Endoscopic Airway Management of Laryngeal Sarcoidosis

Colin R. Butler, BSc, MRCS, DOHNS; S. A. Reza Nouraei, MA, MRCS, DOHNS; Alasdair D. Mace, DLO, FRCS (ORL-HNS); Sherif Khalil, FRCS, MD; Shona K. Sandhu; Guri S. Sandhu, FRCS (ORL-HNS)

Objective: To report the results of treating laryngeal sarcoidosis with intralesional steroids and minimally invasive laser surgery. Sarcoidosis is a rare multisystem inflammatory disorder of unknown cause. Laryngeal involvement is extremely rare, and its optimal management remains controversial.

Design: Retrospective medical chart review.

Settings: Tertiary care center/national referral airway reconstruction center.


Main Outcome Measures: Demographic and clinical information including extralaryngeal manifestations obtained from patient records, laryngeal anatomic subsite manifestation of disease, intraoperative findings, and scores from the Medical Research Council (MRC) dyspnea outcome assessment instrument (which was administered preoperatively, at the first postoperative outpatient visit 4-6 weeks later, and at last follow-up).

Results: The patients included 9 women and 1 man, a total of 2.8% of the unit’s adult surgical airway case mix (10 of 353). Mean (SD) age at presentation was 37 (17) years. All patients presented with dyspnea and dysphonia; 2 required emergency tracheostomy prior to treatment. Six patients presented with isolated laryngeal sarcoid. Supraglottis and arytenoids were affected in all patients. The median number of endoscopic treatments was 2 (range, 1-4). Significant improvement in MRC dyspnea grading was found postoperatively (P < .05), and patients with tracheostomy were successfully decannulated. The mean (SD) follow-up time was 24 (18) months. There were no adverse effects of surgery. Nine patients had a substantial dose reduction or discontinuation of their systemic corticosteroid therapy following endoscopic treatment.

Conclusions: Minimally invasive endoscopic surgery with intralesional corticosteroid injection and laser reduction is an effective method of controlling laryngeal sarcoid. It improves symptoms immediately with minimal morbidity and, most importantly, reduces the need for systemic steroid administration in most patients. This study supports early recognition and endoscopic intervention in the management of laryngeal sarcoidosis.


Sarcoidosis is a rare multisystem disorder first described by Boeck in 1899 and characterized by noncaseating granulomatous lesions of unknown cause. It has a worldwide distribution and typically affects patients aged 20 to 40 years at a female to male ratio of 2:1. African Americans are preferentially affected. No single causative agent has been found. However, pathogenesis is likely to involve initiation of abnormal immunoregulatory mechanisms via environmental factors in genetically susceptible individuals. Any organ can be affected, but extrapulmonary involvement is less common.

Otorhinolaryngologic manifestations are rare, and laryngeal involvement accounts for less than 1% of presentations with variable symptoms and clinical features. Subsequently, laryngeal abnormalities are often overlooked until progressive disease leads to clinically significant symptoms. Despite advances in understanding the causes of sarcoid, the natural history, course, and long-term prognosis of laryngeal sarcoidosis are poorly understood.

Management of sarcoidosis remains challenging, particularly owing to its relapsing and remitting course. Symptoms of dysphonia, dysphagia, and particularly airway obstruction prompt intervention, but current treatment techniques remain controversial. Traditionally, high-dose systemic steroids have been recommended as the first-line treatment for laryngeal sarcoidosis. Surgical options such as endoscopic laser photoreduction have...
been effective but are often used as a last resort when conservative therapy has failed. Herein, we report the largest single-institution series, to our knowledge, of laryngeal sarcoidosis cases treated early with intralesional steroid therapy combined with minimally invasive endoscopic laser surgery.

**METHODS**

**PATIENTS**

Records of all patients with upper airway stenosis due to laryngeal sarcoidosis were reviewed from a prospectively collected database of adult patients with laryngotracheal stenosis. All study patients were jointly managed at our center and at a dedicated sarcoid clinic, where the diagnosis was based on internationally agreed clinical, radiologic, and histopathologic criteria.6

**ETHICAL CONSIDERATIONS**

Because the present study is a retrospective report of the standard treatment for patients undergoing surgery for laryngeal sarcoid at our institution, the local research committee deemed ethical approval unnecessary.

**SURGERY**

Total intravenous anesthesia was established. The airway was secured during induction using a laryngeal mask, and following suspension laryngoscopy, supraglottic jet ventilation was established. Details of the anesthetic technique have previously been described.7 The laryngotracheal complex was visualized using a Lindholm laryngoscope and a combination of microscope and 4-mm 0° Karl Storz endoscope (Karl Storz GmbH, Tuttingen, Germany) were used to visualize and treat the airway.

