Echocardiographic findings and clinical signs in dairy cows with primary cardiac lymphoma: 7 cases (2007–2010)

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Objective—To describe echocardiographic and clinical findings in cattle with cardiac manifestation of lymphoma.

Design—Retrospective case series.

Animals—7 adult Holstein dairy cows with cardiac lymphoma.

Procedures—Medical and necropsy records of all cows that underwent transthoracic echocardiography from January 2007 through April 2010 because of clinical signs of cardiac diseases or bovine lymphoma were reviewed. The diagnosis of cardiac manifestation of lymphoma was confirmed by necropsy examination or cytologic evaluation of pericardial fluid obtained by pericardiocentesis.

Results—Most commonly, cows had clinical signs of right-sided congestive heart failure secondary to cardiac tamponade with moderate to severe anechoic pericardial effusion (5/7 cows). In 2 cows, tachycardia was the only clinical sign in relation to cardiac disease and a heterogenic mass was observed protruding into the right atrium.

Conclusions and Clinical Relevance—The use of transthoracic echocardiography aided in the diagnosis of primary cardiac lymphoma in cows. Transthoracic echocardiography may help to quantify the severity of pericardial effusion and to orient needle placement for pericardiocentesis to determine a final diagnosis. A mass within the right atrium was also suggestive of cardiac lymphoma and should be differentiated from mural bacterial endocarditis. (*J Am Vet Med Assoc* 2012;241:1083–1087)

Cardiac diseases in cattle generally carry a poor prognosis.[1,2] Some therapeutic attempts have been successful in cases of traumatic pericarditis,[3] IHP,[4–6] and bacterial endocarditis.[7,8] Among heart diseases of cattle, cardiac neoplasms are uncommon, except in areas where BLV has not been eradicated, such as North America. Bovine lymphoma can affect various tissues and organs, including the heart.[9,10] The clinical manifestation of cardiac lymphoma varies from nonspecific clinical signs[11] to clinical signs of congestive right-sided heart failure such as peripheral edema and venous jugular distension or pulse.[9,12–15] Although temporary improvement can be observed, with various treatments, the prognosis is poor[11–15] even if there are no clinical signs of heart failure.[14] Lymphoma is the most common neoplasm in cattle in areas where BLV infection is common.[9,16] Although the typical form of enzootic lymphoma with generalized lymphadenomegaly can be easily diagnosed in a clinical setting, 40% to 50% of affected cows do not have peripheral lymph node enlargement on physical examination.[9,10] In those cases, lymphomatous cells can cause nonspecific signs such as abomasal bleeding ulcers, ataxia, or clinical signs of heart diseases, depending on their localization.[9,10,14]

For this reason, ancillary tests must be performed for diagnosis because simple serologic testing for BLV has a low positive predictive value for tumor diagnosis.[15] Pericardial fluid analysis[14] or necropsy[12,13] has been suggested as ancillary tests to assist in the diagnosis of cardiac lymphoma. Although incomplete, echocardiographic findings have been reported for some cattle with cardiac lymphoma[12–14]; there is a lack of information concerning the potential applications of TTE to differentiate cardiac lymphoma from other common heart diseases.[17] The aim of the study reported here was to describe the echocardiographic findings in cows with cardiac lymphoma to help in the antemortem diagnosis of this neoplastic disease, especially when other typical clinical signs of enzootic lymphoma are absent.

Abbreviations

BLV	Bovine leukosis virus
IHP	Idiopathic hemorrhagic pericarditis
TTE	Transthoracic echocardiography

Materials and Methods

Criteria for selection of cases—From January 2007 through April 2010, all dairy cows from the bovine ambulatory clinic of the Faculté de médecine vétérinaire, Université de Montréal, with a presumptive diagnosis of heart disease underwent complete TTE[a] performed by the author using a 2-MHz phased array probe. The reasons for echocardiography included the presence of clinical signs of congestive heart failure, unexplained tachycardia, or anomaly at cardiac auscul-

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tation (murmur or muffled heart rate). Medical records and necropsy records of all cows that underwent TTE during the study period were reviewed. Cows with clinical signs compatible with nonseptic or nonneoplastic pericardial effusion were excluded from the study. The final diagnosis of cardiac lymphoma was made on the basis of cytologic analysis of the pericardial fluid (obtained by pericardiocentesis) or by necropsy with direct inspection of the neoplastic tissue in the heart. Only cows with a definitive diagnosis of cardiac lymphoma, either confirmed on necropsy or on the basis of findings on cytologic evaluation of pericardial fluid, were included in the present study.

