Sensitivity, specificity, and interobserver variability of survey thoracic radiography for the detection of heart base masses in dogs

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OBJECTIVE
To determine the sensitivity, specificity, and interobserver variability of survey thoracic radiography (STR) for the detection of heart base masses (HBMs) in dogs.

DESIGN
Retrospective case-control study.

ANIMALS
30 dogs with an HBM and 120 breed-matched control dogs (60 healthy dogs and 60 dogs with heart disease and no HBM).

PROCEDURES
In a blinded manner, 2 observers (designated as A and B) evaluated STR views from each dog for a mass-like opacity cranial to the heart, tracheal deviation, cardiomegaly, findings suggestive of pericardial effusion or right-sided congestive heart failure, and soft tissue opacities suggestive of pulmonary metastases. Investigators subsequently provided a final interpretation of each dog’s HBM status (definitely affected, equivocal, or definitely not affected).

RESULTS
Considering equivocal interpretation as negative or positive for an HBM, the sensitivity of STR for diagnosis of an HBM was 40.0% (95% confidence interval [CI], 22.5% to 57.5%) and 56.7% (95% CI, 38.9% to 74.4%), respectively, for observer A and 63% (95% CI, 46.1% to 80.6%) and 80.0% (95% CI, 65.7% to 94.3%), respectively, for observer B. The corresponding specificity was 96.7% (95% CI, 93.5% to 99.9%) and 92.5% (95% CI, 87.8% to 97.2%), respectively, for observer A and 99.2% (95% CI, 97.5% to 100%) and 92.5% (95% CI, 87.8% to 97.2%), respectively, for observer B. The presence of a mass-like opacity cranial to the heart or tracheal deviation, or both, was significantly associated with a true diagnosis of HBM.

CONCLUSIONS AND CLINICAL RELEVANCE
Results indicated that STR is a highly specific but not a highly sensitive predictor of HBM in dogs. (J Am Vet Med Assoc 2016;248:1391–1398)

Heart base mass is a general term used to designate any mass located at the base of the heart in association with the ascending aorta and pulmonary trunk, but without right atrial involvement. Chemodectoma of the aortic body is the most common HBM in dogs, but ectopic thyroid and parathyroid carcinoma can also develop at the heart base. Other differential diagnoses for HBMs include thymoma, hemangiosarcoma, abscess, and granuloma. The incidence of HBMs is high in brachycephalic dogs, and a breed predisposition for the development of aortic body tumors in English Bulldogs, Boxers, and Boston Terriers has been reported. Heart base masses can be an incidental finding or, depending on the size and type of mass, may be associated with clinical signs including syncope, cardiac tamponade, and arrhythmias. Various diagnostic tests can be used for the clinical diagnosis of HBM. To achieve a definitive cytologic or histologic diagnosis requires invasive procedures, which are often not appropriate; results of other procedures, such as analysis of any pericardial fluid, are usually nondiagnostic.

For these reasons, HBM is generally a presumptive di-
agnosis determined on the basis of information provided by diagnostic imaging techniques.\textsuperscript{3} Transthoracic echocardiography is a useful noninvasive tool for detecting a cardiac mass, although its sensitivity for cardiac mass detection is variable, depending on the size, echogenicity, and location of the mass as well as the degree of any pericardial effusion.\textsuperscript{3,9–11} Echocardiographic procedures are strongly operator dependent and are useless for detection of pulmonary metastases.\textsuperscript{11} Transesophageal echocardiography can overcome some limitations of TTE because of the proximity of structures of interest to the probe without interposition of other tissues and high transducer resolution.\textsuperscript{12,13} However, the effectiveness of transesophageal echocardiography is mainly limited by its invasiveness and a wide range of reported complications.\textsuperscript{15} Magnetic resonance imaging, CT, and CT angiography are the techniques of choice for use in both humans and small animals because they facilitate examination of the entire thorax, and the cross-sectional image format eliminates the superimposition of other mediastinal structures.\textsuperscript{14–21} However, the use of these advanced techniques is often limited in animals other than humans because of the need for anesthesia, high cost, and possible allergic reaction of patients to contrast media.\textsuperscript{19,20,22} Survey thoracic radiography remains a useful imaging technique for the evaluation of intrathoracic disorders because it is relatively inexpensive, widely available, and easy to perform.\textsuperscript{25}

To our knowledge, reports of systematic studies aimed at establishing the diagnostic value of STR for the detection of HBMs in dogs are lacking. Therefore, the first objective of the study reported here was to estimate the sensitivity, specificity, and interobserver variability of STR for identification of HBMs in dogs. Additionally, the influence of mass size or other factors on radiographic identification of HBMs was assessed.

