led to improved breathing and the possibility to decannulate some patients. The drawback of the procedure was the very weak voice. Ten years later, Hoover [8] attempted "submucous resection" of the vocal cords, but it led to scarring and vocal stenosis, with severe dyspnea. The first major breakthrough came in 1939 when King [9], an orthopedic surgeon, introduced a function-restoring procedure that consisted of suturing the arytenoid cartilage to the omohyoid muscle. He suggested that the improved breathing was related to a return of function of the vocal fold because of the contraction of the omohyoid muscle during inspiration. However, it was later found that the arytenoid became fixed in the lateral position. Kelly [10] modified King's technique by excising the arytenoid through a window in the thyroid cartilage and by placing a suture to lateralize the vocal fold. In 1946, Woodman [11] described a novel method that remained popular for almost 50 years. Using an external approach through the posterolateral part of the larynx, he dissected the arytenoid without entering the larynx. He then excised the arytenoid but left the vocal process intact, and did not lateralize the vocal fold.

In the first endoscopic arytenoidectomy, performed by Thornell [12], the arytenoid cartilage was dissected after tracheostomy, with coagulation of the exposed area to promote scarring. This method had a reported success rate of 80% [13]. The main drawbacks were the difficulty of manipulating the microsurgical instruments through the laryngoscope and associated edema and bleeding [6].

In 1976, Tucker [14] re-innervated the vocal fold by transferring part of the omohyoid muscle along with a branch of the ansa hypoglossus and implanted it within the posterior cricoarytenoid muscle. This technique has not gained popularity because of inconsistent results.

The CO_2 laser was first used for arytenoidectomy by Eskew and Bailey [15] in 1983, in a dog model. It was adapted for patients with bilateral vocal cord palsy by Ossoff et al. [6,16] with good results. In 1989, Dennis and Kashima [3] introduced the posterior cordectomy technique, which entails excision of the posterior part of the vocal cord with the CO_2 laser without arytenoidectomy. Eckel et al. [4] compared laser arytenoidectomy and laser cordectomy and found them both to have a more than 90% success rate. However, they found that cordectomy was easier to perform and resulted in fewer subclinical aspirations.

In the present study of laser-assisted endoscopic ventriculocordectomy without tracheostomy, we included only patients with bilateral vocal cord immobility who were not cannulated before surgery. Besides the aesthetic problem, these inclusion criteria were intended to reduce the risk of infection in the trachea, reduce the risk of aspiration (as tracheostomy fixes the trachea, thereby preventing its rise during swallowing), and reduce hospitalization (owing to the minimal neck and laryngeal tissue trauma) with rapid return to activities of daily living. Other advantages included a short operative time and relatively easy procedure, absence of bleeding and edema, and applicability in patients in whom the anterior commissure is difficult to visualize since the operation is done in the posterior part of the larynx. The overall results were good.

We suggest that the procedure be performed immediately after the 6 month waiting period for possible re-innervation, or sooner if no re-innervation is expected because the longer surgery is postponed the higher the risk of decompensation, which would require emergency tracheostomy. The main limitation of the technique is that is precludes other options in case of failure. It is also inappropriate for patients with a short neck in whom it is difficult to identify the vocal cords and in patients with fixation of the spine in whom it is impossible to extend the neck.

Conclusion

In view of our experience, we recommend endoscopic CO_2 laser posterior ventriculocordectomy for patients with bilateral immobility of the vocal cord in adduction. This procedure can be performed safely with gratifying results without the need for tracheostomy. We recommend that the procedure be done immediately after the 6 month waiting period for recovery, or sooner if the surgeon is confident that the nerve is irreparable.

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