Procedures—The data that were recorded included the reason for consultation, age of the cow, breed, clinical findings, and ancillary test findings. Transthoracic echocardiography was performed with a systematic approach from the right side of the thorax because most of the cardiac parameters are obtained from right-sided echocardiograms.[18,19] The cardiac cavities were assessed in 4 systematic views, including the 4-chamber view, left ventricular outflow tract view, right ventricular outflow tract view, and short-axis view of the cardiac ventricles. The general appearance of each cardiac valve was noted as well as their ability to close normally.

The presence of pericardial fluid, mass lesions, any other anomaly, signs of cardiac tamponade, shortening fraction of the left ventricle, and cardiac chamber dimensions were recorded. The dimension of the mass was noted. Pericardiocentesis was performed when pericardial fluid was observed in a substantial amount (> 1 cm depth surrounding the heart). The effusion was qualified as small, moderate, or severe on the basis of criteria used in human cardiology.[20] The effusion was considered as small if < 1 cm of effusion was determined on the echo-free space, moderate if the effusion was between 1 and 2 cm, and large if > 2 cm of fluid was observed (**Figure 1**). The cytologic examination of pericardial fluid was performed and histopathologic diagnosis was made by board-certified pathologists.

Results

During the study period, 7 Holstein cows were included in the study, with various degrees of decreased appetite and milk production. Of these cows, 5 cows had clinical signs compatible with right-sided heart failure, including increased venous pressure and peripheral edema. The 2 remaining cows had clinical signs of decreased appetite, gastrointestinal stasis, and tachycardia.

Heart rate was increased in all cows (mean, 105 beats/min; range, 84 to 120 beats/min; reference range, 60 to 80 beats/min). Muffled heart sounds were observed in the 5 cows with clinical signs of right-sided heart failure. No other abnormal cardiac auscultatory findings or arrhythmia was found. External lymphadenomegaly was noted in only 1 of the 2 remaining cows. This cow had bilateral external iliac and cervical superficial lymph node enlargement.

Of the 7 cows, 5 cows had signs of right-sided heart failure with a large amount of pericardial effusion apparent on TTE and 2 cows had clinical signs of disease other than heart failure with an echogenic mass apparent in the right atrial myocardium (**Table 1**). In the 5 cows with clinical signs of right-sided heart failure, the dominant findings consisted of a large amount of pericardial effusion and various degrees of collapse of the right ventricle during ventricular diastole (**Figure 1**), which was highly suggestive of cardiac tamponade. In 3 of 5 cows, exaggerated right atrial collapse was observed shortly after the atrial systole. The echocardiographic sign of a swinging heart motion was observed in 3 of 5 cows. No other abnormalities were noted during TTE in the cardiac cavities of the 5 cows except for stranding on the epicardial surface at the right atrioventricular junction in 2 cows or at the right ventricular epicardium in 1 cow.

In the 2 remaining cows with clinical signs of disease other than right-sided heart failure, a small degree of pericardial effusion was noted on TTE in 1 cow but not in the other. The most important finding in both cows was the presence of an echogenic mass attached to the right atrial wall at the level of the aortic root (**Figure 2**). This mass protruded into the right atrial cavity but did not affect tricuspid valve function. In both cows, the mass was not pedunculated but was diffusely attached to the atrial wall. The echogenicity of the mass was hypoechoic to echoic with heterogenic content; its contour was well demarcated from the atrial lumen.

Left ventricular fractional shortening was decreased from the reference value (mean ± SD, 46.5 ± 9.3%) in 3 of 7 cows (25%, 25.9%, and 26.7%) and increased in 1 cow (58.5%). Mean ± SD fractional shortening of the 7 cows was 39.03 ± 13.5%.

Pericardiocentesis was performed in the 5 cows that had a large amount of pericardial effu-

