ORIGINAL ARTICLE

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Carbon Dioxide Laser Endoscopic Posterior Cordotomy Technique for Bilateral Abductor Vocal Cord Paralysis

A 15-Year Experience

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Importance: Treatment of bilateral vocal cord paralysis is a considerable challenge for otolaryngologists. Many surgical techniques have been developed for the management of this entity to eliminate the need for tracheotomy.

Objective: To evaluate the success of the unilateral carbon dioxide laser endoscopic posterior cordotomy technique for bilateral abductor vocal cord paralysis.

Design: A retrospective study.

Setting: A university department of otolaryngology–head and neck surgery.

Participants: Sixty-six patients (58 women and 8 men) diagnosed as having bilateral abductor vocal cord paralysis.

Intervention: Endoscopic posterior cordotomy with the carbon dioxide laser.

Main Outcome Measures: Decannulation and postoperative voice quality and exercise tolerance.

Results: The most common etiologic factor was recurrent laryngeal nerve paralysis after thyroidectomy, observed in 61 patients (92%); an unknown cause was observed in 5 (8%). Unilateral cordotomy sufficed in 58 patients (88%). We performed revision procedures for vocal cord granuloma in 4 patients (6%). Bilateral cordotomy was required for 4 patients (6%) with an insufficient airway. Postoperative tracheotomy was needed for only 4 patients owing to the edema in the operation site. These patients underwent decannulation within a mean period of 7 days. No patient had poor postoperative exercise tolerance. We found no statistically significant difference between the preoperative and postoperative voice quality using the 10-item Turkish version of the Voice Handicap Index.

Conclusions and Relevance: Carbon dioxide laser endoscopic posterior cordotomy is a safe, minimally invasive, effective technique with a short operation time. A bilateral approach or a revision procedure is rarely required. Bilateral cordotomy should be reserved for patients with insufficient airway passage with unilateral cordotomy.

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BILATERAL VOCAL CORD PARALYSIS is a serious medical situation that can cause hoarseness, reduction in speech volume, obstructive sleep apnea syndrome, dyspnea, and even death in patients with restricted lung capacity. The most common etiologic factor is recurrent laryngeal nerve injury due to thyroid operations. Neoplasms of the thyroid gland, trauma of the head and neck region, and idiopathic, neurologic, and inflammatory causes constitute other etiologic factors.[1,2]

Many different techniques have been described to provide an adequate airway without a tracheotomy and to preserve vocal quality. Resection of the vocal cord and ventricle was first described by Jackson in 1922.[3] Later, Woodman[4] described external arytenoidectomy and Thornell[5] described transoral arytenoidectomy. All these techniques require prophylactic tracheotomy and result in a low quality of voice.

In 1989, Dennis and Kashima[6] described the carbon dioxide (CO_2) laser endoscopic posterior cordotomy (EPC) technique with lower aspiration and tracheotomy rates and higher postoperative vocal quality. Since their description, this technique has gained wide acceptance as being fast and safe and not requiring a routine tracheotomy, with lower complication rates.

This study aimed to evaluate the necessity of a bilateral approach in a large se-

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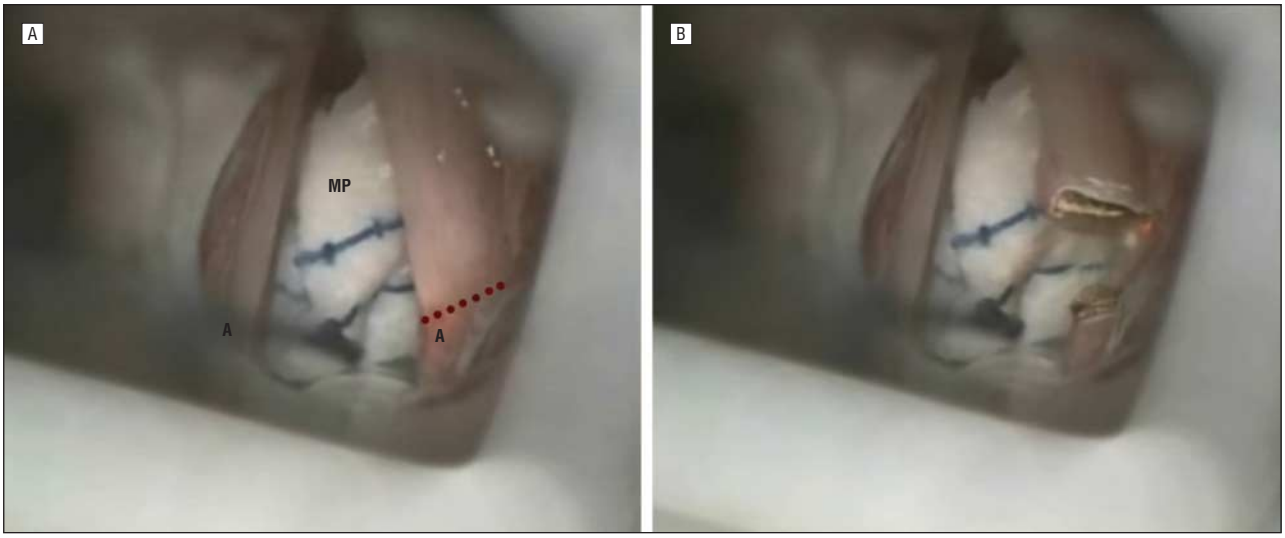