## Materials and Methods

### Case selection

Medical records of dogs with an HBM at the cardiology unit of the veterinary teaching hospitals of the Universities of Teramo and Bologna from August 2001 through December 2013 were retrospectively reviewed. Diagnosis of an HBM was obtained on the basis of combined clinical, radiographic, and echocardiographic (2-D, M-mode, and color flow Doppler) findings. Control dogs were subsequently selected on the basis of the breed of dogs with HBMs. Specifically, for each dog with HBM, 4 dogs of the same breed were selected; of those 4 dogs, 2 had no clinical and echocardiographic evidence of heart disease and 2 had clinical and echocardiographic evidence of heart disease but no HBM. Transthoracic echocardiography was always performed by the same experienced operator (CG or MBT) at each study center. Only dogs with at least 2 orthogonal radiographic images of the thorax were enrolled. Exclusion criteria included echocardiographic evidence of mass involving structures other than the cardiac base (ie, masses that had developed from ventricles, atria, pericardium, and lymph nodes), incorrect positioning for radiography; and radiographic views in which the cardiac silhouette was obscured by pleural effusion.

### Medical records review

For each dog, evaluation of right lateral and VD or DV radiographic views of the thorax was performed by 2 independent investigators (AD and MC), both radiologists with more than 15 years of experience. Investigators were unaware of any information regarding each dog with the exception of signalment, and were asked to record their observations (as subjective assessments or on the basis of detection [ie, yes or no]) regarding the following radiographic signs or features: mass-like opacity effacing or silhouetting with the cranial border of the cardiac silhouette; focal elevation of the terminal portion of the trachea on the lateral view; focal deviation of the terminal portion of the trachea on the DV or VD view in association with a mass-like soft tissue opacity; cardiomegaly; radiographic features of right-sided CHF (ie, enlarged caudal vena cava, hepatoenomagaly, pleural effusion, and ascites); radiographic features of pericardial effusion (ie, enlarged and globoid cardiac silhouette, and distinct margins of the cardiac silhouette); and soft tissue opacities suggestive of pulmonary metastases.\textsuperscript{24} Finally, each investigator was required to provide a final interpretation of each dog’s HBM status (definitely affected, equivocal, or definitely not affected).

### Statistical analysis

The normality of the data was assessed with a 1-sample Kolmogorov-Smirnov nonparametric test. Normally distributed data are reported as mean ± SD. A 1-way ANOVA was used to analyze normally distributed continuous data (age), followed by the Tamhane post hoc test for multiple comparisons. For each of the 2 investigators (designated as observers A and B), the observed frequencies of radiographic signs suggestive of HBM were determined and those data are reported with 95% CIs.

The sensitivity, specificity, and PPV for diagnosis of HBM by means of STR were calculated separately for each investigator. The ability of each investigator to distinguish dogs with HBM from control dogs was evaluated by ROC curve analysis. Values of the AUC were calculated with equivocal cases classified as either positive or negative for an HBM. A weighted kappa test was used to evaluate the degree of agreement between observers for their radiographic diagnosis of HBM with a 3-level judgment. Kappa values were defined as follows: ≤ 0.2, poor agreement; 0.21 to 0.40, fair agreement; 0.41 to 0.60, moderate agreement; 0.61 to 0.80, good agreement; and ≥ 0.81, very good agreement.\textsuperscript{26}

To evaluate the possible effect of mass size on the diagnostic sensitivity of STR for the detection of
HBM, the HBMS:BW was calculated by applying the mean of 2 echocardiographically measured HBM axes as the radius of an assumed spherical shape, and considering 1 kg of body weight as 1,000 cm³. For each observer, the sensitivity of STR for the detection of HBMs was then plotted against the HBMS:BW by classifying the equivocal diagnoses as positive or negative for HBM. Finally, the possible effects of HBM size (measured echocardiographically), dog breed (categorized as brachycephalic vs nonbrachycephalic), and radiographic signs or features suggestive of HBM on formulation of a false-negative diagnosis were investigated. In particular, both the presence of 1 or the presence of 2 or 3 of the 3 main radiographic signs suggestive of an HBM (ie, mass-like opacities effacing or silhouetting with the cranial aspect of the cardiac silhouette, focal elevation of the terminal part of the trachea on the lateral view, and focal deviation of the terminal portion of the trachea on DV or VD view in association with a soft tissue opacity) were evaluated for their univariate association with a false-negative diagnosis by means of a Fisher exact test. Furthermore, a logistic regression model for false-negative results with HBM size, breed, and radiographic signs or features as candidate predictors was built. Data analysis was performed with a statistical software package, and a value of \( P < 0.05 \) was considered significant.

