Outcome following elective unilateral arytenoid lateralization performed in an outpatient manner is comparable to hospitalization for dogs with laryngeal paralysis

Madison P. Shubert, DVM*, and Justin B. Ganjei, DVM, DACVS

Veterinary Surgical Centers, Vienna, VA

*Corresponding author: Dr. Shubert (madison@shubert.me)

OBJECTIVE
To compare outcomes and short-term complications of dogs with laryngeal paralysis treated with unilateral arytenoid lateralization performed on an outpatient versus inpatient basis.

ANIMALS
44 client-owned dogs.

PROCEDURES
Medical records were retrospectively reviewed to identify dogs that underwent unilateral arytenoid lateralization for the treatment of laryngeal paralysis between 2018 and 2022. Signalment, surgical technique, anesthesia time, comorbidities, laryngeal examination, concurrent procedures, use of prokinetics and sedatives, episodes of vomiting, episodes of regurgitation, duration of hospitalization, postoperative complications, anxiety scores, and pain scores were recorded. Variables were compared between dogs and grouped by outpatient or inpatient management.

RESULTS
The overall complication rate was 22.7% (10/44), with 35% (7/20) being in the inpatient group and 12.5% (3/24) being in the outpatient group. The overall mortality rate was 6.8% (3/44). The overall morbidity for hospitalized patients versus those undergoing and outpatient procedure was 5% (1/20) and 4.2% (1/24), respectively. There was no significant difference between overall rate of complications and mortality rates between the inpatient and outpatient groups.

CLINICAL RELEVANCE
Results suggested that outpatient management of dogs with laryngeal paralysis treated with elective unilateral arytenoid lateralization is an appropriate method of postoperative management with no difference in complication or mortality rates. Further prospective studies with standardized surgical, sedative, and antiemetic protocols are warranted to evaluate more definitely.

Laryngeal paralysis is a common disease process that occurs secondary to denervation atrophy of the recurrent laryngeal nerve resulting in dysfunction of the cricoarytenoid dorsalis muscle and failure of the arytenoid cartilages and vocal folds to abduct during inspiration.[1–3] Numerous surgical techniques have been described to treat this condition, with unilateral arytenoid lateralization being the most commonly performed.[1–3] Various complication rates for treatment of laryngeal paralysis have been reported in the literature, with a wide range of morbidity and mortality rates from 10% to 58% and 14% to 67%, respectively.[3–7] Treatment with unilateral arytenoid lateralization results in the lowest complication rate, with some studies reporting as little as 10%.[8] The most common postoperative complications associated with unilateral arytenoid lateralization include aspiration pneumonia, which is reported to occur in 23.6%.[7] In 1 study,[7] the reported mortality rate in patients > 1 year postoperatively was 14.3% and secondary to aspiration pneumonia. Other complications can include coughing and recurrence of clinical signs from tearing of the suture or fracture of the arytenoid cartilage.[2] Complications such as coughing after eating or drinking have also been shown to occur in 89% of dogs.[4,9–11]

Aspiration pneumonia is a lifelong potential complication of the procedure and has been reported to occur in 5% to 25%[3,7,12–15] of patients postoperatively, with 1 study[13] reporting rates as high as 31.8% at 4-year follow-up periods. Because of the increased risk of aspiration pneumonia, numerous techniques have been

evaluated in the immediate postoperative period to reduce the risk of vomiting and regurgitation. A prospective randomized multicenter clinical trial[16] evaluated the effect of perioperative IV constant rate infusion of metoclopramide on the incidence of aspiration pneumonia. This study found no significant differences on the development of aspiration pneumonia between the control and treated groups. A retrospective study[13] evaluating 232 patient undergoing unilateral arytenoid lateralization found that postoperative administration of an opioid was a significant risk factor for the development of aspiration pneumonia in the short term (< 14 days postoperatively).

