Video-Assisted Left Partial Arytenoidectomy by Diode Laser Photoablation for Treatment of Canine Laryngeal Paralysis

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Objectives—To evaluate the clinical outcome of left partial arytenoidectomy by video-assisted laser diode photoablation as a surgical treatment for canine laryngeal paralysis (LP).

Study Design—Case series.

Animals—Dogs with bilateral LP (n = 20).

Methods—After endoscopic diagnosis of bilateral LP, left partial arytenoidectomy was performed by photoablation of arytenoid cartilage tissue using a diode laser (600 µm diameter, 15 W power, 980 nm wave length) to increase the width of the rima glottidis. Outcome was evaluated endoscopically (1 and 6 months) and clinically (1, 6, and 12 months).

Results—No substantial complications occurred during photoablation or in the immediate postoperative period. Postoperative width of the rima glottidis ranged from 6 to 10 mm at its widest aspect. At 1 month, respiratory function after walking and short running appeared good. Clinical and endoscopic examination revealed good outcome at 1 and 6 months. At 6 months, there was no evidence of hypertrophic scar, hypertrophic granulation tissue, or stricture of the laryngeal glottis in any dog. Two dogs developed aspiration pneumonia after 12 months.

Conclusions—Partial arytenoidectomy using video-assisted diode laser photoablation appears to be an effective technique for treating LP.

Clinical Relevance—Partial arytenoidectomy by diode laser photoablation should be considered as an alternative technique for treatment of canine LP.

INTRODUCTION

IN CANINE laryngeal paralysis (LP), there is bilateral loss of abduction of the arytenoid cartilages and vocal folds during inspiration because of recurrent laryngeal neuropathy and dysfunction of the intrinsic laryngeal muscles. LP may be congenital or acquired; the former being diagnosed in dogs < 1 year of age. Acquired LP is often seen in adult, older, large-breed dogs. Labradors, Great Danes, Chesapeake Bay Retrievers, Afghan Hounds, Irish Setters, and Saint Bernards are most commonly affected, and males are more commonly affected than females. Acquired LP may be caused by traumatic or surgical lesions of the cervical region resulting in secondary nerve damage; by intra- or extrathoracic masses that cause compression of the recurrent laryngeal nerves; or by generalized polynuropathy or hypothyroidism; however, in many dogs the cause is unclear and LP is considered idiopathic.

The most frequently observed clinical signs are exercise intolerance, inspiratory stridor, inappropriate inspiratory effort, loss or alteration in phonation, coughing (mainly after food and water ingestion), cyanosis, and collapse. These signs worsen with obesity, exercise, excitement, and high environmental temperatures.
Unilateral lateralization of the arytenoid cartilage or partial arytenoidectomy have been recommended for treatment of LP in dogs. The latter technique is subject to complications including aspiration pneumonia, submucosal hematoma, and seroma development. We report a technique for, and outcome after, video-assisted partial left arytenoidectomy performed by photoablation with a diode laser in 20 dogs.

**Materials and Methods**

**Inclusion Criteria**

Medical records (2004–2006) of dogs with bilateral LP that had partial arytenoidectomy with a diode laser were reviewed. Inclusion criteria were an endoscopic diagnosis of LP and ≥ 6 months follow-up clinically and endoscopically. Laryngeal movement, was evaluated using a 5 mm rigid endoscope positioned caudal to the tip of the epiglottis with the dog in sternal recumbency, premedicated with atropine (0.03 mg/kg intramuscularly), during light, general anesthesia with propofol (1 mg/kg intravenously [IV] as needed to facilitate the examination). The same procedure was used to evaluate outcome 1 and 6 months after partial arytenoidectomy. Thoracic radiographs were taken before surgery and at 15 days, 1–6, and 12 months after surgery. All dogs had complete hematologic and serum biochemical profile analysis before surgery.

**Surgical Technique**

After endoscopic diagnosis, dogs were immediately taken to surgery. They were intubated and anesthesia was maintained with isofluorane in oxygen. Cefazolin (25 mg/kg IV) and dexamethasone (1 mg/kg IV) were administered at anesthetic induction. Partial left arytenoidectomy was performed using a 600μm diameter, 15 W power, and 980 nm wavelength diode laser (easylase 980 nm; Team laser, Padova, Italy). The energy used during surgery was 4–6 J over 50 seconds in continuous mode. Cartilage vaporization was achieved with a triangulation technique between the laser and the endoscope.

