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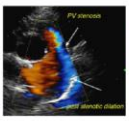
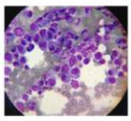
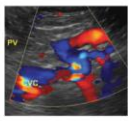




SonoPath
Clinical Sonography & Telecytology
EDUCATIONAL TELECONSULTATION SERVICES™
1-800-838-4268 info@sonopath.com SonoPath.com

PATIENT
Macy Hughes

SPECIES
Canine

BREED
Pug Mix

SEX
Female Spayed

AGE
13 years

WEIGHT
27.8lbs

INTERPRETED BY
Maggie Machen Lamy, DVM, DACVIM (Cardiology)

IMAGING PERFORMED BY
Rachel Runnells, RVT

HOSPITAL NAME
SVS Imaging KC

REFERRING VET
Dr. Meyer

INVOICE
25421

DATE
7/19/22

PRESENTING CLINICAL SIGNS

History: Coughing of 4 days with a history of minor heart enlargement. Macy has been panting and having an increased respiration rate for the past few days and then started coughing so owner brought her in. Macy had radiographs done in January that showed no major changes in heart size, but it was still larger than normal, no VHS was provided with those radiographs. She is not currently on any medication for the heart, but owner says they are current on Simparica Trio, but that was not filled here. Has started pimobendan and furosemide, and on for 3 days at time of ultrasound.
-Abnormal PE/Chem/CBC/UA Results: CBC: WNL GHP/Lytes: -ALP 936 (20-150) H -Ca 12.1 (8.6-11.8) H -Glu 129 (60-110) H -Tbil 0.7 (0.1-0.6) H.

RADIOGRAPHIC FINDINGS *NOTE: Images submitted for supplemental cardiac information only.

Despite an increased VHS, subjectivity only mild right-sided cardiomegaly is appreciated. No obvious evidence of CHF.

ELECTROCARDIOGRAPHIC FINDINGS *Note: Single lead ECGs are evaluated as a rhythm strip. Morphology/MEA cannot be definitively commented on.

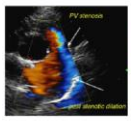
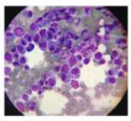
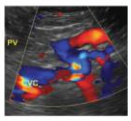
A single lead ECG is available; 25mm/s, 10mm/mV. The underlying rhythm is sinus in origin with dramatic heart rate variation (range 40-150bpm) with frequent sinus pauses. During the sinus pause, a junctional escape beat fires. No AV block or other arrythmias appreciated.
ECG diagnosis: Suspect high vagal tone causing a respiratory sinus arrhythmia and junctional escape beats; sinus node dysfunction cannot be ruled out.

ECHOCARDIOGRAM FINDINGS

2D, m-mode, color flow and doppler imaging is available. Mild thickening of mitral valve leaflets with no obvious prolapse into the left atrial lumen. Trace mitral regurgitation with a normal left atrial dimension. Normal MR velocity. Normal LV diameter with adequate myocardial function. The tricuspid valve appears mildly thickened with no tricuspid regurgitation. Mild right atrial enlargement; mild right ventricular enlargement and hypertrophy consistent with pulmonary arterial hypertension. The pulmonic and aortic valves are normal in morphology and mobility. Minimal main PA and branch dilation. Trace pulmonic insufficiency. Normal pulmonic and aortic outflow velocities. No pericardial or pleural effusion noted. No cardiac tumors observed.

CARDIAC CHART

CANINE CARDIAC PARAMETERS	MR VMAX (m/s)	TR VMAX (m/s)	LA/AO (Boon method)	LA/AO (Heart Base; Swe)	FS (%)	EF (%)	EPSS (cm)
NORMAL PARAMETER	4.5-5.5	<2.7	1.3	<1.6	28-40	40-100	<0.6
PATIENT	6.0	3.5	1.2	1.1	57	88	0.2
CANINE CARDIAC PARAMETERS	**HR** (BPM)	**AV VMAX** (m/s)	**PV MAX** (m/s)	**BODY WEIGHT** (kg)	**LA** 2D short axis Base view (cm)	**LVIDd** Avg; 2D and m-mode short axis (cm)	**LVIDs** Avg; 2D and m-mode short axis (cm)
NORMAL PARAMETER	50-100	0.7-1.7	0.7-1.6	BELOW	BELOW	BELOW	BELOW
PATIENT	80	1.6	1.1	12.6	1.8	3.0	1.3
*Normal chamber parameters expressed as a mean value (SD)				3	1.27 (5.3)	2.46 (2.46)	1.36 (5.5)
BODY WEIGHT DEPENDENT PARAMETERS **Note: All measurements based upon multi-modal images and methods. An average value is reported.*				5	1.40 (4.5)	2.74 (5.2)	1.60 (4.7)
				10	1.50 (3.8)	3.27 (3.5)	2.06 (3.1)
				15	1.83 (2.0)	3.71 (2.4)	2.43 (2.1)

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Adapted from June Boon, Veterinary Echocardiography, 1998 Rishniw M and Hollis NE, J Vet Intern Med 2000; 14:429-435 Hansson et al, Vet Rad and Ultrasound 2002 Bonagura et al. Echocardiography: principles of interpretation, Vet Clin North Am 15:1177, 1995	20	2.02 (1.9)	4.14 (2.2)	2.80 (2.0)
	25	2.18 (2.4)	4.48 (2.9)	3.10 (2.5)
	30	2.33 (3.3)	4.83 (3.9)	3.39 (3.4)
	35	2.48 (4.3)	5.17 (5.0)	3.69 (4.5)
	40	2.62 (5.2)	5.48 (6.1)	3.96 (5.4)
	50	2.88 (7.1)	6.07 (8.3)	4.46 (7.4)

INTERPRETATION OF THE FINDINGS & FURTHER RECOMMENDATIONS

Findings are consistent with mild to moderate pulmonary hypertension (PAH), as evidenced by mild right heart changes and an elevated TR velocity. The estimated systolic pulmonary arterial pressure is 50-60mmHg, with normal being <25mmHg. This is causing mild enlargement of the right heart and MPA (indicating right-heart pressure overload). The left heart is essentially normal, with a subclinical mitral regurgitation and no risk for left-sided CHF. No additional issues are identified.

