

Contact laser surgery in treatment of vocal fold paralysis

La chirurgia laser a contatto nel trattamento endoscopico delle paralisi cordali in adduzione

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Key words

Vocal fold paralysis • Respiratory distress • Surgical treatment • Endoscopic surgery • Laser surgery

Parole chiave

Paralisi cordale • Insufficienza respiratoria • Trattamento chirurgico • Chirurgia endoscopica • Chirurgia laser

Summary

Vocal fold paralysis is a pathological condition characterised by varying degrees of respiratory distress in relation to the degree of glottic stenosis. Dyspnoea may be present even when resting and may even require emergency tracheotomy. Frequently, the patient arrives for attention after the onset of exertional dyspnoea associated with a certain degree of dysphonia. The causes may be central or peripheral, more commonly iatrogenic following thyroid or tracheal surgery or secondary to injury. The aim of all surgical techniques used in the treatment of vocal fold paralysis is to restore a lumen sufficient to guarantee adequate breathing through the natural airway, without the patient having to permanently maintain the tracheotomy tube, while preserving acceptable phonatory quality. Between 1990 and 2001, at the Padua Hospital Unit of Endoscopic Airway Surgery, 48 patients (27 female, 21 male) were treated for respiratory distress secondary to vocal fold paralysis. At the beginning of this experience, 7 patients underwent arytenoidectomy with the Ossoff technique. In 34 cases, a modified Dennis-Kashima posterior cordectomy was performed. In 7 patients, since widening of the airway was necessary, cordectomy was extended to the false homolateral chord in 5 cases and to the arytenoid vocal process in another 2. In 9 patients, the operation was carried out with a Nd Yag (1064 nm) contact laser; the remaining 39 were treated with a GaArAl (810 nm) diode laser in use since 1995. Satisfactory results were obtained in all patients first treated by us and not already tracheotomised (35). In 23 cases (66%), results were considered "good" since no exertional dyspnoea occurred. In 12 patients (34%), the result was considered "sufficient" since there was no resting dyspnoea and normal everyday activity could be undertaken. Of the 13 patients already tracheotomised on arrival, 11 (85%) were decannulated on average 2 months after surgery. In conclusion, the present results show that endoscopic posterior cordectomy, performed by contact diode laser, gives reliable results, is rapid and simpler to perform than arytenoidectomy and guarantees a sufficient airway without impairing swallowing, while maintaining entirely acceptable voice quality.

Riassunto

La paralisi cordale in adduzione è una condizione patologica caratterizzata da insufficienza respiratoria di entità variabile in relazione al grado di stenosi glottica. La dispnea può essere presente anche a riposo ed essere tale da richiedere l'esecuzione di una tracheotomia d'urgenza. Più frequentemente il paziente giunge alla nostra osservazione per la comparsa di difficoltà respiratoria durante l'attività fisica associata ad un certo grado di disfonia. Le cause possono essere centrali o periferiche più comunemente iatrogene a seguito di chirurgia tiroidea o tracheale oppure secondarie a traumi. Scopo di tutte le tecniche chirurgiche descritte per il trattamento delle paralisi cordali adduttorie è quello di ripristinare un lume aereo sufficiente a garantire una adeguata respirazione attraverso le vie naturali evitando al paziente di dover mantenere la tracheotomia a permanenza pur conservando un'accettabile qualità fonatoria. Tra il 1990 ed il 2001 sono stati trattati presso l'Unità Operativa di Chirurgia Endoscopica delle Vie Aeree dell'Azienda Ospedaliera di Padova 48 pazienti (27 femmine e 21 maschi) per insufficienza respiratoria secondaria a blocco cordale in adduzione. Sette pazienti, all'inizio della nostra esperienza, sono stati sottoposti ad aritenoidectomia secondo la tecnica di Ossoff. In 34 casi abbiamo preferito eseguire una cordectomia posteriore con tecnica di Dennis-Kashima modificata. In 7 pazienti, vista la necessità di creare uno spazio aereo più ampio la cordectomia è stata estesa in 5 casi alla falsa corda omolaterale ed in altri 2 al processo vocale dell'aritenoidite. In 9 pazienti l'intervento è stato condotto con l'impiego di laser a contatto Nd Yag (1064 nm); i restanti 39 pazienti sono stati trattati con laser a diodi GaArAl (810 nm) a nostra disposizione dal 1995. Tutti i pazienti da noi trattati in prima istanza non portatori di tracheotomia (35) hanno ottenuto un risultato soddisfacente. In 23 casi (66%) il risultato è stato considerato "buono" per l'assenza di dispnea anche dopo sforzo fisico. In 12 pazienti (34%) il risultato è stato considerato "sufficiente" per l'assenza di dispnea a riposo e la possibilità di una normale attività quotidiana. Tredici pazienti sono giunti alla nostra osservazione già portatori di tracheotomia; di questi 11 (85%) sono stati decannulati in media a 2 mesi dall'intervento. In conclusione, riteniamo che la cordectomia posteriore endoscopica eseguita con laser a diodi a contatto sia una tecnica affidabile nei risultati, rapida, e di esecuzione più semplice rispetto all'aritenoidectomia e che garantisca uno spazio respiratorio sufficiente senza compromettere la deglutizione e mantenendo una qualità vocale del tutto accettabile.