### Results

#### Study population

Medical records of 38 dogs with an HBM were evaluated, and 30 of them fulfilled the inclusion criteria. Eight dogs were excluded because, radiographically, the cardiac silhouette was obscured by pleural effusion. Thus, a total of 150 dogs, including 30 dogs with an HBM, 60 healthy dogs, and 60 dogs with heart disease and no HBM were eligible for the study. In the group of dogs with an HBM, brachycephalic breeds were overrepresented (18/30 [60%] dogs). There were 12 Boxers, 4 mixed breeds, 2 English Bulldogs, 2 Yorkshire Terriers, and 1 each of the following breeds: American Staffordshire Terrier, Beagle, Briard, Cane Corso, Dogue de Bordeaux, Dalmatian, French Bulldog, German Shepherd Dog, Pug, and Rottweiler. The same breeds were included in the 2 control groups; each control group had 24 Boxers, 8 mixed breeds, 4 English Bulldogs, 4 Yorkshire Terriers, and 2 each of the remaining breeds. Dogs with an HBM were significantly \( (P < 0.001) \) older (mean ± SD age, 10.3 ± 2.0 years) than the healthy dogs (mean ± SD age, 7.9 ± 3.7 years) and the dogs with heart disease and no HBM (mean ± SD age, 7.9 ± 3.8 years). Among the dogs with an HBM, healthy dogs, and dogs with heart disease, there were 17, 29, and 41 males, respectively, and 13, 31, and 19 females, respectively.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dogs with an HBM (n = 30)</th>
<th>Healthy dogs (n = 60)</th>
<th>Dogs with heart disease and no HBM (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observer A</td>
<td>Observer B</td>
<td>Observer A</td>
</tr>
<tr>
<td>Frequency of radiographic sign or feature (No. [%] of dogs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiomegaly</td>
<td>20 (66.7)</td>
<td>26 (86.7)</td>
<td>8 (13.3)</td>
</tr>
<tr>
<td>Mass-like opacities effacing or silhouetting with the cranial aspect of the cardiac silhouette</td>
<td>14 (46.7)</td>
<td>19 (63.3)</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>Focal elevation of the terminal portion of the trachea (lateral view)</td>
<td>12 (40.0)</td>
<td>18 (60.0)</td>
<td>3 (5.0)</td>
</tr>
<tr>
<td>Focal deviation of the terminal portion of the trachea in association with a soft tissue opacity (DV or VD view)</td>
<td>7 (23.3)</td>
<td>10 (33.3)</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>Pericardial effusion</td>
<td>7 (23.3)</td>
<td>12 (40.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Right-sided CHF</td>
<td>7 (23.3)</td>
<td>9 (30.0)</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>Pulmonary metastasis</td>
<td>1 (3.3)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>HBM status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definitely affected</td>
<td>12 (40.0)</td>
<td>19 (63.3)</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>Equivocal</td>
<td>5 (16.7)</td>
<td>5 (16.7)</td>
<td>2 (3.3)</td>
</tr>
<tr>
<td>Definitely not affected</td>
<td>13 (43.3)</td>
<td>6 (20.0)</td>
<td>57 (95.0)</td>
</tr>
</tbody>
</table>

