
Scott P. Hammel, DVM; Heidi A. Hottinger, DVM, DACVS; Roberto E. Novo, DVM, MS, DACVS

Objective—To evaluate postoperative results for dogs with idiopathic laryngeal paralysis that underwent unilateral arytenoid lateralization (UAL).

Design—Retrospective case series.

Animals—39 dogs with idiopathic laryngeal paralysis.

Procedure—Medical records were reviewed, and information on surgical technique, hospitalization time, postoperative treatment, and complications was obtained. Owners were contacted by telephone for additional information if necessary.

Results—In all dogs, UAL had been performed by a single surgeon who used a standard surgical technique. Long-term follow-up information was available for all 39 dogs; mean follow-up time was 29.6 months (range, 3 to 61 months). Seven (18%) dogs developed postoperative pneumonia, and 6 of the 7 recovered with treatment. Twenty-two of the 39 (56%) dogs had minor complications, including unresolved coughing or gagging, continued exercise intolerance, vomiting, and seroma formation. Owners of 35 of the 39 (90%) dogs reported an improvement in postoperative quality-of-life score. Median survival time was 12 months; only 1 dog was euthanized because of respiratory tract disease following surgery.

Conclusions and Clinical Relevance—Results suggest that UAL will improve quality of life in most dogs with idiopathic laryngeal paralysis. However, the complication rate is high, with postoperative pneumonia being the most important major complication. Minor complications were common but did not adversely affect owner-assigned quality-of-life scores in most dogs. (J Am Vet Med Assoc 2006;228:1215–1220)

Abbreviations

UAL Unilateral arytenoid lateralization

diseases. However, in most dogs with acquired laryngeal paralysis, the condition is idiopathic.

Various surgical methods for treatment of laryngeal paralysis in dogs have been described, including bilateral arytenoid lateralization, UAL, partial arytenoidectomy, unilateral ventriculocordectomy, and castellated laryngofissure. Reported success rates (ie, resolution of clinical signs of airway obstruction) range from 65% to 100%, depending on the procedure used and various case factors, whereas reported complication rates range from 10% to 58%. In general, UAL, which involves permanent fixation of the arytenoid cartilage to the caudal aspect of the thyroid or cricoid cartilage, has been reported to be superior in terms of complication rate, surgical time, resolution of airway obstruction, and survival time.

The objective of UAL is to relieve upper airway obstruction by relocating the obstructing laryngeal tissue. The success of the procedure relies, in part, on minimizing postoperative complications. Aspiration pneumonia has been reported to be the most common serious complication following UAL, whereas other postoperative complications that have been reported include continued dyspnea, stridor, coughing, gagging, and choking when eating or drinking; failure of the surgical repair; signs of gastrointestinal tract disease; continued exercise intolerance; and megaesophagus.

Variations in surgical technique, surgeon skill level, and anesthetic protocol complicate assessments of previously reported results of UAL. In particular, the wide range of reported complication rates (0% to 28%) has been a cause for discussion among surgeons. It has been suggested that long-range retrospective studies arising from institutions where procedures were performed by numerous surgeons of varied experience levels and various anesthetic protocols were used may have different success rates than would be expected for studies from institutions with smaller numbers of surgeons where experience and protocols were more consistent.

The purpose of the study reported here was to evaluate postoperative results for dogs with idiopathic laryngeal paralysis that underwent UAL performed by a single surgeon with a consistent anesthetic protocol at a single facility over a limited period of time. It was our hope that by minimizing confounding factors associated with these variables we would be better able to determine clinical outcome for dogs undergoing UAL. Additionally, we were interested in identifying any
variables that were associated with a higher rate of postoperative pneumonia.

Criteria for Selection of Cases

Medical records of dogs examined at the Gulf Coast Veterinary Specialists between October 1996 and July 2002 were examined. Cases were included in the study if a diagnosis of idiopathic laryngeal paralysis had been made, UAL had been performed by a single surgeon (HAAH), and at least 3 months of follow-up data was available. Dogs with preoperative pneumonia and dogs in which laryngeal paralysis had developed as a result of neoplasia, radiation therapy, myasthenia gravis, or trauma were excluded.

