Prevalence of laryngeal paresis in dogs undergoing general anaesthesia

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Objective To estimate the prevalence of laryngeal paresis within a selected population of dogs and identify some of the distinguishing characteristics of affected dogs.

Design A prospective study involving laryngoscopic examination of 250 dogs.

Procedure The laryngeal movements of 250 dogs undergoing general anaesthesia were observed. The severity of laryngeal paresis in these dogs was graded (0 = normal laryngeal movements, 4 = bilateral laryngeal paralysis). The following information was also recorded for each dog: age, sex, weight, breed, condition score, anaesthetic protocol, clinical suspicion of disease and observer.

Results Twenty five percent of the dogs examined had some degree of laryngeal paresis. Affected dogs were significantly older than unaffected dogs ($P < 0.001$). There was a trend for the severity of laryngeal paresis to increase with age. There was no difference between the sexes. Dogs with laryngeal paresis were significantly heavier than normal animals ($P < 0.02$). Overweight animals had a significantly higher laryngeal grade than those with a normal condition score ($P < 0.05$). Labrador Retrievers and Rottweilers had a significantly higher risk of having laryngeal paresis ($P < 0.05$). Clinical suspicion was found to have high diagnostic value. An intra-class correlation coefficient for inter-rater reliability between the two observers was 0.95.

Conclusions Laryngeal paresis had a high prevalence in the animals surveyed and was strongly associated with age and breed. The results of this study are consistent with the concept of a progressive degenerative disease with a breed susceptibility. Clinical suspicion for the presence of the disease was a reliable indicator. The grading system used had a high degree of inter-observer agreement.

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Laryngeal paralysis is a well recognised cause of upper airway obstruction in dogs. In this condition, paralysis of the dorsal cricoarytenoid muscle prevents abduction of the vocal folds and arytenoids, allowing them to be drawn into a median position with resultant airway obstruction.[1] Clinical signs include gagging, coughing, exercise intolerance, vomiting, regurgitation, hoarse bark, laryngeal stridor and respiratory distress and collapse.[2]

Both hereditary and acquired forms of laryngeal paralysis have been described. Hereditary forms of laryngeal paralysis have been reported in the Bouvier des Flandres,[3] Dalmatian[4] and Siberian Husky.[5] An autosomal dominant inheritance had been determined for the Bouvier des Flandres[6] while an autosomal recessive inheritance has been proposed for the Dalmatian.[4] Affected animals are generally under 6 months of age. Idiopathic laryngeal paralysis is the most common acquired form and is thought to be one component of a more generalised neuropathy.[7] This form of the disease occurs most frequently in large breeds, such as the Labrador Retriever, Irish Setter and Afghan Hound.[2,8]

The majority of publications on laryngeal paralysis describe methods of treatment in clinical cases. There has been little published on the pathogenesis or epidemiology of the idiopathic form of laryngeal paralysis. There have also been no reports of the prevalence of laryngeal paresis within the dog population. The purpose of this paper is to document a survey of the prevalence of laryngeal paresis and the characteristics of affected animals.

Materials and methods

Two hundred and fifty dogs undergoing general anaesthesia at Massey University Veterinary Teaching Hospital were examined laryngoscopically by one of two observers at anaesthetic induction. The anaesthetic plane of the animals was allowed to lighten until either pronounced laryngeal movements were present or the dog started to swallow. Animals had their laryngeal movements and symmetry graded using a system based upon previous descriptions of canine laryngoscopic findings[9,10] and the authors' clinical experience. The grading system is as follows:

Grade 0: Normal laryngeal symmetry and movements.

Grade 1: Mild asymmetry with left side being more axially placed. Left side arytenoid can abduct but fails to do so consistently or fully. Right side arytenoid abducts normally.

Grade 2: Severe asymmetry. No abduction of left arytenoid. Right side arytenoid abducts normally.

Grade 3: No abduction of left arytenoid and right arytenoid fails to always abduct or do so fully.

Grade 4: Paradoxical movements of both arytenoids present.

The dog's age, sex, breed, weight and condition score based on clinical observation (scale 1-5, 1 = thin, 3 = normal, 5 = obese) were recorded. In addition, the reason for anaesthesia and the anaesthetic protocol was documented for each dog. Each dog was assessed both for clinical suspicion of laryngeal paralysis and actual laryngeal movements by one of two observers.