Introduction

Vocal fold paralysis is characterised by varying degrees of respiratory distress in relation to the degree of glottic stenosis. Dyspnoea may be present even when resting and such as may even require emergency tracheotomy. Frequently, the patient reaches the specialist's attention after the onset of exertional dyspnoea associated with a certain degree of dysphonia.

The causes may be central or peripheral, more commonly iatrogenic following thyroid or tracheal surgery or secondary to injury¹.

Several surgical techniques have been proposed to resolve this condition, both through cervicotomy and endoscopically^{2,3}. The common aim of all these procedures, nonetheless, remains that of guaranteeing a sufficient, stable widening of the airway without impairing swallowing and with an acceptable reduction of the phonatory function.

In this retrospective study, personal experience in the endoscopic treatment of vocal fold paralysis with contact laser surgery is analysed.

Case studies

Between 1990 and 2001, 48 adult patients (27 female, 21 male) were treated for respiratory distress secondary to vocal fold paralysis. Age ranged between 19 and 77 years, mean 55. Thyroid surgery sequelae were, by far, the most frequent cause of recurrent laryngeal nerve paralysis, occurring in 35 cases. In 6 patients, the laryngeal block was secondary to cervical injury, while in 2 it was the consequence of laryngeal surgery performed elsewhere. In one case, paralysis of the vocal chords was due to cricoarytenoid ankylosis determined by rheumatoid arthritis. One patient presented acute dyspnoea caused by oesophageal carcinoma infiltration to the recurrent laryngeal nerves. In one case, vocal fold paralysis was of central origin in the course of autoimmune neuropathy. In 2 patients, no cause was found for the paralysis.

Patients and Methods

All patients underwent contact laser endoscopic surgery. The indication for surgery was made for patients with videoendoscopically-ascertained cordal paralysis (Fig. 1) who presented resting dyspnoea or respiratory difficulty inhibiting ordinary physical activity. In those patients in whom vocal fold paralysis occurred following thyroid surgery, the operation was delayed 6-8 months to evaluate a possible recovery of motility.

