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How does multilevel upper airway surgery influence the lives of dogs with severe brachycephaly? Results of a structured pre- and postoperative owner questionnaire

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ABSTRACT

Brachycephalic airway syndrome in dogs is typified by a variety of anatomical abnormalities causing a diverse spectrum of clinical signs of varying intensity. This variability makes the assessment of the surgical outcome after upper airway surgery difficult. Using a structured questionnaire, the present study investigated the dog owner-perceived severity and frequency of a broad spectrum of welfare-relevant impairments 2 weeks before and 6 months after brachycephalic dogs underwent a recently developed multi-level upper airway surgery. All dogs underwent surgical treatment of stenotic nares (alavestibuloplasty), the nasal cavity (laser-assisted turbinectomy, LATE), the pharynx (palatoplasty and tonsillotomy), and if indicated, laryngeal surgery (laser-assisted ablation of everted ventricles and partial cuneiformectomy). Owners of brachycephalic dogs ($n = 102$) referred for upper airway surgery were eligible to participate.

Questionnaire data from owners of 37 Pugs and 25 French bulldogs were evaluated. In all dogs, the clinical signs associated with brachycephaly improved markedly after surgery. Most encouraging was the striking reduction in life-threatening events by 90% (choking fits decreased from 60% to 5% and collapse from 27% to 3%). The incidence of sleeping problems decreased from 55% to 3%, and the occurrence of breathing sounds declined by approximately 50%. There was a marked improvement in exercise tolerance and a modest improvement in heat tolerance. Dogs with severe brachycephaly benefitted substantially from multi-level surgery, and there were particular improvements in the incidences of severe impairment and life-threatening events. However, despite the marked improvement perceived by dog owners, these dogs remained clinically affected and continued to show welfare-relevant impairments caused by these hereditary disorders.

Introduction

Brachycephalic airway syndrome is a complex hereditary disease (Haworth et al., 2001; Bannasch et al., 2010) that includes stenotic nares (Trader, 1949); under-sized nasal chambers (Farquarson and Smith, 1942) with malformed and misshapen nasal conchae (Oechtering et al., 2007) and an elongated and thickened soft palate (Farquarson and Smith, 1942); laryngeal collapse (Leonard, 1960); everted lateral ventricles (Leonard, 1957) and tracheal hypoplasia (Suter et al., 1972). Affected dogs can have any combination of these anatomic abnormalities, which can cause varying degrees of upper airway compromise (Riecks et al., 2007) and a diverse set of clinical signs (Lorinson et al., 1997; Poncet et al., 2006; Fasanella et al., 2010). Surgical treatment is individualised to each dog depending on the severity of the upper airway abnormalities (Cantatore et al., 2012).

It can be difficult to objectively assess surgical outcome due to the complexity of clinical signs and the need for individualised combinations of different surgical procedures. Numerous studies have employed pet owner surveys to assess surgical outcome (Lorinson et al., 1997; Torrez and Hunt, 2006; Riecks et al., 2007). Common to all these studies is that they required the pet owners to recognise and independently evaluate the degree of improvement.

Knowledge of normal dog behaviour differs significantly among dog owners, who could misinterpret some clinical signs in brachycephalic breeds as being normal (Torrez and Hunt, 2006). A recent study by Packer et al. (2012) found that dog owners were able to recognise and describe clinical signs in detail, but did not understand their clinical relevance. Therefore, it is preferable for therapeutic outcomes to be assessed by someone other than the dog owner (Virkkula et al., 2005).

In a recent study, we described the development and application of a new structured questionnaire (Roedler et al., 2013). The

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questions addressed objective criteria that were easily observed by dog owners, such as recovery time after physical exercise and other activities. Using this questionnaire, we successfully analysed the frequency and severity of various clinical signs. Therefore, we hypothesised that a survey addressing objective and easily observable criteria could be an appropriate tool for owner-based assessment of surgical outcomes.

The objectives of this study were: (1) to identify the frequency and severity of clinical signs reported by dog owners before and after upper airway surgery using a structured survey, and (2) to examine the effects of upper airway surgery on clinical signs.

Materials and methods

All owners of brachycephalic dogs (Pugs and French bulldogs) presenting for upper airway surgery at the authors' institution between December 2011 and February 2013 participated in this prospective study. Each dog owner completed a survey 2 weeks before and 6 months after surgery. The study protocol was approved by the institutional review board at the University of Leipzig (Approval No.: VMF G 2011/12, 2 December, 2011). All dog owners provided informed written consent to treatment of their dogs and to participate in the survey.

Dog owners were provided with an online-based questionnaire using commercially available online survey software and a questionnaire tool (SurveyMonkey.com). The questionnaire was developed and validated in a previous study by Roedler et al. (2013) and included general questions, as well as specific questions about breathing, exercise and heat tolerance, eating, sleep and welfare. In the objective questions, dog owners were asked about the presence and frequency of various clinical signs at the time of the survey. For all questions concerning clinical signs that might have been difficult for dog owners to recognise (e.g. inspiratory effort or cyanosis), the answer choice 'I cannot tell.' was additionally available. The postoperative questionnaire was slightly revised to include subjective questions concerning surgical outcomes. In these questions, dog owners were asked to subjectively describe any changes they observed in their dogs postoperatively in a variety of categories, as follows: 'How did your dog's condition change after surgery for the following parameters: breathing, exercise and heat tolerance, eating, sleeping, general welfare and the ability to smell? Evaluate on a scale from –5 to +5, where –5 represents maximal deterioration, +5 represents maximal improvement, and 0 is no change.'