Data were stored using the database management system Access97 (Microsoft Corporation). Statistical analysis was performed using the statistical packages NCSS2000 (NCSS Inc), Minitab12 (Minitab Inc) and SPSS 8.0 for Windows

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(SPSS Inc). The data were analysed using the Mann-Whitney U test when comparing dogs with and without laryngeal paresis and the Kruskal-Wallis test for comparisons of continuous or ordinal type variables between groups formed by categorical variables. Both tests are nonparametric and use ranking to determine if group differences exist. Any variables that showed significance in these analyses ($P \leq 0.05$) were then included in a backward stepwise multivariate logistic regression analysis for ordinal, nominal and binary outcome variable to accommodate different levels of aggregation of the different grades of laryngeal paralysis. The goodness-of-fit of the final model was assessed using the deviance statistic. Specificity and sensitivity were calculated for clinical suspicion as a diagnostic method, using the result of the laryngoscopic examination as the gold standard. Relative risks were calculated for any risk factors measured at a categorical scale. The 95% confidence limits were calculated where applicable.

In addition, seventeen dogs were examined concurrently by the two observers and laryngeal grades recorded for both observers. Interobserver reliability was then calculated using an intraclass correlation coefficient (ICC [A, 1]) utilising a two-way random effects model as described by McGraw and Wong.[11]

Results

The numbers of dogs within each grade are shown in Table 1. The prevalence of abnormalities of laryngeal movement and symmetry was 25.6% with a 95% confidence interval of 20.2 to 31%. Clinical signs of upper respiratory tract obstruction were observed predominantly in dogs with grade 4 laryngeal paresis. Dogs with laryngeal paresis were significantly older than unaffected dogs (Mann-Whitney U test $Z = -7.461$, $P < 0.001$). There was also a trend for the age of affected animals to increase with the severity of the laryngeal paresis (Figure 1). Dogs with laryngeal paresis grades 1 to 4 were older than grade 0 animals (Kruskal-Wallis test $Z = 2.11 – 5.99$, $P = 0.05$) and grades 2-4 were older than grade 1 animals (Kruskal-Wallis test $Z = 2.75 – 3.80$, $P = 0.05$). However, there was no statistical difference between grades 2 to 4.

There was no significant difference between sexes in the prevalence of laryngeal paresis.

Seventy-three different breeds of dog were observed including cross-breds. Dogs with laryngeal paresis were found in a large variety of breeds, including many smaller breeds such as Corgis and Dachshunds. Dogs were grouped into Labrador Retrievers, Rottweilers, Huntaways (New Zealand working dog), German Shepherd dogs and other breeds. These categories were based upon prevalence of breeds. Labrador Retrievers were significantly more likely to have a higher laryngeal grade than both German Shepherd and other breeds (Kruskal-Wallis test $Z = 4.62$ and 4.27 respectively, $P = 0.01$). Rottweilers and Huntaways were significantly more likely to have laryngeal paresis than German Shepherds (Kruskal-Wallis test $Z = 2.44$ and 1.97 respectively, $P = 0.05$). The relative risks for these breeds are shown in Table 2.

Animals with laryngeal paresis were significantly heavier than animals without laryngeal paresis (Mann-Whitney U test $Z = -2.43$, $P = 0.02$). However, when animals were categorised according to laryngeal grades, the only significant differences were between those animals with grade 3 laryngeal paresis and those with grades 0 (Kruskal-Wallis test $Z = 2.96$, $P = 0.01$) and 1 (Kruskal-Wallis test $Z = 2.09$, $P = 0.05$). A box plot of the distribution of weights for each grade is shown in Figure 2. There was no difference in prevalence of laryngeal paresis between animals under and over 15 kg body weight. There was no significant difference between dogs with laryngeal paresis and those without laryngeal paralysis in terms of condition score. However, animals that were overweight (condition score 4 or 5) had a statistically higher laryngeal grading than animals of normal condition score (Kruskal-Wallis test $Z = 2.48$, $P = 0.05$) but were not significantly different from underweight (condition score 1 or 2) animals.

Although data were collected on anaesthetic protocol, it was decided not to analyse this data. There were two reasons for this. Firstly, there were many different combinations of anaesthetic drugs, resulting in a low statistical power. Secondly,

Table 1. Prevalence of each laryngeal paresis grade for dogs in the study.