Both human- and veterinary-based studies have shown that stress during hospitalization results in delayed wound healing, gastrointestinal diseases (gastric ulceration, vomiting, and nausea), and increased susceptibility to infections.[10,11,17-19] In veterinary medicine, the following factors play a role in the high rate of stress seen in hospitalized patients: separation from primary caretaker, new environment and stimuli, increased noise levels, and confinement in cages.[20-26] One study[27] examined a less-invasive unilateral arytenoid lateralization and reported same-day discharge with no life-threatening adverse events. To the authors' knowledge, no studies have directly compared inpatient versus outpatient treatment of dogs undergoing unilateral arytenoid lateralization. The objective of this study was to compare short-term outcome and complication rates between outpatient management and traditional inpatient management of dogs undergoing unilateral arytenoid lateralization. An additional objective was to determine whether outpatient management is a safe alternative to the traditional inpatient postoperative management with careful patient selection. The authors hypothesized that outpatient unilateral arytenoid lateralization would be a safe alternative to inpatient postoperative management and may be associated with less postoperative complications.

Materials and Methods

Case selection
Dogs were eligible for study inclusion if they were diagnosed with laryngeal paralysis and treated with an elective unilateral arytenoid lateralization. Dogs were grouped according to whether the procedure was performed on an outpatient basis (outpatient group) or they were hospitalized overnight postoperatively (inpatient group). Dogs were excluded if they had incomplete medical records, had other concurrent upper airway procedures performed, failed to have a complete 2-week follow-up medical record, or underwent emergency surgery for an upper airway crisis. The minimum information required in the records included a sedated laryngeal examination to diagnose laryngeal paralysis, neurologic examination, preoperative thoracic radiographs to rule out the presence of aspiration pneumonia and megaesophagus, a complete surgical report, and an in-person follow-up examination at 2 weeks postoperatively.

Medical records review
Electronic medical records were searched to identify all dogs that underwent unilateral arytenoid lateralization between July 30, 2018, and July 20, 2022. The search terms included "laryngeal paralysis" and "arytenoid lateralization." Cases were included if the medical records met the inclusion criteria listed above. Data retrieved from the medical records included signalment, clinical signs, neurologic examination, diagnostics performed preoperatively and up to the 2-week recheck, results of sedated oral examination, surgical procedure (thyroarytenoid lateralization or cricoarytenoid lateralization), duration of anesthesia, use of gastroprotectants, use of promotility agents, premedication and induction agents used, postoperative opioid use, postoperative sedative use, pain scores, and anxiety scores.

Anesthesia
All dogs underwent a laryngeal examination at the time of anesthetic induction to confirm the diagnosis of laryngeal paralysis. Anesthesia was induced using propofol (4 to 6 mg/kg, IV) to effect. A diagnosis of laryngeal paralysis was made if there was minimal or absent abduction of the arytenoid cartilages or if there was adduction of the arytenoid cartilages observed during inspiration. If necessary, doxapram (1.0 to 2.0 mg/kg, IV) was administered to stimulate ventilation. Following diagnosis, patients were then premedicated with either butorphanol, hydromorphone, methadone, or fentanyl and midazolam or diazepam. Dogs were induced with propofol that was titrated to effect and subsequently intubated. Anesthesia was maintained with isoflurane in oxygen for all patients. Lactated Ringer solution was administered IV at a rate of 5 mL/kg/h. Cefazolin (22 mg/kg, IV) was administered prior to surgery and every 90 minutes during the surgical procedure.

Surgical technique
All dogs were placed in right lateral recumbency with a towel placed under the neck in an extended position. The thoracic limbs were retracted caudally. Following aseptic preparation of the left lateral cervical region, an approximately 3- to 4-cm horizontal incision was made over the larynx just ventral to the jugular vein. Following dissection of the subcutaneous tissue and platysma muscle, the thyropharyngeus muscle was exposed and incised transversely to expose the arytenoid and thyroid cartilages. A single stay suture of 3-0 polydioxanone was inserted through the freed thyroid cartilage to facilitate ventrolateral retraction. The cricothyroid articulation was disarticulated at the discretion of the surgeon. The fascial membrane of the larynx was then incised. The cricoarytenoideus dorsalis muscle was freed from the caudal aspect of the muscular process using either sharp dissection or bipolar electrosurgery, with care taken to stay as close to the muscular process as possible. The cricoarytenoid articulation was then partially dissected. Two sutures of 2-0 polypropylene or polyglyconate were then used to secure the muscular process of the arytenoid cartilage to the caudodorsal aspect of the cricoid cartilage in cases of cricoarytenoid

lateralization or to the caudal edge of the thyroid cartilage in cases of thyroarytenoid lateralization, and the sutures were tightened. After lavage, routine closure with polydioxanone and monocryl was performed. The larynx was examined immediately after surgery but prior to anesthetic recovery to ensure that left arytenoid lateralization had been adequately abducted.

