Topographical distribution and radiographic pattern of lung lesions in canine eosinophilic bronchopneumopathy

PAPER

Topographical distribution and radiographic pattern of lung lesions in canine eosinophilic bronchopneumopathy

E. J. Y. Lo *,†, T. Schwarz * and B. M. Corcoran[1,*]

*Hospital for Small Animals, Royal (Dick) School of Veterinary Studies, University of Edinburgh, Easter Bush Veterinary Centre, Roslin, Mid-Lothian Scotland, EH25 9RG, UK
†Drove Veterinary Hospital, 252 Croft Road, Swindon SN1 4RW, UK

[1]Corresponding author email: brendan.corcoran@ed.ac.uk

Objectives: To evaluate the radiographic lung pattern and topographical distribution in canine eosinophilic bronchopneumopathy.

Materials and Methods: Medical records were retrospectively reviewed for dogs diagnosed with eosinophilic bronchopneumopathy. Lateral thoracic radiographs were examined for the presence of increased radiopacity, classification of pattern, topography of lung changes (cranioventral, perihilar, caudodorsal, caudoventral) and severity of pulmonary lesions.

Results: Forty-four cases were identified with the Labrador retriever being the most commonly affected breed; there was a mean age of 5 years and an equal gender distribution. Coughing was the most common clinical sign. Circulating eosinophilia was present in 39% of dogs, with a mean peripheral eosinophilia of 5.1×10^9 cells/L and a mean bronchoalveolar lavage fluid eosinophilia of 40%. Eighty percent of dogs had an abnormal lung pattern in at least one of the four lung fields; the remaining had normal thoracic radiographs. The most common patterns were a bronchial and a bronchointerstitial pattern, with 41 and 89% distribution to the caudodorsal lung field, respectively.

Clinical Significance: A bronchial and bronchointerstitial pattern are the most common radiographic lung patterns seen in canine eosinophilic bronchopneumopathy with these patterns most frequently topographically distributed to at least the caudodorsal lung field. Furthermore, within the caudodorsal lung field, a bronchointerstitial pattern predominates. This radiographic and topographical finding may allow eosinophilic bronchopneumopathy to take precedence on a differential diagnoses list before confirmatory bronchoalveolar lavage fluid sampling.

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INTRODUCTION

Eosinophilic bronchopneumopathy (EBP), also known as pulmonary infiltration with eosinophilia, is a canine respiratory disease characterised by infiltration of the airways and pulmonary tissue with eosinophils (Lord *et al.* 1975, Corcoran *et al.* 1991, Clercx *et al.* 2000, Rajamäki *et al.* 2002). While the underlying cause is unknown, the respiratory tissue eosinophilia, and concurrent peripheral eosinophilia in some cases, suggest hypersensitivity (Corcoran *et al.* 1991, Clercx *et al.* 2002). A possible Th2-dominant immune response with an increase in $CD4^+$ T-cells and a significant increased expression of the cytokines eotaxin-2 and -3 and MCP-3 have been reported (German *et al.* 2002, Peeters *et al.* 2005, Peeters *et al.* 2006).

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JSAP

EBP is a sporadic disease with no apparent geographic or gender predisposition. A variety of breeds can be affected, although some studies reported over-representation in Siberian Huskies, Alaskan Malamutes and Rottweilers (Clercx *et al.* 2000, Lilliehöök *et al.* 2000). Similarly, EBP can occur in a wide age range but is most common in young to middle-aged dogs (Corcoran *et al.* 1991, Clercx *et al.* 2000, Clercx & Peeters 2007, Johnson *et al.* 2019). Typically, dogs present with a mild cough and are otherwise well, but tachypnoea, dyspnoea and exercise intolerance can be reported in more severely affected cases (Corcoran *et al.* 1991, Clercx *et al.* 2000). The main differential diagnoses are respiratory parasitism and chronic bronchitis, but other differentials include chronic bacterial pneumonia, fungal granulomas (aspergillosis), neoplastic processes and idiopathic eosinophilic bronchitis (German *et al.* 2002, Clercx & Peeters 2007, Johnson *et al.* 2019).