Clinical signs of weakness, heavy breathing, cyanosis, and syncope are attributed to severe PAH. The underlying genesis of PAH is poorly understood in cases other than heartworm infestation, though it occurs with increased frequency in a variety of forms of chronic lung disease and in patients with idiopathic pulmonary fibrosis. Given the predisposed breed and chronic respiratory signs, underlying airway disease is the likely cause. COPD/chronic bronchitis results and leads to PAH over time. Patients with this degree of PAH and pulmonary disease can develop right-sided congestive heart failure (ascites), debilitating cyanosis, labored breathing and exertional syncope if poorly controlled.

Given the presumably recent history of a worsening cough, the most common cause is an infectious or inflammatory insult causing a decline in already poor oxygenation status. A PTE cannot be ruled out but is less likely. Coverage with broad spectrum pulmonary antibiotic (fluoroquinolone) is recommended if the cough is still an issue, in addition to vasodilation using sildenafil. Lasix is certainly not indicated as diuretics can actually further reduce preload in cases of debilitating PAH and worsen clinical signs. If ascites or pleural effusion develops in the future, then diuretic therapy becomes necessary.

Depending on severity of symptom, use of theophylline and/or taper course of anti-inflammatory steroids can also be beneficial in these cases, to treat exertional dyspnea or acute flare ups and decrease the inflammatory component as much as possible. PRN use of cough suppressants may also be beneficial. Unfortunately, the prognosis overall is poor, however I am hopeful we can provide some medical relief going forward.

Omega fatty acid supplementation (anti-inflammatory) may be of some long-term benefit. Monitor for worsening of labored breathing, exercise intolerance or collapse episodes.

The ECG is most consistent with high vagal tone. This is likely secondary to a combination of sedation and respiratory disease; however, if the arrythmia is noted without sedation, reassessing the ECG is advised. High vagal tone causes brief sinus pauses which in this patient are resulting in an escape focus firing. This is considered an appropriate response, rather than a pathologic finding. No follow up is necessary unless bradycardia persists inappropriately. In this instance, an Atropine challenge is recommended as below.

Anesthetic risk is considered mild if needed. Cardiac protective drug choices (opioid/benzodiazepine premedication, propofol or alfaxalone induction, isoflurane gas) are recommended. **Pre-medication with a vagolytic is recommended.** Monitor for arrhythmias,

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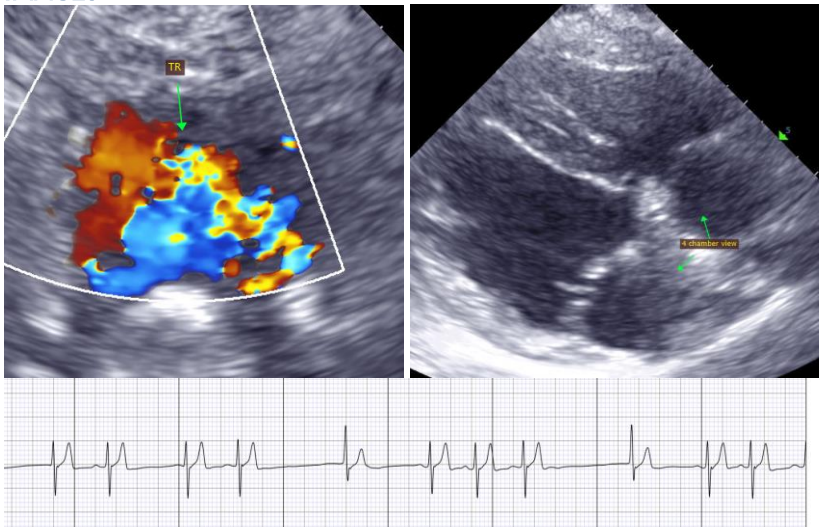
hypotension, and hypoxia both intra and post-operatively and intervene as necessary. Mild IV fluid restriction is recommended to avoid fluid overload.

PLAN:

Consider a course of pulmonary antibiotics (Enrofloxacin 5-7mg/kg PO q24h for 10 days). Institute sildenafil (Viagra) 1-2mg/kg PO q12h. Can also use hydrocodone and/or theophylline depending on chronic clinical signs of cough/exertional dyspnea. Discontinue Lasix and Pimobendan therapy. If the bradycardia persists without sedation, an Atropine challenge can be considered: administer 0.04mg/kg IV or IM and assess response.

Recommend recheck echocardiogram in 6 months to reassess pulmonary pressures, sooner if any development of clinical signs.

IMAGES



The information and recommendations provided are based on the images presented by the referring veterinarian. No evaluation can be communicated regarding pathology that was not visible in the image/video clips provided.

Thank you for this referral. If the clinical or image interpretation does not parallel your findings or if I can be of any further assistance, please contact me.

Maggie Machen Lamy, DVM
Diplomate of the American College of Veterinary Internal Medicine (Cardiology)
info@sonopath.com