

Focused cardiac ultrasound in cats

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Abstract:

Cardiac ultrasound and echocardiographic scanning tips will be provided to improve your ability to get a diagnostic scan. The pros and cons of a focused cardiac ultrasound versus an echocardiogram will be discussed. The goal is to make you more comfortable interpreting radiographic and echocardiographic findings in cats suspected of having underlying heart disease.

Keywords: cardiac ultrasound, feline, scanning tips, cardiomyopathy

Focused cardiac ultrasound:

- ◆ Focused cardiovascular ultrasound examination is performed as an adjunct to the physical examination as a screening tool for heart disease.
- ◆ Is your patient in respiratory distress due to congestive heart failure or feline respiratory disease?
- ◆ Used as a screening tool but lacks detailed information on heart anatomy and function and may fail to identify all cardiac abnormalities.

- ◇ Overlap may exist between normal cardiac anatomy and early or mild cardiomyopathy (CM) on ultrasound, especially in older cats. Equivocal findings will prompt serial monitoring to evaluate for the progression of more severe disease (*watch for an increase in the left atrial size).

Clinical indications for Focused cardiac ultrasound:

- ◇ Cats with clinical signs attributable to heart disease dyspnea, collapse, +/- dragging a limb.
- ◇ Cat in need of or currently receiving medical treatment that could result in cardiac complications such as steroids, fluid therapy, sedation, or general anesthesia.
- ◇ Any cat for screening for occult CM as part of a routine wellness exam.

Rule-outs before a diagnosis of cardiac disease

- ◇ Rule out underlying causes of hypertrophic phenotypes, such as hyperthyroidism and hypertension, before diagnosing idiopathic CM.
- ◇ Volume status can alter cardiac morphology.
 - Dehydration will create pseudohypertrophy. The left ventricular chamber is decreased in size with apparent thickening of the left ventricular (LV) wall. These changes can mimic the appearance of hypertrophic cardiomyopathy without enlargement of the left atrium.
 - Volume overload: Avoid evaluating the cat's heart while receiving fluid therapy, long-acting steroids, or anemia because these medications/conditions will cause an increase in the left ventricular chamber size and the left atrial size.

- Serial cardiac ultrasound and TFAST could be utilized to monitor volume overload from IV fluid therapy. An increase in the left atrial size and an increase in lung interference are hallmarks of fluid overload.

Cat positioning for cardiac ultrasound/echo

- ◇ Lateral recumbent, sternal, standing, or on the operator's lap.
- ◇ Sedation has to be on their approved list of drugs if submitting the study to a cardiologist.
- ◇ IDEXX-approved sedation protocols include:
 - ◇ Gabapentin 2-3 hours before the exam
 - ◇ Butorphanol
 - ◇ Butorphanol plus midazolam
 - ◇ +/- Alphaxalone

My scanning advice:

- ◇ Attempt to learn to perform a portion of the exam while the patient is in sternal recumbency. All the right-side images can be obtained while in the sternal position. If the heart is enlarged, the left-sided scans can also be easily obtained while the patient is sternal.
- ◇ Cardiac table is still helpful to remove the slot so the probe can be placed perpendicular to the body just above the sternum when scanning the right side.
- ◇ Keep it quiet (whisper), "mood" lighting for the best cat behavior, door closed (low to no traffic), and away from barking dogs if possible.

Extracardiac structures that will aid in the diagnosis of cardiac disease:

- ◇ You must look for pericardial, pleural, and abdominal effusions and lung interference (B-line artifacts). You may need to perform a global FAST of the thorax and abdomen to find evidence of fluid/lung interference.
- ◇ The presence of scant to mild pericardial effusion with heart disease can indicate left-sided congestive heart failure.
- ◇ Pleural effusion is commonly seen with left-sided congestive heart failure, unlike in dogs.
- ◇ It can be hard to visualize a small volume of pericardial effusion if the cat has concurrently had pleural effusion.

LA size is the most critical measurement in dyspneic cats:

- ◇ Normal left atrium at the heart base, measured from a right parasternal short axis view, should not be >1.5 cm.
- ◇ Moderate to severe left-sided heart disease typically accompanies left atrial enlargement.
- ◇ Look for “smoke” in the enlarged left atrium/auricle, which will have a greater risk of developing left auricular thrombus and aortic thromboembolism.

LA/Ao ratio is right parasternal short axis view:

- ◇ To find this image, a cat can be sternal or recumbent. Aim the probe perpendicular to the thoracic cavity to get a mushroom view. From the mushroom room, tip the probe towards the shoulder by dropping the handle towards the table, to visualize the aorta and the left

atrium. Be careful not to measure the pulmonary artery dorsal to the left atrium. Place your index finger on the sternum, which keeps the leg forward and stabilizes the probe.