Diagnosis of EBP is based on clinical presentation, radiographic evidence of lower respiratory tract pathology, eosinophilia in bronchoalveolar lavage (BAL) fluid (BALF) or bronchial biopsies, and exclusion of other respiratory diseases and non-respiratory causes of eosinophilia (Clercx *et al.* 2000, Clercx & Peeters 2007). A circulating eosinophilia is supportive of a diagnosis, but is only present in about half of all cases, and it alone is not sufficient for a diagnosis (Clercx *et al.* 2000, Rajamäki *et al.* 2002). Standard thoracic radiography typically shows increased lung opacity with a bronchointerstitial lung pattern of varying severity, and occasionally alveolar infiltrates, peribronchial thickening and bronchiectasis (Clercx *et al.* 2000, Rajamäki *et al.* 2002). CT findings have been reported and are heterogeneous, including pulmonary parenchymal changes, bronchial wall thickening, bronchial luminal plugging and bronchiectasis (Meler *et al.* 2010, Mesquita *et al.* 2015). The CT parenchymal changes in distribution can be generalised, localised, lobar or multifocal; changes in lung pattern can be ground-glass, septal, nodular or consolidative. Treatment with systemic or oral glucocorticosteroids alone will give a rapid improvement in clinical signs in the majority of cases, often irrespective of the severity of radiographic changes or clinical signs; this rapid response to therapy can be supportive of a diagnosis (Lord *et al.* 1975, Corcoran *et al.* 1991, Clercx *et al.* 2000, Clercx & Peeters 2007, Canonne *et al.* 2016).

Part of the diagnosis of EBP requires BALF sampling under general anaesthesia; however, this may be a limiting factor in certain patients particularly those too unstable to undergo anaesthesia. Thus, we were interested to determine if thoracic radiography, particularly topographical distribution of any lesions, could enhance diagnostic suspicion before the confirmatory BALF testing; these findings could assist in prioritising of a differential diagnoses list. Currently, descriptive studies of the topography of radiographic lung patterns in EBP are lacking. The aim of this retrospective case series study, therefore, was to evaluate the radiographic pattern and its topographical distribution in a series of dogs with a confirmed diagnosis of EBP. We hypothesised that on a right lateral thoracic radiograph a bronchointerstitial pattern would dominate and this would be distributed primarily to the caudodorsal lung field (LF).

MATERIALS AND METHODS

The clinical database of the hospital for small animals (HfSA), Royal (Dick) School of Veterinary Studies, the University of Edinburgh archives was searched for dogs with a diagnosis of EBP between 1999 and 2018. All dogs were presented for routine clinical diagnosis and treatment, and consent was given by owners to permit access and to reporting of clinical data.

Dogs were diagnosed with EBP by the HfSA based on radiographic evidence of lower respiratory tract pathology; presence of an eosinophil percentage of greater than 4% of total nucleated cell count in BAL fluid cytology; and exclusion of respiratory parasitism via Baermann faecal analysis, bronchoscopic identification of larvae or qPCR examination of BAL fluid (Clercx *et al.* 2000). Dogs were included in the study if they had available haematology and BALF records for review, at least one right lateral thoracic radiograph, and were not receiving therapy that could impact on results in the week before the presentation to the HfSA. All BAL samples were obtained bronchoscopically under general anaesthesia using a flexible fibreoptic endoscope of appropriate diameter for the patient's size. There was no consistent sampling site reported, but bronchi with obvious secretions were selected. The endoscope was lodged in a bronchus and instilled with warmed normal saline at 1 mL/kg through the endoscope biopsy channel. The sample was immediately retrieved by syringe suction or by pump suction into a sample trap. A sample was regarded as adequate if approximately 40% of the volume was retrieved and the sample was grossly cloudy, and if not, one additional sampling was undertaken and the combined volumes pooled. All BAL samples were processed by Cytospin centrifugation (Cytospin, Woburn, MA) in the Veterinary Pathology Unit of the HfSA and stained with May-Grünwald Giemsa. Samples were prepared within 2 h of sampling or kept refrigerated at 4°C overnight and then immediately prepared the following morning. Samples were assessed by board-certified clinical pathologists for cellularity as mild, moderate or severe and the percentage of cell types reported.