Postoperative care

Following the procedure, patients were monitored closely for respiratory distress. All dogs were maintained on crystalloids IV (60 mL/kg/d) until discharge. Cefazolin, 22 mg/kg, IV was continued every 8 hours for 24 hours. Patients were monitored every hour for vomiting, regurgitation, pain, and anxiety. The use of postoperative metoclopramide constant rate infusion (2 mg/kg/d) was clinician dependent. Because most patients received Cerenia at induction, the perioperative use of ondansetron (0.5 mg/kg) every 8 hours was used if deemed necessary. Additionally, gastroprotectants such as famotidine (1 mg/kg) or pantoprazole (1 mg/kg) was used if directed by the attending clinician.

Anxiolytic therapy was provided to patients on the basis of their anxiety score and if they displayed signs of panting, pacing, whining, and barking. Anxiety scores in hospital were recorded and categorized as follows: none (0), mild (1), moderate (2), and severe (3). For patients that were hospitalized for 24 hours after surgery (inpatient group), anxiolytic medications administered included dexmedetomidine (1 μg/kg, IV), dexmedetomidine constant rate infusion (0.5 to 0.75 μg/kg/h), and acepromazine (0.005 to 0.1 mg/kg, IV). The outpatient group received butorphanol (0.15 mg/kg, IV) if painful perioperatively and dexmedetomidine (1 μg/kg) if anxiety was noted.

Respiratory rate, effort, and presence of stridor was monitored and documented every hour for all patients while in hospital.

Dogs in both the inpatient and outpatient group were discharged with tramadol (4 to 5 mg/kg) every 6 to 8 hours, gabapentin (5 to 10 mg/kg) every 8 hours, trazodone (3 to 5 mg/kg) every 8 to 12 hours, and carprofen (2 mg/kg) every 12 hours.

Follow-up

Dogs returned 10 to 14 days postoperatively for suture removal and recheck. Information gathered included incisional complications, presence of vomiting or regurgitation, anxiety, pain, and respiratory effort.

Complications

For the purposes of the present study, complications were divided into perioperative and postoperative. Perioperative complications were those that occurred during the period following admission to the hospital and following the surgical procedure but prior to discharge from the hospital. Postoperative complications were defined as those that occurred during the period following discharge from the hospital up until the 2-week recheck examination. Complications were defined as any respiratory problem requiring hospitalization or necessitating additional surgical intervention, surgical site infection, surgical

site dehiscence, and any condition that resulted in death or euthanasia. A diagnosis of aspiration pneumonia was made on the basis of clinical signs and radiographic findings on thoracic radiographs.

Continuation of mild inspiratory stridor with activity or excitement following surgery was not documented as a complication in the perioperative or postoperative period. Perioperative and postoperative coughing and change in phonation following unilateral laryngeal tie-back were not recorded as complications, as these are common developments.

Statistical analysis

Normal probability plots were inspected to assess whether numerical variables followed a normal distribution. Subsequently, numerical variables were summarized as mean (SD). Categorical variables were summarized as counts and percentages. Inpatients were compared to outpatients using the 2-sample t test (for age, body weight, and anesthesia time) or the Fisher exact test (for the categorical variables). Statistical significance was set to $P < .05$. All analyses were performed using SAS version 9.4 (SAS Institute Inc).

