

LARYNGOLOGY

# Endoscopic treatment of Zenker's diverticulum by carbon dioxide laser

## *Il trattamento endoscopico con laser CO<sub>2</sub> del diverticolo di Zenker*

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### SUMMARY

The management of Zenker's diverticulum remains controversial, as both external and endoscopic procedures are potentially associated with post-operative complications and risks. The endoscopic approach is based on cricopharyngeal myotomy or myectomy by laser, cauterization or stapling. A retrospective chart review has been made from December 1994 to April 2009 of all patients with Zenker's diverticulum treated by endoscopic cricopharyngeal myectomy using CO<sub>2</sub> laser at the Department of Otorhinolaryngology – Head and Neck Surgery of the University of Brescia, Italy. Of the 28 patients (19 males, 9 females; mean age, 64 years; range, 46-95) scheduled for the trans-oral procedure, 27 (96%) were endoscopically treated. Diagnosis was based on the patient's history, flexible fiberoptic examination of the larynx, hypopharynx, and oesophagus, and videofluoroscopy with barium. Exclusion criteria included severe medical co-morbidities, impossibility to endoscopically expose the diverticulum, and small (< 2 cm) or large (> 6 cm) diverticula. The endoscopic procedure was performed using a CO<sub>2</sub> laser to section the cricopharyngeal muscle and remove the posterior part in order to obtain partial myectomy. Major complications occurred in 2 (7%) patients. No cases of recurrent nerve paralysis, pharyngo-cutaneous fistula, neck emphysema, post-operative bleeding, mediastinitis or aspiration pneumonia were observed in the present series. A swallow survey was obtained by telephone: 85% of patients reported improved swallowing (without symptoms in 11 and with moderate dysphagia in 7). Based on the present series, endoscopic CO<sub>2</sub> laser cricopharyngeal myectomy for Zenker's diverticulum can be considered an effective and safe procedure, with reduced hospitalization time and complication rate.

KEY WORDS: Zenker's diverticulum • Endoscopic treatment • Carbon dioxide laser • Cricopharyngeal myectomy

### RIASSUNTO

*La gestione del diverticolo di Zenker rimane controversa in quanto sia l'approccio endoscopico che quello cervicotomico sono potenzialmente associati a complicanze postoperatorie e rischi. L'approccio endoscopico è basato su una miotomia o miectomia cricofaringea mediante laser, elettrobisturi o punti metallici. Il nostro studio è basato sull'analisi retrospettiva di pazienti affetti da diverticolo di Zenker e trattati endoscopicamente con miectomia cricofaringea mediante laser CO<sub>2</sub> tra il dicembre 1994 e l'aprile 2009 presso la Clinica Otorinolaringoiatrica dell'Università degli Studi di Brescia. Dei 28 pazienti (19 uomini, 9 donne; età media, 64 anni; range, 46-95) destinati a procedura endoscopica, 27 (96%) hanno ricevuto tale trattamento. La diagnosi si è basata sulla storia clinica del paziente, sullo studio endoscopico condotto con fibre ottiche flessibili di laringe, ipofaringe, esofago, e sulla videofluoroscopia con bario. I criteri di esclusione hanno compreso: gravi comorbidità associate, impossibilità di una corretta esposizione endoscopica del diverticolo, dimensioni ridotte (< 2 cm) o eccessive (> 6 cm) dello stesso. È stata eseguita una sezione e rimozione della porzione posteriore del muscolo cricofaringeo mediante laser CO<sub>2</sub> al fine di eseguirne una parziale miectomia. Complicanze maggiori si sono presentate in 2 pazienti (7%). Non abbiamo riscontrato casi di paralisi del nervo ricorrente, fistola faringo-cutanea, enfisema del collo, sanguinamento postoperatorio, mediastinite o polmonite ab ingestis. Il risultato funzionale è stato indagato telefonicamente: l'85% dei pazienti ha riferito un miglioramento della disfagia (con assenza di sintomi in 11 e disfagia moderata in 7). In relazione alla presente casistica, la miectomia cricofaringea mediante approccio endoscopico con laser CO<sub>2</sub> può essere considerata una procedura efficace e sicura, con una ridotta ospedalizzazione ed incidenza di complicanze.*

PAROLE CHIAVE: Diverticolo di Zenker • Trattamento endoscopico • Laser CO<sub>2</sub> • Miectomia cricofaringea

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## Introduction

Hypopharyngeal diverticulum, also known as Zenker's diverticulum<sup>1</sup>, develops into a triangular shaped area between the oblique muscle fibres of the inferior pharyngeal constrictor muscle and the horizontal muscle fibres of the cricopharyngeus. Even though a number of aetiologic mechanisms have been proposed, such as abnormalities in relaxation of the cricopharyngeal muscle or lack of coordination of the upper oesophageal sphincter, the cause of Zenker's diverticulum still remains unclear. Dysphagia is the main presenting symptom, sometimes associated with regurgitation of undigested food, choking, cough and, in advanced cases, oesophageal obstruction.