For each dog with an HBM, 4 control dogs of the same breed were selected; of those 4 dogs, 2 had no clinical and echocardiographic evidence of heart disease (healthy dogs) and 2 had clinical and echocardiographic evidence of heart disease but no HBM. Right lateral and DV or DV radiographic views of the thorax in the medical records of each dog were examined in a blinded manner by each observer. Radiographic features of right-sided CHF included enlarged caudal vena cava, hepatomegaly, pleural effusion, and ascites. Radiographic features of pericardial effusion included enlarged and globoid cardiac silhouette and distinct margins of the cardiac silhouette. Each observer’s radiographic interpretation of each dog’s HBM status was recorded as definitely affected, equivocal, or definitely not affected.
Definitive histologic diagnoses were available for 4 of 30 (13.3%) dogs with an HBM and included 3 cases of chemodectoma and 1 case of aortic carcinoma. The most common heart disease in dogs with heart disease and no HBM was chronic degenerative valvular disease (32/60 [53.3%] dogs), followed by congenital heart diseases (18/60 [30%] dogs), arrhythmogenic right ventricular cardiomyopathy (6/60 [10%] dogs), idiopathic pericardial effusion (3/60 [5%] dogs), and hypertrophic cardiomyopathy (1/60 [1.7%] dogs). Echocardiographically confirmed pericardial effusion was present in 16 of 30 (53.3%) dogs with HBM and in 7 of 60 (11.7%) dogs with heart disease without HBM. Clinically confirmed right-sided CHF was present in 10 of 30 (33.3%) dogs with HBM and in 18 of 60 (30.0%) dogs with heart disease and no HBM. The echocardiographically measured dimensions of HBMs ranged from 2 X 2 cm to 5 X 10 cm. The mean ± SD HBMs:BW was 14.9 ± 16.4 (range, 1.5 to 63.1).

Radiographic evaluation

Radiographic observations recorded by the 2 observers, including the frequency of each radiographic sign or feature suggestive of HBM and the final radiographic interpretation, were summarized (Table 1). For the 30 dogs with HBM, the most frequently observed radiographic signs or features were cardiomegaly (66.7% and 86.7% of cases for observers A and B, respectively), mass-like opacity effacing or silhouetting with the cranial border of the cardiac silhouette (46.7% and 63.3% of cases for observers A and B, respectively), focal elevation of the terminal portion of the trachea on the lateral view (40% and 60% of cases for observers A and B, respectively), focal deviation of the terminal portion of the trachea in association with a soft tissue opacity (DV or VD view) (23.3% and 33.3% of cases for observers A and B, respectively), pericardial effusion (23.3% and 33.3% of cases for observers A and B, respectively), right-sided CHF (6.7% and 20.0% of cases for observers A and B, respectively), and pulmonary metastasis (3.3% and 0.0% of cases for observers A and B, respectively).

### Table 2

<table>
<thead>
<tr>
<th>Radiographic sign or feature</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
<th>PPV (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observer A</td>
<td>Observer B</td>
<td>Observer A</td>
</tr>
<tr>
<td>Cardiomegaly</td>
<td>66.7</td>
<td>86.7</td>
<td>73.3</td>
</tr>
<tr>
<td></td>
<td>(49.8–83.5)</td>
<td>(49.8–83.5)</td>
<td>(65.4–81.3)</td>
</tr>
<tr>
<td>Mass-like opacities effacing or silhouetting with the cranial aspect of the cardiac silhouette</td>
<td>46.7</td>
<td>63.3</td>
<td>97.5</td>
</tr>
<tr>
<td></td>
<td>(28.8–64.5)</td>
<td>(46.1–80.6)</td>
<td>(94.7–100)</td>
</tr>
<tr>
<td>Focal elevation of the terminal portion of the trachea (lateral view)</td>
<td>40.0</td>
<td>60.0</td>
<td>95.8</td>
</tr>
<tr>
<td></td>
<td>(22.5–57.5)</td>
<td>(42.5–77.5)</td>
<td>(92.3–99.4)</td>
</tr>
<tr>
<td>Focal deviation of the terminal portion of the trachea in association with a soft tissue opacity (DV or VD view)</td>
<td>23.3</td>
<td>33.3</td>
<td>97.5</td>
</tr>
<tr>
<td></td>
<td>(8.2–38.5)</td>
<td>(16.5–50.2)</td>
<td>(94.7–100)</td>
</tr>
<tr>
<td>Pericardial effusion</td>
<td>23.3</td>
<td>40.0</td>
<td>95.0</td>
</tr>
<tr>
<td></td>
<td>(8.2–38.5)</td>
<td>(28.5–57.5)</td>
<td>(91.1–98.9)</td>
</tr>
<tr>
<td>Right-sided CHF</td>
<td>6.7</td>
<td>20.0</td>
<td>95.0</td>
</tr>
<tr>
<td></td>
<td>(0.0–15.6)</td>
<td>(5.7–34.3)</td>
<td>(91.1–98.9)</td>
</tr>
<tr>
<td>Pulmonary metastasis</td>
<td>3.3</td>
<td>0.0</td>
<td>99.2</td>
</tr>
<tr>
<td></td>
<td>(0.0–9.7)</td>
<td>(97.5–100)</td>
<td>(97.5–100)</td>
</tr>
</tbody>
</table>

See Table 1 for key.