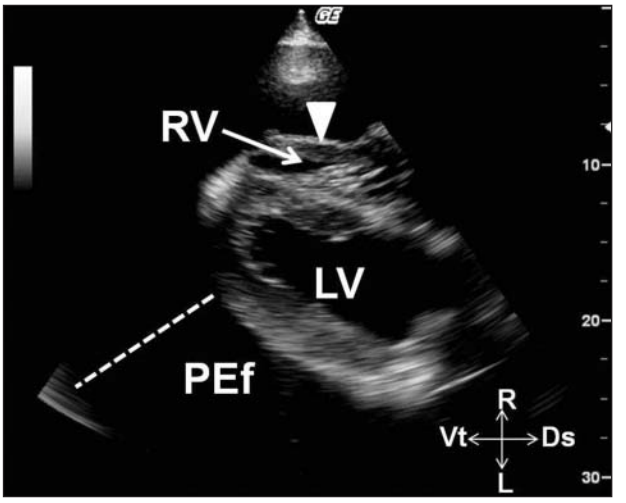

Figure 1—Right 4-chamber long-axis TTE view of the heart of a cow with primary cardiac lymphoma and clinical signs of congestive right-sided heart failure with brisket and submandibular edema as well as distended jugular veins. Cardiac tamponade is evident with severe pericardial effusion secondary to cardiac lymphoma. The TTE image was obtained during ventricular diastole, which reveals large amounts of anechoic pericardial effusion (PEf), leading to right ventricular (RV) collapse (arrowhead). Ds = Dorsal. L = Left. LV = Left ventricle. R = Right. RV = Right ventricle. Vt = Ventral. Dotted line denotes the severity of pericardial effusion. The TTE image was obtained with a 2-MHz phased-array probe.

Table 1—Echocardiographic data and clinical signs of 7 cows with cardiac lymphoma.

Variable	1	2	3	4	5	6	7	Reference value[18,19]
Signs of heart failure								
Brisket edema	Yes	Yes	Yes	Yes	Yes	No	No	NA
Submandibular edema	Yes	No	Yes	Yes	No	No	No	NA
Jugular distension	Yes	Yes	Yes	Yes	No	No	No	NA
Jugular pulse	No	Yes	No	Yes	No	No	No	NA
Heart rate (beats/min)	98	108	84	120	112	92	120	60–80
Other signs of lymphoma								
Gastrointestinal infiltration	No	No	No	No	No	Yes	No	NA
Lymph node enlargement	No	No	No	No	No	No	Yes	NA
Echocardiographic measurements								
RVDd (cm)	3.05	3.01	2.51	2.47	3.47	3.88	4.36	4.1 ± 1.02
RVDs (cm)	2.28	1.37	1.35	1.68	1.8	1.89	1.22	3.6 ± 0.98
IVSd (cm)	2.2	2.91	2.78	2.8	2.7	2.33	2.45	2.2 ± 0.51
IVSs (cm)	3.71	3.03	2.59	3.07	3.36	3.65	3.31	3.1 ± 0.38
LVDd (cm)	8.92	5.35	7.33	6.97	8.45	7.22	7.78	8.7 ± 1.0
LVDs (cm)	3.7	3.22	5.43	3.58	4.35	5.3	5.83	4.2 ± 0.8
LAD (cm)	10.43	8.12	9.45	NP	10.7	7.94	11.12	12 ± 1.2
RAD (cm)	7.62	3.25	6.69	5.1	5.88	5.44	3.29	NA
Ao (cm)	7.01	5.83	6.76	6.27	6.36	6.32	6.64	6.4 ± 0.6218
PA (cm)	4.77	NP	NP	NP	NP	5.17	5.04	5.5 ± 0.8
FS (%)	58.6	39.9	25.9	48.6	48.5	26.7	25	46.5 ± 9.3
PEf depth (cm)	2.70	4.91	4.73	3.79	3.31	0.77	0	NA
Echocardiographic findings								
RVC	Yes	Yes	Yes	Yes	Yes	No	No	NA
RAC	No	Yes	Yes	Yes	No	No	No	NA
SH	No	Yes	Yes	Yes	No	No	No	NA
RAM (cm)	No	No	No	No	No	4.2 × 1.45	1.96 × 2.88	NA

The data were collected via the right parasternal approach with a 2-MHz phased-array probe. Reference values given as range or mean ± SD.

Ao = Aortic diameter. FS = Fractional shortening. IVSd = Interventricular septal thickness in diastole. IVSs = Interventricular septal thickness in systole. LAD = Left atrial diameter. LVDd = Left ventricular diameter in diastole. LVDs = Left ventricular diameter in systole. NA = Not available. NP = Not performed. PA = Pulmonary artery diameter. PEf = Pericardial effusion. RAC = Right atrial collapse. RAD = Right atrial diameter. RAM = Right atrial mass. RVC = Right ventricular collapse. RVDd = Right ventricular diameter in diastole. RVDs = Right ventricular diameter in systole. SH = Swinging heart.