Grade[a]	Number	Percentage
0	186	74.4
1	27	10.8
2	9	3.6
3	15	6
4	13	5.2
Total	250	100

[a]For a detailed description of the grading scheme, refer to text.

Table 2. Relative risks of laryngeal paresis for the selected breeds relative to a pool population of other breeds.

Breed	Crude relative risk	Confidence limits (95%)
Labrador Retriever	2.527	1.629 – 3.920
Rottweiler	2.069	1.022 – 4.190
Huntaway	1.821	0.811 – 4.091
German Shepherd	0.314	0.080 – 1.231
Other Breeds	1	1

Table 3. Diagnostic properties of clinical suspicion using laryngoscopic observation as the gold standard.

Test criteria	Detection of laryngeal paresis (95% Confidence limits)	Detection of grades 3 and 4 (95% Confidence limits)
Sensitivity	40.6% (34.5% – 46.7%)	91.6% (88.2% - 95.0%)
Specificity	99.4% (98.4% - 100%)	98.5% (97.0% - 100%)

Table 4. Final binary logistic regression model for presence of signs of laryngeal paralysis.

Predictor	Adjusted odds ratios	95% Confidence limits
Age (years)	1.4	1.28 – 1.54
High Risk Breed (Labrador or Rottweiler vs. Others)	4.77	1.90 – 11.98

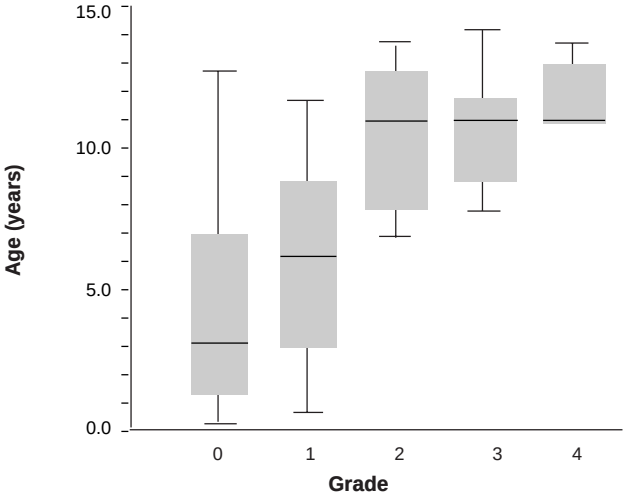

Figure 1. Box and whisker plot of the age distribution of dogs for each grade of laryngeal paresis. Top and bottom of each box represent the 75th and 25th percentile respectively; the line across the box represents the group median; the vertical lines represent the adjacent values.

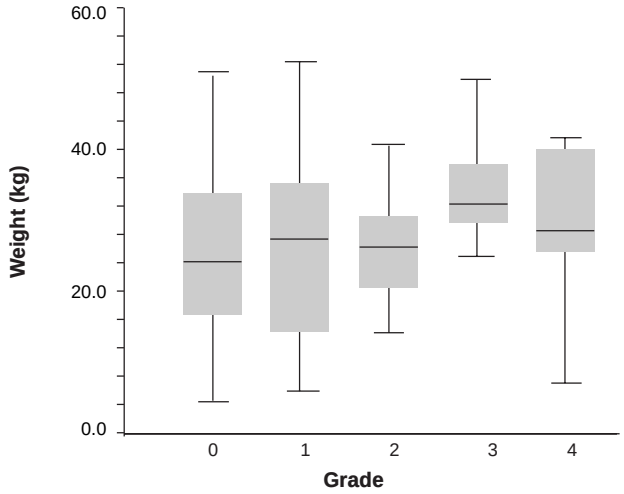

Figure 2. Box and whisker plot of the distribution of body weights for each grade of laryngeal paresis. Top and bottom of each box represent the 75th and 25th percentile respectively; the line across the box represents the group median; the vertical lines represent the adjacent values.

since anaesthetic protocol was selected based on the animal's presenting signalment and physical condition, interpretation of the effect of anaesthetic protocol on laryngeal grade would be very difficult.

The results of the evaluation of clinical suspicion as a diagnostic test are shown in Table 3. This shows that clinical suspicion has good specificity. Sensitivity appears to be related to severity, improving with increasing severity.

