FACULTY OF VETERINARY MEDICINE
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EPIGLOTTIC RETROVERSION IN DOGS

Word count: 9.109

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A dissertation submitted to Ghent University in partial fulfilment of the requirements for the degree of Master of Veterinary Medicine

Academic year: 2018 - 2019

GHENT UNIVERSITY

Preface

I want to thank my supervisor, dr. Bart Van Goethem, for the guidance and freedom he gave me during the writing process of my thesis.

Furthermore, I am grateful towards my partner and family for their support during my veterinary studies. They have never doubted my ability to successfully complete the six-year long course and stood by me during every phase of the program.

And lastly, I am thankful for my friends who shared the same joys and struggles during the past year and in whom I found great support.

Table of contents

List of abbreviations

BCS	Body condition score
BOAS	Brachycephalic obstructive airway syndrome
CAL	Cricoarytenoid lateralisation
ER	Epiglottic retroversion

1. Summary

Objective: To report perioperative characteristics, surgical technique, complications and outcome in dogs undergoing surgical treatment for epiglottic retroversion (ER).

Materials and methods: Medical records of dogs diagnosed with ER from 2017 to 2019 were reviewed. All received surgical treatment of their ER and/or concurrent upper respiratory tract disorders. ER was treated surgically by performing a temporary or permanent epiglottopexy, or revision epiglottectomy when the previous had failed. Follow-up consisted of control visits and telephone interviews with owners.

Results: Nine dogs were identified. All dogs were small breeds (median 4.56 kg). The majority was neutered (78%) and older than seven years (56%). The median BCS was 5/9. The most frequently seen clinical symptoms were chronic intermittent inspiratory stridor (89%), exercise intolerance (78%), and dyspnoea (67%). Concurrent respiratory disorders were highly prevalent (78%). On short-term evaluation, 67% of the patients that underwent surgical treatment of ER showed improvement of their respiratory symptoms. On long-term evaluation, this increased to 83% due to the successful outcome of the revision epiglottectomies. On short- and long-term evaluation, 100% of dogs only treated surgically for concurrent upper airway disorders showed clinical improvement. Owners were generally satisfied (87.5%) with the long-term treatment outcome in their dog. The epiglottopexies failed in 57% of the cases, seemingly independent from the presence of comorbidities. The prevalence of dysphagia was higher after partial epiglottectomy (67%) than after epiglottopexy (33%).

Conclusion: The high prevalence of respiratory comorbidities might indicate that ER is secondary to, or an unrecognised component of, these disorders. Subsequently, satisfying results could be achieved after management of only the concurrent respiratory disorders. However, in primary ER or in cases where the presence of secondary ER leads to significant respiratory symptoms, performing a partial epiglottectomy as a primary surgical technique appears to be the most successful treatment option.

1.1 Samenvatting

Doelstelling: Het doel van deze studie is om perioperatieve kenmerken, chirurgische technieken, complicaties en resultaten van honden chirurgisch behandeld voor epiglottis retroversie (ER) te rapporteren.

Materiaal en methoden: De medische gegevens van honden gediagnosticeerd met ER tussen 2017 en 2019 werden geanalyseerd. Allen ondergingen chirurgische behandeling voor ER en/of respiratoire comorbiditeiten. ER werd chirurgisch behandeld door middel van een tijdelijke of permanente epiglottopexie, of revisie epiglottectomie als de voorgaande ingrepen faalden. Follow-up werd mogelijk gemaakt door middel van controlebezoeken en telefonische interviews.

Resultaten: Negen honden werden gediagnosticeerd. Alle honden behoorden tot kleine rassen (mediaan 4.56 kg). De meerderheid was gecastreerd (78%) en ouder dan zeven jaar (56%). De mediane BCS was 5/9. De meest voorkomende symptomen waren chronisch intermitterende inspiratoire stridor (89%), inspanningsintolerantie (78%) en dyspneu (67%). Respiratoire comorbiditeiten waren veelvoorkomend (78%). Op korte termijnevaluatie toonde 67% van de honden die chirurgisch behandeld werden voor ER een klinische verbetering. Op lange termijnevaluatie steeg dit percentage naar 83%, te wijten aan de succesvolle resultaten van de revisie-epiglottectomieën. Op korte en lange termijnevaluatie toonde 100% van de honden die enkel chirurgisch behandeld waren voor hun respiratoire comorbiditeiten klinische verbetering. De meeste eigenaars (87.5%) waren op lange termijn tevreden met het resultaat van de behandeling. De epiglottopexieën faalden in 57% van de gevallen, schijnbaar onafhankelijk van de aanwezigheid van comorbiditeiten. De prevalentie van dysfagie was hoger na partiële epiglottectomie (67%) dan na epiglottopexie (33%).

Conclusie: De hoge prevalentie van respiratoire comorbiditeiten kan indiceren dat ER secundair is aan, of een niet-erkende component is van deze afwijkingen. Vervolgens zouden bevredigende resultaten kunnen worden bereikt na behandeling van enkel de respiratoire comorbiditeiten. In geval van primaire ER of wanneer de aanwezigheid van secundaire ER leidt tot significante ademhalingssymptomen, lijkt het uitvoeren van een partiële epiglottectomie als primaire chirurgische techniek de meest succesvolle optie.

2. Introduction

Epiglottic retroversion is a recently discovered, rare disorder in dogs characterized by retroflexion of the epiglottis over the rima glottidis during inspiration (Mullins et al., 2014). This leads to an intermittent obstruction of the upper respiratory tract with an inspiratory stridor and dyspnoea as a result (Skerret et al., 2015).

2.1 Epiglottic anatomy and physiology

The epiglottis is a dorsally concave spade-shaped structure formed by the epiglottic cartilage (Evans and de Lahunta, 2013). The hyoepiglotticus muscle is a paired extrinsic laryngeal muscle with a common tendon of insertion, innervated by the hypoglossal nerve, and connects the lingual surface of the epiglottis to the ceratohyoid bone of the hyoid apparatus (Evans and de Lahunta, 2013). It is responsible for the active positioning of the epiglottis within the laryngeal cavity (Amis et al., 1996b), besides the passive movements of the epiglottis due to active positioning of the soft palate and tongue (Biewener, 1985). During nasal breathing, the hyoepiglotticus muscle primarily shows phasic activity during inspiration, when its contractions pull the ventral surface of the epiglottic tip in contact with the dorsal surface of the soft palate (Amis et al., 1996a). With increasing breathing efforts, the electromyographic phasic and tonic activity of the hyoepiglotticus muscle also increases, with involvement during expiration. Eventually, the muscle pulls the epiglottis towards the base of the tongue, thus opening the oropharyngeal airway. This provides dogs with the ability to pant (Amis et al., 1996a). Therefore, this muscle plays an active role in the reduction of upper airway resistance (Amis et al., 1996a). Furthermore, the importance of the presence of the epiglottis during swallowing is controversial (Medda et al., 2003).

2.2 Aetiology

The aetiology of epiglottic retroversion in dogs is still unknown (Skerret et al., 2015). Epiglottic retroversion can be defined as primary or secondary regarding the presence of concurrent upper airway disorders (Skerret et al., 2015). In case of primary ER, the cause could be found at the level of the epiglottic cartilage, which could be fractured or compromised due to chondromalacia (Flanders and Thompson, 2009). An abnormal appearance of the epiglottis during laryngoscopy could be an indication for these causes, besides the presence of radiological abnormalities in the structure of the epiglottis, although these can be difficult to detect (Flanders and Thompson, 2009).