Right lateral thoracic radiographs taken at the time of first presentation and when the diagnosis of EBP was made were blindly examined independently by EJYL and TS, with BMC acting as the arbiter in case of disagreement. Digital radiographic images (DICOM and JPEG formats) were viewed with a medical image viewer (Horos v3.3.5, Geneva, Switzerland). Assessors recorded their findings identifying the presence of increased lung radiopacity, topographical location of increased opacity, classification of lung pattern, and severity of pattern within the specific location. The four topographical LFs selected for evaluation included cranioventral, perihilar, caudodorsal and caudoventral (Fig 1) as previously described (Maï *et al.* 2008). Topographical terms were used to describe a lung area and not a specific lung lobe. Changes in lung pattern were classified as bronchial, interstitial, bronchointerstitial, alveolar or vascular. A bronchial pattern was characterised as peribronchial thickening and increased radiopacity of the bronchial tree. An interstitial pattern was defined as a hazy increase in background parenchymal radiopacity greater than that of normal limits. A bronchointerstitial pattern

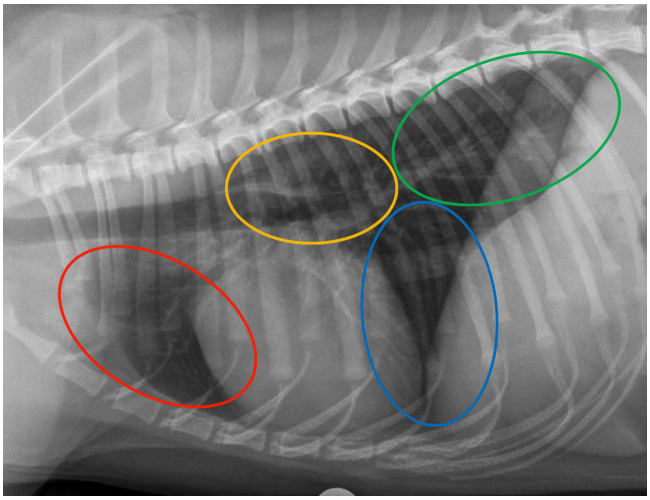

FIG 1. Lateral thoracic radiography showing the four topographical lung fields. Red=cranioventral, yellow=perihilar, green=caudodorsal, blue=caudoventral

was characterised as evidence of both a bronchial and interstitial pattern. An alveolar pattern was classified by the presence of consolidation depicted by air bronchograms with or without a lobar sign. A vascular pattern was defined as enlargement of the lobar artery and vein compared to the proximal portion of the fourth rib width where they intersected (Maï *et al.* 2008). Severity was scored 1–3 based on the degree and extent of increased radiopacity (Fig 2) and as follows: mild (1) radiographs had focal changes in radiopacity whereby the changes were clear and took up no more than 30% of the LF; moderate (2) radiographs had more localised lesions occupying between 30% and 60% of the LF with a conspicuous degree in increased radiopacity; severe (3) radiographs had a pronounced degree of radiopaque and extensive lesions dominating more than 60% of the LF.

RESULTS

Seventy-six dogs were diagnosed with EBP by the HfSA. Of these 76 dogs, 32 were excluded due to the following reasons: eight for incomplete medical records, two for lack of thoracic radiographs available for review, 18 for having only CT images, four due to confirmation of *Crenosoma vulpis* infection and two had recent glucocorticosteroid therapy. The remaining 44 dogs met the inclusion criteria and were included in the present study.