Figure 1. Unilateral carbon dioxide laser endoscopic posterior cordotomy. A, Surgical technique. A indicates arytenoid; MP, moistened pledget. B, Perioperative view of the right vocal cord after cordotomy.

ries of patients. We observed a small series and a usually bilateral approach in the analysis of reported articles about CO_2 laser EPC in bilateral vocal cord paralysis. We also analyzed the patients' exercise tolerance and voice quality, etiologic factors, tracheotomy rates, and necessity of revision procedures. Decannulation and exercise tolerance of patients were evaluated as a success.

METHODS

We identified 66 patients who underwent CO_2 laser EPC because of bilateral vocal cord paralysis from January 1, 1997, through February 29, 2012, in the Department of Otolaryngology–Head and Neck Surgery, Çukurova University School of Medicine. The patient group consisted of 58 women and 8 men, with an age range of 19 to 76 (median, 48) years. No patient was excluded from the study for any reason.

All study subjects signed written informed consent for the procedures and underwent a complete preoperative otorhinolaryngologic examination. Laryngoscopy was performed for CO_2 laser EPC under general anesthesia using a commercially available microscope (Opmi 1; Carl Zeiss Meditec) with a 400-mm lens. We used 1 of 2 laser laryngoscopes (Pilling [Pilling Surgical Instruments] or Kleinsasser [Karl Storz]) for exposition. The CO_2 laser (AcuPulse; Lumenis Surgical) was set to 3 W in the continuous pulse and superpulse modes. Patients without tracheotomy underwent intubation transorally with a laser-compatible endotracheal tube. Prophylactic tracheotomy was not performed routinely, but 7 patients (11%) had undergone a previous tracheotomy in our clinic under urgent conditions or in hospitals where they had undergone primary thyroid operations. These patients also underwent intubation with a laser-compatible endotracheal tube through their stomas. We examined the movability of the arytenoid cartilage for cricoarytenoid fixation with the use of laryngoscopic pincers under general anesthesia while the patients were fully relaxed. Moistened surgical pledgets were located in the subglottic space to prevent heat damage to the trachea and endotracheal tube. After exposure of the larynx, the posterior part of the vocal cord was incised with the CO_2 laser from the anterior part of the vocal process of the arytenoid cartilage to the thyroid cartilage perichondrium (**Figure 1** and **Figure 2**). Charred segments located in the lased areas were cleaned. The length of the surgery varied from 15 to 45 (mean, 25) minutes. Intravenous perioperative corticosteroid (methylprednisolone, 1 mg/kg) was administered to prevent vocal cord edema in the absence of contraindications, such as hypertension or diabetes mellitus. Patients, as a precaution, were observed for any respiratory distress problem in an intensive care unit during the first postoperative day. Oxygen saturation levels were monitored routinely during the postoperative hospitalization. The dose of corticosteroid was gradually reduced during a 16-day period. Laryngopharyngeal reflux prophylaxis (a single 30-mg dose of oral lansoprazole) and a nonsteroidal anti-inflammatory agent were administered routinely in the postoperative period. Patients were also given broad-spectrum antibiotics during their hospitalization. The mean length of hospitalization was 5 (range, 3-32) days. One patient was hospitalized for 32 days owing to her poor general condition caused by chronic obstructive pulmonary disease and diabetes mellitus. This patient underwent tracheotomy because of the narrow laryngeal passage due to excessive vocal cord edema on the third postoperative day. She underwent decannulation on day 25 after corticosteroid and antibiotic therapy.

The patients participating in the study were primarily from abroad and of poor socioeconomic status. The patients who underwent this operation had variable degrees of vocal cord edema, on the first 3 days in particular. Before being discharged to home, the patients were free of respiratory distress with normal vocal cords, thus extending the mean length of the hospital stay.