Another possible cause of primary ER could be found at the level of the hypoglossal nerves (Holcombe et al., 1997). Trauma or degeneration of these nerves can result in dysfunction and denervation atrophy of the hyoepiglotticus muscle, with the possibility of the epiglottis retroflexing caudally in the direction of the rima glottidis (Holcombe et al., 1997). In case the hypoglossal nerve is affected, atrophy and deviation of the tongue with dysphagia would also be expected, as the hypoglossal nerve also innervates the tongue (Platt and Olby, 2004).

Furthermore, both dogs in the study by Flanders and Thompson (2009) were diagnosed with hypothyroidism, giving rise to the differential of hypothyroidism-associated peripheral neuropathy. For diagnosis, thyroid function testing, electrophysiological examination and muscle or nerve biopsies can be undertaken if the anamnesis, clinical presentation and/or haematology or biochemistry lead to a suspicion of hypothyroidism (Cuddon, 2002). However, the incidence of clinical manifestation of hypothyroidism-associated peripheral neuropathy is low (Panciera, 2001).

In the study by Flanders and Thompson (2009) one dog was previously diagnosed with epilepsy. In another study, three dogs showed epileptic seizures and two dogs were suspected of limbic epilepsy (Skerret et al., 2015). The prevalence of epilepsy could therefore possibly indicate an underlying neurological disorder which also affects hypoglossal nerve function (Flanders and Thompson, 2009).

Degeneration or denervation atrophy of the hyoepiglotticus muscle could be diagnosed via biopsy or electromyography (Platt and Olby, 2004; Flanders and Thompson, 2009; Mullins et al., 2014). Biopsy of the hyoepiglotticus muscle has been attempted in the studies of Flanders and Thompson (2009) and Skerret et al. (2015) but only one sample contained muscle tissue, which showed myofiber degeneration after a failed epiglottopexy.

Epiglottic retroversion could also be secondary to other concurrent upper airway disorders, which cause increased turbulence, upper airway resistance and negative upper airway pressures (Skerret et al., 2015). Moreover, ER could be a component of these concurrent upper airway disorders (Skerret et al., 2015).

2.3 ER in other species

Epiglottic retroversion can be found in adult horses as a rare cause of exercise intolerance, inspiratory stridor and dyspnoea during exercise (Lane et al., 2010). In the study by Terrón-Canedo and Franklin (2013), ER could be visualised in different stages, from a dorsal angulation of the epiglottis, progressing to an occlusion of the rima glottidis or even a caudal displacement into the rima glottidis during inspiration. The frequency of occurrence hereby increased with augmented breathing efforts (Terrón-Canedo and Franklin, 2013). In some cases, the stridor seems to have developed after surgical correction of concurrent upper respiratory tract disorders or after upper respiratory tract infections (Parente et al., 1998; Terrón-Canedo and Franklin, 2013). Some horses showed concurrent palatal instability or mild pharyngeal wall collapse during exercise (Terrón-Canedo and Franklin, 2013). Performing an epiglottic augmentation or a resection of the glosso-epiglottic mucosa as surgical treatment in horses appears to have a variable outcome (Parente et al., 1998; Terrón-Canedo and Franklin, 2013).

A similar condition has also been described in humans, called acquired laryngomalacia with epiglottis prolapse (Woo, 1992). This disorder is primarily characterized by dyspnoea with stridor (Woo, 1992). It is mainly diagnosed in patients who suffered from head injury and coma, laryngeal trauma or surgery resulting in neurological dysfunction (Woo, 1992), but can also develop due to age-related changes in the hyoepiglottic ligament (Sawatsubashi et al., 2010). In these cases, an endoscopic carbon dioxide laser epiglottectomy, suture epiglottopexy or laser epiglottoplasty can be successfully performed (Marcus et al., 1990; Woo, 1992; Kanemaru et al., 2007). Furthermore, a congenital (Kawamoto et al., 2013), exercise-induced (Smith et al., 1995), and acquired idiopathic form (Kawamoto et al., 2013) of laryngomalacia with epiglottis prolapse exist.

2.4 Signalment

Epiglottic retroversion is mainly described in small to medium-sized breeds, such as the Yorkshire terrier, English cocker spaniel, pug, Pekingese, English bulldog, Pomeranian, Cavalier King Charles spaniel and shih tzu. The condition is most frequently seen in Yorkshire terriers (Skerret et al., 2015). The disorder has also been described in boxers (Flanders and Thompson, 2009; Skerret et al., 2015).

In 58% of the clinical cases, it affects dogs that are older than seven years (Skerret et al., 2015). Especially spayed bitches (58%) and neutered males (29%) are diagnosed with epiglottic retroversion. Also, 61% of the dogs have a body condition score greater than or equal to 6/9.

2.5 Clinical presentation

Inspiratory stridor and dyspnoea are the most frequently reported symptoms, caused by obstruction of the upper respiratory tract (Skerret et al., 2015). In several cases, these symptoms worsen during sleeping (Skerret et al., 2015). Sixty-seven percent of the dogs are presented in a respiratory crisis (Skerret et al., 2015). Coughing and cyanosis can also be observed (Flanders and Thompson, 2009; Mullins et al., 2014). In one dog, a 'smacking' sound could be heard during inspiration as a result of the retroversion (Mullins et al., 2014).

Skerret et al. (2015) divided the dogs into two groups according to their clinical presentation: group one showed intermittent respiratory episodes, usually preceded by excitation or exercise, with the dogs being clinically normal in the intervals between the episodes; group two showed continuous respiratory symptoms, usually associated with other concurrent upper respiratory diseases.

2.6 Comorbidities

In the study by Skerret et al. (2015), 79% of dogs diagnosed with epiglottic retroversion suffered from other disorders of the respiratory tract, such as an elongated soft palate, eversion of the laryngeal sacculi, laryngeal paralysis, laryngeal collapse, laryngeal oedema, trachea collapse and bronchial collapse. Therefore, epiglottic retroversion might be secondary to other causes of upper airway obstruction (Skerret et al., 2015). A history of pneumonia, non-cardiogenic pulmonary oedema, pectus excavatum, etc. was also found in a number of dogs (Skerret et al., 2015).

In addition, several dogs showed intervertebral disc hernia, epileptiform seizures and hypersalivation with a suspicion of limbic epilepsy (Skerret et al., 2015). Furthermore, both dogs in the study by Flanders and Thompson (2009) were diagnosed with hypothyroidism, which can be associated with peripheral neuropathy.

2.7 Diagnosis

Epiglottic retroversion can be diagnosed by direct laryngoscopic examination, video endoscopic examination of the larynx, or fluoroscopic examination (Flanders and Thompson, 2009). In addition to the obstruction of the rima glottidis, loss of the concave structure of the epiglottis can also be observed (Skerret et al., 2015). Depending on the length of the soft palate, the epiglottis is located rostral or caudal to the soft palate (Skerret et al., 2015). The epiglottis can also be weak and easy to move (Flanders and Thompson, 2009). During the examination of the upper respiratory tract, false negative results can be obtained because of pressure exerted on the epiglottis or rostral traction on the tongue (Skerret et al., 2015).