Labrador retrievers were the most commonly represented breed (10/44, 23%). Other breeds included three Border terriers and Lhasa Apsos each; and two each of Bearded collies, Border collies, Cockerpoos, Jack Russell terriers, Lurchers, and Weimaraners. Remaining dogs were either represented once or were crossbreeds. There were 21 males (nine entire) and 23 females (seven entire). Ages at diagnosis ranged from 7 months to 12 years (mean ± sd=5.0 ± 3.5 years). Weights measured at initial presentation at the HfSA ranged from 5.2 to 65.2 kg (mean ± sd=20.3 ± 12.0 kg). The most common clinical sign was coughing (44/44, 100%), followed by dyspnoea (17/44, 39%) and sneezing (14/44, 32%). Circulating eosinophilia was found in 17/44 dogs (39%), ranging from 1.1 to 27.5×10^9 cells/L (mean ± sd=5.1 ± 6.5×10^9 cells/L; normal range 0–1×10^9 cells/L). The BALF eosinophil percentage (BALFeos%) ranged from 5 to 95% (mean ± sd=40.0% ± 24.5%), with 31 dogs (31/44, 70%) having a BALFeos% greater or equal to 20%. All faecal analyses were negative for parasites and no dog had a travel history to areas where *Dirofilaria immitis* is prevalent. BALF bacterial culture identified *Bordetella bronchiseptica* (n=2), *Pseudomonas* spp. (n=2, *P. aeruginosa* and *P. putida*) and one each for *Mycoplasma* spp., *Pasteurella* spp., *Escherichia coli* and *Achromobacter xylosoxidans* (same dog), *Acinetobacter baumannii* and *Stenotrophomonas maltophilia* (same dog), *Enterococcus durans* and *Klebsiella pneumoniae*. *Aspergillus fumigatus* was isolated in one dog.

Radiographic changes in lung opacity in any LF were considered abnormal in 35 of 44 (80%) dogs (Table 1). Abnormal lung changes were most frequently seen in the caudodorsal LF (Fig 3), and present in all 35 (35/35, 100%) dogs with radiographic lung abnormalities (Table 2). Of the 35 radiographically abnormal dogs, 11 (11/35, 31%) had changes in lung opacity at only the caudodorsal LF, whereas the remaining 24 (24/35, 69%) had changes in opacity in at least one other LF in addition to the caudodorsal LF. Fifteen of the 24 dogs (63%) had two LFs with changes in lung pattern, seven of 24 (29%) had three LFs affected and two of 24 (8%) had changes in all four LFs. For the 35 dogs with radiographic changes in lung opacity, three radiographic lung patterns were identified: bronchial, interstitial and bronchointerstitial. Within the caudodorsal LF, a bronchial pattern was observed in 18 dogs (18/35, 51%) and a bronchointerstitial pattern in 16 dogs (16/35, 46%). A bronchial pattern was identified in 44 of the 176 LFs (25%) (Fig 4), with 18 of this pattern (18/44) located to the caudodorsal LF (18/44, 41%). A bronchointerstitial pattern was identified in 18 of 176 LFs (10%), with 16 of these located to the caudodorsal LF (16/18, 89%). The proportion of LFs containing a specific lung pattern is summarised in Table 3. Alveolar and vascular patterns were not observed in any LF. The individual subjective severity grades for the 35 abnormal radiographs were classified as mild (13/35, 37%), moderate (9/35, 26%) or severe (13/35, 37%).

DISCUSSION

The present study is the first to examine the radiographic lung pattern and topographical distribution in dogs with EBP. The results of the present study indicate that a caudodorsal topography was most frequently identified to have radiographic abnormalities in dogs with EBP. In the caudodorsal LF, bronchial and bronchointerstitial patterns predominated. However, 89% of all bronchointerstitial patterns were identified in the caudodorsal LF compared to only 41% of all bronchial patterns being in that same LF. Therefore, this study illustrates a bronchointerstitial pattern is most commonly distributed to the caudodorsal LF in dogs with EBP. Identifying this radiographic topography and lung pattern in a dog with the associated clinical signs, and where a circulating eosinophilia is also present, would help to prioritise EBP in the differential diagnoses list, with the caveat that BALF