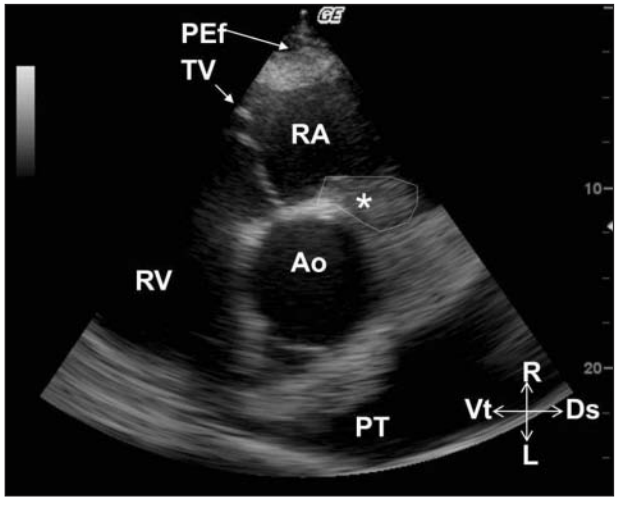

Figure 2—Right parasternal cranial long-axis TTE view of the heart of a cow with primary cardiac lymphoma. Notice the echogenic mass (asterisk) attached to the posterior wall of the right atrium (RA). The echogenicity of the mass is hypoechoic with heterogenic content; its contour is well demarcated from the atrial lumen (as outlined). The mass was confirmed to be lymphomatous tissue on necropsy. A small quantity of pericardial effusion is also observed (PEf). Ao = Aorta. PT = Pulmonary trunk. TV = Tricuspid valve. *See* Figure 1 for remainder of key.

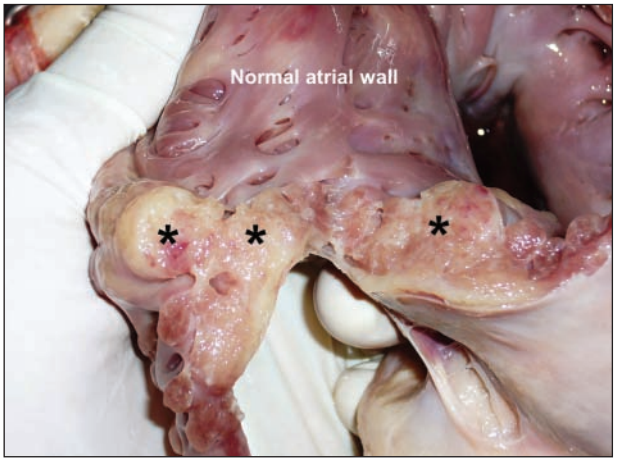

Figure 3—Postmortem examination of lymphomatous infiltration in the right atrial wall in the same cow as in Figure 2 with primary cardiac lymphoma. This cow was confirmed to have lymphomatous infiltration of the right atrial wall on necropsy, as was suspected by TTE examination. Notice the heterogenic aspect of the neoplastic tissue (asterisks), compared with normal atrial wall.

sion. Pericardiocentesis yielded hemorrhagic pericardial fluid, which contained large quantities of neoplastic cells. In all 5 cows, cytologic analysis of the pericardial fluid revealed large numbers of great lymphocytes and intermediary lymphocytes with a small amount of highly basophilic cytoplasm and a high nuclear-to-cytoplasmic ratio compatible with lymphoma. Necropsy confirmed the diagnosis of cardiac lymphoma in the 2 remaining cows, with lymphomatous tissue observed directly in the right atrial wall (**Figure 3**).

Discussion

Echocardiographic data concerning cardiac lymphoma in cattle were limited to 3 cases in other reports in the veterinary literature.[12–14] Moreover, the data obtained were subjective data in only 2 of 3 cattle.[12,13] To our knowledge, the present study is the first to specifically assess echocardiography as an ancillary tool in the diagnosis of primary cardiac lymphoma in multiple cattle. The term primary cardiac lymphoma is preferred when the manifestation of lymphoma is limited to the heart, including cattle in which neoplastic tissue is limited to the heart as well as those in which clinical signs are mainly those of heart disease.[21] Two echocardiographic and clinical manifestations of cardiac lymphoma in cattle were distinguished in the study reported here. The first typically consisted of the observation of a large pericardial effusion without any gross myocardial anomaly. In these cattle, various signs of cardiac tamponade due to increased intrapericardial pressure were observed, including the presence of a swinging heart motion as the heart appeared to be floating in the pericardial space and right ventricular and atrial collapse.[20] These echocardiographic findings were associated with various clinical signs of right-sided heart failure, including distended jugular veins as well as abnormal jugular pulse and peripheral edema. However, no neoplastic tissue or mass was observed in these cattle during TTE, although a small amount of fibrin strands could be seen.[14] A complete necropsy was not performed in each cow with large pericardial effusion, so we cannot assume that myocardial involvement by neoplastic tissue was totally absent. The sensitivity of TTE can be too low to detect small neoplastic lesions in humans with cardiac lymphoma, compared with other diagnostic imaging procedures (eg, transesophageal ultrasonography, CT, or MRI).[21]