2.8 Management

There are three surgical options for the treatment of epiglottic retroversion: a temporary or permanent epiglottopexy, and a partial epiglottectomy (Mullins et al., 2014). Flanders and Thompson (2009) recommended to perform a temporary epiglottopexy first to evaluate the respiratory function and the occurrence of dysphagia post-operatively. When the results were favourable, it could be followed by a permanent epiglottopexy.

A temporary epiglottopexy consists of placing one to four mattress sutures (in resorbable or non-resorbable suture material) that connect the lingual part of the epiglottis (with a possible involvement of the epiglottic cartilage) to the base of the tongue, fixating the epiglottis in a horizontal position (Flanders and Thompson, 2009; Mullins et al., 2014; Skerret et al., 2015). In 37% of dogs, this intervention fails due to degradation and breakage of the suture material, or suture pull-out (Skerret et al., 2015). The mucosa can also become stretched at the level of the lingual side of the epiglottis (Mullins et al., 2014).

When performing a permanent epiglottopexy, a wedge-shaped part of the mucosa on the lingual side of the epiglottis and the base of the tongue is removed, followed by the placement of one to four mattress sutures or single interrupted sutures with or without involvement of the epiglottic cartilage (Flanders and Thompson, 2009; Mullins et al., 2014; Skerret et al., 2015). However, this intervention fails in 62% of dogs (Skerret et al., 2015).

In the study by Skerret et al. (2015), at least one revision surgery was performed in 32% of the dogs that underwent a temporary or permanent epiglottopexy. The percentage of interventions could possibly be reduced by managing the other disorders of the upper respiratory tract, resulting in a decrease of the high negative inspiratory pressures (Skerret et al., 2015).

A third option is to perform a partial epiglottectomy. One centimetre of the apex of the epiglottis is resected, after which the rima glottidis remains patent if the epiglottis retroflexes (Skerret et al., 2015). This surgical technique is performed when recidivism occurs after epiglottopexy failure (Mullins et al., 2014). Furthermore, both revision temporary and permanent epiglottopexies can also be attempted after epiglottopexy failure (Mullins et al., 2014; Skerret et al., 2015).

When it is estimated that other comorbidities are more important and are treated primarily, epiglottic retroversion can be treated medically by means of antitussives, corticosteroids, sedatives and antibiotics (Skerret et al., 2015).

2.9 Prognosis

In 53% of the dogs that have undergone a surgical procedure for epiglottic retroversion an improvement in the clinical symptoms can be observed (Skerret et al., 2015). In the study by Skerret et al. (2015), 17% of dogs were only treated medically for epiglottic retroversion. Seventy-five percent of these dogs have also undergone surgery for the treatment of other concurrent upper respiratory diseases. Consequently, an improvement in clinical symptoms is visible in 60% of dogs treated medically for epiglottic retroversion (Skerret et al., 2015).

The surgical procedures can cause dysphagia or aspiration pneumonia as a complication (Mullins et al., 2014). The median survival time after diagnosis is 875 days (Skerret et al., 2015).

3. Objective and hypothesis

The objective of this study is to analyse the data of the nine dogs that were diagnosed and treated at the Small Animal Clinic of the Faculty of Veterinary Medicine in Merelbeke and to draw parallels with other cases described in literature in terms of signalment; anamnesis; findings on clinical examination, (video-)laryngoscopy, tracheoscopy, bronchoscopy and radiology; concurrent neurological or endocrine disorders; surgical technique, including revision surgery in case of therapy failure; and the results during follow-up control visits and telephone interviews. Given the data gathered from literature regarding epiglottic retroversion, we hypothesize that mainly small to medium-size dogs older than seven years with a high body condition score will be affected. Furthermore, respiratory tract and neurological comorbidities might be highly prevalent. We also hypothesize that the complication rate, results and satisfaction of the owner during follow-up will depend on the type of surgical intervention and the presence of comorbidities.

4. Materials and methods

4.1 Patient inclusion criteria

All nine dogs diagnosed with epiglottic retroversion at the Small Animal Clinic of the Faculty of Veterinary Medicine in Merelbeke from 2017 to 2019 have been included in this study. In these dogs, ER was diagnosed through a (video-)laryngoscopic examination after performing an anamnesis and clinical examination.

4.2 Diagnostic work-up

The dogs were presented through consultations or through the emergency service. If a dog was presented as an emergency, stabilisation of the clinical situation was prioritised, after which further examinations were performed.

To diagnose the presence of ER and concurrent upper respiratory disorders, a laryngoscopy or endoscopy was performed in all dogs. Normally, the epiglottis should be positioned against the base of the tongue during laryngeal inspection. Epiglottic retroversion can present in different grades depending on the severity of the obstruction of the rima glottidis and the presence of structural abnormalities of the epiglottis. In a mild form, the epiglottis points dorsally throughout the respiratory cycle, without showing any ventral movement during inspiration, resulting in a partial obstruction of the rima glottidis. In more severe cases, the epiglottis retroflexes caudally on inspiration resulting in complete obstruction of the rima glottidis or is even pulled into the rima glottidis. In addition, the epiglottic shape can be altered due to structural abnormalities.

A tracheoscopy and bronchoscopy were performed if there was an indication for concurrent disorders of the trachea and main stem bronchi. Thoracic X-rays were taken to diagnose disorders of the upper respiratory tract or intra-thoracic structures. An electrophysiological examination was be performed to exclude an underlying polyneuropathy if indicated.

4.3 Treatment

All dogs underwent surgery, either to treat ER and the accompanying comorbidities, or to solely treat the comorbidities. The initial surgical techniques used to treat ER were either a temporary or a permanent epiglottopexy. A temporary epiglottopexy was performed by placing one to two mattress sutures using nonabsorbable suture material (polypropylene; Prolene, Ethicon) between the epiglottis, engaging the epiglottic cartilage, and the glossopharyngeal mucosa at the base of the tongue.

For performing a permanent epiglottopexy, a wedge of mucosa ventrorostrally on the epiglottis and caudally at the base of the tongue were excised. This was followed by placing a continuous suture line between the glossopharyngeal mucosa and the epiglottis, engaging the epiglottic cartilage, with respectively poliglecrapone (Monocryl, Ethicon) or nylon (Ethilon, Ethicon), after which the position of the epiglottis was assessed with the tongue in a neutral position.

In case of failure of these techniques, a laryngoscopy or endoscopy was performed, possibly followed by a partial epiglottectomy as a revision surgery. For performing a partial epiglottectomy, one to two thirds of the epiglottis were excised, followed by an evaluation of the patency of the larynx. A cruciate suture was placed to prevent retraction of the mucosae. Haemostasis was achieved with bipolar electrocoagulation. Additionally, the remaining suture material from the previous epiglottopexy was removed.

Midazolam, dexmedetomidine and/or ACP were used in the pre-medication protocol. For analgesia, methadone or buprenorphine were administered IV, possibly combined with a splash block local anaesthetic. The products used for induction and maintenance were propofol and isoflurane, respectively. In case additional surgical techniques for concurrent respiratory disorders or a partial epiglottectomy were performed, a fentanyl CRI was provided.

Medical management of the upper respiratory tract disorders was only applied in patients diagnosed with tracheal collapse grade three. This included the application of glucocorticoids, bronchodilators, antitussives, and sedatives.