Procedures

Medical records were reviewed, and information on signalment, body weight, clinical signs, duration of clinical signs, radiographic abnormalities, results of thyroid function testing, and results of laryngeal examination was obtained. Information was also obtained on any variations in surgical technique, additional procedures performed during the same anesthetic episode, surgery time for UAL, total anesthesia time, and anesthetic protocol. Postoperative data that were obtained included hospitalization time following surgery; postoperative medical management; results of postoperative thoracic radiography; if performed; complications; and information on any episodes of pneumonia that occurred, including time after surgery; severity; treatment; and whether hospitalization was required.

Postoperative complications were classified as major or minor. Complications were considered major if hospitalization was required (eg, development of pneumonia or respiratory distress). Complications were considered minor if hospitalization was not required (eg, development of a chronic cough, continued exercise intolerance, or seroma formation).

Owners of dogs included in the study were contacted via telephone to clarify information regarding preoperative clinical signs and postoperative signs and complications. Cause of death and postoperative survival time were recorded when applicable. Owners were asked to rate their pets’ quality of life, with 1 being poor and 10 being excellent, immediately prior to surgery, to ensure that the left arytenoid cartilage had been adequately abducted and that the larynx was patent. Regurgitated material was removed by means of suctioning, but suctioning was not routinely performed during anesthesia.

Surgical protocol—Dogs suspected of having laryngeal paralysis were examined and hospitalized for up to 48 hours before surgery, and during this time, owners were educated about possible complications and postoperative care for dogs undergoing UAL for laryngeal paralysis. Dogs were given acepromazine (0.025 to 0.05 mg/kg [0.011 to 0.023 mg/lb]; SC, IM, or IV; as needed) if sedation was required prior to surgery. In all dogs, laryngeal examination was performed to confirm the diagnosis of laryngeal paralysis prior to surgery. Laryngeal examination was performed at the time of anesthetic induction for UAL or as a separate procedure at the time of initial evaluation. A diagnosis of laryngeal paralysis was made if there was minimal or absent abduction of the arytenoid cartilages and secondary changes in tissues adjacent to the rima glottis, such as edema, erythema, and mucoid discharge. Observation of paradoxical movement of the arytenoid cartilages was also used to confirm the diagnosis of laryngeal paralysis. If necessary, doxapram (1.0 to 1.5 mg/kg [0.45 to 0.68 mg/lb], IV) was administered to stimulate ventilation during laryngeal examination.

Food was withheld for 12 to 18 hours, and water was withheld for 2 hours prior to induction of anesthesia. Dogs in which laryngeal examination had been performed previously were anesthetized with propofol (6 mg/kg [2.7 mg/lb], IV). Dogs in which laryngeal examination was to be performed prior to surgery were premedicated with oxymorphone (0.05 mg/kg, IM) or morphine (0.1 mg/kg [0.045 mg/lb], IM) and atropine (0.03 mg/kg [0.014 mg/lb], IM) or glycopyrrolate (0.02 mg/kg [0.009 mg/lb], IM) and sedated with propofol (up to 6 mg/kg, IV). Dogs were intubated, and anesthesia was maintained with isoflurane in oxygen. Lactated Ringer’s solution was administered IV at a rate of 22 mL/kg/h (10 mL/lb/h) for the first hour of anesthesia and at a rate of 11 mL/kg/h (5 mL/lb/h) for the remainder of the anesthetic period. A single dose of cefazolin (22 mg/kg, IV) was administered prior to surgery.

Left arytenoid lateralization was performed as described,11 with minor modifications. A lateral approach to the left arytenoid cartilage was performed, with the thyropharyngeus muscle incised transversely to increase exposure. The thyroid cartilage was disarticulated from the cricoid cartilage, exposing the muscular process of the arytenoid cartilage. The muscular process was sharply disarticulated from the cricoid cartilage, and the transverse arytenoid ligament was blindly transected with scissors after having been identified by means of palpation. A single suture of 2-0 polypropylene on a tapered needle was used to secure the muscular process of the arytenoid cartilage to the caudal edge of the thyroid cartilage. The suture was tightened as firmly as possible without pulling through the cartilage or breaking. The thyropharyngeus muscle, platysma, and subcutaneous fat were closed in layers with polydioxanone suture material in simple continuous patterns. A subcuticular pattern of polydioxanone suture material was used to close the skin; no skin sutures were placed. The larynx was examined immediately after surgery, but prior to anesthetic recovery, to ensure that the left arytenoid cartilage had been adequately abducted and that the rima glottis was patent. Regurgitated material observed at the time of laryngeal examination was removed by means of suctioning, but suctioning was not routinely performed during anesthesia.