Age, weight, condition score and whether the animal belonged to the high risk breeds of Labrador Retriever or Rottweiler were entered into the multivariate models. Both ordinal and nominal logistic regression using the laryngeal paralysis grade as a dependent variable resulted in models with limited value due to poor goodness-of-fit. However, backward stepwise logistical regression using presence of signs of laryngeal paresis as a binary outcome variable resulted in a final model that contained the risk factors age and high risk breed (Table 4). The goodness-of-fit model was acceptable by the deviance statistics (Chi square = 44.9, DF = 51, P = 0.71). A plot of the probabilities was performed for age and the two breed risk categories (Figure 3).

The intraclass correlation coefficient for inter-observer reliability was 0.957 with the 95% confidence limits being 0.89 – 0.98.

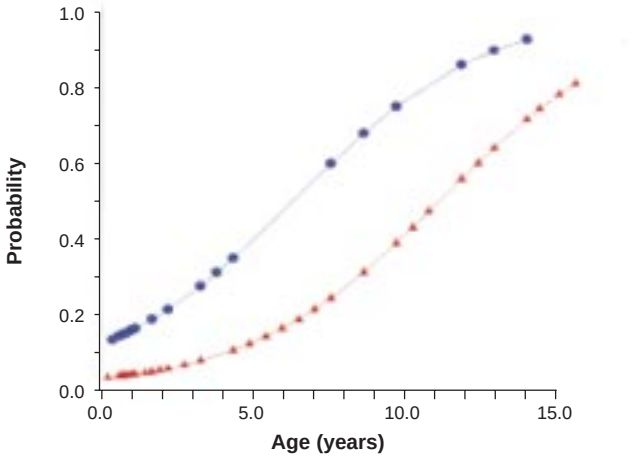

Figure 3. Plots of the probability of laryngeal paresis with age amongst a high risk breed (● - Labrador Retriever or Rottweiler) and other breeds (▲). Data/plots based on binary logistic regression analysis.

Discussion

Laryngeal paralysis was common amongst the dogs examined in this study. Of these dogs, it was predominantly the dogs classified as grade 4 laryngeal paresis (5.2% of the population studied) that demonstrated clinical signs of upper respiratory tract obstruction typical of laryngeal paralysis. Thus, although a significant proportion of animals may be affected with laryngeal paresis, only a small proportion appear to show clinical signs. Care should be taken to correlate laryngoscopic findings with clinical signs before recommending surgical intervention in affected animals. It may be argued that the population of animals examined is not representative of the normal population or even the population presenting to the hospital. Whilst this is true, the population examined is representative of animals being anaesthetised at the hospital, since no attempt was made to select amongst these animals. It was therefore concluded that laryngeal paresis has a high prevalence in dogs undergoing anaesthesia at the Massey University Veterinary Teaching Hospital.

This study demonstrated that idiopathic canine laryngeal paresis is a disease that occurs in older animals. It would appear from the animals in this study that the disease is unlikely to occur in animals under 6 years of age. It would also appear that

more severely affected animals tend to be older. This would support clinical impressions that canine idiopathic laryngeal paralysis is a progressive degenerative disease. However, further investigations would be needed to document disease progression in individual animals. If canine idiopathic laryngeal paralysis is a progressive disease, there is likely to be a variable age of onset, making it impossible to postulate a rate of progression from the data in this study.

The lack of a significant difference between the two sexes suggests that if the condition is heritable, a sex-linked gene does not transmit it.

The results of this study indicate that both Labrador Retrievers and Rottweilers have a higher risk of developing laryngeal paresis. The Huntaway breed showed a trend towards being at a higher risk whilst the German Shepherd dog showed a trend towards being less at risk. Other breeds may have tendencies to being at greater or lesser risk, however this could not be demonstrated due to low numbers in the majority of breeds. Whereas Labrador Retrievers were expected to have a higher risk of developing laryngeal paralysis based on clinical reports, the finding that Rottweilers also have a higher risk of developing laryngeal paresis was unexpected. In addition, the fact that laryngeal paresis was seen in a number of smaller breeds is interesting. This demonstrates that the disease is not confined to medium to large breeds. This latter observation is supported by the fact that there was no difference in the prevalence of laryngeal paresis between dogs under 15 kg bodyweight and those over 15 kg bodyweight. Since previous reports have been based on animals with clinical disease, it may be possible that some factor prevents Rottweilers and small breeds of dogs from exhibiting clinical signs of the disease. Possible factors may include level of exercise or severity of paresis. The apparent breed specific prevalence may support a genetic susceptibility to the disease.