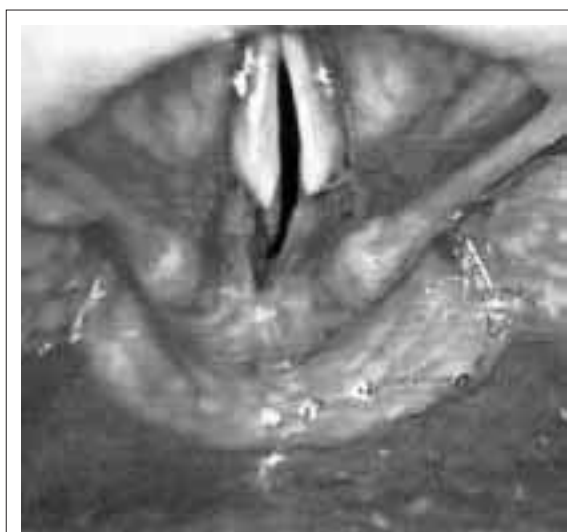


Fig. 1. Videolaryngoscopy: bilateral vocal fold paralysis resulting from thyroidectomy.

None of the patients were submitted to tracheotomy prior to endoscopic treatment. Before coming to our attention, 13 patients had undergone tracheostomy for acute dyspnoea.

At the beginning of our experience, 7 patients underwent arytenoidectomy according to Ossoff^{4,5}. In 34 cases, posterior cordectomy was carried out. Since it was necessary to widen the airway, cordectomy was extended to the homolateral false cord in 5 cases⁶ and to the arytenoid vocal process in 2 others⁷. In 3 patients previously tracheostomised, Montgomery T-tube positioning was associated with posterior cordectomy.

In 9 patients, the procedure was carried out using an Nd Yag (1064 nm) laser; the remaining 39 patients were treated with a GaAlAr (810 nm) diode laser in use since 1995.

In all cases, the operation was performed under general anaesthesia by means of suspension laryngoscopy under videoendoscopic control.

The patients were ventilated with an orotracheal tube reinforced for laser surgery.

The vocal folds were better exposed by means of a Lindholm-type autostatic separator. The laser transmitting fibre head (600-300 μ) was mounted on a 4 mm direct vision telescope, allowing the tip to protrude by about 1.5 cm.

A modified Dennis-Kashima technique² was used in the patients undergoing posterior cordectomy. Excision began between the medial and posterior thirds of the free margin of the vocal fold and continued laterally and posteriorly to the arytenoid vocal process without exposing the cartilage. A trapezoidal area

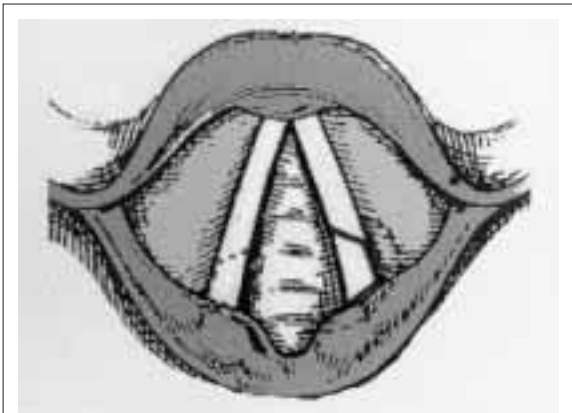


Fig. 2. Surgical limits of posterior cordectomy and possible extensions to false cord, homolateral arytenoid and posterior third of contralateral vocal cord.

was thus delineated, which could, if necessary, be extended to the false cord or medial portion of the arytenoid (Fig. 2). The surgical margins were desloughed with cottonoid sponges soaked with saline solution to remove the charred tissue and promote cicatrisation (Fig. 3).

Unless contraindications were present, the patients received 8 mg of betametasone iv intraoperatively and then 4 mg every 24 hours for the following 48 hours. The patients underwent endoscopic examination at 24 and 72 hours and on days 7 and 15 after surgery to evaluate cicatrisation and remove any excess fibrin. Patients were usually discharged on the 2nd-3rd day.



Fig. 3. Immediate outcome of right posterior cordectomy extended to homolateral false cord, performed with diode laser.