4.4 Post-operative care

After surgical treatment, the dogs were monitored in the hospitalisation ward or intensive care unit. Infusion therapy with crystalloids (1.5 times maintenance) was required to compensate for additional fluid losses due to hyperventilation. Furthermore, hyperventilation was minimalised by the administration of butorphanol with an interval of four hours. Analgesia was attained by the administration of butorphanol and carprofen. Tranquilizers like ACP could also be used. Oxygen was supplemented in case of the occurrence of dyspnoea.

In all dogs that underwent surgical treatment of upper respiratory disorders, it was important to monitor for dyspnoea during the hospitalisation period. A temporary tracheostomy was performed in case of severe dyspnoea. In addition, the dogs were kept sober for 12 to 24 hours post-operatively, after which they were manually fed small balls of wet food to prevent dysphagia and aspiration. If the patients did not show dysphagia, a bowl of water was presented. If dysphagia remained absent, the patient was discharged. The owners were recommended to gradually shift from small balls of wet food to soaked kibble and eventually dry food.

Antibiotic treatment with cefalexin was used prophylactically concerning aspiration pneumonia in patients that underwent a cricoarytenoid lateralisation. The antibiotic treatment was continued with amoxicillin-clavulanic acid for five days. If a temporary tracheostomy was performed, doxycycline was administered during one week.

The dogs were discharged with carprofen during three to seven days or prednisolone, gradually reduced over three weeks, potentially combined with omeprazole and tramadol. If excessive dysphagia or coughing were present, the owners were recommended to contact a veterinarian.

4.5 Follow-up

Control visits were planned one month and one year post-operatively. Telephone interviews were conducted to provide an indication of long-term results. Improvement at follow-up was defined as ‘excellent’, ‘good’, ‘moderate’ or ‘bad’ based on the reoccurrence and severity of the respiratory symptoms. In case there was epiglottopexy failure or no improvement of the respiratory symptoms, the result was described as ‘bad’. In case the symptoms decreased in severity but were still present, the result was described as ‘moderate’. In case there was a significant decrease in the severity and number of respiratory symptoms, the result was described as ‘good’. In case the respiratory symptoms had resolved, the result was described as ‘excellent’.

4.6 Statistical analysis

Statistical analysis was performed by calculating the percentages, medians and intervals of relevant data collected in a database (Excel, Microsoft), e.g. signalment, clinical presentation and history, findings on (video-) laryngoscopy, tracheoscopy, radiology, treatment methods, complications, hospitalisation data and treatment outcomes.

5. Results

5.1 Patient population

Nine dogs were included. Represented breeds were Maltese (n=2), Chihuahua (n=2), Cavalier King Charles spaniel (n=2), shih tzu (n=1), Yorkshire terrier (n=1), and Pomeranian (n=1).

The median age was eight years and one month (range, one year and two months to nine years and six months). Five dogs (56%) were more than seven years old at time of diagnosis, two dogs (22%) were between three and seven years of age and two dogs (22%) were less than three years old.

Sex distribution was 6/9 (67%) male, with 4/6 (67%) neutered, and 3/9 (33%) female dogs, all spayed.

The median weight was 4.56 kilograms (range, 2.85 kg to 13.5 kg). The median body condition score was 5/9 (range, 4/9 to 7/9).

5.2 Clinical presentation

Eight patients (89%) were diagnosed through consultations, whereas one patient (11%) came in through emergency services with episodes of dyspnoea with stridor and cyanosis. This dog was suspected of congestive heart failure after radiology and was therefore stabilised with furosemide boli, followed by a furosemide CRI, and oxygen supplementation. After receiving furosemide, she was diagnosed with mitral valve endocardiosis stage B1, indicating that the respiratory crises were non-cardiogenic. She was later diagnosed with an elongated soft palate and epiglottic retroversion.

The presenting respiratory clinical signs were inspiratory stridor (89%), exercise intolerance (78%), dyspnoea (67%), coughing and gagging (44%), reverse sneezing (44%), cyanosis (44%), tachypnoea (33%), sneezing (22%), and dysphagia when drinking (11%). Three patients (33%) had a history of bronchitis and/or pneumonia at a young age and one patient (11%) had a history of head trauma. Two patients (22%) had stenotic nares, of which one patient had already undergone a naroplasty two years earlier. A cardiac murmur could be heard on auscultation in two patients (22%). One patient (11%) also suffered from idiopathic epilepsy and one was later diagnosed with cervical syringomyelia (11%). Another patient (11%) was clinically suspected of Cushing’s syndrome.

Six out of nine dogs (67%) showed these respiratory symptoms intermittently, whereas three dogs (33%) showed symptoms frequently during the day. The median time since the start of the symptoms at presentation was 12 months (range, one week to eight years and seven months).

5.3 Diagnostic work-up

All nine patients underwent a laryngoscopy or endoscopy for the diagnosis of ER. In 33% of the dogs, the epiglottis pointed dorsally throughout the respiratory cycle, partially obstructing the rima glottidis. In one of these dogs (33%), the epiglottis was bent caudally with a concave lingual side.

In 67% of the dogs, the epiglottis retroflexed caudally on inspiration resulting in a complete obstruction of the rima glottidis (Figure 1D). In one of these dogs (17%), the epiglottis folded and was partially sucked into the rima glottidis (Figure 1B).