At the third postoperative month, we assessed the patients' exercise tolerance and voice quality. Exercise tolerance was assessed through stair-climbing capacity. Preoperative and postoperative exercise tolerances of the patients were evaluated according to patient self-reports and physical examination results. Exercise tolerance was rated as excellent (4 or 5 flights of stairs), good (2 or 3 flights of stairs), or poor (1 flight of stairs or dyspnea at rest).[7]

The voice quality and strength measures used the 10-item Turkish version Voice Handicap Index (VHI-10) questionnaire adapted from the original VHI.[8,9] The VHI-10 questionnaire consisted of 10 questions that each ranged from 0 (never) to 4 (always), with total scores ranging from 0 to 40. Increasing of this score represents a decrease in the quality of voice. The VHI-10 was administered before and in the third month after the operation. Postoperative reports were obtained from the patients through follow-up visits or via a mailed response from the patient.

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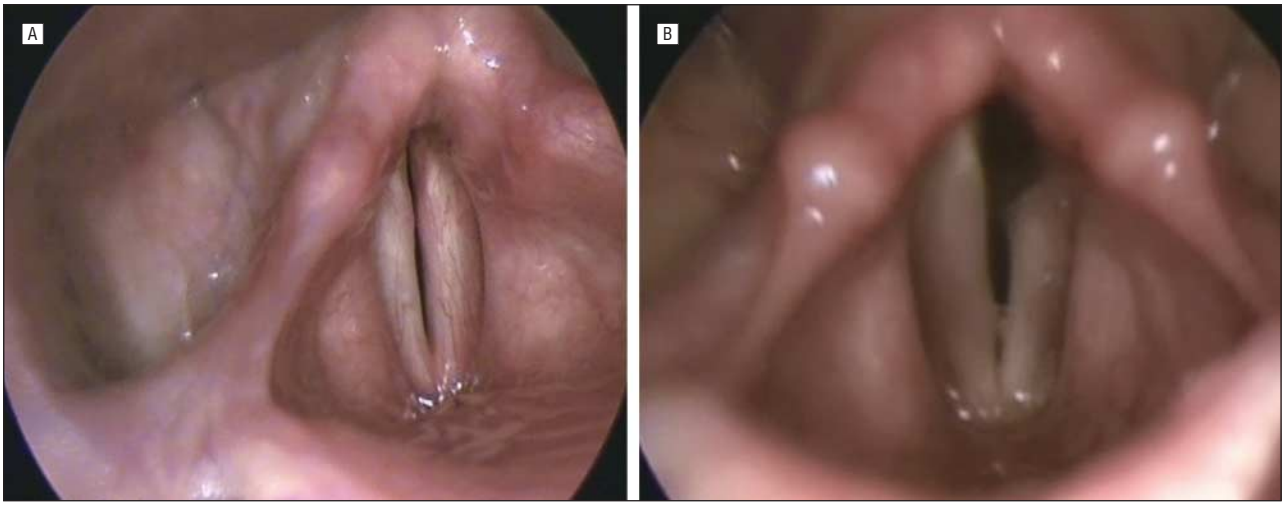


Figure 2. Ninety-degree rigid laryngoscopic views of a patient during office visits. A, Preoperative view. B, Six months after unilateral carbon dioxide laser endoscopic posterior cordotomy.

RESULTS

We observed a total of 66 patients (58 men [88%] and 8 women [12%]) aged 19 to 76 (median, 48) years. The follow-up ranged from 4 to 120 (median, 40) months.

Thyroid surgery was the most common etiologic factor, observed in 61 patients (92%). None of these patients underwent operation at our clinic. The other 5 patients (8%) had idiopathic causes. Furthermore, 7 patients (11%) underwent tracheotomy in our clinic under emergency conditions or in the hospitals where they had undergone primary thyroid operations. Tracheotomy was performed on 4 patients postoperatively because of dyspnea caused by vocal edema. Prophylactic tracheotomy was not performed on any patient.

For 58 patients (88%), airway restoration was maintained by performing a successful 1-step surgical procedure on the vocal cords. Seven patients (11%) had vocal edema in the postoperative hospitalization period. Medical treatment with oral corticosteroids corrected edema in 3 patients, whereas tracheotomy was required for 4 (6%). All 11 patients who underwent preoperative or postoperative tracheotomy underwent decannulation within a mean of 7 days.