Laryngeal lesions were identified, and a biopsy routinely performed. Variable doses of between 40 and 120 mg of methylprednisolone acetate at a concentration of 40 mg/mL (Pharmacia Limited, Kent, England) were administered according to lesion size. A modified 27G butterfly needle was used to deliver multiple injections of steroid into the base of the lesion. Each intralesional steroid injection was delivered over 30 seconds. The quantity of steroid delivered was determined by the volume of mucosal disease; the end point of the intralesional injection was complete blanching of the lesion. It was difficult to exceed 120 mg of methylprednisolone in the case of a fully affected supraglottis. Immediately after complete infiltration of the lesion, laser photoreduction was performed using a carbon dioxide laser at continuous settings of 8 to 10 W. As the surgical technique evolved, standard laser debulking was replaced by a mucosa-sparing multispot laser technique, which involved creating numerous laser spots throughout and to the depth of the lesion spaced 1 to 2 mm apart, thus creating a “pepper pot” effect (Figure 1).

**DATA ANALYSIS**

Patient demographics and the nature and timing of treatments were obtained from patient records. Initial presenting symptoms and Medical Research Council (MRC) dyspnea scores were obtained preoperatively, postoperatively, and at last follow-up. The MRC dyspnea outcome assessment instrument has been shown to correlate well with the degree of luminal obstruction and has been validated for adult patients with laryngotracheal stenosis.8 Sites of laryngeal involvement were recorded intraoperatively. Qualitative assessment was via a prospectively recorded endoscopic photograph database. A timeline plot was used to illustrate the number and nature of treatment episodes each patient received. Data were presented either as mean values with standard deviation or binomial percentages when appropriate. Data were analyzed and displayed using SPSS software, version 16.0 for Windows (SPSS Inc, Chicago, Illinois).

Laryngeal sarcoidosis accounted for 2.8% of the unit’s workload (10 of 353), which includes all surgically treated adult airway cases presenting from 2004 to 2008. There were 9 women and 1 man, and the mean (SD) age at presentation was 37 (17) years (range, 18-62 years). All patients had dyspnea on presentation. In addition, 2 patients were stridulous on presentation, and 2 were referred to our unit after having received an emergency tracheostomy elsewhere. Six patients presented with isolated laryngeal sarcoid, and the remaining 4 patients had multiple systems involved. Laryngeal subsite manifestation of disease was restricted to the supraglottis. The most common sites (in descending order) were arytenoids, aryepiglottic folds, epiglottis, and false vocal folds. One patient had disease in the interarytenoid region. There were no cases of laryngeal sarcoid affecting the glottis.

All patients presented with dyspnea and dysphonia. Five patients presented with stridor, 7 with dysphagia, and 2 with a cough. It was the unit’s experience that a high degree of dyspnea prompted a patient’s preference for surgery. The Table lists further information about patient and disease characteristics in this series. Excluding patients with tracheostomy tubes, the median preoperative and last postoperative MRC dyspnea grade was 3 (range, 2-4) and 1 (range, 1-2), respectively. Dyspnea grading scores improved significantly postoperatively (Table) (P < .05 for the Wilcoxon signed-rank test), and
patients with tracheostomy tubes were successfully decannulated 5 to 7 days after their initial operation. The median number of endoscopic treatments was 2 (range, 1-4).

**Figure 2** shows a detailed treatment timeline for all patients. The mean (SD) follow-up time was 24 (18) months with no mortalities and no surgical adverse effects reported during that time. Prior to endoscopic surgery, all patients were being treated with high-dose corticosteroid therapy (>40 mg/d of prednisolone). Postoperatively, 6 patients had a substantial dose reduction in their daily steroid requirement (to <7 mg/d of prednisolone). Three patients were able to discontinue their systemic corticosteroid therapy following endoscopic treatment (Table).