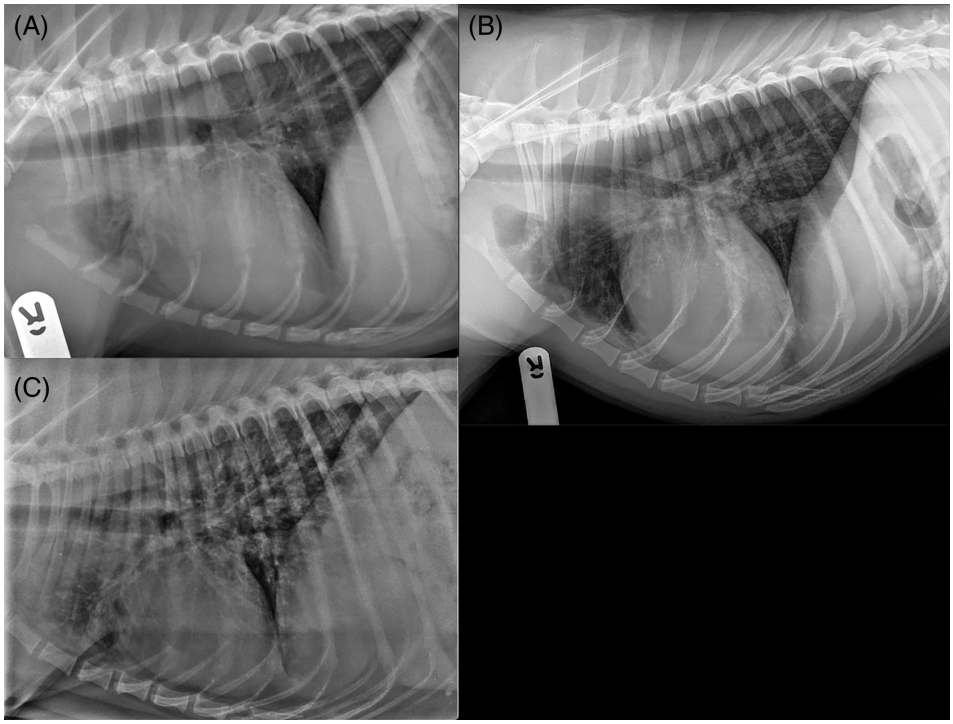

FIG 2. Representative right lateral thoracic radiographs in dogs with EBP illustrating (A) mild, (B) moderate and (C) severe bronchointerstitial lung patterns

Table 1. Radiographic lung changes in four lung fields

		Lung field			
		Cranioventral	Perihilar	Caudodorsal	Caudoventral
Lung pattern	Bronchial	13	2	18	11
	Interstitial	3	3	1	1
	Bronchointerstitial	1	1	16	0
	No changes	27	38	9	32
Total (i.e. number of dogs)		44	44	44	44

eosinophilia analysis would be required to confirm a diagnosis (Corcoran *et al.* 1991, Clercx *et al.* 2002, Rajamäki *et al.* 2002). Interestingly, 92% (11/12) of all caudoventral lesions demonstrated a bronchial pattern, although there were relatively fewer dogs (12/35, 34%) with radiographic changes in the caudoventral LF as compared to the caudodorsal LF (35/35, 100%).

As the previously reported clinical criteria for the diagnosis of EBP were used to select cases in this study, it is not surprising the case cohort had a predictable clinical profile. Labrador dogs were the most commonly represented breed type in this study, which contrasts to the predominance of the Siberian husky and Alaskan Malamute in another study (Clercx *et al.* 2000). The large number of Labradors likely reflect the particular popularity of that breed in Scotland and are unlikely to indicate a specific breed predisposition; the Labrador retriever made up 15% of all cases seen in the HfSA over the census period. The equal gender and mean age at the time of presentation were in line with expectations (Lilliehöök *et al.* 2000, Clercx & Peeters 2007). The mean age was found to be lower than previously reported for chronic bronchitis, including eosinophilic bronchitis (Hawkins *et al.* 2010, Johnson *et al.* 2019); it is interesting to note the similar mean age in the current study compared with the age predilection of atopy, considering the latter's type I hypersensitivity mechanism (Clercx *et al.* 2000). Clinical signs in the present study were similar to previous reports (Corcoran *et al.* 1991, Clercx *et al.* 2000, Clercx & Peeters 2007, Johnson *et al.* 2019). The presence of the bacteria isolated in this study raises a question as to their possible contribution to EBP. While *Mycoplasma pneumoniae* and *Bordetella pertussis* have been suggested to either trigger or exacerbate human asthma, a previous veterinary report has found association between *Mycoplasma* spp. and *Bordetella bronchiseptica* with canine EBP to be unlikely (Canonne *et al.* 2018). The positive culture of opportunistic pathogens such as *Stenotrophomonas*, *Pseudomonas* and *Aspergillus* could suggest a role in the pathogenesis of EBP, although the presence of these microorganisms could be incidental (Clercx *et al.* 2000, Rajamäki *et al.* 2002, Johnson *et al.* 2016, Johnson *et al.* 2019).

