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**CARDIAC AUSCULTATION: Part 1**

## Method & Assessment of Transient Heart Sounds

### Cardiac Auscultation – Overview

Auscultation of the heart remains an important examination for the detection of cardiovascular disease. The auscultatory exam is expedient and cost effective. When completed by an experienced clinician, auscultation carries a high predictive value for identification of many – though not all – serious heart diseases. For example, hearing the classic continuous machinery murmur of patent ductus arteriosus or the typical holosystolic left apical murmur of mitral regurgitation allows the clinician to express a “most-likely” diagnosis of high accuracy. Results of auscultation, combined with the signalment, findings from physical diagnosis, and consideration of the clinical situation often point to a logical cardiac diagnosis. This presumption can then be confirmed, refined, or refuted, as necessary, by Doppler echocardiography (for valvular disease, pericardial disease, cardiomyopathy, or shunts) or by electrocardiography (for arrhythmias).

The essential abnormalities evaluated by *cardiac auscultation* include: abnormal heart rate or irregular rhythm of heart sounds (arrhythmia); abnormal intensity of sounds (loud, soft, or variable); extra sounds (such as gallops and clicks); split sounds; cardiac murmurs; and pericardial friction rubs. Respiratory sounds should be classified as well.

### Methods

One method of cardiac auscultation is demonstrated in the figures associated with this Circulation article. Auscultation is preceded by palpation of the thoracic wall over the heart (precordium) in order to assess the apical beat (FIGURE 1). The prominent left apical impulse occurs coincident with opening of the semilunar valves (a systolic thrust). The impact is normally strongest at or near the left 5th intercostal space near (ICS) the costochondral junction. A weaker impulse is normally palpable on the right hemithorax at approximately the right 3rd to 4th ICS (FIGURE 2). Dilatation of the ventricle displaces the apex beat caudoventrally. Hypertrophy of the ventricle can produce a more prominent than normal impulse. Interpretation of these changes requires considerable experience and practice. A precordial vibration or ‘thrill’ is often palpable over a point of maximal intensity of a loud cardiac murmur.



FIGURE 3



FIGURE 1



FIGURE 2

**Stethoscope //** Many heart sounds fall within the inaudible frequency-threshold range; accordingly, careful auscultation is necessary to detect those vibrations that are audible. This requires a stethoscope (FIGURE 3). This instrument must be properly used by employing an instrument of acceptable quality and length. The binaurals orientation should be rostral (towards the nose). The binaurals and ear pieces should be aligned to the ear canals with

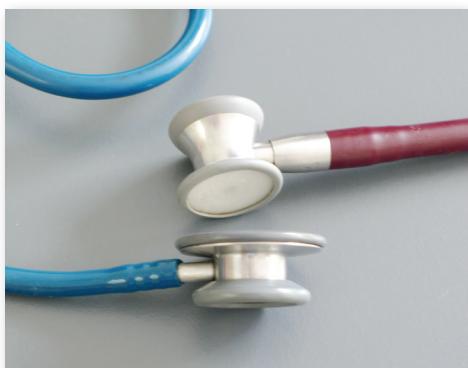


FIGURE 4



FIGURE 5

the earpieces snugly but comfortably fit to obtain an airtight seal. Use of the stethoscope chest pieces should also be understood. The flat diaphragm is applied gently but firmly to the chest to accentuate higher frequency sounds such as normal heart and breath sounds. The bell is applied lightly to achieve an airtight seal in order to enhance auscultation of lower frequency sounds such as the third and fourth heart sounds as well as some diastolic murmurs. Combined chestpieces ("tunable diaphragms") change their frequency response with pressure such that flattening the chestpiece accentuates higher pitched sounds like the normal heart sounds and most systolic murmurs. Conversely, gentle pressure brings out lower pitched sounds like gallops or diastolic murmurs.

The choice of a stethoscope is very personal. The traditional stethoscope has operator selected diaphragm and bell (FIGURE 4) but as mentioned above many stethoscope models are designed to allow a single chest piece to function as both a bell and a diaphragm (FIGURE 5). Light pressure creates a "bell" effect while heavier pressure flattens the chestpiece into a diaphragm. While acoustically superior in some ways, the chest pieces design of many human adult stethoscopes is simply too large for cats and small dogs. However, some of the newer models combine both "adult" and "pediatric" chest pieces into one rotating head. While amplified stethoscopes generally are not recommended because of the potential for artifacts and distortion, they can be useful for those hard of hearing or for recording/documenting sounds.

**Examination Pointers //** Conditions for auscultation are often overlooked but substantially impact the results of the examination. The room must be quiet, the patient gently restrained, and the examiner relaxed. It is preferable for the dog to stand in order to locate the valve areas accurately. A cat can be restrained gently with one hand under the abdomen; this encourages the cat to rest on the forelimbs. The patient must be calm and ventilation and purring controlled if possible. Synchronous ventilation can mimic cardiac murmurs. Gently holding the mouth closed, whistling, or briefly obstructing the nares are effective maneuvers for reducing ventilation artifacts. Showing the cat water in a sink, holding the cat, or gently pressing the larynx may reduce the degree of purring.