Prednisolone sodium succinate (15 mg/kg [6.8 mg/lb]) was administered IV at the time of closure to minimize postoperative inflammation. To minimize sedation, additional doses of oxymorphone or morphine were given only if there was evidence of tachycardia or agitation during recovery from anesthesia. The goal was to allow dogs to recover from anesthesia.
quickly but with minimal agitation to prevent exaggerated laryngeal swelling. Endotracheal tubes were removed only when the dog was able to swallow well, and dogs were closely monitored for dyspnea or agitation for 24 to 48 hours after surgery. Low doses of acepromazine (0.025 to 0.05 mg/kg, IV or SC) were administered as needed for sedation. Fluids were administered IV (53 mL/kg/d [24 mL/lb/d]) for the first 12 hours after surgery, and small amounts of canned food were offered the morning after surgery. Prednisone (0.5 mg/kg [0.23 mg/lb], PO) was administered once daily for 3 days after surgery and every other day for an additional 5 to 10 days. Cephalexin (20 mg/kg [9 mg/lb], PO, q 8 h) was administered for 5 days. Butorphanol (0.1 to 0.2 mg/kg [0.045 to 0.09 mg/kg], PO) was dispensed for dogs that required additional sedation or analgesia after discharge from the hospital. For the first 2 weeks after surgery, dogs were fed canned food or dry food soaked in water. Dry food was offered after this time, but if there was an increase in coughing, canned food or dry food soaked in water was fed for an additional 2 weeks. All dogs were offered dry food 4 weeks after surgery if the owner desired.

Owners received written instructions at the time dogs were discharged from the hospital that outlined feeding instructions and advocated 3 weeks of exercise restriction. Use of a harness was suggested to replace use of a standard neck collar. Owners were also instructed to immediately seek veterinary attention if there was any increase in respiratory rate or effort, change in gum color, decrease in appetite, or decrease in exercise tolerance, as these were considered possible signs of aspiration pneumonia.

Statistical analysis. χ² Analyses were performed to determine whether outcome (survived vs died or euthanatized) was significantly associated with age at the time of surgery (≤ 11 years vs > 11 years); breed; body weight (≤ 31 kg [68 lb] vs > 31 kg); sex; duration of clinical signs prior to surgery (≤ 8 months vs > 8 months); the presence (yes vs no) of various preoperative signs, including coughing, exercise intolerance, altered phonation, vomiting, and episodes of collapse or cyanosis; the presence of various postoperative signs, including persistent coughing, seroma formation, and persistent exercise intolerance; medications used before and after surgery; surgery time (≤ 32 minutes vs > 32 minutes); anesthesia time (≤ 95 minutes vs > 95 minutes); total postoperative hospitalization time (≤ 2 days vs > 2 days); development of pneumonia (yes vs no); and preoperative owner-assigned quality-of-life score (≤ 3.5 vs > 3.5). Similarly, t tests were used to determine whether mean values for these factors were significantly different between dogs that were still alive at the time of final follow-up and dogs that were deceased. Kaplan-Meier survival analyses were performed to test for differences in survival time distributions for these factors. Additional χ² analyses, t tests, and Kaplan-Meier survival analyses were performed to evaluate possible associations between the listed factors and development of pneumonia after release from the hospital. All analyses were performed with standard software; values of P ≤ 0.05 were considered significant.
ized for additional days at the owner's request or because the anticipated discharge day occurred on a day when the hospital was closed for patient release (ie, weekend or holiday). When this additional time was excluded, mean hospitalization time following surgery was 1.9 days (range, 1 to 4 days).

In 3 dogs, thoracic radiography was performed following surgery but prior to discharge from the hospital because of suspected pneumonia. None of these dogs had radiographic evidence of pulmonary infiltrates at that time, and none were judged to require treatment for pneumonia prior to discharge. One of these dogs developed clinical and radiographic evidence of pneumonia 3 months after surgery; this dog recovered and was alive and doing well at the time of final follow-up. The other 2 dogs never developed clinical signs of pneumonia.

Major complications occurred in 7 of the 39 (18%) dogs. All 7 had at least 1 episode of pneumonia verified radiographically following surgery. Mean time from surgery to onset of clinical signs of pneumonia was 4.2 months (median, 2 months). Two dogs developed pneumonia > 6 months after surgery. One of these 2 dogs had episodes of pneumonia 6, 10, 15, and 25 months after surgery, all of which required hospitalization. At the time of final follow-up 30 months after surgery, the dog was reportedly doing well. The other dog was euthanized 17 months after surgery because of pneumonia that developed 16 months after surgery. Owners of 6 of the 7 dogs that developed pneumonia after surgery indicated that they were satisfied with the clinical outcome despite the development of pneumonia. None of the dogs in the study was reported to have developed megaesophagus before or after surgery.