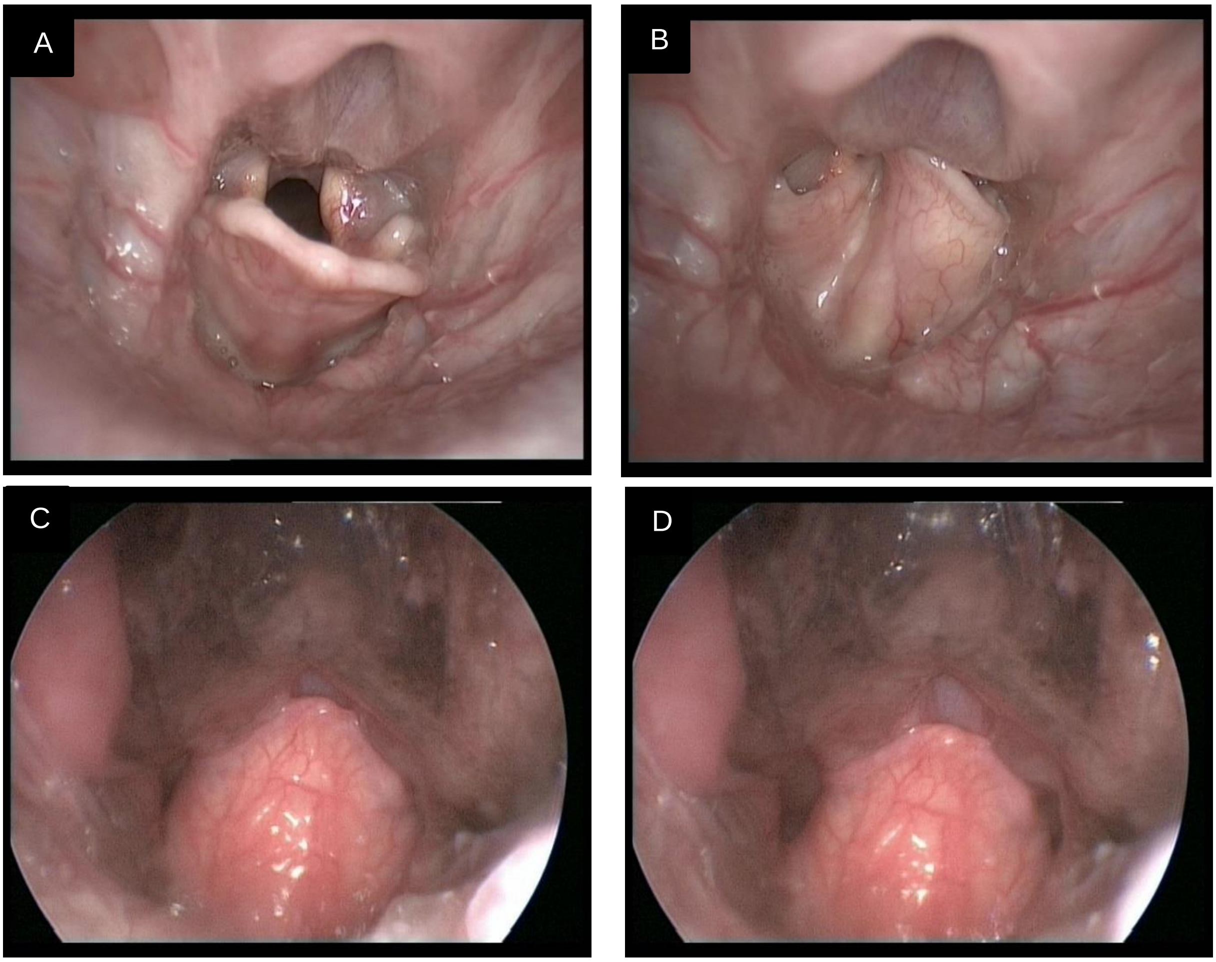

Fig. 1. Endoscopic images of two patients with epiglottic retroversion. Patient 1 has a patent rima glottidis during expiration (**A**), but a complete obstruction of the rima glottidis, with folding of the right part of the epiglottis, during inspiration (**B**). In Patient 2, the epiglottis is in contact with the slightly elongated soft palate during expiration (**C**), with the epiglottis completely obstructing the rima glottidis during inspiration because of negative inspiratory pressure (**D**).

Seven out of nine patients (78%) had concurrent upper airway disorders on laryngeal inspection, consisting of a hyperplastic or elongated soft palate (44%), hyperplastic or inverted tonsils (44%), laryngeal paralysis (33%), laryngeal collapse of the first grade (11%), relative macroglossia (11%), and laryngeal inflammation (11%). Hence 56% of the dogs had concurrent brachycephalic obstructive airway syndrome. Six out of nine dogs (67%) underwent a tracheoscopy, of which 3/9 (33%) were diagnostic for tracheal collapse, 2/9 (22%) showed no abnormalities and 1/9 (11%) showed an increased presence of mucus. Of the three patients with tracheal collapse, 1/3 was grade one and 2/3 were grade three, with one also showing collapse of the left mainstem bronchus.

Eight out of nine dogs (89%) underwent a radiological examination. In three patients (37.5%) no abnormalities were detected. In only 1/3 patients diagnosed with tracheal collapse, there were radiological indications for this disorder. One patient with a history of head trauma was diagnosed with a unilateral avulsion fracture of the stylohyoid bone. The patient clinically suspected of Cushing's syndrome showed hepatomegaly on radiology.

One patient with ER and concurrent laryngeal paralysis underwent an electromyography and electroneurography, but both examinations were normal and thus excluded an underlying polyneuropathy.

5.4 Surgical treatment

All patients diagnosed with ER underwent surgery as their primary treatment. A temporary epiglottopexy was performed in 5/9 dogs (56%). The number of matrass sutures placed ranged from one to two. The materials used for this procedure were polypropylene (Prolene, Ethicon) 5/0 (60%), polypropylene (Prolene, Ethicon) 4/0 (20%) and polypropylene (Prolene, Ethicon) 2/0 (20%). One of these five patients (20%) also received a palatoplasty and unilateral tonsillectomy as a treatment for BOAS.

A permanent epiglottopexy was performed in 2/9 dogs (22%), using a continuous suture line in either poliglecaprone (Monocryl, Ethicon) 5/0 or nylon (Ethilon, Ethicon) 3/0 (Figure 2). One of these two patients (50%) also underwent a palatoplasty.

All three patients diagnosed with laryngeal paralysis underwent a cricoarythenoid lateralisation. For two of these three patients (67%), this was the only surgical procedure that was performed.

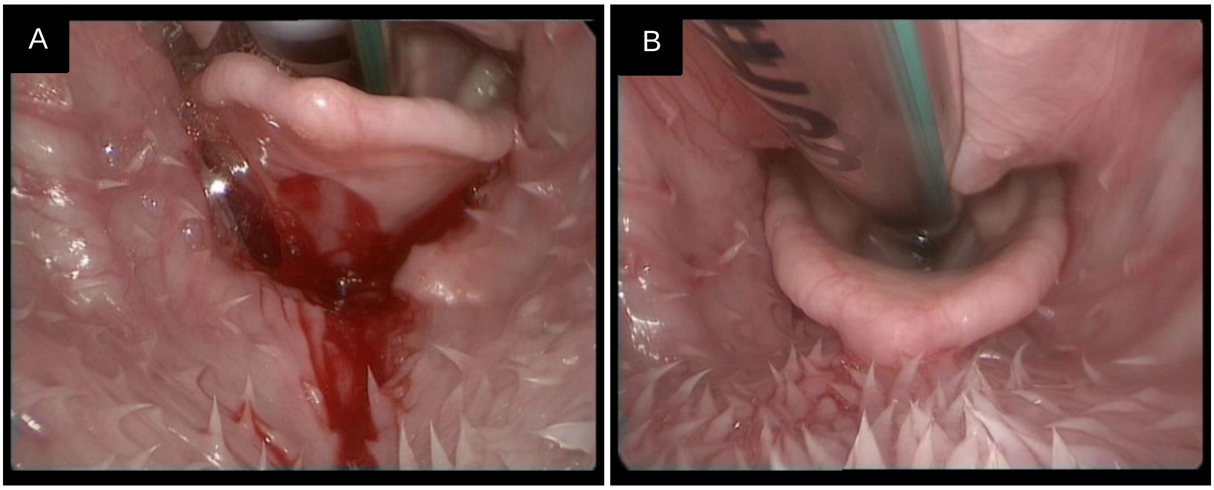

Fig. 2. Intra-operative images of a permanent epiglottopexy. A wedge of mucosa ventrorostrally on the epiglottis and caudally at the base of the tongue is excised (**A**). Following fixation by placement of a continuous suture line between the glossopharyngeal and epiglottic mucosae, the position of the epiglottis is assessed with the tongue in a neutral position; the rima glottidis is now patent throughout the respiratory cycle (**B**).

5.5 Post-operative care

In the dogs solely treated for ER with either an epiglottopexy or partial epiglottectomy, the short post-operative hospitalisation period was uneventful. These dogs were hospitalised for one day. Fifty percent of the dogs that solely underwent an epiglottopexy and 1/3 dogs that underwent a partial epiglottectomy recovered in the intensive care unit. Eighty percent of the dogs that underwent a cricoarytenoid lateralisation for their concurrent laryngeal paralysis or that additionally underwent a palatoplasty and/or tonsillectomy recovered in the intensive care unit. The median amount of days these dogs were hospitalised was three.