Results

One hundred five dogs met the initial criteria and were screened for study inclusion. Sixty-one cases were excluded due to lack of follow-up, incomplete medical records, or concurrent upper airway comorbidities. The remaining 44 dogs that underwent unilateral arytenoid lateralization were included in the study. Of the 44 patients included in the study, 35 (79.5%) were Labrador Retrievers, 2 (4.5%) were Golden Retrievers, 2 (4.5%) were Labradoodles, 1 (2.3%) was a Labrador Retriever mix, 1 (2.3%) was a Shepherd mix, 1 (2.3%) was a Doberman Pinscher, 1 (2.3%) was an American Staffordshire Terrier, and 1 (2.3%) was an American Pit Bull **(Table 1)**.

Table 1—Description of the population.

Variable	Inpatient group n (%)	Outpatient group n (%)	P value
Breed			
Golden Retriever	0 (0.0)	1 (4.2)	.1951
American Pit Bull	0 (0.0)	1 (4.2)	
American Staffordshire Terrier	1 (5.0)	0 (0.0)	
Doberman Pinscher	1 (5.0)	0 (0.0)	
Golden Retriever	0 (0.0)	1 (4.2)	
Labradoodle	2 (10.0)	0 (0.0)	
Labrador Retriever	15 (75.0)	20 (83.3)	
Labrador Retriever mix	0 (0.0)	1 (4.2)	
Shepherd mix	1 (5.0)	0 (0.0)	
Castration status			.7490
FI	0 (0.0)	1 (4.2)	
FS	8 (40.0)	11 (45.8)	
MI	1 (5.0)	0 (0.0)	
MN	11 (55.0)	12 (50.0)	
Presence of comorbidities	17 (85.0)	14 (58.3)	.0958

FI = Female intact. FS = Female spayed. MI = Male intact. MN = Male neutered.

3

Mean and median body weights were 36.1 and 35.2 kg, respectively (range, 23 to 51 kg). Mean and median age was 11.9 and 12 years, respectively (range, 8 to 15 years). Twenty-three (52.3%) patients were male neutered, 19 (43.2%) were female spayed, 1 (2.3%) was female intact, and 1 (2.3%) was male intact. Of the 44 patients included in the study, 20 (45.4%) were hospitalized for 24 hours after surgery (inpatient group) and 24 (54.5%) were discharged the day of surgery (outpatient group). Of the surgical procedures performed, 12 (27.3%) were unilateral thyroarytenoid lateralizations, 32 (72.7%) were unilateral cricoarytenoid lateralizations, and there was no combination of unilateral thyroarytenoid and cricoarytenoid lateralization performed. Prokinetics were used in 26 patients with 10 (50%) of those being in the inpatient group and 16 (66.7%) being in the outpatient group. Antiemetic injections were used in 16 (80%) inpatients and 22 (91.7%) outpatients. Perioperative opioids were used in 10 (50%) inpatients versus 8 (33.3%) outpatients (*P* = .3588; **Table 2**).

Table 2—Results of intergroup comparison of postoperative variables.

Variable	Inpatient group n (%)	Outpatient group n (%)	*P* value
Anxiety score in hospital			.2777
0	11 (55.0)	19 (79.2)	
1	3 (15.0)	3 (12.5)	
2	4 (20.0)	1 (4.2)	
3	2 (10.0)	1 (4.2)	
Use of prokinetics	10 (50.0)	16 (66.7)	.3588
Use of antiemetics	16 (80.0)	22 (91.7)	.3871
Perioperative opioid usage	10 (50.0)	8 (33.3)	.3588
Perioperative dexmedetomidine administration	16 (80.0)	22 (91.7)	.3871
Perioperative acepromazine administration	1 (5.0)	0 (0.0)	.4545
Aspiration pneumonia	5 (25.0)	1 (4.2)	.0773
Overall morbidity	1 (5.0)	1 (4.2)	.1443
Overall mortality	1 (5.0)	2 (8.3)	1.00

Dexmedetomidine was administered perioperatively in 4 (20%) inpatients and 2 (8.3%) outpatients (*P* = .3871). In the inpatient group, 11 (55%) had an anxiety score of 0, 3 (15%) had an anxiety score of 1, 4 (20%) had an anxiety score of 2, and 2 (10%) had an anxiety score of 3. In the outpatient group, anxiety scores were assigned on a scale of 0 to 3 and were found to be 19 (79.2%), 3 (12.5%), 1 (4.2%), and 1 (4.2%), respectively. In-hospital regurgitation was noted in 2 (10%) inpatients and none of the dogs in the outpatient group, and vomiting in hospital was noted in 1 (5%) inpatient and no outpatients. In the inpatient group, 4 (20%) dogs were represented to the emergency department for complications related to surgery within 2 weeks postoperatively compared to 2 (8.3%) dogs in the outpatient group (*P* =