### Table 3

<table>
<thead>
<tr>
<th>Observer</th>
<th>Interpretation of equivocal cases</th>
<th>No. of affected dogs assigned correct diagnosis of an HBM (n = 30)</th>
<th>Sensitivity (95% CI)</th>
<th>No. of unaffected dogs assigned correct diagnosis of no HBM (n = 120)</th>
<th>Specificity (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Positive for HBM</td>
<td>17</td>
<td>56.7 (38.9–74.4)</td>
<td>111</td>
<td>92.5 (87.8–97.2)</td>
</tr>
<tr>
<td></td>
<td>Negative for HBM</td>
<td>12</td>
<td>40.0 (22.5–57.5)</td>
<td>116</td>
<td>96.7 (93.5–99.9)</td>
</tr>
<tr>
<td>B</td>
<td>Positive for HBM</td>
<td>24</td>
<td>80.0 (65.7–94.3)</td>
<td>111</td>
<td>92.5 (87.8–97.2)</td>
</tr>
<tr>
<td></td>
<td>Negative for HBM</td>
<td>19</td>
<td>63.0 (46.1–80.6)</td>
<td>119</td>
<td>99.2 (97.5–100)</td>
</tr>
</tbody>
</table>

See Table 1 for key.
on DV or VD view in association with a soft tissue mass (23.3% and 33.3% of cases for observers A and B, respectively), and pericardial effusion (23.3% and 40% of cases for observers A and B, respectively).

The sensitivity, specificity, and PPV of each radiographic sign or feature suggestive of an HBM were summarized (Table 2). With the exception of cardiomegaly, all the considered radiographic signs and features were highly specific (ie, specificity > 85%) for identification of an HBM. Radiographic signs with higher sensitivity (ie, ≥40% for both observers) for identification of an HBM in the 30 dogs with an HBM were mass-like opacity effacing or silhouetting with the cranial border of the cardiac silhouette, focal elevation of the terminal portion of the trachea on the lateral, view, focal deviation of the terminal portion of the trachea on DV or VD view in association with a soft tissue opacity.

The overall sensitivity and specificity of the 2 observers’ radiographic observations for the identification
of an HBM were analyzed with equivocal cases classified as positive or negative for an HBM (Table 3). The accuracy of observations by the 2 independent observers for the identification of an HBM was determined by ROC curve analyses (Figure 1). Of the dogs with an HBM, 13 (43.3%) were incorrectly identified as negative for an HBM by observer A and of those 13 dogs, 6 (20%) were also incorrectly identified as negative for an HBM by observer B. The dimension of the HBM in each of these 13 dogs was ≤ 5 × 6 cm; 6 dogs were brachycephalic, and 1 dog had right-sided CHE. With equivocal cases classified as positive or negative for an HBM, the diagnostic accuracy was moderate for both observers (AUC ± SE was 0.746 ± 0.058 and 0.683 ± 0.062, respectively for observer A and 0.867 ± 0.045 and 0.796 ± 0.057, respectively, for observer B). Values of AUC were higher when equivocal cases were considered positive for HBM. The interobserver agreement was good (weighted kappa ± SE, 0.679 ± 0.070; 95% CI, 0.541 to 0.817). Smaller relative dimension of HBM was associated with progressive reduction of HBM radiographic identification, but the overall sensitivity based on the HBM:BW was always ≥ 57% and ≥ 80% for observers A and B, respectively (Figure 2).

Both the presence of 1 (P = 0.002 and P < 0.001 for observers A and B, respectively) and the combined presence of 2 or 3 (P = 0.02 and P = 0.014 for observers A and B, respectively) of the 3 main radiographic signs suggestive of an HBM were significantly associated with a true diagnosis of HBM. Both the HBM size (P = 0.12 and P = 0.14 for observers A and B, respectively) and brachycephaly (P = 0.18 and P = 0.10 for observers A and B, respectively) were not significantly associated with a false-negative diagnosis of HBM in the dogs of the study reported here.