Minor postoperative complications occurred in 22 of 39 (56%) dogs. Eleven of the 39 (28%) dogs had unresolved coughing or gagging, 9 (23%) had continued exercise intolerance, 6 (15%) had episodes of vomiting, and 4 (10%) developed a seroma that required drainage. Thoracic radiography was performed in all dogs in which coughing did not resolve, but none of these dogs had radiographic evidence of pneumonia. Owners of 19 of the 22 (86%) dogs with minor complications indicated that their dogs' quality of life had improved after surgery despite development of minor complications. Two owners indicated that their dogs' quality of life had worsened after surgery because of persistent coughing, and the owner of a dog with exercise intolerance and stridor indicated that quality of life was unchanged because of a lack of improvement in clinical signs after surgery.

In 1 dog, stridor recurred 5 months after surgery, and in a second dog, stridor recurred 2 and 7 months after surgery. During all 3 episodes, laryngeal examination revealed moderate inflammation but adequate lateralization of the left arytenoid cartilage, and dogs responded favorably to short-term corticosteroid administration. None of the dogs required revision of the UAL.

Only 1 of 39 (3%) dogs was reported to have died or been euthanized because of respiratory tract disease. This was the dog that was euthanized 17 months after surgery because of pneumonia. Twenty-three dogs died or were euthanized because of unrelated conditions, and 15 dogs were still alive at the time of the present study. Mean survival time for the 39 dogs for which long-term follow-up information was available was 15.4 months (median, 12 months; range, 3 to 36 months). The most common causes of death or euthanasia were neoplasia (6 dogs) and poor quality of life because of arthritis (3).

None of the factors examined related to survival (age, weight, breed, or sex), presence of preoperative clinical signs (coughing, exercise intolerance, altered phonation, vomiting, or episodes of collapse or cyanosis) or postoperative clinical signs (persistent coughing, seroma formation, or persistent exercise intolerance), medications used before or after surgery, duration of surgery or anesthesia, development of pneumonia, or owner-assigned quality-of-life score was significantly associated with outcome (survived vs died or euthanized) or development of pneumonia after surgery. Mean values for survival time and time to development of pneumonia were not significantly different between groups when dogs were grouped on the basis of these factors, and Kaplan-Meier survival analysis did not reveal any differences in survival time distributions for any of these factors.

For all dogs, median quality-of-life score assigned by the owner prior to surgery was 4 (possible scores ranged from 1 to 10), and median score assigned > 2 weeks after surgery was 8. Median change in score was 3.5 points. Thirty-five of the 39 (90%) owners reported an improvement in postoperative score, compared with the preoperative score, whereas 2 (5%) reported no change in score, and 2 (5%) reported a decrease in score.

Discussion

The present study was designed to remove confounding factors associated with case selection, surgical technique, surgeon skill level, and anesthetic protocol to provide a better estimate of outcome for dogs undergoing UAL because of idiopathic laryngeal paralysis. Results suggest that UAL will improve quality of life in most dogs with idiopathic laryngeal paralysis. However, the complication rate is high, with postoperative pneumonia being the most important major complication. Although most dogs that develop postoperative pneumonia will recover, hospitalization may be required. Minor complications such as unresolved coughing or gagging, continued exercise intolerance, vomiting, and seroma formation were common but did not adversely affect owner-assigned quality-of-life scores in most dogs.

The only major postoperative complication in the present study was pneumonia, which occurred in 7 of 39 (18%) dogs. This was higher than the 10% complication rate reported in 2 previous studies, both of which involved populations similar to the population in the present study. In contrast, it was lower than the 28% major complication rate reported in a retrospective study of 109 dogs that underwent UAL. However, that study included dogs with laryngeal paralysis caused by factors such as trauma, mass lesions, congenital diseases, and neurologic disorders. Inclusion of dogs in which laryngeal paralysis was the result of an
Identifiable primary disease, particularly dogs in which laryngeal paralysis was a result of neoplasia or megaesophagus, may have substantially increased the complication rate in that report. In addition, a temporary tracheostomy tube was used in some dogs in that study, which increased the complication rate, whereas a tracheostomy tube was not used in any of the dogs in the present study.