The presence of a circulating eosinophilia was less than 50% of the cohort and in line with previous reports, as was the mean blood eosinophilia of 5.1×10^9 cells/L (Clercx *et al.* 2000, Rajamäki *et al.* 2002). While the presence of circulating eosinophilia can increase the index of suspicion, on its own it is not

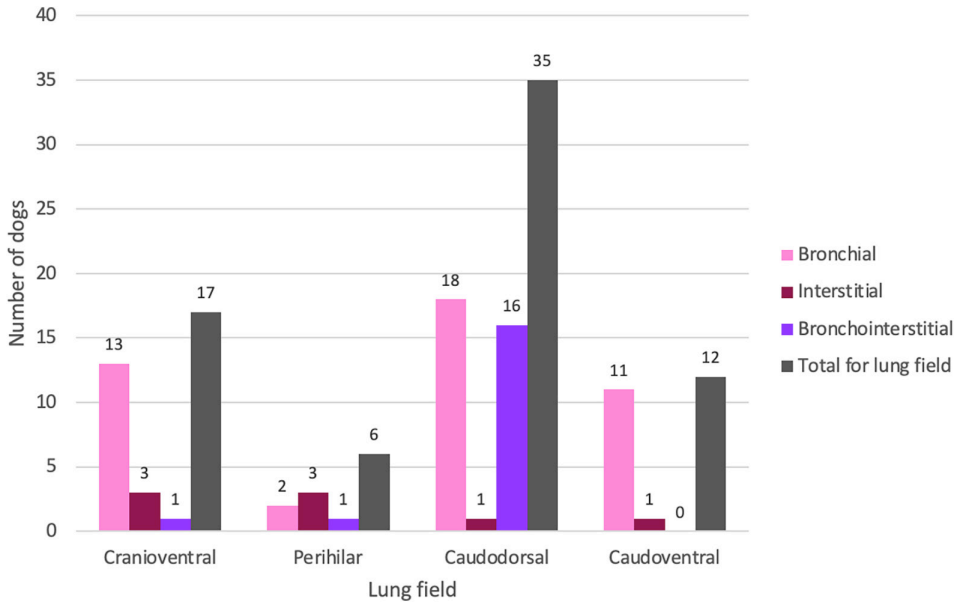

FIG 3. Topographical distribution of lung patterns to a specific lung field in the 35 radiographically abnormal dogs with EBP

Table 2. Radiographic changes in lung pattern within a specific lung field

		Lung field			
		Cranioventral	**Perihilar**	**Caudodorsal**	**Caudoventral**
Lung pattern	Bronchial	13/17 (77%) *(56%, 97%)*	2/6 (33%) *(0%, 71%)*	18/35 (51%) *(35%, 68%)*	11/12 (92%) *(76%, 100%)*
	Interstitial	3/17 (18%) *(0%, 36%)*	3/6 (50%) *(10%, 90%)*	1/35 (3%) *(0%, 8%)*	1/12 (8%) *(0%, 24%)*
	Bronchointerstitial	1/17 (6%) *(0%, 17%)*	1/6 (17%) *(0%, 47%)*	16/35 (46%) *(29%, 62%)*	0
Total for lung field		17	6	35	12