0.3871). Radiographic evidence of aspiration pneumonia within the 2-week postoperative period was documented in 5 (25%) dogs in the inpatient group and 1 (4.2%) dog in the outpatient group (*P* = .0773). Three patients died within the 2-week postoperative period, resulting in a 6.8% mortality rate. Of those 3 patients, 2 were euthanized secondary to their disease process (5.0% of inpatients and 4.2% of outpatients) and 1 died on the way to the hospital after having an obstructive respiratory event (*P* = 1.00). The overall morbidity in the inpatient versus outpatient group was 5% versus 4.2%, respectively. The mortality rate for inpatients versus outpatients was 5.0% versus 8.3%, respectively. There was no significant difference in morbidity and mortality rates between groups (*P* = 1.00 and 1.00, respectively). The overall complication rate in this study was 22.7% with 35% of those being in the inpatient group and 12.5% being in the outpatient group. There was no significant difference in rate of complications between groups (*P* = .1466).

Discussion

The objectives of the present study were to compare complication rates and short-term outcome following elective unilateral arytenoid lateralization in dogs with laryngeal paralysis and determine whether there was a difference between outpatient procedures compared with inpatient procedures. Results of the present study suggest no statistically significant difference in mortality or morbidity during the postoperative period between the inpatient group (5%) and outpatient group (8.3%). Therefore, we accept our hypothesis that outpatient unilateral arytenoid lateralization is a safe alternative to overnight hospitalization following surgery.

Historically, the purpose of hospitalizing patients after unilateral cricoarytenoid lateralization was to administer prokinetic and antinausea therapy to try and reduce episodes of vomiting and regurgitation that may lead to development of aspiration pneumonia, as well as to monitor respiratory status. The effects of metoclopramide administration on the presence of postoperative aspiration pneumonia has been evaluated in several studies with mixed results. A retrospective study[28] including 43 client-owned dogs after unilateral arytenoid lateralization suggested that postoperative aspiration pneumonia may be reduced from 50% to 17% by metoclopramide administration in the immediate perioperative period. Another multicenter randomized clinical trial found no significant differences in the rate of development of aspiration pneumonia when a metoclopramide constant rate infusion was used.[16] Given the minimal effects that prokinetic therapy had on the incidence of aspiration pneumonia, patients without a history of frequent regurgitation or vomiting likely wouldn't benefit from hospitalization. Instead, it is possible that hospitalization may cause anxiety and distress, which would manifest as restlessness, panting, and vocalization. A catastrophic sequela of this would be strain on the surgical site and failure. Results of

4

a large prospective observational study[29] found that 79% of dogs in a veterinary clinic had signs consistent with fear and anxiety. In the present study, the inpatient group had higher anxiety scores compared with those in the outpatient group. It is vital to keep patients calm after arytenoid lateralization procedures for a variety of reasons. The longer patients are hospitalized, the more likely they are to experience trigger stacking, necessitating fast-acting anxiolytics administered IV. Trigger stacking occurs when a patient experiences numerous stressors without time to return to baseline, which can be seen when measuring serum and salivary cortisol levels.[30,31] This can occur during short and long periods of time.[30,31] Trigger stacking often results in progressive anxiety and is associated with behaviors such as pacing, panting, barking, and whining. Excessive barking, panting, and whining could lead to increased stress on the arytenoid lateralization site and tearing of suture or breakage of arytenoid cartilages. In addition, the increased hyperventilation caused by anxiety could lead to excessive carbon dioxide loss and respiratory alkalosis. Lastly, hospitalization following surgery is associated with a higher cost compared to outpatient procedures. A 2019 paper[32] in human medicine explored the perioperative costs and readmission rates in 73,724 individuals undergoing either ambulatory (outpatient) versus inpatient elective procedures (hernia repair, primary or total thyroidectomy, laparoscopic cholecystectomy, or laparoscopic appendectomy). Findings suggested that adjusted mean surgical costs were significantly lower for ambulatory versus inpatient cases for each procedure. Additionally, the odds of experiencing readmission within a 30-day period of the surgery was lower in ambulatory versus inpatients surgeries.[32] Because there is no increased mortality with outpatient unilateral cricoarytenoid lateralization procedures, significant reductions in healthcare expenditures could allow for more owners to afford this procedure.