Exercise levels and respiratory effort may possibly explain the trend for weight to increase with grade up to grade 3 and then decrease in grade 4 animals. Animals with lower grades, although they are unlikely to have overt respiratory distress, are likely to have some exercise intolerance. This could lead to reduced activity and weight gain. However, once the laryngeal obstruction becomes more severe the animal must expend considerable energy on the mechanics of breathing, leading to weight loss. This may account for the apparent weight difference between animals in grade 3 and those in grade 4. Another possible explanation for this apparent loss of weight is generalised muscle atrophy, associated with a generalised neuropathy.

Whereas the analysis of condition score does not entirely support the interpretation of the weight analysis, the results of this analysis may be confounded by a non-linear alteration in condition score as suggested by the weight analysis.

Binary logistic regression produced the best multivariate model. The fact that the model found both age and membership of a high-risk breed to be predictive was not surprising based upon previous clinical reports. The finding that there was a relatively high probability of developing laryngeal paresis with age in dogs not considered to be from high risk breeds, could indicate that the disease process is simply slower in these breeds. However, it may simply reflect that high-risk breeds that were not identified (due to low numbers) were included in this group. Unfortunately, this model has limitations, in that it only considers the presence or absence of laryngeal paresis. It does not consider the severity of the paresis and thus whether clinical signs are likely to be present. The results of this analysis can be considered consistent with a degenerative process with a genetic susceptibility.

Although the inter-observer reliability between the two observers in this study was high, studies involving larger numbers of observers would be needed to establish the universal consistency and acceptance of this grading system.

Clinical suspicion would appear to be a useful diagnostic tool. It has acceptable accuracy in predicting animals that are likely to have grade 3 and 4 laryngeal paresis.

In conclusion, the data gathered in this study showed that laryngeal paresis was common in the dogs examined. This suggests that there is a high prevalence in the normal population. The data would also support the clinical impression that laryngeal paresis is a degenerative, progressive disease. There appear to be breed differences in the prevalence of laryngeal paresis, suggesting a genetic component. In the dogs examined, clinical suspicion was a useful indicator of the severity of the disease. Amongst the variables measured here, the most predictive for the presence of laryngeal paresis were age and membership of either the Labrador Retriever or Rottweiler breeds.

References

1. Amis TC, Smith MM, Gaber CE, Kupershoek C. Upper airway obstruction in canine laryngeal paralysis. *Am J Vet Res* 1986;47:1007-1010.
2. Gaber CE, Amis TC, LeCouteur RA. Laryngeal paralysis in dogs: A review of 23 cases. *J Am Vet Med Assoc* 1985;186:377-380.
3. Venker-van Haagen AJ, Hartman W, Goedegebuure SA. Spontaneous laryngeal paralysis in young Bouviers. *J Am Anim Hosp Assoc* 1978;14:714-720.
4. Braund KG, Shores A, Cochrane S et al. Laryngeal paralysis-polyneuropathy complex in young Dalmations. *Am J Vet Res* 1994;55:534-542.
5. O'Brien JA, Hendricks J. Inherited laryngeal paralysis in the Husky cross. *Vet Q* 1986;8:301-302.
6. Venker-van Haagen AJ, Bourv J, Hartman J. Hereditary transmission of laryngeal paralysis in Bouviers. *J Am Anim Hosp Assoc* 1981;17:75-76.
7. Braund KG, Steinberg S, Shore A et al. Laryngeal paralysis in immature and mature dogs as one sign of a more diffuse polyneuropathy. *J Am Vet Med Assoc* 1989;194:1735-1740.
8. Harvey CE, O'Brien JA. Treatment of laryngeal paralysis in dogs by partial laryngectomy. *J Am Anim Hosp Assoc* 1982;18:551-556.
9. Wykes PM. Canine Laryngeal Diseases Part II. Diagnosis and Treatment. *Compend Contin Educ Pract Vet* 1983;5:105-110.
10. Roudebush P. Laryngoscopy. *Vet Clin North Am Small Anim Pract* 1990;20:1291-1295.
11. McGraw KO, Wong, SP. Forming inferences about some intraclass correlation coefficients. *Psychol. Methods* 1996;1:30-46.

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