The management of Zenker's diverticulum has undergone several evolutionary changes. The external approach, proposed for the first time by Bell in 1830, as pointed out by Mayo<sup>2</sup>, has been the treatment of choice for decades. This approach is associated with a high complication rate, including bleeding, mediastinitis, fistulas, recurrent nerve paralysis, and oesophageal stricture. In order to decrease the morbidity and complication rate, a variety of surgical treatment modalities, such as the oesophagoscope-assisted cervicotomic approach<sup>3</sup>, have been described. Diverticulectomy with crico-pharyngeal myotomy, first performed through an external route by Kaplan in 1951<sup>4</sup>, is the key point of modern surgical management. Mosher<sup>5</sup> first described a trans-oral-only approach in 1917, but crico-pharyngeal myotomy was endoscopically performed by Dohleman and Mattsson<sup>6</sup> only in 1960. In the last few decades, endoscopic treatment has gained more popularity<sup>7-9</sup> also due to the use of carbon dioxide laser, first introduced, in 1981, by van Overbeek<sup>10</sup>. Endoscopic stapler-assisted diverticulostomy was introduced more recently, in 1993, by Martin-Hirsch et al.<sup>11</sup> and Collard et al.<sup>12</sup> and later refined by Scher<sup>13</sup>.

The present report focuses on an analysis of 15 years' experience in the endoscopic management of Zenker's diverticulum by carbon dioxide laser-assisted cricopharyngeal partial myectomy.

## Patients and Methods

A retrospective chart review was performed from December 1994 to April 2009 of all patients with Zenker's diverticulum treated by endoscopic carbon dioxide laser surgery at the Department of Otorhinolaryngology – Head and Neck Surgery of the University of Brescia, Italy.

Diagnosis was based on the patient's history, flexible fiberoptic examination of the larynx, hypopharynx, and oesophagus, and videofluoroscopy with barium. The symptoms most frequently encountered were dysphagia, regurgitation, and foreign body sensation. Exclusion criteria included severe medical co-morbidities precluding surgery under general anaesthesia and impossibility to

adequately expose the diverticulum itself after complete curarization. Relative contraindications for endoscopic treatment were small (< 2 cm) or large (> 6 cm) diverticula<sup>14</sup>.

With the patient under general anaesthesia, a Holinger-Benjamin endoscope (Karl Storz, Tuttlingen, Germany) was used for diverticulum exposure during the trans-oral procedure. The partial myectomy was performed using a CO<sub>2</sub> laser (Sharplan 1055 S CO<sub>2</sub> laser, Tel Aviv, Israel) with super-pulse delivery in continuous mode, coupled to an Acuspot 712 micromanipulator (270-µm spot size), until 1997. Since 1998, a CO<sub>2</sub> laser (Lumenis, Santa Clara, California) has been used with ultra-pulse delivery in continuous mode, coupled to a digital Acublade system. Section of the cricopharyngeal muscle was performed for the whole height of the posterior part of the muscle itself, following two vertical paramedian lines and removing the intervening portion of the muscle fibres up to the external fascial layer. In this way, a partial myectomy of the posterior part of the cricopharyngeal muscle was obtained. Post-operatively, patients were kept on total parenteral nutrition for a period of at least 48 hours. No routine radiological swallow examination was performed except in those patients with post-operative clinical signs suggesting oesophageal perforation. Antibiotic treatment was routinely administered.

## Results

Of these 28 patients, 19 (68%) were males and 9 (32%) females, mean age 64 years (range 46-95). Endoscopic laser-assisted partial myectomy of the cricopharyngeal muscle was attempted in all patients and completed in 27 (96%). One endoscopic procedure was abandoned before starting the endoscopic myectomy on account of an oesophageal perforation during placement of the diverticuloscope.

None of the patients had been previously treated, except one, who had experienced persistence after a previous endoscopic treatment performed at another institution. The average length of the diverticulum was 3.8 cm (range 2-5.8). Mean hospitalization time was 7.6 days (range 3-13). Histological examination of the excised specimen revealed chronic inflammation of the mucosa in all cases. No carcinoma within the diverticulum was detected endoscopically.

All patients underwent total parenteral nutrition for at least 48 hours (mean 3 days; range 2-9) through a central venous catheter into the femoral vein.