Results

All patients were observed at follow-up of minimum 6 months (Fig. 4). Improvement in respiratory capacity was seen already in the very first few hours after surgery and had stabilised by about 10 days after the procedure. All those patients first treated by us and not previously tracheotomised (n. 35) had satisfactory results. In 23 cases (66%), the result was considered "good", as no exertional dyspnoea was observed after physical effort evaluated as the ability to climb 3 flights of 10 stairs each. In 12 patients (34%), the result was considered "sufficient" since there was no resting dyspnoea and normal everyday activity was possible. Three of these patients, however, underwent a second procedure to widen the airway lumen. In 2 cases, contralateral posterior cordectomy was performed, and in 1 patient the previous resection area was extended to the homolateral false cord. Upon reaching us, 13 patients had already been tracheotomised; of these, 11 (85%) were decanulated, on average, 2 months after surgery. In 2 cases, it was



Fig. 4. Results 6 months after right posterior cordectomy extended to homolateral false cord.

possible to remove the tracheostomy tube after a second contralateral cordectomy. Two patients, who had been tracheotomised for over 5 years and presented associated cardiopulmonary disorders, could not be decanulated.

No significant intraoperative complications occurred. The only complications observed, in the post-operative period, were 3 cases of granulation, which was removed on an outpatient basis, and 1 case of posterior synechia that required no further treatment. All patients maintained good deglutition, which was, however, more difficult in the patients who had undergone arytenoidectomy.

The reduction in voice function was within acceptable limits in all cases. Voice quality, initially typically "breathy", continued to improve up to 8-12 months after surgery.

Discussion

The aim of all of the surgical techniques used in the treatment of vocal fold paralysis is to restore a lumen sufficient to guarantee adequate breathing through the natural airway, without the need to maintain a permanent tracheotomy tube, while preserving acceptable phonatory quality^{3 8}.

The evolution of endoscopic microsurgery, now associated with the use of CO₂ laser, has opened new frontiers in the treatment of this condition. The observation that the preservation of the anterior 2/3 of the vocal folds guaranteed adequate phonatory function while sufficiently enlarging the glottic space has led to systematisation in recent arytenoidectomy⁵, posterior cordectomy² and medial arytenoidectomy⁹ techniques.

Initially, we performed the classical arytenoidectomy, whereas we now prefer a modified version of the Dennis-Kashima posterior cordectomy, extending the vocalis muscle resection to the limit between the posterior and medial thirds of the free margin of the fold; the ensuing cicatricial retraction enables a sufficient, stable airway lumen to be obtained. The resection may be extended, if necessary, during the initial or later surgery, to the medial portion of the arytenoid, the homolateral false cord or the posterior third of the contralateral cord (Fig. 2). Preservation of the arytenoid and aryepiglottic plica maintains the integrity of the laryngeal vestibule and piriform sinus, guaranteeing prompt recovery of deglutition without the

risk of inhalation¹⁰. Preservation of the laryngeal sphincter, furthermore, allows a certain degree of compensation of the false cords, which improves phonatory function up to 8-12 months after surgery. Moreover the risk of complications is reduced in comparison to Ossoff's procedure; indeed, no chondritis or posterior synechia requiring further treatment were observed.

Unlike the description of Dennis and Kashima², our procedure was carried out under videoendoscopic control with a contact diode laser, the 600 μ cone-shaped vectorial fibre tip of which had been mounted on a 4 mm direct vision telescope. The energy emitted by the laser, in virtue of its wavelength (810 nm), is less susceptible to water than that of the CO₂ laser (10600 nm), which translates into greater thermal diffusion to neighbouring tissue with the same intensity applied. For these reasons, the power we used was on average 10 W, to attain the right balance between cutting precision and thermal diffusion. In this way, we obtained immediate and long-term results identical to those obtained with the CO₂ laser^{8 10-12}, with the added advantages offered by fibre optic transmission. Reducing the intensity to about 3-5W, the diode laser allows thermal coagulation that was unimaginable with the CO₂ laser^{13 14}. The cutting precision of the NdYAG (1064 nm) laser employed before the diode laser became available is considerably lower, and the instrument also led to greater immediate and deferred inflammatory damage due to thermal diffusion. For these reasons, that is no longer used for vocal fold surgery.