One dog in this study required a temporary tracheostomy during recovery due to a slowly progressive dyspnoea, possibly caused by post-operative swelling after performing a permanent epiglottopexy and palatoplasty. Excitation during hospitalisation also contributed to her dyspnoea. Therefore, this dog was discharged, with doxycycline, prednisolone and omeprazole.

5.6 Epiglottopexy failure

Four out of the seven patients (57%) that received an epiglottopexy were presented at the clinic with reoccurrence of their respiratory symptoms. The median interval between the placement of the epiglottopexy and the failure of this technique was 1.5 months (range, one to twelve months), with 3/4 patients (75%) presented at the clinic within two months. Failure was diagnosed via laryngeal inspection.

Failure occurred in 3/5 temporary epiglottopexies (60%). There are no additional records on one of the patients that underwent a permanent epiglottopexy because the owner could not be contacted. Therefore, the only conclusion that can be made about the success rate of this surgical technique is that at least one of the two permanent epiglottopexies (50%) failed.

One patient (25%) developed respiratory symptoms due to the presence of comorbidities rather than the reoccurrence of ER, whereas 3/4 patients (75%) had respiratory symptoms similar to those present before surgical treatment of ER. These three patients underwent a partial epiglottectomy as revision surgery.

5.7 Short-term evaluation

Eight out of nine patients that underwent initial surgical treatment of their upper respiratory tract disorders were presented for a control visit one month after surgery. Seventy-five percent of the dogs showed clinical improvement. Short-term results were excellent in 12.5%, good in 37.5%, moderate in 25% and bad in 25%.

Six out of the seven patients that underwent an epiglottopexy were presented for a control visit on month post-surgically. Clinical improvement was seen in 67% of the patients treated surgically for ER. There was one excellent result (17%), one good result (17%), two moderate results (33%) and two bad results with epiglottopexy failure (33%). Failure occurred after one temporary and one permanent epiglottopexy.

The two patients that only underwent a CAL obtained a good result (100%).

Both patients with epiglottopexy failure underwent a partial epiglottectomy. Only one of these patients returned for a control visit one month post-surgically and obtained a moderate result. This patient also developed dysphagia as a complication of the partial epiglottectomy.

Complications after epiglottopexy occurred in 2/6 patients (33%) and consisted of dysphagia after the surgical intervention. None of the patients developed aspiration pneumonia.

5.8 Long-term evaluation

Eight out of nine patients were available for a long-term evaluation. Median follow-up was 16 months (range, 5 to 23 months). Long-term results were excellent in 37.5%, good in 25%, moderate in 25%, and bad in 12.5% (Table 1).

Three dogs (37.5%) achieved excellent results, with 2/3 dogs showing none of the pre-surgical respiratory symptoms, and with 1/3 dogs only occasionally sneezing. At the time of follow-up, one of these patients had been euthanised due to an unrelated disorder. This patient lived for 15 months after a temporary epiglottopexy and did not show any more respiratory symptoms related to ER during that time.

The dog with bad long-term results (12.5%) had a temporary epiglottopexy, which failed after twelve months. She also underwent cricoarythenoid lateralization that failed to improve her dyspnoea and was treated medically for tracheal collapse. No revision surgery was performed in this patient.

Table 1. Long-term results and epiglottopexy failure in function of the surgical technique performed and the presence of concurrent respiratory tract disorders.

BOAS	Laryngeal paralysis	Tracheal collapse	Initial surgical technique	Recurrence ER	Partial epiglottectomy	LT[d] results
			Temporary[a]	Yes	Yes	Moderate
Yes	Yes	Yes	Temporary[a] + CAL	Yes	No	Bad
		Yes	Temporary[a]			Moderate
Yes			Temporary[a]	Yes	Yes	Good
Yes			Temporary[a] + BOAS[b]			Excellent
			Permanent[a]	Yes	Yes	Excellent
Yes	Yes		CAL			Excellent
Yes			Permanent[a] + BOAS[b]	-[c]	-[c]	-[c]
	Yes	Yes	CAL			Good

[a]Epiglottopexy.
[b]Palatoplasty and/or tonsillectomy.
[c]No follow-up records available.
[d]Long-term results.

The placement of a temporary epiglottopexy as the only treatment for ER in three patients resulted in one excellent (33%), one moderate (33%) and one bad result (33%). The moderate result was achieved in a patient that receives medical treatment for their concurrent tracheal collapse. The excellent result was achieved in a patient that additionally underwent a palatoplasty and unilateral tonsillectomy for their concurrent BOAS.

Performing a partial epiglottectomy as a revision surgery in patients with epiglottopexy failure was performed in 3/7 dogs (43%) and resulted in one excellent (33%), one good (33%), and one moderate result (33%) and thus clinical improvement in 100%. The patient that obtained a good result was also diagnosed with an elongated soft palate and everted tonsils without specific treatment. The other two patients had no concurrent respiratory disorders.

The two patients that underwent a cricoarytenoid lateralisation as a sole surgical treatment for their concurrent laryngeal paralysis obtained excellent (50%) and good results (50%). The patient with the excellent result only had respiratory symptoms a couple of days after an epileptic seizure. The patient with the good result was also being treated medically for concurrent tracheal collapse.

Consequently, of the six dogs that underwent surgical treatment of ER and were presented for long-term follow-up, five (83%) showed improvement of their respiratory symptoms. In both cases where the dogs were only treated surgically for their concurrent laryngeal paralysis, improvement of the respiratory symptoms was seen (100%).

The patients can be divided in two groups by the presence of concurrent respiratory disorders. Group one consists of two patients that were only diagnosed with ER. Group two consists of seven patients that were diagnosed with concurrent respiratory disorders like laryngeal paralysis (n = 3), tracheal collapse (n = 3) and BOAS (n = 5).

Of the two patients in group one, both underwent a revision epiglottectomy after failure of their epiglottopexy (100%), after which one achieved a moderate result (50%) and one achieved an excellent result (50%).

In group two, there are no long-term records available for one patient. Of the other six patients, there were two excellent (33%), two good (33%), one moderate (17%) and one bad result (17%).

In none of these patients any new respiratory disorders or symptoms developed. The two patients diagnosed with tracheal collapse grade three are treated medically, including glucocorticoids, bronchodilators, antitussives and sedatives.

Four patients out of the seven (57%) that were treated surgically for ER developed dysphagia after partial epiglottectomy (n = 2; 67% of partial epiglottectomies) or a temporary epiglottopexy (n = 2; 33% of epiglottopexies). None of these patients developed an aspiration pneumonia.

The owners described the severity of the respiratory symptoms in comparison to the pre-surgical symptoms as ‘improved’ in six cases (75%), as ‘similar’ in one case (12.5%) and as ‘worse’ in another case (12.5%). The post-surgical progression of the respiratory symptoms was described as ‘stable’ (75%), ‘improving’ (12.5%) and ‘worsening’ (12.5%). Seven out of eight owners (87.5%) are satisfied with the treatment of their dog. One owner (12.5%) was dissatisfied because of the regular occurrence of dysphagia while drinking after receiving a partial epiglottectomy.