This study had several limitations secondary to its retrospective nature. Sixty-one cases were excluded because of incomplete medical records, loss of follow-up, and concurrent upper airway surgery. Additionally, patients were excluded if they presented as a transfer from the emergency department for respiratory distress. There was no standardized perioperative complication period, postoperative protocol, or grading for anxiety and pain management and lack of consistency in personnel observing and evaluating patients that were hospitalized. This could have led to under- or overreporting anxiety in the patients hospitalized following surgery. There was no standardized anesthetic, antiemetic, prokinetic, or gastroprotectant protocol among the surgeons in the study, which could have affected outcome of adverse events such as regurgitation, vomiting, and/or ileus. There were 5 patients (3 inpatients and 2 outpatients) that received hydromorphone IV as part of a premedication protocol. Due to its μ opioid receptor agonist properties, vomiting can occasionally be seen following administration. One study[33] found that the route of administration in dogs undergoing routine orthopedic surgery had no effect on the likelihood of vomiting. All patients that received hydromorphone in their anesthetic protocol were administered maropitant IV prior to reduce the chances of vomiting. Numerous studies have evaluated the efficacy of maropitant on inhibiting vomiting in patients receiving hydromorphone (both IV and IM).[34] These found that maropitant prevented vomiting, retching, and nausea when given prior to hydromorphone administration.[34] The surgeries performed in the current study were performed by 5 board-certified surgeons, and variations in surgeon experience and surgical technique may have also led to variation in outcome. Both cricoarytenoid and thyroarytenoid lateralization were performed in this study. Although studies have shown that each of these procedures affects the rima glottidis area differently, the clinical outcomes observed in dogs treated with either procedure have not been shown to differ.[14] The decision to perform cricothyroid disarticulation was also left up to the surgeons' discretion in this study, which also could have affected outcome as disarticulation has been shown to destabilize the larynx and affect glottic diameter.[35] Finally, one surgeon routinely used polyglyconate suture for arytenoid lateralization while the others used polypropylene. Although the former is absorbable, it retains a great amount of tensile strength after 4 weeks. Given the short-term follow-up period of 2 weeks used in this study, this likely shouldn't have caused any clinical difference between groups. It is important to note that it is recommended to place a permanent suture (polypropylene) to reduce risk of failure of lateralization in the long term given the dynamic nature of the organ. Future prospective studies should be performed to look at inpatient versus outpatient unilateral cricoarytenoid lateralization and thyroarytenoid lateralization procedures. A prospective study would allow for standardized patient recordkeeping and protocols evaluating anxiety.

Results of the current study suggest no greater increase in mortality nor morbidity in patients discharged the same day as surgery. It is important to note that careful patient selection is vital to determining whether outpatient surgery is feasible.

Acknowledgments

References

1. Hedlund CS. Surgery of the upper respiratory system. In: Fossum TW, ed. *Small Animal Surgery.* 2nd ed. Mosby; 2002:734–740.
2. Monnet E. Surgical treatment of laryngeal paralysis. *Vet Clin North Am Small Anim Pract*. 2016;46(4):709–717. doi:10.1016/j.cvsm.2016.02.003
3. Schofield DM, Norris J, Sadanaga KK. Bilateral thyroarytenoid

cartilage lateralization and vocal fold excision with mucosoplasty for treatment of idiopathic laryngeal paralysis: 67 dogs (1998–2005). *Vet Surg*. 2007;36(6):519–525. doi:10.1111/j.1532-950X.2007.00302.x

4. Gaber CE, Amis TC, LeCouteur RA. Laryngeal paralysis in dogs: a review of 23 cases. *J Am Vet Med Assoc*. 1985;186(4):377–380.