Two (7%) major complications were encountered: one oesophageal fistula, which resolved spontaneously after 8 days with antibiotic treatment and total parenteral nutrition, and one intra-operative oesophageal perforation with pneumo-thorax that occurred during diverticulum exposure. In the latter case, the endoscopic procedure

was abandoned and an open-neck approach was adopted in order to simultaneously repair the perforation and remove the diverticulum. A chest drainage was also intra-operatively placed that was removed after 10 days with complete resolution of the pneumothorax. Three (11%) patients presented a post-operative temperature peak > 38.5°C that was resolved with anti-pyretic treatment. One patient presented retro-sternal pain on the first post-operative day that resolved spontaneously. No cases of recurrent nerve paralysis, pharyngocutaneous fistula, neck emphysema, post-operative bleeding, mediastinitis or aspiration pneumonia were observed in the present series.

A swallow survey was obtained by telephone in 20 (74%) of the 27 patients (3 patients died from other causes and 4 were lost to follow-up). Two (10%) patients reported no benefit from the operation: one is still dysphagic, and the other underwent a second endoscopic procedure at another institute. Eleven (55%) patients were satisfied (without any symptoms) and 7 (30%) were fairly satisfied (with moderate symptoms).

## Discussion

Controversy still remains concerning the management of Zenker's diverticulum: both the external and endoscopic approaches are associated with complications and potential risks. The external approach is performed via a left lateral cervical route, identifying the diverticulum, performing a cricopharyngeal myotomy and then inverting, suspending or excising the pouch. The endoscopic procedures, on the other hand, are based on myotomy or partial myectomy of the common wall between the diverticulum and the oesophagus, using laser, cautery or stapling devices.

According to the literature, cervicotomic diverticulectomy carries a higher complication rate, including death, recurrent nerve paralysis, oesophageal stenosis, mediastinitis, neck emphysema, fistula, and pneumonia<sup>15 16</sup>. In a review of the literature, Zbären et al.<sup>17</sup> reported the occurrence of mediastinitis after the open-neck approach in up to 9.5% of cases and oesophageal stenosis in 7.1%. Cutaneous fistulas and recurrent laryngeal nerve paralysis were described in up to 19% and 12.9% of patients, respectively. Dauer et al.<sup>18</sup> compared the results of the endoscopic laser-assisted procedure to those of the open-neck approach, reporting an overall success rate that was higher for the laser group based on the "Functional Outcome Swallowing Scale". Complications in the endoscopic group included fever (n = 2) and chest pain (n = 1); in the open-neck group, complications included chest pain (n = 1), prolonged intubation (n = 1), and fistula (n = 1). No mediastinitis was found in either group.

Chang et al.<sup>19</sup> reported on a comparison between endoscopic and open-neck approaches: in the first group, no major complications (mediastinitis, pharyngocutaneous fistula, recurrent nerve paralysis, stenosis or death) were observed. More than 90% of the patients submitted to complete follow-up reported normal or near normal swallowing function.

In 1994, van Overbeek<sup>10</sup> reported results on 544 endoscopically-treated patients (by electrocoagulation in 328 cases, and CO<sub>2</sub> laser in 216): almost 90% were highly satisfied. One patient died on account of cardiac failure 2 days after the operation, 10 experienced neck emphysema, and 12 mediastinitis.

According to the literature and to our series, the risk of mediastinitis, after a microendoscopic laser partial myectomy, is lower than after an external approach. However, post-operative transient fever seems to be a common phenomenon<sup>17 19 20</sup>.

Not unlike results reported by other Authors, swallowing function in our series was normal or near normal in 85% of patients<sup>10 19</sup>.

Endoscopic partial myectomy is relatively quick and easy to perform, although it may sometimes be difficult to expose the diverticulum and adequately introduce the diverticuloscope. The learning curve seems longer even though the complication rate is generally low. In our opinion, this surgical option is preferable in respect to cricopharyngeal myotomy for a number of reasons:

- 1) from a practical point of view, removal of the intervening portion of the cricopharyngeal muscle between two paramedian section lines is straightforward and safer on account of a wider surgical field and the possibility to gradually deepen the muscle removal up to the external fascial layer;
- 2) partial myectomy allows formation of a wider communication between the diverticulum itself and the oesophageal lumen;
- 3) it would appear to reduce the incidence of further strictures and recurrences of diverticulum by weakening the dysfunctional upper oesophageal sphincter.

In comparing treatment modalities, most series show that endoscopic and external approaches are equally effective, even if the external approach seems to be associated with a higher rate of complications. However, most of these studies were retrospective and lacked homogeneous inclusion criteria, making it difficult to draw definitive conclusions.

In summary, we found endoscopic CO<sub>2</sub> laser-assisted crico-pharyngeal partial myectomy for Zenker's diverticulum to be an effective and safe procedure, with reduced hospitalization time and complication rates when compared to the open-neck approach.

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