The clinical challenge when performing TTE in cattle with large pericardial effusion is to differentiate neoplastic pericardial effusion from septic effusion resulting from traumatic pericarditis (the most common bovine pericardial disease)[17] or the recently described IHP.[4–6] When no fibrin strands are observed, the diagnosis of traumatic pericarditis with septic pericardial effusion is unlilkely.[17] Typically, cattle with traumatic pericarditis classically have hypoechoic to echoic pericardial effusion with various amounts of echogenic fibrin strands.[17] On the other hand, the presence of a large amount of anechoic fluid with no echogenic strands or few echogenic strands can also be found in cattle with IHP.[4–6] Therefore, it is important to perform a pericardiocentesis and pericardial fluid analysis to differentiate IHP from neoplastic pericardial effusion in affected cattle. This is of practical importance because it will have an important impact on the prognosis. In contrast to cardiac lymphoma or traumatic pericarditis, IHP has a good prognosis with treatments that can be used on the farm.[4–6]

The second type of echocardiographic manifestation in this study was consistent with an echogenic mass adherent to the right atrial wall.[13] In these cattle, pericardial effusion was absent to small and clinical signs of cardiac dysfunction were limited to tachycardia. The ultrasonographic characteristics of the neoplastic tissue were hypoechoic to echoic with heterogenic content. The most important differential diagnosis for these types of echocardiographic findings is mural bacterial endocarditis. This lesion could also theoretically lead to a mass effect adhered to the atrial wall. However, the well-demarcated contour of the neoplastic mass in the present study was different from classical echocardiographic findings of endocarditis. The echocardiographic contour of a bacterial endocarditis lesion is classically less demarcated with a shaggy and vegetative appearance (pedunculated vegetations).[17,22] The clinical manifestation and hematologic findings suggestive of chronic active inflammatory process are usually present in cases of bacterial endocarditis but not in cases with primary cardiac lymphoma; moreover, the mural localization of bacterial endocarditis is a rare event, compared with valvular localization.[1,17,22–24]

Localization of neoplastic infiltration in the right atrium is the most frequently reported manifestation of cardiac lymphoma of cattle,[13] as in humans.[24] However, other localizations have been reported.[12,25] The predominance of this preferred localization has still not been fully explained.[24] It is important to mention that direct inspection of neoplastic tissue in the myocardium is uncommon in cattle. Just 2 of 7 cattle in the present study and 1 bull[13] and 2 cattle[12,14] in other clinical reports involved a mass in the right atrium.

Interestingly, up to 20% of human patients with primary cardiac lymphoma have a history of cardiac disease (pericarditis, ischemic heart disease, or dysrhythmia).[22] None of the cows of the present study had a history of heart disease. Recently, Peek et al[26] mentioned the hypothesis that IHP could be a precursor of cardiac lymphoma because most cattle with IHP are seropositive for BLV[4,5] and that cardiac lymphoma has been diagnosed in a cow that had IHP 14 months before neoplastic pericardial effusion occurred. However, this theory has not been proven because IHP can also be diagnosed in a BLV-negative heifer.[6] For these reasons, the presumptive link between IHP and cardiac lymphoma still needs to be explored with long-term follow-up in future cases of IHP.

In conclusion, although primary cardiac lymphoma is a rare disease in cattle, it should be suspected in any cow with clinical signs of pericardial effusion as well as in cows with an intracardiac mass found in the right atrium when performing TTE. Transthoracic echocardiography can be of value in the management of cattle with suspected cardiac lymphoma. In these cattle, pericardiocentesis should be obtained to achieve a final diagnosis. In cattle in which pericardial effusion is absent or small, a mass effect in the right atrium may be observed and differentiated from mural endocarditis. The ultimate goal of these ancillary tests is to determine a diagnosis quickly to avoid useless treatments or suffering in affected cows.

a. LogiqBook XP, General Electric, Wawatosa, Wis.

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