5. Lahue TR. Treatment of laryngeal paralysis in dogs by unilateral cricoarytenoid laryngoplasty. *J Am Anim Hosp Assoc*. 1989;25:317–324.

6. Petersen SW, Rosin E, Bjorling DE. Surgical options for laryngeal paralysis in dogs: a consideration of partial laryngectomy. *Compend Contin Educ Pract Vet*. 1991;13(10):1531–1538.

7. MacPhail CM, Monnet E. Outcome of and postoperative complications in dogs undergoing surgical treatment of laryngeal paralysis: 140 cases (1985–1998). *J Am Vet Med Assoc*. 2001;218(12):1949–1956. doi:10.2460/javma.2001.218.1949

8. White RA. Unilateral arytenoid lateralisation: an assessment of technique and long term results in 62 dogs with laryngeal paralysis. *J Small Anim Pract*. 1989;30(10):543–549. doi:10.1111/j.1748-5827.1989.tb01469.x

9. Bureau S, Monnet E. Effects of suture tension and surgical approach during unilateral arytenoid lateralization on the rima glottidis in the canine larynx. *Vet Surg*. 2002;31(6):589–595. doi:10.1053/jvet.2002.34671

10. Gilbert-Gregory SE, Stull JW, Rice MR, Herron ME. Effects of trazodone on behavioral signs of stress in hospitalized dogs. *J Am Vet Med Assoc*. 2016;249(11):1281–1291. doi:10.2460/javma.249.11.1281

11. Glaser R, Kiecolt-Glaser JK. Stress-induced immune dysfunction: implications for health. *Nat Rev Immunol*. 2005;5(3):243–251. doi:10.1038/nri1571

12. Hammel SP, Hottinger HA, Novo RE. Postoperative results of unilateral arytenoid lateralization for treatment of idiopathic laryngeal paralysis in dogs: 39 cases (1996–2002). *J Am Vet Med Assoc*. 2006;228(8):1215–1220. doi:10.2460/javma.228.8.1215

13. Wilson D, Monnet E. Risk factors for the development of aspiration pneumonia after unilateral arytenoid lateralization in dogs with laryngeal paralysis: 232 cases (1987–2012). *J Am Vet Med Assoc*. 2016;248(2):188–194. doi:10.2460/javma.248.2.188

14. Griffiths LG, Sullivan M, Reid SW. A comparison of the effects of unilateral thyroarytenoid lateralization versus cricoarytenoid laryngoplasty on the area of the rima glottidis and clinical outcome in dogs with laryngeal paralysis. *Vet Surg*. 2001;30(4):359–365. doi:10.1111/j.1532-950x.2001.00359.x

15. Bahr KL, Howe L, Jessen C, Goodrich Z. Outcome of 45 dogs with laryngeal paralysis treated by unilateral arytenoid lateralization or bilateral ventriculocordectomy. *J Am Anim Hosp Assoc*. 2014;50(4):264–272. doi:10.5326/JAAHA-MS-6081

16. Milovancev M, Townsend K, Spina J, et al. Effect of metoclopramide on the incidence of early postoperative aspiration pneumonia in dogs with acquired idiopathic laryngeal paralysis. *Vet Surg*. 2016;45(5):577–581. doi:10.1111/vsu.12491

17. Dhabhar FS. Enhancing versus suppressive effects of stress on immune function: implications for immunoprotection versus immunopathology. *Allergy Asthma Clin Immunol*. 2008;4(1):2–11. doi:10.1186/1710-1492-4-1-2

18. Broadbent E, Petrie KJ, Alley PG, Booth RJ. Psychological stress impairs early wound repair following surgery. *Psychosom Med*. 2003;65(5):865–869. doi:10.1097/01.psy.0000088589.92699.30

19. Kemeny ME, Schedlowski M. Understanding the interaction between psychosocial stress and immune-related diseases: a stepwise progression. *Brain Behav Immun*. 2007;21(8):1009–1018. doi:10.1016/j.bbi.2007.07.010

