



Age when presumptive innocent cardiac murmurs spontaneously disappear in clinically healthy Cairn terrier puppies

M.D.B. van Staveren, V. Szatmári*

Department of Clinical Sciences of Companion Animals, Faculty of Veterinary Medicine, Utrecht University, Yalelaan 108, 3584 CM, Utrecht, The Netherlands

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ABSTRACT

Innocent cardiac murmurs are common findings in Cairn terrier puppies during their first veterinary health check. The age when these murmurs spontaneously disappear is unreported. The purpose of this study was to establish the age when presumably innocent cardiac murmurs disappear in a population of clinically healthy Cairn terrier puppies. Over a period of 9 months, 227 clinically healthy Cairn terrier puppies (median age, 53 days; range, 45–76 days) underwent auscultation by a veterinary cardiology specialist, who identified 82 puppies with a presumably innocent cardiac murmur. Owners of 20 puppies volunteered to return to the clinic for serial rechecks. Owners of three puppies returned only once, therefore these puppies were censored. Hence this longitudinal observational study followed 17 puppies with monthly cardiac auscultation until the disappearance of their murmurs.

The median age of the 20 puppies when the murmur was last audible was 65 days (range 52–285 days). The median age of the 17 puppies when the murmur was no longer audible was 87 days (range 71–347 days; 95% confidence interval 63–111 days). Four of the 17 puppies had a murmur after 3 months of age and two of them had a murmur beyond 6 months of age. The oldest puppy to have an audible murmur was 9.5 months old; this murmur was not audible at 11.5 months of age.

In most Cairn terrier puppies in this population, the presumably innocent murmur resolved spontaneously by 3 months of age.

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Introduction

Innocent cardiac murmurs are common findings in clinically healthy puppies, particularly in Cairn terriers (Côté et al., 2015; Marinus et al., 2017; Szatmári et al., 2015). As physiologic anemia plays a role in the genesis of innocent murmurs in puppies, maturation can lead to the spontaneous resolution of both anemia and murmur (Harper et al., 2003; Szatmári et al., 2015). First opinion veterinary practitioners often advise breeders and owners of puppies that have cardiac murmurs at the initial health check to return for re-auscultation when vaccinations are next due instead of immediately referring the puppy to a veterinary cardiologist (Côté et al., 2015; Dennis, 2013; Fonfara, 2015). There is an expectation that innocent cardiac murmurs should disappear spontaneously with age, whereas pathologic murmurs would not. Non-peer reviewed sources have estimated that innocent murmurs in puppies tend to disappear by approximately 6 months of age (Côté et al., 2015; Kvart and H äggström, 2002). As this is anecdotal information based on expert

opinion, our aim was to determine the age when presumptive innocent cardiac murmurs disappear in a cohort of clinically healthy Cairn terrier puppies.

Materials and methods

Animals

Between October 2015 and June 2016, client-owned Cairn terrier puppies presented to the authors' clinic were auscultated during screening for congenital portosystemic shunts. Puppies were deemed clinically healthy based on medical history, physical examination and blood ammonia test results. Dog owners signed an informed consent for puppies to be enrolled in the study. No institutional permission from an ethical committee was required for the study, as only data from cardiac auscultation was collected.

Auscultation

Auscultation was performed by one investigator (VSz, ECVIM-CA [Cardiology] specialist) using a non-electronic acoustic pediatric stethoscope. After blood sampling, each puppy was auscultated in a standing position on a table in a quiet examination room. The investigator was masked to the blood test results at the time of the first auscultation. All puppies were auscultated in the regions of the left and right cardiac base and apex. Once a murmur was recognized, the timing (systolic, diastolic or continuous), intensity (scale 1–6), point of maximal intensity, and additional characteristics, such as musical character and beat-to-beat variability in murmur intensity, were noted. Murmurs were classified as grade 1 (soft and was

* Corresponding author.

E-mail address: v.szatmari@uu.nl (V. Szatmári).

heard only after several seconds of auscultation), or grade 2 (soft, but heard immediately; Levine, 1961; Rishniw, 2018).

Follow-up

Breeders of puppies with murmurs were informed and asked to encourage future owners to return to the authors' clinic on a monthly basis for a cardiac auscultation until the disappearance of the murmur. The investigators gave two printed letters to the breeders, one for the breeder, which contained information about innocent cardiac murmurs in puppies. The other letter was intended for the future owner and contained similar information, plus investigator contact details to facilitate recheck cardiac auscultations, on a voluntary basis. All auscultation rechecks were performed by the same person who did the initial auscultation screening (VSz).

Echocardiography was performed on one puppy whose murmur was audible for the longest duration. The examination was performed by the same investigator who auscultated the puppies (VSz). Right and left parasternal standard views were obtained for two-dimensional, color Doppler, pulsed wave and continuous wave Doppler examinations. The flow velocity in the main pulmonic artery and right ventricular outflow tract was obtained from the right parasternal short axis view and the flow velocity in the aorta and left ventricular outflow tract was obtained from the subcostal view, using a continuous wave Doppler technique, according to a previously described protocol (Szatmári et al., 2015).

Statistical analysis

To describe the age of the puppies at various time points, median and range (days) were used. Confidence intervals (95%) were calculated for the median age when the murmurs disappeared. A Kaplan–Meier curve was drawn to illustrate the time points when murmurs disappeared. Commercially available software was used for the statistical analysis (a SPSS v24.0; IBM Statistics and R v3.4.4; R Foundation for Statistical Computing¹).