Ninety-five percent confidence intervals are shown in italicised parentheses

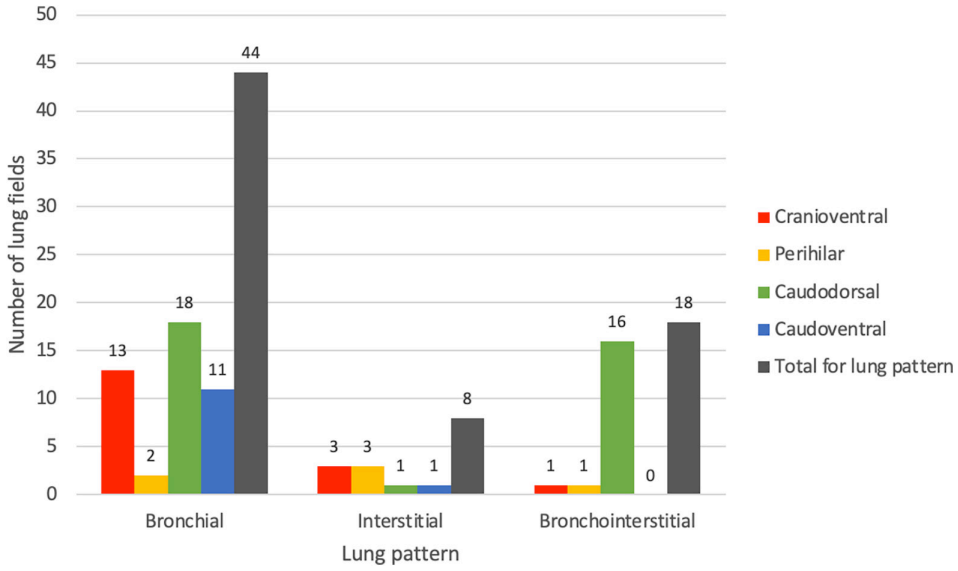

FIG 4. Proportion of lung fields containing a specific lung pattern on the right lateral view of 44 dogs with EBP

diagnostic for EBP, with other differentials of a peripheral eosinophilia including parasitism, gastroenteritis and dermatitis (Lilliehöök *et al.* 2000). A percentage of up to 4% of eosinophils in BALF tends to be regarded as normal in the dog, although occasionally higher values are seen (Rebar *et al.* 1980, King *et al.* 1988, Hawkins *et al.* 1990). All dogs in the present study

Table 3. Proportion of lung fields containing a specific lung pattern

		Lung field				Total for pattern
		Cranioventral	Perihilar	Caudodorsal	Caudoventral	
Lung pattern	Bronchial	13/44 (30%) *(16%, 43%)*	2/44 (5%) *(0%, 11%)*	18/44 (41%) *(26%, 55%)*	11/44 (25%) *(12%, 38%)*	44
	Interstitial	3/8 (38%) *(4%, 71%)*	3/8 (38%) *(4%, 71%)*	1/8 (13%) *(0%, 35%)*	1/8 (13%) *(0%, 35%)*	8
	Bronchointerstitial	1/18 (6%) *(0%, 16%)*	1/18 (6%) *(0%, 16%)*	16/18 (89%) *(74%, 100%)*	0	18

Ninety-five percent confidence intervals are shown in italicised parentheses

had an eosinophil percentage in BAL cytology of greater than 4% while a majority (31/44, 70%) had a BALFeos% greater than 19%. In line with previous reports, this study supports the notion that the presence of a circulating eosinophilia is not diagnostic for EBP.

The radiographic findings reported here are fairly similar to that in previous reports. Among the radiographic lung patterns identified, a bronchial pattern was most frequently detected, which differs from the bronchointerstitial pattern previously reported (Clercx *et al.* 2000, Rajamäki *et al.* 2002). An alveolar lung pattern was not seen in any of the dogs which is consistent with the report by Rajamäki and others (2002). However, this is in contrast with earlier studies where alveolar infiltration, diffuse patchy alveolar densities and a mixed alveolar-interstitial pattern were reported (Lord *et al.* 1975, Corcoran *et al.* 1991, Clercx *et al.* 2000). In the current study, 20% of the dogs (9/44) had no radiographic changes despite having a BALF eosinophilia, ranging from 5 to 63%. This is in contrast to the recent report by Johnson and others (2019) where all dogs (n=35) had abnormal thoracic radiographs. However, they classified dogs with a BALF eosinophilia and normal thoracic radiographs as eosinophilic bronchitis rather than EBP. Whether or not such a distinction exists is worth considering, although this non-universal categorisation of eosinophilic lung disease in dogs could explain the contrasting radiographic findings. There are a few similarities between the radiographic findings in this series of dogs with EBP as compared to those in clinicopathologically similar diseases, such as canine angiostrongylosis and chronic bronchitis. The predominance of bronchial and bronchointerstitial patterns in the present study is similar to that in chronic bronchitis (Pavelski *et al.* 2017). Moreover, 69% of dogs in this study had multiple LFs affected, which is comparable to primarily diffuse radiopacities seen in angiostrongylosis and chronic bronchitis (Gallagher *et al.* 2012, Pavelski *et al.* 2017). However, a distinguishing feature is the lack of an alveolar pattern identified in the current study as compared to dogs with *Angiostrongylus vasorum* infection (Boag *et al.* 2004, Gallagher *et al.* 2012). Furthermore, only 4% of dogs with angiostrongylosis had a localised bronchial or bronchointerstitial pattern (Gallagher *et al.* 2012); no dogs with chronic bronchitis had focal bronchial or bronchointerstitial patterns (Pavelski *et al.* 2017). Future studies determining the topographical and radiographic features of chronic bronchitis and pulmonary parasitism could further support the prioritisation of a differential diagnoses list.