6. Discussion

In this study, both temporary and permanent epiglottopexies were performed as primary surgical techniques, depending on the surgeon's preference. Cricoarytenoid lateralisations were performed in addition or as the sole surgical technique in case of the presence of laryngeal paralysis. A palatoplasty and/or tonsillectomy was performed in some cases of concurrent BOAS. An additional medical treatment was initiated in the dogs that suffered from concurrent grade three tracheal collapse.

On short-term evaluation, 67% of the patients that underwent surgical treatment of ER showed improvement of their respiratory symptoms. On long-term evaluation, this increased to 83% due to the successful outcome of the revision epiglottectomies. On short- and long-term evaluation, 100% of dogs only treated surgically for concurrent upper airway disorders showed clinical improvement. This treatment option was performed assuming ER could be secondary to the increased negative upper airway pressure these disorders cause. This could indicate that the surgical treatment of concurrent respiratory disorders suffices in the management of ER. This is also supported by the findings of Skerret et al. (2015), who reported a higher percentage of dogs that showed improvement of their respiratory symptoms after surgical treatment of concurrent respiratory tract disorders and/or medical treatment of ER. However, performing a palatoplasty in two dogs with concurrent elongated soft palate in the study by Flanders and Thompson (2009), was not satisfying in resolving their respiratory symptoms and an additional epiglottopexy was indicated. Furthermore, Skerret et al. (2015) suggested that the placement of a temporary epiglottopexy might be more suitable for dogs that can be treated for concurrent respiratory tract disorders with a proper decrease in negative upper airway pressures, whereas the placement of a permanent epiglottopexy might be more suitable for dogs with primary ER or dogs that cannot be treated sufficiently for their respiratory comorbidities. However, this conclusion cannot be made in this study due to the limited patient population.

Moreover, most owners were satisfied (87.5%) with the long-term treatment outcome in their dog, with most of them reporting a stable post-surgical clinical situation which improved in comparison to the pre-surgical situation. In contrast to our hypothesis, we found that the satisfaction of owners is mainly influenced by the decreased risk of respiratory crisis after surgical treatment, and the occurrence of complications, rather than the applied surgical techniques and their outcome.

However, the majority of the epiglottopexies failed (57%) after a relatively short post-operative interval. The failure rate of the temporary epiglottopexies was 60%. No conclusions can be drawn about the failure rate of the permanent epiglottopexies. In a larger study, 37% of the temporary and 62% of the permanent epiglottopexies failed (Skerret et al., 2015). This last finding might suggest that the additional excision of mucosa is unnecessary or even disadvantageous (Skerret et al., 2015). Moreover, epiglottopexy failure occurred in patients with and without concurrent respiratory disorders, and even in both patients with primary ER, whereas we expected a higher prevalence of epiglottopexy failure in patients with concurrent respiratory tract disorders due to the increased negative upper respiratory pressures they cause.

Epiglottopexy failure could possibly be reduced by involving the epiglottic cartilage into the suture line to improve the strength of the suture pattern (Mullins et al., 2014; Skerret et al., 2015). However, this resulted in integrity loss of the epiglottic cartilage after a second revision epiglottopexy in a case previously described in literature (Mullins et al., 2014). In this study, engaging the epiglottic cartilage did not result in integrity loss of the epiglottis. However, it still resulted in epiglottopexy failure. Regarding the choice of suture pattern, Mullins et al. (2014) placed six single interrupted sutures in polydioxanone, of which four pulled through the mucosa, resulting in failure of the permanent epiglottopexy. Therefore, the placement of tension resistant mattress sutures might be a more suitable suture pattern to apply in the treatment of ER, given the repetitive forces applied on the suture material in this region (Mullins et al., 2014). However, in this study, the use of mattress sutures also resulted in failure. Therefore, it is difficult to draw any conclusion about which suture pattern is the most successful.

Other possible reasons for epiglottopexy failure are degradation and breakage of suture material and stretching of the mucosae (Mullins et al., 2014; Skerret et al., 2015). In this study, the gauge and type of the utilised suture material did not seem to affect the failure rate.

In 75% of the epiglottopexy failures, the dogs showed symptoms similar to those before surgical treatment of ER and were therefore considered for a partial epiglottectomy because this implied that the symptoms were mostly related to the reoccurrence of ER rather than the presence of respiratory comorbidities. Improvement of respiratory symptoms was seen in 100% of dogs after partial epiglottectomy, seemingly independent from the concurrent presence of BOAS. This indicates that performing a partial epiglottectomy could be the most successful surgical treatment method for ER.

Dysphagia with the potential of developing aspiration pneumonia is a possible complication after undergoing an epiglottopexy or partial epiglottectomy (Mullins et al., 2014; Skerret et al., 2015). In the study by Skerret et al. (2015), post-operative aspiration pneumonia occurred in 32% of dogs that underwent epiglottopexy as well as in a few dogs that did not undergo surgical treatment for ER. The latter could be caused by hypoglossal nerve dysfunction given it is a possible cause of ER (Skerret et al., 2015). In this study, dysphagia was relatively more prevalent after partial epiglottectomy than after epiglottopexy, but none developed aspiration pneumonia within the follow-up period. Therefore, owners should be made aware of the possible occurrence of dysphagia after surgical treatment of ER, especially after performing a partial epiglottectomy.

Other possible complications are the development of surgical-site infections or post-operative oedema with dyspnoea due to surgical manipulation of the laryngeal tissue. The latter possibly occurred in one dog in this study, requiring a temporary tracheostomy during recovery after a permanent epiglottopexy and palatoplasty. Epiglottectomy failure due to excision of an inappropriate portion of the epiglottis has not been reported yet, nor has aspiration pneumonia due to dysphagia. Further studies are needed to evaluate the outcome and complication rate of this treatment option.

The dogs that only underwent surgical treatment of ER spent only one day in hospitalisation. Dogs that underwent additional surgical treatment for concurrent respiratory disorders were generally recovered in the intensive care unit (80%) and hospitalised for a longer period. In general, they were monitored for dyspnoea and dysphagia and received supportive medical treatment. During the long-term follow-up period, no patients died because of respiratory tract disorders. Possible causes of death would be severe dyspnoea and aspiration pneumonia (Skerret et al., 2015).

In the study by Skerret et al. (2015), epiglottic retroversion is mainly described in small to medium-sized breeds. In 58% of the clinical cases, it affects dogs that are older than seven years. Especially spayed bitches (58%) and neutered males (29%) are diagnosed with epiglottic retroversion. Sixty-one percent of the dogs have a body condition score greater than or equal to 6/9 (Skerrett et al., 2015). Therefore, we hypothesized that mainly small to medium-size dogs older than seven years with a high BCS would be affected. The dogs presented in this study were small breeds. The median age was eight years and one month, with 56% of the dogs more than seven years old at the time of diagnosis, which complies with the findings of Skerret et al. (2015). However, the median BCS of the dogs presented was 5/9, which is normal and therefore does not completely correspond with the hypothesis. Sixty-six percent of the patients were male, with the majority of them neutered. All female dogs presented were neutered. Similar results can be detected in all case reports found in literature (Flanders and Thompson, 2009; Mullins et al., 2014; Skerret et al., 2015).