In total, 12 patients (18%) required a second operation, including the 4 who underwent postoperative tracheotomies. Four patients (6%) required a revision procedure because of shortness of breath caused by granulomas on the operated-on side. In addition, 4 patients (6%) underwent contralateral posterior cordotomy because of an insufficient airway in a second operation. Granulomas were excised with the CO_2 laser. Tracheotomy was not performed on these 8 patients. During the postoperative period, no serious aspiration problem was observed in any of the patients. Aspiration problems were assessed according to patient report and by the lack of or presence of pneumonia. A total of 100% airway restoration success was achieved.

Furthermore, we evaluated the exercise tolerance according to the stair-climbing capacity of the patients. Before the operation, 59 patients (89%) who did not have tracheotomy had poor exercise tolerance. In the postoperative period, 42 patients (64%) had good and 24 (36%) had excellent exercise tolerance. No patients had poor postoperative exercise tolerance.

The VHI-10 questionnaire was administered to 45 patients before and after the operation. The mean change after surgery was to have increased the VHI-10 score from 4.8 to 9.9 (increase of 5.1), representing a decrease in vocal quality. We found no statistically significant difference between the preoperative and postoperative VHI-10 scores.

COMMENT

Bilateral vocal cord paralysis is a serious, life-threatening situation caused mainly by recurrent laryngeal nerve injury during thyroid surgery (in one study,[10] 77% of patients). Permanent vocal cord paralysis rates after thyroid surgery range from 0.3% to 14% in the literature.[11] The goal of treatment should be restoration of the airway, maintenance of vocal quality, and decannulation of patients undergoing tracheotomy.

Tracheotomy, vocal cord lateralization, cordectomy, and external arytenoidectomy had been the common surgical options for this population until Ossof et al[12] reported their series of patients undergoing CO_2 laser endoscopic arytenoidectomy. In later years, Dennis and Kashima[6] reported another series of patients undergoing CO_2 laser EPC with improved phonatory and respiratory results and minimal aspiration rates, who did not require prophylactic tracheotomy.

Laccourreye et al[10] reported a 68% success rate for 1-step airway restoration, whereas, in our study, we maintained airways using the 1-step procedure on the vocal cords in 58 patients (88%). Reasons for failure of the 1-step operation included granulomas in the cordotomy area and insufficient airway, requiring revision or bilateral surgery. Bigenzahn and Hoefler[13] reported a 25% revision surgery rate in their study. In our series, 12 patients (18%) underwent a second operation. We performed 4 revision operations for granulomas, 4 bilateral cordotomies, and 4 postoperative tracheotomies.

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Dursun and Gökcan[14] routinely performed bilateral posterior transverse cordotomies in all 22 patients in their study. They concluded that the requirement for tracheotomy in patients with bilateral abductor vocal cord paralysis could be reduced and that success in the laryngeal airway was long lasting. On the other hand, the quality of the voice in the postoperative period was observed to be impaired, although it would return to an acceptable level over time. In our study, we aimed to evaluate whether to use a bilateral approach. The results revealed that 1-step surgery in 58 patients maintained airway restoration. The success rate of the 1-step operation was 88%, and we included a larger patient population than other studies.

Decannulation of patients with tracheotomy is the essential goal of the treatment. Tracheotomy is a quick and safe procedure in the treatment of bilateral vocal cord paralysis, especially under emergency conditions. Tracheotomy is hard for patients to tolerate for cosmetic reasons and because of the resulting low quality of life. All 12 patients with tracheotomy underwent successful decannulation in our study.

Previous studies in which older techniques were performed reported aspiration problems, particularly among patients undergoing arytenoidectomy. Pneumonia is a serious complication, especially in older patients. Phonation of patients after surgery also has been evaluated in the literature. Maurizi et al[15] reported lower phonation scores after cordotomy. Furthermore, Bosley et al[16] found no statistically significant difference between the preoperative and postoperative VHI-10 scores for medial arytenoidectomy and transverse cordotomy, supposedly resulting from the number of and the variability in the patients (17 patients). We assume that, although no statistically significant difference between preoperative and postoperative VHI-10 scores in our study existed, the posterior cordotomy could have a minimal negative effect on phonatory functions because of the procedure's ability to enlarge the laryngeal airway.

The mean operation time was 25 minutes in our study, which corresponds to operating times reported in the related literature.[10]

In conclusion, unilateral CO_2 laser EPC is a safe, minimally invasive, and effective technique with a short operation time that can be used in restoration of the airway after bilateral vocal cord paralysis. A revision operation or a bilateral approach is rarely required. However, patients must be closely observed in the postoperative period and should be informed about revision and bilateral procedures before surgery. In addition, the bilateral cordotomy should be reserved for patients who have insufficient airway passage with unilateral cordotomy.

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