---

**Table.** Characteristics of Patients With Laryngeal Sarcoidosis

<table>
<thead>
<tr>
<th>Patient No./Sex/ Age, y</th>
<th>Extralaryngeal Sites</th>
<th>Laryngeal Subsites</th>
<th>Presenting Symptoms</th>
<th>MRC Dyspnea Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>At Presentation Last Follow-up</td>
<td>Systemic Steroid Requirement at Last Follow-up</td>
</tr>
<tr>
<td>1/F/54</td>
<td>lungs</td>
<td>E</td>
<td>D&amp;D, stridor, dysphagia</td>
<td>2 (trach) 2 (decan)</td>
</tr>
<tr>
<td>2/F/27</td>
<td>none</td>
<td>A, E</td>
<td>D&amp;D, cough</td>
<td>3 1</td>
</tr>
<tr>
<td>3/F/23</td>
<td>none</td>
<td>A, E, FC (bilateral)</td>
<td>D&amp;D, stridor, dysphagia</td>
<td>2 2</td>
</tr>
<tr>
<td>4/F/21</td>
<td>none</td>
<td>A, AEF</td>
<td>D&amp;D, stridor, dysphagia</td>
<td>2 1</td>
</tr>
<tr>
<td>5/M/60</td>
<td>none</td>
<td>A, AEF</td>
<td>D&amp;D, stridor</td>
<td>1 (trach) 1 (decan)</td>
</tr>
<tr>
<td>6/F/35</td>
<td>lungs, skin, nose</td>
<td>A, AEF, IA</td>
<td>D&amp;D, stridor, dysphagia</td>
<td>3 1</td>
</tr>
<tr>
<td>7/F/19</td>
<td>none</td>
<td>A, AEF, E, FC (Left)</td>
<td>D&amp;D, dysphagia, cough</td>
<td>3 1</td>
</tr>
<tr>
<td>8/F/48</td>
<td>lungs, skin, nose</td>
<td>A, AEF, E</td>
<td>D&amp;D, dysphagia</td>
<td>3 1</td>
</tr>
<tr>
<td>9/F/62</td>
<td>lungs, skin, nose</td>
<td>A, AEF, E</td>
<td>D&amp;D, dysphagia</td>
<td>4 2</td>
</tr>
<tr>
<td>10/F/23</td>
<td>none</td>
<td>A, AEF, E</td>
<td>D&amp;D</td>
<td>3 1</td>
</tr>
</tbody>
</table>

**Abbreviations.** A, arytenoids; AEF, aryepiglottic folds; D&D, dyspnea and dysphonia; decan, decannulation performed; E, epiglottis; FC, false cord; G, glottis; IA, interarytenoid; MRC, Medical Research Council; SG, subglottis; trach, tracheostomy in situ.

---

**Figure 3.** Characteristic appearances of laryngeal sarcoidosis in 2 different patients. A, An endoscopic photograph demonstrating a diffusely pale and edematous lesion affecting the interarytenoid region (patient 8, Table). B, An endoscopic photograph demonstrating significant supraglottic obstruction: the diffusely pale lesion of sarcoidosis is infiltrating the epiglottis, aryepiglottic folds, and arytenoids (patient 10, Table).

**COMMENT**

Otorhinolaryngologic manifestations of sarcoidosis occur in less than 3% of cases, and laryngeal involvement is often overlooked. The reported incidence of laryngeal sarcoidosis is 1%.9-11 Clinical features include dyspnea, dysphonia, dysphagia, and cough.7 The macroscopic appearance of laryngeal sarcoid is considered pathognomonic, with the supraglottic characteristically diffusely thick, edematous, and pale or pink (Figure 3).9 The disease follows a relapsing and remitting course and may ultimately “burn out.” Symptoms are recognized when granulomatous lesions are present, and these lesions may persist due to subsequent fibrosis after sarcoidosis remission.12

Optimum treatment techniques are still debated, and various approaches exist, all intended to slow disease progression and/or remove it permanently. The international consensus on sarcoidosis is that corticosteroids are indicated when critical organs are involved or if sarcoidosis is severe.6,13 Systemic steroids therefore remain the first-line treatment for laryngeal disease. However, in patients with significant airway compromise, unless specialist shared-airway surgical and anesthetic expertise is
available, a tracheostomy may become mandatory.\textsuperscript{12} Although systemic corticosteroid therapy is initially effective, many patients require long-term low-dose steroid treatment to maintain remission, which is not without complications. Other treatment options have been sought to reduce comorbidities associated with systemic steroid use. These steroid-sparing options have included external beam radiotherapy,\textsuperscript{14,15} cytotoxic agents such as azathioprine, and immune modulators that include systemic cyclosporine, hydroxychloroquine, infliximab, and topical mitomycin C.\textsuperscript{13,16} The proof of efficacy of these treatments for laryngeal sarcoid is still limited to case reports and implied translational evidence.

Intralesional corticosteroids have been administered via direct or indirect laryngoscopy with moderate success.\textsuperscript{5,12} Symptomatic relief and reduction of systemic steroid requirements were obtained in many of these patients, but recurrence rates were variable, and individuals required multiple injections to control disease. Furthermore, some patients were unresponsive and still required oral steroids.