During the procedure, the endotracheal tube was protected by using a straight malleable retractor, 4–5 mm wider than the endotracheal tube, which prevented contact of the tube with the laser beam. Photoablation of the arytenoid cartilage was performed under constant endoscopic observation and consisted of photovaporization of a portion of the corniculate process of the left arytenoid cartilage with char removal by use of a gauze sponge. The portion of laser-vaporized cartilage extended from the interarytenoid band to the cuneiform process of the arytenoid cartilage (Fig 1A). The interarytenoid band was preserved to prevent collapse of the arytenoid cartilage and stricture formation. Caudally, photovaporization was limited to the laryngotracheal junction (Fig 1B). At the end of the procedure, the final width of the rima glottidis was measured at its widest portion from the medial aspect of the left corniculate process to the corresponding medial aspect of the right corniculate process (Fig 1E). Straight malleable retractors of differing diameters were used to make the measurements (Fig 1C).

**Postoperative Care**

Cephalexin (25 mg/kg, orally twice daily for 5 days) was administered to prevent infection, prednisone (0.5 mg/kg orally every 6 hours for 7 days) to decrease postoperative edema, and omeprazole (0.7 mg/kg orally once daily for 30 days) to treat the potential gastric ulcers were administered. All dogs were discharged 48 hours after surgery.

**Outcome**

Dogs were reevaluated on day 15, and again at 1, 6, and 12 months, or as needed, and complications (aspiration pneumonia, formation of hypertrophic granulation tissue, or laryngeal strictures) recorded. At ~1 month, dogs were evaluated after 15 minutes walking and 5 minutes running. Owners were also asked to rate their dog’s activity level as improved, no change, or worse than before surgery.

**Results**

Left partial arytenoidectomy was performed in 20 dogs. There were 4 large mixed-breed dogs (weighing >30 kg), 4 medium mixed-breed dogs (weighing 19–24 kg), 3 Labrador Retrievers, 2 Maremmano Shepherds, 2 Newfoundlands, and 1 each of Cocker Spaniel, Saint Bernard, Irish Setter, Springer Spaniel, and Pit Bull (Table 1). All 20 dogs had pronounced inspiratory stridor, cough, exercise intolerance, and alteration in phonation. Three dogs (1 Maremmano Shepherd, 1 Labrador Retriever, 1 Newfoundland) also had cyanosis and syncopal episodes. Eleven dogs had arytenoid cartilage “kissing lesions” and 9 had “paradoxical motion” of the arytenoid cartilages.

During laser photovaporization no major complications occurred. Some hemorrhage occurred in all dogs but was easily controlled with the laser. At the end of surgery, width of the rima glottidis ranged from 6 to 10 mm; 6 mm for dogs weighing <30 kg; 7–8 mm for dogs 30–50 kg; and 10 mm for dogs >50 kg. No complications were observed in the immediate postoperative period. At 1 month, respiratory function after 15 minutes walking and 5 minutes running appeared good and all owners noted that dogs had improved exercise tolerance. There was no evidence of aspiration pneumonia on follow-up radiographs at 15 days or at 1, 6, and 12 months after surgery in 16 dogs; however, 2 dogs (dogs 9 and 14) developed aspiration pneumonia after 12 months. One of the 2 Maremmano Shepherds (dog 12) developed a peripheral neuropathy and was euthanatized after 10 months. One mixed breed dog died from gastric dilatation-volvulus, 9 months after surgery (dog 3) and had
no evidence of abnormal respiratory effort after laryngeal surgery.

Endoscopy at 1 and 6 months revealed complete healing of the arytenoid cartilage by 1 month (Fig 1D–F). No hypertrophic scars, hypertrophic or polypoid granulation tissue, or stricture formation of the glottis was observed.

**DISCUSSION**

Partial arytenoidectomy using video-assisted diode laser ablation appears to result in minimal tissue trauma in human patients.\(^{11-15}\) Observation of laryngeal structures can sometimes be impaired, especially in the latter part of the surgery, because the vaporized mucosa and cartilage tend to become dark, making it difficult to recognize the limits of the cricoid cartilage; however, these darkened portions of the vaporized cartilage have been shown to have a preserved histologic cellular organization in man and horses.\(^{16,17}\)

In humans, laser arytenoidectomy is an intralaryngeal surgery that results in acceptable air passage through the glottis while preserving vocal quality.\(^{11,13,15,18-23}\) This technique is also associated with a reduced incidence of aspiration pneumonia in humans, because it does not require that temporary tracheotomy be performed after the procedure.\(^{11,13,15,18-23}\) Formation of hypertrophic granulation tissue resulting in dyspnea has been reported as a complication in human patients.\(^{11-13,22}\) This tissue can be easily removed with diode laser.\(^{14,21,24}\) Another reported complication is stricture formation, but these do not normally require surgical treatment.\(^{13,14,22}\)