- ◇ When clinical signs are present, the ratio of the left atrium/aorta diameter >2.0 is suggestive of left-sided heart failure in cats. Alternatively, if the left atrium is normal in size and the TFAST shows dry lungs, the cat's clinical signs are less likely to be due to left-sided heart failure.

- ◇ **DON'T pull the cat's leg forward! You will never win a tug-of-war with a cat.**

The scanning trick to obtaining a 2D image of the right and left ventricle:

- ◇ Right parasternal short-axis view of RV/LV. Perpendicular to the thoracic wall (no tipping) to obtain this image. Called the “mushroom” view. Without the right heart chamber offsetting the septum, you may accidentally measure the right ventricular free wall and septum as one structure. If you don't see a half-moon of the right ventricular chamber, move cranial one intercostal space +/- dorsally.

Assessment of RV/LV for Focused Cardiac Ultrasound:

- ◇ Goals of RV/LV short-axis view measurements from 2D images only:
 - ◇ Left ventricular chamber size, contractility, and wall thickness.
 - ◇ Critical measurements are wall thickness in diastole.
 - ◇ Fractional shortening: $LVIDd - LVIDs / LVIDd$ typically 45-55% in unsedated cats, $<35\%$ would be concerning for cardiac dysfunction due to DCM or end-stage HCM.

Challenges of Assessment of Focused Cardiac Ultrasound:

- ◇ Challenges of RV/LV or mushroom view:
 - ◇ Are the LV wall alterations due to positioning or real?
 - ◇ The right heart measurements have not been established. However, if the right heart is noticeably enlarged, this may indicate RCM or ARVCM.
- ◇ Disease detection from cardiac ultrasound:
 - ◇ LV wall thickness (interventricular septum and left ventricular free wall in diastole) ≥ 6.0 mm. If you find LV wall thickness in the normal range in diastole with increased LA, this could still be RCM or UCM.
 - ◇ Enlarged papillary muscles (**this is very subjective**)
 - ◇ Left ventricular chamber decreased in systole (decreased volume detected). Be careful of volume-depleted patients or when the heart is hypercontractile when the nervous.

Longitudinal view of the left atrium/left ventricle and left ventricle:

- ◇ A right parasternal long-axis view of the left atrium can be obtained by rotating the probe 90 degrees from the short-axis view of the RV/LV. No tipping needs to be perpendicular to the thoracic wall.
- ◇ Less frequent use of these longitudinal views to evaluate chamber size, wall thickness, contractility, and more highly variable measurements.

Left ventricular outflow tract:

- ◇ Left ventricular outflow tract. Obtain image from right parasternal long axis view tipping slightly towards heart base. The goal is to look for focal thickening of the interventricular septum that causes LVOT obstruction. M-mode of the mitral valve can document systolic anterior motion (SAM).

Feline cardiomyopathy from the ACVIM 2020 consensus: All except ARVCM will typically present with variable enlargement of the left atrium.

- ◇ **Hypertrophic (HCM)**- Diffuse or regional left ventricular hypertrophy with normal to decrease in size of the LV chamber, variable left atrial enlargement, and diastolic dysfunction.
 - ◇ **Obstructive**- myocardial hypertrophy of the interventricular septum obstructing the left ventricular outflow tract results in functional subvalvular aortic stenosis.
- ◇ **Restrictive (RCM)**-myocardial form with LV dimensions and wall thickness in the normal range with left atrial or biatrial enlargement. Hypokinesis or alterations in echogenicity may be seen in the left ventricular wall. Endomyocardial form scar that occurs between the interventricular septum and free wall with LV apical thinning and left atrial or biatrial enlargement.
- ◇ **Arrhythmogenic right ventricular cardiomyopathy (ARVCM)**-arrhythmia present, severe right atrial and ventricular dilatation, RV systolic dysfunction, and RV wall thinning. The left heart may be affected. These cats may present with radiographic signs of right-sided congestive heart failure (pleural effusion, peritoneal effusion).

- ❖ **Dilated (DCM)**- left ventricular systolic dysfunction with a progressive increase in ventricular size, normal to reduced LV wall thickness, and atrial dilatation. The left ventricular chamber size increased with a drop in the fractional shortening $\leq 28\%$.
- ❖ **Unclassified cardiomyopathy (UCM)**- echo changes don't fit into other categories.

Echocardiogram rules of thumb:

- ❖ Left atrial size no greater than 1.5 cm at the heart base obtained from the right parasternal short axis view. Less than 1.6 cm when measured from the right parasternal long-axis view.
- ❖ The interventricular septum and left ventricular free wall abnormally thickened if greater than 0.6 cm in diastole.
- ❖ Fractional shortening: typical cat ranges from 45-55%, can be elevated in early disease or due to patient excitement (repeat during the same exam if patient calms down), decreased in a failing heart.
- ❖ Rule of thumb for the left ventricular chamber in diastole 1.5 cm and systole .9 cm.
- ❖ EPSS in normal cats most <0.2 cm.

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