The clinical utility of the findings in this study can be appreciated when considering the factors that affect decision-making when investigating patients with suspected EBP, including cost, test availability, diagnostic utility, interpretative skill of the clinician and hazard to the patient. In the case of respiratory disease, a combination of thoracic radiography and BALF cytology in dogs and cats with chronic bronchitis and asthma respectively has a much superior diagnostic accuracy (95%) than the use of either test alone (Pavelski *et al.* 2017). Similarly, the use of combined radiography and BALF cytology would be the preferred approach in all suspected cases of EBP. The findings of this study do not preclude the use of BALF cytology in such cases, but can heighten the clinician's suspicion of a possible diagnosis of EBP. However, BALF sampling requiring anaesthesia is not an option in some dogs. The combination of clinical presentation and the radiographic lung lesions topographical distribution characteristic of EBP, supported by the presence of a circulating eosinophilia, would justify trial glucocorticosteroid therapy in these cases, once the possible contribution of parasitism had been addressed.

There are various limitations to this study including being retrospective. By applying clear clinical guidelines, we excluded 42% of the dogs where a diagnosis of EBP had been entered in the patient record. To minimise the effect of glucocorticosteroid therapy, known to dampen circulating and BALF eosinophil counts and radiographic intensity (Rajamäki *et al.* 2002), two dogs were directly excluded and for the remainder, in line with hospital referral policy for referral of respiratory cases with chronic non-life-threatening clinical signs, all treatment was stopped at least 7 days before being presented (Corcoran *et al.* 1991, Moore *et al.* 1992, Clercx *et al.* 2000). The interpretation of thoracic radiographic images has recognised limitations and confounding factors. Thoracic structures are viewed as superimposed onto each other which result in a composite image, and the non-recumbent lungs contribute more visible lung structures to the image. When assessing thoracic areas on a lateral radiograph, it is not possible to determine the exact lobar location of a lesion. The concept of *lung fields* was developed to express this ambiguity and this traditional radiologic term was used in the current study. Furthermore, the caudodorsal LF comprises the largest lung volume compared to the other LFs and this may be a contributing factor to the increased density detected in this area. Regardless of this, we were still able to determine that, in the context to EBP, radiographic lung pat-

tern changes are most visible in the caudodorsal LF. There is a degree of arbitrary subjectivity in our radiographic severity scoring system. Therefore, to improve objectivity to the best of our efforts, two independent blinded assessors evaluated the radiographs separately with a third assessor acting as arbiter. Lastly, considering the extended census period, radiography would have been undertaken by a wide range of staff, and this might have had some impact on our findings (Thrall 2013). Incorrect body positioning and radiographic technique, inadequate ventilation, and sedation protocols also increase the risk of misdiagnosing radiographic pathology, which are the most common causes of identifying an interstitial pattern (Thrall 2013). The phase of inspiration was varied between the radiographs in this study, and the increased radiopacity occasionally seen in thoracic radiographs taken in the expiratory phase can be mistaken for an interstitial pattern as well (Thrall 2013). Nevertheless, the consistency of the findings in this study suggests a credible diagnostic feature of EBP has been identified, and that it can have diagnostic utility in clinical practice. Future research investigating the CT and radiographic features of EBP could provide a more comprehensive topographical evaluation of the pulmonary lesions in this disease.

In conclusion, this study demonstrates radiographic changes in EBP are dominated by an increased bronchointerstitial pattern in the caudodorsal LF on a right lateral thoracic radiograph. While performing a BAL is still warranted in diagnosis, this topographical finding could aid in prioritising EBP in a differential diagnoses list and inform decision-making on the potential diagnostic benefit of BALF sampling in dogs with clinical, haematologic and radiographic features suggestive of EBP.

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Conflict of interest

None of the authors of this article has 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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