A medical history was obtained and a complete physical exam was performed in all dogs on admission. After inducing anaesthesia, each dog underwent computed tomography (CT) of the head and thorax and upper airway endoscopy before surgery. Each dog was evaluated for the presence and severity of stenotic nares, an abnormally long and thick soft palate, tonsillar enlargement, abnormal turbinate growth obstructing the intranasal airway, and everted laryngeal ventricles and other laryngeal abnormalities (e.g. collapse of the cuneiform processes and redundant laryngeal mucosa). Abnormal turbinate growth was defined as turbinates with multiple mucosal contacts to each other or the nasal cavity walls (Schuenemann and Oechtering, 2014a; Oechtering et al., 2016a).

Owners of dogs that previously underwent upper airway surgery or showed cardiopulmonary disease on physical or CT examination of the thorax were excluded from the study. Dog owners questioned previously during the study conducted by Roedler et al. (2013) were also excluded.

In all dogs, various upper airway surgeries were performed to treat obstructions of the nasal entrance (ala-vestibuloplasty), nasal cavity (laser-assisted turbinectomy, LATE), pharynx (palatoplasty and tonsillotomy) and if indicated, the larynx (laser-assisted ablation of everted ventricles, partial cuneiformectomy and resection of redundant laryngeal mucosal tissue). The term tonsillotomy refers to a removal of only the protruding tonsillar tissue, a procedure routinely performed in children instead of tonsillectomy. Tonsillotomy produces comparable results to tonsillectomy, but postoperative complications are reduced (Ericsson et al., 2014). Abnormally enlarged cuneiform processes, when overlapping and additionally obstructing the laryngeal inlet, were resected microlaryngoscopically using an operating microscope for magnification. The extent of surgery depended on the results of endoscopic examination.

The pre- and postoperative survey results were analysed. Because the interval between the two surveys was only 6 months, dog owners were categorised into two groups so that answers concerning exercise and heat tolerance ('How long can you go for a walk with your dog in summer/winter?; How much time does your dog need to recover after physical stress in summer/winter?') could be evaluated. Group 1 comprised dog owners for whom summer was immediately prior to or during the postoperative survey, and group 2 comprised dog owners for whom winter was immediately prior to or during the postoperative survey.

Statistical methods

All statistical analyses were performed using SPSS 16.0 for Microsoft Windows (SPSS, IBM). The significance level was set at $P < 0.05$. A chi-square test was used to detect any significant differences in the frequency and severity of clinical signs between pre- and postoperative Pugs and French bulldogs.

Results

During the study period, 102 dog owners fulfilled the inclusion criteria to participate. Of the 102 preoperative surveys, 84 were returned (response rate, 82%). A total of 62 pre- and postoperative surveys were returned complete and evaluable (response rate 74%).

Epidemiological data

Sixty-two dog owners participated in the study. The canine population studied comprised 39 male and 23 female dogs (37 Pugs and 25 French bulldogs). The mean age at the time of surgery was 3.4 years (range, 1–11 years). Mean ± standard deviation bodyweight was 10.5 ± 2.3 kg; Pugs weighed 8.9 ± 1.8 kg and French bulldogs weighed 12.0 ± 1.9 kg.

Endoscopic examination and surgical treatment

The results of the endoscopic examination and subsequent surgery are shown in Table 1. All 62 dogs underwent ala-vestibuloplasty, laser-assisted turbinectomy, staphylectomy, and tonsillotomy. Laryngocelectomy was performed in 35/62 (56%) dogs and a partial cuneiformectomy and resection of redundant mucosal tissue was performed in 16/62 (26%) dogs.

Questionnaire

A total of 62 questionnaire pairs were evaluated. There were no statistically significant differences between the Pug and French bulldog owners in the questionnaire answers, except for those responses concerning eating before surgery. Therefore, the survey responses are grouped by activity herein.

Breathing

The responses concerning breathing sounds and observed inspiratory effort are presented in Table 2. Dog owners felt that

Table 1
Results of endoscopic examination and subsequent surgical treatment in 62 dogs (Pugs $n = 37$; French bulldogs $n = 25$).

Endoscopic finding	Surgical treatment	All dogs *n* (%)	Pugs *n* (%)	French bulldogs *n* (%)
Stenotic nasal entrance	Ala-vestibuloplasty (bilateral enlargement of nares and vestibulum nasi)	62 (100)	37 (100)	25 (100)
Intranasal obstruction (malformed and aberrant growing conchae)	LATE	62 (100)	37 (100)	25 (100)
Elongated and thickened soft palate	Staphylectomy	62 (100)	37 (100)	25 (100)
Enlarged tonsils	Tonsillotomy	62 (100)	37 (100)	25 (100)
Obstructing everted lateral laryngeal ventricles	Laryngocelectomy (laser assisted ablation of everted ventricles)	35 (56)	24 (65)	11 (44)
Collapsed cuneiform processus	Partial cuneiformectomy and resection of redundant mucosal tissue	16 (26)	16 (43)	–

LATE, Laser assisted turbinectomy.