Eighty-nine percent of patients were admitted through consultation, whereas 67% of the patients in the study by Skerret et al. (2015) were presented on emergency in acute respiratory crisis. In this study, the median duration at which the dogs showed symptoms before presentation was approximately 12 months. Thus, this disorder can also have a chronic presentation. Sixty-six percent of the dogs showed their symptoms intermittently, mostly incited by excitation or exercise. Skerret et al. (2015) found that the dogs that showed intermittent symptoms usually only had ER, whereas the dogs with continuous symptoms mostly had concurrent respiratory disorders. In this study, this conclusion cannot be made because 78% had concurrent respiratory disorders.

The majority of the dogs presented with a history of inspiratory stridor, exercise intolerance and dyspnoea. Inspiratory stridor and dyspnoea are the most common symptoms of ER found in literature, resulting from intermittent upper airway obstruction (Skerret et al., 2015). Other highly prevalent symptoms in this study were coughing, reverse sneezing and cyanosis, which were also reported by Skerret et al. (2015). Epiglottic retroversion leads to a turbulent airflow which can result in mucociliary escalator dysfunction. Therefore, it can cause coughing (Mullins et al., 2014). A 'smacking' sound produced by retroversion of the epiglottis, as detected by Mullins et al. (2015), was not reported by the owners or heard after admittance of the patients in this study.

All patients in this study underwent a laryngoscopy or endoscopy for the diagnosis of ER and concurrent upper airway disorders. Laryngeal inspection can show different grades of ER depending on the severity of the obstruction of the rima glottidis and the presence of structural abnormalities of the epiglottis. In a mild form, the epiglottis points dorsally throughout the respiratory cycle, without showing any ventral movement during inspiration, resulting in a partial obstruction of the rima glottidis. In more severe cases, the epiglottis retroflexes caudally on inspiration resulting in complete obstruction of the rima glottidis or is even pulled into the rima glottidis. In addition, the epiglottic shape can be altered due to structural abnormalities. Another possible technique for diagnosing ER is fluoroscopy of the larynx (Skerret et al., 2015), but direct laryngoscopy appears to suffice as a diagnostic tool and is simple, efficient and cheap. However, this examination should be performed under a light plane of anaesthesia. Also, pressure at the level of the epiglottis or rostral lingual traction can result in false negative results (Skerret et al., 2015). Epiglottic retroversion can also be absent on laryngoscopic examination if retroversion mainly occurs during exercise or excitation (Mullins et al., 2014).

Three patients (33%) were diagnosed with concurrent laryngeal paralysis on laryngoscopy. Furthermore, the majority of dogs (56%) was diagnosed with concurrent BOAS. On tracheoscopy, three dogs (33%) had concurrent tracheal collapse of grade one or three. However, there were only radiological indications for tracheal collapse in one of these dogs. This highlights the importance of tracheoscopy for the diagnosis of tracheal collapse. Subsequently, 78% of the patients had concurrent respiratory disorders, which complies with the results of Skerret et al. (2015). This agrees with our hypothesis that respiratory tract comorbidities would be highly prevalent. The high prevalence of concurrent respiratory tract disorder might implicate an association with the development of ER (Skerret et al., 2015). As stated above, ER could be secondary to these concurrent respiratory disorders as they cause an increased upper airway resistance, leading to a more turbulent airflow and abnormally high negative respiratory pressures (Skerret et al., 2015). Furthermore, it could also be an unrecognised component of BOAS, given the high prevalence of the disorder in this study (Skerret et al., 2015). Moreover, ER could be a component of laryngeal collapse, although this was only diagnosed in one patient in this study. One dog with primary ER also showed tonsillar eversion on laryngoscopy. In this case, it is likely that ER is the initiating factor of the increased upper airway resistance and abnormally high negative respiratory pressures.

Only two dogs in this study had no concurrent respiratory disorders and were thus diagnosed with primary epiglottic retroversion. In one dog diagnosed with primary ER in this study, there was a history of head trauma with a development of respiratory symptoms three months later. On radiological examination, a unilateral avulsion fracture of the stylohyoid bone was visible. On laryngoscopy, the epiglottis retroverted towards the rima glottidis with the epiglottis unilaterally folding, ipsilateral to the avulsion fracture. This could be an indication that the epiglottis was fractured due to laryngeal trauma, although this is unlikely given the interval between the occurrence of the trauma and the respiratory symptoms. In the other dog, no possible causes were detected during the diagnostic work-up, so it might have been interesting to attempt a biopsy of the hyoepiglotticus muscle or an electrophysiological examination (Mullins et al., 2014).

Regarding the aetiology of ER, the prevalence of epilepsy could possibly indicate an underlying neurological disorder which also affects hypoglossal nerve function (Flanders and Thompson, 2009; Skerret et al., 2015). In this study, one patient was diagnosed with idiopathic epilepsy. Therefore, no conclusions can be drawn regarding a possible association between the cause of ER and the cause of the epileptic seizures. Furthermore, one patient in this study showed dysphagia pre-surgically, possibly indicating hypoglossal nerve dysfunction. However, no lingual abnormalities were seen during laryngoscopy. Also, no patients in this study were clinically suspected of hypothyroidism. Therefore, thyroid function tests were not performed. However, one patient diagnosed with laryngeal paralysis and ER underwent electrophysiological testing to exclude hypothyroidism-associated peripheral neuropathy, with normal results.

The limitations of this study include the small patient population. Therefore, it is difficult to draw any statistical conclusions and larger studies are needed to further analyse the most successful treatment option for ER. ER might be underdiagnosed and possibly undertreated for several reasons. Although ER is easily diagnosable via direct laryngoscopy, laryngeal inspection is not always conclusive because it is an intermittent disorder mainly induced by exercise or excitation. Also, ER is a relatively rare condition and therefore not widely recognised in the veterinary community. Furthermore, the surgical treatment of upper airway disorders in this study was performed by different surgeons, using different suture materials and a varying amount of mattress sutures. Therefore, it is more complex to make conclusive statements about which factors influenced the failure rate of the epiglottopexies. Moreover, not all dogs diagnosed with components of BOAS underwent surgical treatment depending on the owner and the relative necessity for surgical treatment. This might also influence treatment outcomes. Concerning epiglottopexy failure, the owners generally reported of a relapse of respiratory symptoms similar to the pre-surgical presentation. Thus, epiglottopexy failure can only be diagnosed if there is a high owner compliance regarding control visits. Therefore, it is possible that the actual number of epiglottopexy failures might be underestimated. Moreover, reasons for epiglottopexy failure reported in literature are degradation, breaking or pull-out of suture materials, or stretching of the mucosa (Mullins et al., 2014; Skerret et al., 2015). In this study, the epiglottopexy failure was caused by suture pull-out in a few patients, but because of limited information available in other patient records regarding the findings on laryngeal inspection after epiglottopexy failure, no conclusions can be drawn.

7. Conclusion

Since epiglottopexy failure is highly prevalent, performing a partial epiglottectomy as a primary surgical technique appears to be the most satisfying treatment option in case of primary ER or when the presence of secondary ER leads to significant respiratory symptoms. Furthermore, there is a high prevalence of concurrent respiratory disorders, which might indicate that ER is secondary to, or an unrecognised component of, these disorders. Therefore, satisfying results could possibly also be achieved after management of only the concurrent respiratory disorders. The prognosis after surgical treatment of epiglottic retroversion or concurrent respiratory disorders is generally favourable. A significant improvement of the clinical presentation with long-term survival rates is expected.

8. References

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