**Discussion**

To our knowledge, the present study is the first to objectively evaluate the diagnostic characteristics of HBMs in thoracic radiographic views obtained from a large group of affected dogs. In addition, this study included 2 control groups (healthy dogs and dogs with heart disease and no HBM) that were cross-matched by breed with the dogs with an HBM. An attempt was also made to evaluate the influence of different variables on the sensitivity of radiographic detection of an HBM.

On the basis of results of previous studies, 1, 4, 6 brachycephalic dogs represent the majority of dogs with HBM, as was confirmed by findings of the present study. Breed-related differences in thoracic conformation and intrathoracic organs must be kept in mind when interpreting thoracic radiographic views obtained from dogs. 23 For example, an increased opacity in the cranial mediastinum and right lateral deviation of the trachea in DV views from healthy brachycephalic dogs, particularly English Bulldogs, are frequently found and mimic some of the radiographic features of an HBM. 27 Radiographic signs such as mass-like opacities effacing or silhouetting with the cranial aspect of the cardiac silhouette, focal elevation of the terminal portion of the trachea on lateral view, and focal deviation of the terminal portion of the trachea in association with a soft tissue opacity on DV or VD view had a high PPV (ie, ≥ 70%) and were highly specific (ie, specificity > 90%) but less sensitive (ie, sensitivity < 63%) indicators of an HBM in dogs of the present study. Cardiomegaly was more commonly detected in dogs with an HBM (range of sensitivity, 66.7% to 86.7%), but the specificity and PPV of cardiomegaly as an indicator of an HBM were < 74% and < 39%, respectively.

The associated radiographic features (ie, pericardial effusion, pleural effusion, right-sided CHE, and pulmonary metastases) of other cardiorespiratory disorders in dogs with HBM have highly variable sensitivities, specificities, and PPVs as indicators of an HBM. In a previous study 3 of 107 dogs with pericardial effusion, including 23 dogs with HBM, thoracic radiography had low sensitivity for detection of pulmonary metastases; pulmonary metastases were identified by use of radiography in 7 of 21 (33.3%) dogs with confirmed pulmonary metastases. Similarly, the diagnostic accuracy of thoracic radiography in the identification of pericardial effusion in dogs is only moderate, independent of the amount of fluid. 28

The overall specificity of thoracic radiography for the identification of an HBM in dogs was > 92% for both observers in the present study, but the sensitivity was low-moderate; with equivocal cases classified as negative or positive for an HBM, specificity of STR for identification of an HBM was 40% or 56.7%, respectively, for observer A and 63% or 80%, respectively, for observer B. Data regarding diagnostic accuracy of other imaging techniques for the identification of HBM in dogs are scarce in the veterinary medical literature. The sensitivity and specificity of echocardiography for the detection of an HBM in 23 dogs with pericardial effusion were 74% and 98%, respectively. 5

In the present study, the observed difference in sensitivity between the 2 observers, who had a similar level of experience as radiologists, can be explained by the effect of failure of perception and of misjudgment, which are among the main causes of error and variation in the interpretation of radiographic images. 29, 30 Failure of perception may account for approximately 60% of diagnostic errors in human diagnostic radiology, and experienced radiologists are not immune to errors of judgment. 30, 31 In humans, it has been demonstrated that second reviews of radiographic images typically generate discordance rates (ie, differences between first and second interpretations) in the range of 2% to 20% for most general imaging formats, with higher rates sometimes possible. 32 Furthermore, among experienced radiologists in human medicine, the interpretation of chest radiographic views obtained from accident and emergency patients was associated with a lower level of interobserver agreement than that for skeletal or abdominal radiographic images. 31 Detection of subtle radiographic abnormalities in a given patient can also be enhanced by comparison of current images with previous or successive images. However, follow-up
radiographic views were not evaluated in dogs of this study. Nevertheless, the interobserver agreement was good, which indicated that in many cases both observers were able to correctly identify an HBM, whereas in other cases they had similar difficulty in making a diagnosis of an HBM. All false-negative diagnoses were made for dogs with small HBMs (<5 cm in diameter), but the absolute mass size did not significantly influence false-negative diagnosis of HBM nor did the type of dog breed (ie, brachycephalic vs nonbrachycephalic). Information on mass size in comparison to body size in dogs with HBMs is lacking in the veterinary medical literature, but mass diameters ranging from 1 to 16 cm (mean diameter, 5 cm) have been previously reported.23–37 In the present study, a wide range of HBM size (range, 2 × 2 cm to 5 × 10 cm) and associated HBMs:BW (range, 1.5 to 63.1) was found. The lack of a significant influence of HBM size on diagnostic sensitivity of thoracic radiography for the detection of HBMs was likely related to the relative number of dogs with a false-negative diagnosis of HBM (13 and 6 dogs for observers A and B, respectively). In contrast, the radiographic presence ( singly or in some combination) of mass-like opacities effacing or silhouetting with the cranial aspect of the cardiac silhouette, focal elevation of the terminal portion of the trachea on the lateral view, and focal deviation of the terminal portion of the trachea along with a soft tissue opacity on DV or VD view were significantly associated with a true diagnosis of an HBM. Therefore, these radiographic signs deserve particular attention for the radiographic identification of an HBM.