Various techniques of surgical debulking and excision of laryngeal sarcoid lesions have been described. Open procedures with laryngofissure\textsuperscript{12} and laryngectomy\textsuperscript{17} have been used but are understandably associated with significant morbidity and disability. More recently, minimally invasive direct laryngoscopy with carbon dioxide laser ablation has been shown to improve symptoms, create adequate airways, and remove disease,\textsuperscript{10,13} although this effect is often temporary.\textsuperscript{10,10}

Combining intralesional corticosteroid injections with laser ablation and/or photoreduction is a natural progression of these techniques, but this combination has been described only in case reports and small series.\textsuperscript{3,20} Treatment efficacies are therefore unknown, and management of laryngeal sarcoidosis with minimally invasive laryngoscopic surgery remains controversial. We report the largest single-institution series, to our knowledge, of laryngeal sarcoidosis cases treated early with intralesional steroid therapy combined with minimally invasive endoscopic laser surgery.

The results of our study demonstrate that our case mix of laryngeal sarcoid is not dissimilar to that of other studies.\textsuperscript{3,5,12,21} Clinically, patients presented with predominant symptoms of dyspnea and dysphonia. However, it was the unit’s experience that the high degree of dyspnea prompted the patient’s preference for surgical treatment. We found that all patients with sarcoid-induced airway obstruction could be safely anesthetized, and no tracheostomy-free patient treated at our institution required a tracheostomy. Laser photoreduction and intralesional steroids led to significant and sustained improvement in MRC dyspnea score, and flares of disease were effectively managed with further endoscopic treatment. There were no clinically significant complications associated with disease treatment. Furthermore, as surgical experience was gained, the pepper pot laser photoreduction was introduced with good effect. We found that by preserving mucosal islands, we effectively decreased sarcoid lesion bulk and volume while reducing the likelihood of laryngeal circumferential contracture and scarring.

The results of this study are consistent with earlier findings in the management of other inflammatory conditions of the laryngotracheal complex, such as Wegener granulomatosis and postintubation laryngotracheal stenosis where intraliteral steroids and laser surgery administered in the active phase of the disease can prevent progression to fibrotic scarring by altering the natural history of the disease.\textsuperscript{22,23} We found that in most patients with sarcoid, control of local disease with minimally invasive surgery allowed systemic treatment to be stopped or reduced, and this may have major benefits in terms of reduced exposure to systemic steroids and associated comorbidities.

To our knowledge, this is the largest study undertaken of the management of laryngeal sarcoidosis by a single operator in a single setting using a single treatment philosophy over a short period during which data were systematically and prospectively collected. This study demonstrates the effectiveness of minimally invasive laser surgery and furthermore suggests that laser treatment can be made even safer by the use of the mucosal-sparing pepper pot reduction technique, as shown in Figure 1. The main limitation is the small sample size, which is an inescapable consequence of this rare disease entity that can only be addressed through a prospective multicenter study.

Our study highlights minimally invasive endoscopic surgery with intralesional corticosteroid injection and laser photoreduction as an effective method of controlling laryngeal sarcoid. Combining both intralesional injection and laser ablation and/or debulking can successfully improve symptoms immediately with minimal morbidity. Our technique of pepper pot lasering the lesion adequately reduces lesion bulk while not compromising functional anatomy. More importantly, we have shown that endoscopic management reduces the need for systemic steroid administration in most patients. Because sarcoidosis can be progressive, we would advocate early recognition and endoscopic intervention as the standard of care in the management of laryngeal sarcoidosis.

Submitted for Publication: April 29, 2009; final revision received July 21, 2009; accepted September 17, 2009.

Correspondence: Colin R. Butler, BSc, MRCS, DOHNS, Department of Otolaryngology–Head and Neck Surgery, The National Centre for Airway Reconstruction, Charing Cross Hospital, London W6 8RF, England (colinbutler@doctors.org.uk).

Author Contributions: Dr Butler had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Butler and G. S. Sandhu. Acquisition of data: Butler, Khalil, and S. K. Sandhu. Analysis and interpretation of data: Butler, Nouraei, and Mace. Drafting of the manuscript: Butler, Nouraei, Khalil, and S. K. Sandhu. Critical revision of the manuscript for important intellectual content: Butler, Mace, and G. S. Sandhu. Statistical analysis: Butler and Nouraei. Administrative, technical, and material support: Khalil. Study supervision: Mace and G. S. Sandhu.

Financial Disclosure: None reported.
REFERENCES