Preliminary results of the use of the diode laser for unilateral partial arytenoidectomy for treatment of LP in dogs appears to compare favorably with our experience with intraoral partial arytenoidectomy. Our experience suggests that it may allow for surgical resolution of obstruction caused by LP with fewer complications than occur with intraoral partial arytenoidectomy. Further, our experience suggests that use of video-assisted diode laser enhances precision of arytenoid cartilage resection.
because of the magnification afforded by the endoscope. This, in turn, reduces the total amount of vaporization performed, which may reduce the risk of aspiration pneumonia.15,22 The risk of surgical trauma is low and there appears to be a reduced incidence of marked postoperative edema, in humans as well as in the 20 dogs we report, which may reduce the need for intubation or temporary tracheotomy in the early postoperative period.11–15

The diode laser promotes coagulation from local thermal action created over the cartilaginous tissue during photovaporization,11,14,15,22,25–27 which dramatically decreases the risk of intramural hematoma formation.11,14,15,22,25–27 Intramural edema and hematoma formation are potential complications of standard intraoral techniques and generally occur during the early postoperative period28 as dyspnea, inspiratory stridor, and occasional cough.29–31 In the worst-case scenario, edema and hematoma formation, if marked, can be life threatening.29–31

CO₂ lasers are commonly used for laryngeal surgery in people in conjunction with microlaryngoscopy.27 Reported advantages are improved accuracy, rapid epithelialization, prevention of scar or granulation tissue formation, and a low incidence of aspiration pneumonia.11–13,15,19 Hemostasis is generally good with a CO₂ laser, unless the arytenoid artery is incised; the latter vessel requires electrocautery because of its size.11,27 Electrocautery is not needed when a diode laser is used.

Despite the relatively small number of the dogs treated, the risk of aspiration pneumonia (2/20 dogs) is similar to other studies and it is an acknowledged common and potentially fatal complication noted after standard surgical techniques.7,30,32,33 In 1 report,28 aspiration pneumonia occurred in 15 of 45 (33%) dogs treated with ventriculocordectomy and partial arytenoidectomy during the early postoperative period, and in 7 of 45 (16%) dogs it was a long-term complication. Aspiration of food can occur because the laryngeal aperture at the level of the corniculate process of the arytenoid cartilage is too large creating difficulty in closure during deglutition, especially if the LP is associated with a neuromuscular problem.6,30,34–36

Another serious medium- to long-term complication that can occur after intraoral arytenoidectomy is glottic stenosis, which may occur as a direct consequence of the formation of hypertrophic granulation or scar tissues after resection of oral tissues. Clinically, affected dogs appear to have reduced exercise tolerance and marked laryngeal inspiratory stridor.28–31,34,37 In our study, glottic stenosis did not occur within 6 months.

Partial arytenoidectomy by diode laser photoablation is a relatively quick technique taking 25–30 minutes11,15 with a maximum of 60 minutes in large dogs. To be successful, the surgeon must have good knowledge of endoscopic laser technique and video-assisted procedures. Lasers may also be used to remove the hypertrophic tissue that occurs after other surgical procedures.14,21,24

Our results suggest that unilateral partial arytenoidectomy by diode laser photoablation is a safe and promising technique for treatment of LP in dogs.

| Table 1. Summary Data for 20 Dogs with Bilateral Laryngeal Paralysis Treated by Unilateral Partial Arytenoidectomy with Photoablation by Diode Laser |
|---|---|---|---|---|
| Dog | Breed | Sex | Age (Years) | Weight (kg) | Final Aditus Diameter (mm) | Concurrent Conditions |
| 1 | Mixed breed | Male | 11 | 32 | 7 |
| 2 | Mixed breed | Male | 10 | 74 | 10 |
| 3 | Mixed breed | Female | 11 | 33 | 7 |
| 4 | Mixed breed | Male Castrate | 12 | 65 | 10 |
| 5 | Mixed breed | Female spayed | 11 | 24 | 6 |
| 6 | Mixed breed | Female | 14 | 22 | 6 |
| 7 | Mixed breed | Female spayed | 12 | 21 | 6 |
| 8 | Mixed breed | Male | 13 | 19 | 6 |
| 9 | Labrador | Male | 13 | 35 | 7 |
| 10 | Labrador | Male | 13 | 31 | 7 |
| 11 | Labrador | Male | 9 | 41 | 7 |
| 12 | Maremmano Shepherd | Female | 11 | 49 | 8 |
| 13 | Maremmano Shepherd | Male | 11 | 41 | 7 |
| 14 | Newfoundland | Female | 3 | 43 | 8 |
| 15 | Newfoundland | Male | 9 | 45 | 8 |
| 16 | Irish Setter | Male | 14 | 23 | 6 |
| 17 | Springer Spaniel | Male Castrate | 13 | 25 | 6 |
| 18 | Pit Bull | Male | 8 | 26 | 6 |
| 19 | Cocker Spaniel | Male | 10 | 10 | 6 |
| 20 | Saint Bernard | Male | 4 | 67 | 10 |
REFERENCES