20. Fallani G, Prato Previde E, Valsecchi P. Behavioral and physiological responses of guide dogs to a situation of emotional distress. *Physiol Behav*. 2007;90(4):648–655. doi:10.1016/j.physbeh.2006.12.001

21. Hiby EF, Rooney NJ, Bradshaw JW. Behavioural and physiological responses of dogs entering re-homing kennels. *Physiol Behav*. 2006;89(3):385–391. doi:10.1016/j.physbeh.2006.07.012

22. Sales G, Hubrecht R, Peyvandi A, Milligan S, Shield B. Noise in dog kennelling: is barking a welfare problem for dogs? *Appl Anim Behav Sci*. 1997;52(3-4):321–329. doi:10.1016/S0168-1591(96)01132-X

23. Beerda B, Schilder MB, Bernadina W, van Hooff JA, de Vries HW, Mol JA. Chronic stress in dogs subjected to social and spatial restriction. II. Hormonal and immunological responses. *Physiol Behav*. 1999;66(2):243–254. doi:10.1016/S0031-9384(98)00290-X

24. Hubrecht RC, Serpell JA, Poole TB. Correlates of pen size and housing conditions on the behaviour of kennelled dogs. *Appl Anim Behav Sci*. 1992;34(4):365–383. doi:10.1016/S0168-1591(05)80096-6

25. King T, Hemsworth PH, Coleman GJ. Fear of novel and startling stimuli in domestic dogs. *Appl Anim Behav Sci*. 2003;82(1):45–64. doi:10.1016/S0168-1591(03)00040-6

26. Hekman JP, Karas AZ, Sharp CR. Psychogenic stress in hospitalized dogs: cross species comparisons, implications for health care, and the challenges of evaluation. *Animals (Basel)*. 2014;4(2):331–347. doi:10.3390/ani4020331

27. von Pfeil DJ, Edwards MR, Déjardin LM. Less invasive unilateral arytenoid lateralization: a modified technique for treatment of idiopathic laryngeal paralysis in dogs: technique description and outcome. *Vet Surg*. 2014;43(6):704–711. doi:10.1111/j.1532-950X.2014.12151.x

28. Greenberg MJ, Reems MR, Monnet E. Use of perioperative metoclopramide in dogs undergoing surgical treatment of laryngeal paralysis: 43 cases (1999–2006). *Vet Surg*. 2007;36:E11. https://doi.org/info:doi/

29. Döring D, Roscher A, Scheipl F, Küchenhoff H, Erhard MH. Fear-related behaviour of dogs in veterinary practice. *Vet J*. 2009;182(1):38–43. doi:10.1016/j.tvjl.2008.05.006

30. Hargrave C. Anxiety, fear, frustration and stress in cats and dogs—implications for the welfare of companion animals and practice finances. *Companion Anim*. 2015;20(3):136–141. doi:10.12968/coan.2015.20.3.136

31. Edwards PT, Smith BP, McArthur ML, Hazel SJ. Fearful fido: investigating dog experience in the veterinary context in an effort to reduce distress. *Appl Anim Behav Sci*. 2019;213:14–25. doi:10.1016/j.applanim.2019.02.009

32. Friedlander DF, Krimphove MJ, Cole AP, et al. Where is the value in ambulatory versus inpatient surgery? *Ann Surg*. 2021;273(5):909–916. doi:10.1097/SLA.0000000000003578

33. Stern LC, Palmisano MP. Frequency of vomiting during the postoperative period in hydromorphone-treated dogs undergoing orthopedic surgery. *J Am Vet Med Assoc*. 2012;241(3):344–347. doi:10.2460/javma.241.3.344

34. Hay Kraus BL. Efficacy of maropitant in preventing vomiting in dogs premedicated with hydromorphone. *Vet Anaesth Analg*. 2013;40(1):28–34. doi:10.1111/j.1467-2995.2012.00788.x

35. Lozier S, Pope E. Effects of arytenoid abduction and modified castellated laryngofissure on the rima glottidis in canine cadavers. *Vet Surg*. 1992;21(3):195–200. doi:10.1111/j.1532-950x.1992.tb00045.x