Conclusion

In our opinion, posterior cordectomy is an effective, reliable technique in the treatment of vocal fold paralysis, in that it guarantees sufficient glottic space without impairing swallowing, while preserving good voice quality. The technique is, furthermore, faster and simpler to perform than total arytenoidectomy; it can be carried out even in the acute phase without prior tracheotomy and is rarely accompanied by complications.

The use of a diode laser is particularly indicated in the treatment of this condition, as it offers surgical precision identical to that of the CO₂ laser, with the further advantages of fibre optic transmission, contact operativity and greater coagulation capacity.

References

- ¹ Alajmo E, Accordi M, Croatto L, De Vincentiis M, Fini-Storchi O, Ottaviani A, et al. *Le paralisi laringee*. Acta Otorhinolaryngol Ital 1986;6:225-94.
- ² Dennis DP, Kashima H. *Carbon dioxide laser posterior cordectomy for treatment of bilateral vocal cord paralysis*. Ann Otol Rhinol Laryngol 1989;98:930-4.
- ³ Friedman EM, de Jong AL, Sulek M. *Pediatric bilateral vocal fold immobility: the role of carbon dioxide laser posterior transverse partial cordectomy*. Ann Otol Rhinol Laryngol 2001;110:723-8.
- ⁴ Ossoff RH, Duncavage JA, Shapsay SM, Krespi YP, Sisson GA. *Endoscopic laser arytenoidectomy revisited*. Ann Otol Rhinol Laryngol 1990;99:764-71.
- ⁵ Ossoff RH, Sisson GA, Moselle HI, Duncavage JA, Andrews PE, McMillan WG. *Endoscopic laser arytenoidectomy for the treatment of bilateral vocal cord paralysis*. Laryngoscope 1984;94:1293-7.
- ⁶ Pia F, Pisani P. *Carbon dioxide laser posterior ventriculo-cordectomy for treatment of bilateral vocal cord abductor paralysis*. Acta Otorhinolaryngol Ital 1994;14:377-84.
- ⁷ Reker U, Rudert H. *Die modifizierte posteriore Chordektomie nach Dennis und Kashima bei der Behandlung beidseitiger Rekurrensparesen*. Laryngo-Rhino-Otol 1998;77:213-8.
- ⁸ Mérite-Drancy A, Laccourreye O, Brasnu D, Laccourreye H. *Cordectomie partielle postérieure au Laser CO₂ dans les paralysies récurrentielles bilatérales*. Ann Oto-Laryng 1992;109:235-9.
- ⁹ Crumley RL. *Endoscopic laser medial arytenoidectomy for airway management in bilateral laryngeal paralysis*. Ann Otol Rhinol Laryngol 1993;102:81-4.
- ¹⁰ Eckel HE, Vössing M. *Endolaryngeale Operationsverfahren zur Glottiserweiterung bei beidseitiger Rekurrenslähmung*. Laryngol Rhinol Otol 1996;75:215-22.
- ¹¹ Eskew JR, Bailey B. *Laser arytenoidectomy for bilateral vocal cord paralysis*. Otolaryngol Head Neck Surg 1983;91:294-8.
- ¹² Lannigan FJ, Robb PJ, Alderson DJ, Shaheen OH. *Carbon dioxide laser cordectomy in the management of bilateral vocal cord paralysis*. JR Coll Surg Edinb 1991;36:378-80.
- ¹³ Manolopoulos L, Stavroulaki P, Yiotakis J, Segas J, Adamopoulos G. *CO₂ and KTP-532 laser cordectomy for bilateral vocal fold paralysis*. J Laryngol Otol 1999;113:637-41.
- ¹⁴ Segas J, Stravroulakis P, Manolopoulos L, Yiotakis J, Adamopoulos G. *Management of bilateral vocal fold paralysis: experience at the University of Athens*. Otolaryngol Head Neck Surg 2001;124:68-71

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