Variations in surgical technique and surgeon experience may have affected complication rates in previous studies. Some studies included dogs in which surgery was performed by various surgeons with different levels of experience, including residents and staff surgeons. One of these studies did not specifically report on details of the surgical technique (e.g., whether the thyroid cartilage was disarticulated from the cricoid cartilage or whether the transverse arytenoid ligament was transected).

Variations in complication rate among studies may also be a result of differences in criteria used to determine whether a complication had occurred. In the present study, as in a previous study, we defined a complication as major if hospitalization or surgical revision was required. Major complications in that previous study included pneumonia (19%), death (14%), and surgical failure (6%). In a study of 20 dogs that underwent UAL, Demetriou and Kirby reported that the only major complication was pneumonia, which occurred in 2 (10%) dogs. In a study of 65 dogs that underwent UAL, White also reported a complication rate of 10%, but complications that occurred included surgical failure, severe inflammation requiring temporary tracheostomy, and development of a seroma requiring additional surgery.

Only 2 dogs in the present study were confirmed to have developed pneumonia > 6 months after undergoing UAL. Although we agree with the previous suggestion that dogs that undergo UAL are susceptible to pneumonia for the remainder of their lives, it appears that dogs may undergo an adjustment period following surgery, such that they are less likely to develop pneumonia as the time from surgery increases. In the present study, we were unable to identify any factors associated with postoperative development of pneumonia; however, the low number of dogs that developed pneumonia limited our ability to identify significant differences.

Only 1 dog in the present study had multiple episodes of pneumonia following UAL. The reason for this dog's repeated episodes of pneumonia was not known, but excessive abduction of the arytenoid cartilage, undiagnosed megaesophagus, another concurrent primary neuromuscular disorder, immune dysfunction, or chronic subclinical pneumonia may have played a role. The fact that only 1 dog had repeated episodes of pneumonia suggests that occurrence of a single episode of postoperative pneumonia does not necessarily predispose dogs to additional episodes.

Six of the 7 dogs in the present study that developed pneumonia after surgery recovered. This suggests that in the absence of specific risk factors, dogs that develop pneumonia are likely to recover. It is unknown whether the dog that was euthanized would have recovered had the owner elected treatment for the pneumonia.

Duration of follow-up can affect the reported incidence of complications. Follow-up time ranged from 3 to 61 months in the present study, but for 35 of the 39 dogs for which follow-up information was available, follow-up time was > 12 months. Only 1 dog developed a complication > 12 months after surgery, suggesting that follow-up time was sufficient for most dogs in the study.

Complication rate was also likely affected in the present study by the diligence with which owners detected and reported clinical problems following surgery. Although all owners were provided information on possible signs of aspiration pneumonia, it is possible that some owners may not have recognized low-grade pneumonia as a clinically relevant problem, particularly because transient coughing is common following UAL. In addition, although all owners were questioned whether specific complications had occurred, some owners may not have recalled or reported all complications. Because follow-up thoracic radiography was not routinely performed, the true incidence of pneumonia was probably higher than recognized.

Eleven of 39 (28%) dogs in the present study had persistent coughing or gagging after undergoing UAL. Although none of these dogs had radiographic evidence of pneumonia, it is possible that recurrent pneumonia was responsible for clinical signs in some of these dogs.

Thirty-five of 39 (90%) owners in the present study reported an improvement in quality-of-life score following UAL, which is similar to owner satisfaction rates reported in previous studies. Although owners were asked to discount conditions unrelated to the respiratory tract, such as severe arthritis, when assigning quality-of-life scores, it is possible that unrelated conditions may have affected quality-of-life scores assigned by some owners.

Only 1 of 39 (3%) dogs in the study died or was euthanized because of respiratory tract disease. Percentages of dogs in previous studies that died or were euthanized because of respiratory tract disease following UAL were 0%, 5%, 3%, 2%, and 14%. In the studies that reported deaths related to respiratory tract disease, pneumonia was the most common cause of death.

An association between hypothyroidism and laryngeal paralysis has been suggested previously, but a specific link has not been substantiated. In the present study, serum thyroxine concentration was low in 16 of 22 (73%) dogs. However, because thyroid-stimulating hormone assays were not performed, the clinical importance of this finding is unknown and a cause-and-effect relationship cannot be established.

References

4. White RAS. Unilateral arytenoid lateralization: an assess-