Results

Between October 2015 and June 2016, 227 Cairn terrier puppies from 52 litters were auscultated. The median age at first auscultation was 53 days (range, 45–76 days). In 82 puppies (36%), a cardiac murmur was heard. The auscultation characteristics of the murmurs in all puppies were compatible with those of innocent murmurs (Szatmári et al., 2015). All murmurs were systolic with a maximal intensity of 2/6. The vast majority had a musical character and the point of maximal intensity was in the region of the left cardiac base. Pathologic murmurs were not suspected in any of the puppies. All puppies with murmurs had fasting blood ammonia concentrations within the reference range (<45 µmol/L). Echocardiographic examination was performed in one puppy at 271 days old (9 months), when the murmur was still audible. In this puppy, the murmur was last heard at 285 days old. Echocardiographic examination revealed no structural or functional abnormalities and color Doppler examination showed a physiologic pulmonary artery valve regurgitation. The peak flow velocity in the left ventricular outflow tract and aorta was 2.1 m/s; in the right ventricular outflow tract and pulmonic artery the peak flow velocity was 1.7 m/s.

The breeders of all 82 Cairn terrier puppies with murmurs agreed to ask future owners to return to the authors' clinic for monthly rechecks. Of these 82 puppies, 20 (24%) were brought back at least once. Of these 20 puppies, 17 were followed until the disappearance of the murmur.

The median age when the murmur was still audible in the 20 puppies was 65 days (range, 52–285 days). The median age of the 17 puppies when the murmur was no longer audible was 87 days (range, 71–347 days; 95% confidence interval 63–111 days). Four of the 17 puppies (24%) had a murmur audible after 3 months of age and two of them had an audible murmur after 6 months of age (Fig. 1). The oldest puppy to have an audible murmur was 9.5

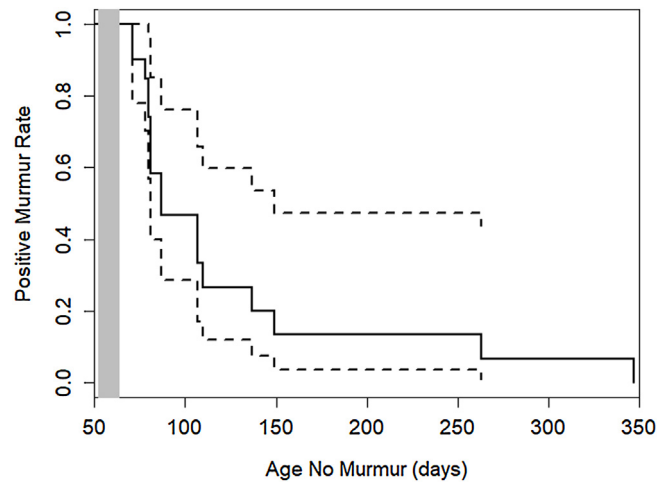


Fig. 1. Kaplan Meier curve showing the age of 20 Cairn terrier puppies when their presumably innocent murmurs disappeared. Seventeen puppies were followed until their murmurs were no longer audible. Three puppies were censored at their last auscultation, when their murmurs were still audible. Dashed lines indicate the 95% confidence intervals. The median age when murmurs spontaneously disappeared in this group of puppies was 3 months. The first auscultation took place at a median age of 54 days (range 52–64 days). This period is indicated with a vertical gray zone at the left of the graph.

months old (285 days). All murmurs that were audible beyond 3 months of age subsequently disappeared.

Discussion

This is the first study to document the age at which presumptive innocent cardiac murmurs resolved in a cohort of clinically healthy asymptomatic Cairn terrier puppies. The exact age when the murmurs disappeared could not be precisely established, because the rechecks took place at approximately monthly intervals to facilitate compliance by dog owners.

The median age when the murmurs disappeared was 12 weeks (3 months). However, murmurs in two puppies persisted as long as 7 and 9.5 months of age.

The most likely reason for the resolution of the cardiac murmurs was the rising hematocrit (HCT) as the growing puppies matured. To prove this hypothesis, HCT should have been measured at each cardiac auscultation, but this would have been outside the normal management protocols used for clinical care in these owned puppies. Our earlier study of 195 clinically healthy puppies demonstrated that puppies with innocent murmurs had lower HCTs than those without murmurs (Szatmári et al., 2015), but HCT was not determined in puppies enrolled in the present study. A longitudinal study of 44 healthy Labrador retriever puppies reported rising median HCT with age as follows: 0.32 L/L (range, 0.20–0.38 L/L) at 3.1–8.0 weeks old; 0.37 L/L (range, 0.20–0.69 L/L) at 8.1–16 weeks old; and 0.43 L/L (range, 0.32–0.49 L/L) at 16.1–52 weeks old (Harper et al., 2003).

There are a number of limitations of the present study. First is the relatively small sample size used, potentially threatening the generalizability of the study. Secondly, echocardiography was not performed in all puppies with cardiac murmurs. Therefore, the presence of a congenital cardiac anomaly cannot be entirely excluded as the cause of the murmurs. However, soft murmurs caused by congenital cardiac anomalies do not usually disappear spontaneously over months while puppies remain clinically healthy. Moreover, pediatric cardiologists do not recommend performing echocardiographic examinations in children where cardiac murmurs are deemed innocent based on cardiac auscultation alone (Advani et al., 2000; Chantepie et al., 2016). A third

¹ See: The R Project for Statistical Computing <https://www.R-project.org> (Accessed 2 April 2019).

limitation of our study is that all puppies were of a single breed. Whether our results can be extrapolated to other breeds, or even to small breed dogs only, remains to be determined.

Conclusions

In most Cairn terrier puppies in this population, presumptive innocent cardiac murmurs resolved spontaneously by 3 months of age. The maximum age of murmur disappearance was 9.5 months.

Conflict of interest statement

None of the authors of this paper have a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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