**Introductory Echocardiography: a Case Based Approach**

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**Common 2-D Echocardiographic Views**

Most standard views are obtained from either the right or left chest wall, over the heart and close to the sternum (parasternal) with the animal gently restrained in lateral recumbency. Occasionally, images are obtained from subxiphoid (subcostal) or thoracic inlet (suprasternal) positions. Images of better quality can usually be obtained with the transducer applied to the recumbent side of the animal, using a table with a cut-out to allow imaging from underneath the patient. Some animals can be adequately imaged from above.

Long axis views are those obtained with the imaging plane parallel to the long axis of the heart, while short axis views are perpendicular to this plane. Images are described by the location of the transducer and the imaging plane used, e.g., right parasternal short axis view. The figure below illustrates commonly used 2D imaging planes.

**The Use of Ultrasound in the Diagnosis of Acquired Heart Diseases**

**Myocardial Diseases**

Echocardiography allows for rapid, non-invasive identification of myocardial disease and differentiation between hypertrophic and dilated cardiomyopathies. Image quality and resolution are important for identifying cardiac wall edges, so that septal and ventricular measurements can be accurately made. This is especially important in cats because of their small size. In general, it is easier to measure wall thickness and chamber dimensions using M-mode images; however, the location and level of the M-mode beam is optimally determined using 2-D echocardiography. Hypertrophic cardiomyopathy is characterized by increased septal and left ventricular freewall thickness.
In cats, a diastolic thickness of these structures greater than 5 to 5.6 mm indicates hypertrophy. Thickened papillary muscles and reduced left ventricular lumen size are also common. In patients with hypertrophic cardiomyopathy, the fractional shortening is normal to increased and the left atrium is often markedly enlarged. With hypertrophic obstructive cardiomyopathy, septal thickness may be greater than the freewall thickness (asymmetric septal hypertrophy) and systolic narrowing of the left ventricular outflow region from the bulging, hypertrophied septum and SAM may be seen on 2-D imaging. A thrombus is occasionally visualized within the left atrium or auricle in cats with cardiomyopathy.

Dilated cardiomyopathy is characterized by dilation (eccentric hypertrophy) of the left and, typically the right heart chambers. Systolic wall and septal motion is poor, causing the left ventricular systolic as well as diastolic dimensions to be increased; thus, fractional shortening and other indices of myocardial function are reduced. Increased mitral valve E point to septal separation and reduced aortic root motion are common, while left ventricular freewall and septal thicknesses are normal to decreased.

Other forms of cardiomyopathy also occur in cats. Endomyocardial fibrosis and restriction enhances the brightness of endocardial surface. Excess moderator bands may be visualized as extra echoes toward the left ventricular apex. Left atrial size tends to be greatly increased in cases of restrictive cardiomyopathy.

**Valvular Insufficiency**

Mitral or tricuspid valve insufficiency results in progressive dilation of the affected side of the heart. Massive atrial enlargement may develop in patients with chronic valvular regurgitation. Ventricular motion throughout the cardiac cycle is accentuated, especially in mitral insufficiency. The diastolic left (and/or right) ventricular dimension is increased but systolic dimension is normal until the myocardium itself begins to fail. Therefore, prior to myocardial failure, there is exaggerated septal motion, normal E point-septal separation, and high fractional shortening. Calculation of the end systolic volume index may also be helpful in assessing myocardial function. With severe tricuspid regurgitation, paradoxical septal motion may occur.

The affected valve cusps are thicker than normal and may take on a knobby appearance at their edges. With good image resolution, smooth thickening is seen with degenerative disease (endocardiosis); bacterial endocarditis tends to cause rough and irregular vegetative valve lesions. It is often difficult to distinguish between these valve lesions with ultrasound alone, however. Rupture of a chorda tendineae causes part of the valve leaflet to have a flailed or paradoxic motion. Sometimes the broken chordae itself can be seen.

Aortic insufficiency, whether resulting from infectious endocarditis or congenital malformation, also leads to left ventricular and possibly, left atrial dilation. Evidence of a vegetative lesion or rapid diastolic fluttering (as blood leaks back into the ventricle) may be seen while imaging the aortic valve. A flailed aortic leaflet will prolapse into the ventricular outflow tract during diastole. Also, the regurgitant jet of blood during diastole may cause the open anterior mitral leaflet to flutter.

**Pericardial Diseases**

Pericardial effusion can be readily detected using echocardiography. Since fluid is sonolucent, pericardial effusion appears as an echo-free space between the bright parietal pericardium and the epicardium. Pericardial effusion must be differentiated from pleural effusion on the echocardiogram. The following guidelines are helpful in this differentiation. Since the pericardium is more tightly adhered to the heart at its base, the majority of fluid will surround the heart near the apex; thus, very little fluid is seen behind the left atrium.

Also, the parietal pericardium is a relatively strong reflector of ultrasound; as recorded echoes are progressively rejected by the operator (i.e., “dialed away”), the last echoes to disappear should originate from the pericardium. Noting where the fluid is located relative to the pericardium helps differentiate pleural from pericardial effusion. Evidence of collapsed lung lobes or pleural folds may appear in patients with pleural effusion. Very large amounts of pericardial fluid allow the heart to swing wildly within the pericardial sac.

In addition, pericardial effusion of sufficient volume (pressure) to cause cardiac tamponade results in diastolic compression or collapse of the cardiac chambers, especially the right atrium and ventricle. A soft tissue density mass may be identified in cases of neoplastic pericardial effusion. The usual locations are the right auricle (hemangiosarcoma) and around the ascending aorta (chemodectoma). Tumors of the pericardium itself or the myocardium may also be a cause of pericardial effusion. Sometimes, intracardiac masses occur and are not associated with pericardial effusion.