The present study had some limitations that need to be emphasized. First, a low number of definitive histologic diagnoses was available for the dogs with HBM, and diagnoses were mainly based on results of TTE. However, HBM biopsy of affected dogs is usually limited by the high procedure-related risk of complications.1,3,33 Second, no dog with cranial mediastinal masses other than an HBM (ie, abscess, granuloma, thymoma, or tracheobronchial lymphadenopathy) that mimicked the radiographic features of HBMs was included as a study control. Third, adherence to a consistent standardized protocol for TTE measurements of HBMs was not possible, and only 2-D measurements were available for all masses in dogs with an HBM. Because HBMs are 3-D structures, their growth may occur in all directions, sometimes not uniformly. Thus, the accuracy of measuring the actual size of 3-D masses in a single scan plane and 2 orthogonal dimensions may be questioned. Finally, only HBMs with a minimum diameter of 2 cm were found in dogs of the present study. Therefore, the diagnostic performance of STR in the identification of HBM with a diameter <2 cm could not be evaluated.

Results of the present retrospective study indicated that STR is a highly specific but less sensitive predictor of HBMs in dogs. The presence of mass-like opacities effacing or silhouetting with the cranial aspect of the cardiac silhouette and focal deviation of the terminal portion of the trachea both on lateral and DV or VD views were highly specific and had moderate-to-high PPV for identification of an HBM. For HBMs that were >2 cm in diameter, the interobserver agreement was good, and absolute mass size had a positive influence on radiographic sensitivity. Survey thoracic radiography still maintains an essential role in the clinical assessment of dogs with an HBM, especially when advanced imaging techniques are not available.

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References

Effects of magnesium sulfate and propofol on the minimum alveolar concentration preventing motor movement in sevoflurane-anesthetized dogs

Alanna N. Johnson et al

OBJECTIVE
To evaluate the effect of MgSO$_4$ alone, and in combination with propofol, on the minimum alveolar concentration preventing motor movement (MAC$_{NM}$) in sevoflurane-anesthetized dogs.

ANIMALS
6 healthy purpose-bred adult male Beagles (least squares mean ± SEM body weight, 12.0 ± 1.1 kg).

PROCEDURES
Dogs were anesthetized 3 times at weekly intervals. The MAC$_{NM}$ was measured 45 minutes after induction of anesthesia (baseline; MAC$_{NM}$basal) and was determined each time by use of a noxious electric stimulus. Treatments were administered as a loading dose and constant rate infusion (CRI) as follows: treatment 1, MgSO$_4$, loading dose of 45 mg/kg and CRI of 15 mg/kg/h; treatment 2, propofol loading dose of 4 mg/kg and CRI of 9 mg/kg/h; and treatment 3, MgSO$_4$ and propofol combination (same doses used previously for each drug). A mixed-model ANOVA and Tukey-Kramer tests were used to determine effects of each treatment on the percentage decrease from MAC$_{NM}$basal. Data were reported as least squares mean ± SEM values.

RESULTS
Decrease from MAC$_{NMbasal}$ was 3.4 ± 3.1%, 48.3 ± 3.1%, and 50.3 ± 3.1%, for treatments 1, 2, and 3, respectively. The decrease for treatments 2 and 3 was significantly different from that for treatment 1; however, no significant difference existed between results for treatments 2 and 3.

CONCLUSIONS AND CLINICAL RELEVANCE
MgSO$_4$ did not affect MAC$_{NM}$, nor did it potentiate the effects of propofol on MAC$_{NM}$. Administration of MgSO$_4$ in this study appeared to provide no clinical advantage as an anesthetic adjuvant. (Am J Vet Res 2016;77:575–581)