FIGURE 6

The clinician must be aware of sound artifacts that may be misinterpreted as abnormal heart or lung sounds. Artifacts include ventilation and panting (mimics murmurs); twitching (sounds like an extra heart sound); and friction from rubbing the chest piece across hair (sounds like pulmonary crackles or rales). Excessive pressure on the chest can distort the thorax of small animals and create abnormal flow patterns and murmurs.

Auscultation is usually preceded by palpation of the arterial pulse and palpation of the precordium to identify the apical impulse and any precordial vibrations for thrills that would indicate a loud heart murmur. Assessment of pulses is reviewed in another Circulation article.

**Areas for Auscultation //** The precordium (area over the heart) is examined, with particular attention directed to the cardiac valve areas. While the exact anatomic location of the valve areas depends on the species, breed, chest conformation, and size of the heart, a common relative location is found from cranial to caudal: *pulmonic-aortic-tricuspid-mitral* with the tricuspid valve on the right and other valves on the left. A useful clinical pointer in dogs is to first palpate the left apical impulse and place the stethoscope there (FIGURE 6) where mitral sounds radiate and the first heart sound will be loudest. The mitral valve area is located over the apex and immediately dorsal to this point.

Find other valve areas from the apex. The aortic valve area is located craniodorsal to the left apex (FIGURE 7) and the second heart sound is best heard there. Once the aortic second sound is identified, the stethoscope can be moved one interspace cranial and slightly ventral (over the pulmonary valve area) (FIGURE 8).

The relative position of these valve areas is consistent from dog to dog; however, the exact intercostals space can vary depending on the breed and size of the heart.

The tricuspid valve is heard over the right hemithorax (FIGURE 9), cranial to the mitral area, and covers a relatively wide area. The pulmonary artery extends dorsally from the pulmonic valve and is located on the left craniodorsal thorax. The LV outlet is in the center of the heart and aortic murmurs usually radiate well to each hemithorax. Very cranial placement of the stethoscope (ventral and dorsal) often leads to identification of functional flow murmurs in dogs and in cats (FIGURE 10).

The cardiac apex and the cardiac base are commonly used expressions to designate the regions ventral and dorsal to the atrioventricular groove. Atrioventricular valve sounds from the mitral and tricuspid valves often radiate ventrally towards the apex. Murmurs originating at the semilunar valves and great arteries are detected best over the base.

In cats the valve areas are less distinct and the chest piece usually covers more than one valve area. Consequently, most clinicians don't identify specific valve areas but instead use terms like "apical" or "caudal" for the location near the palpable apex beat and "cranial" for sounds rostral to the apex. In cats the apical impulse is often on the sternum so that listening areas are typically along the left and the right sternal borders. Thus a typical murmur of mitral regurgitation will be loudest at the caudal sternal border or apex whereas ejection and functional murmurs are most often loudest along the left or right cranial sternal edge (FIGURE 11).



FIGURE 7



FIGURE 8

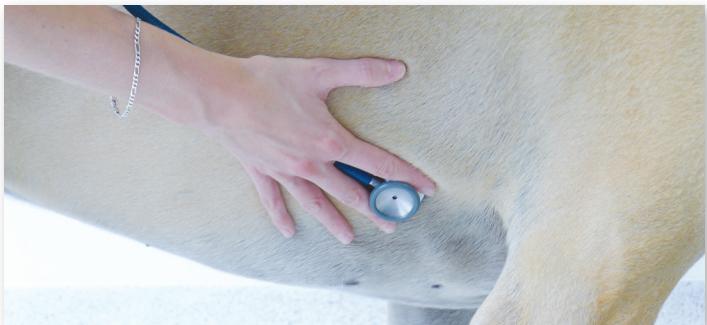


FIGURE 9



FIGURE 10

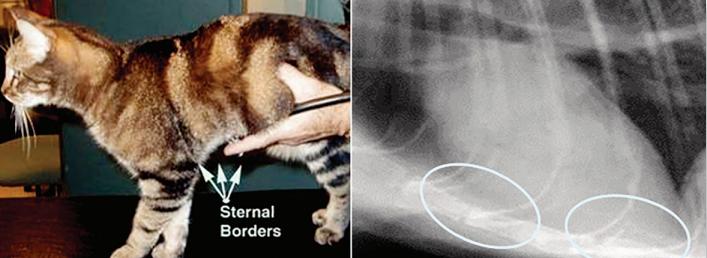


FIGURE 11

## Transient Cardiovascular Sounds

Transient sounds are vibrations of short duration because their genesis depends on abrupt changes in blood flow and pressure. CV transient sounds, as well as cardiac murmurs, are timed relative to the first (S1) and second (S2) heart sounds. Following initial activation of the ventricles, the first sound is heard indicating the beginning of systole.

This typically coincides with the external thrust of the left apical impulse (which peaks in early systole). At the end of ventricular ejection, the second sound is generated (FIGURE 12). The femoral arterial pulse is typically palpated between these two sounds. The longer period between the second and ensuing first sound represents diastole to the clinician. Diastolic transient sounds, if present, are generally abnormal in small animals.

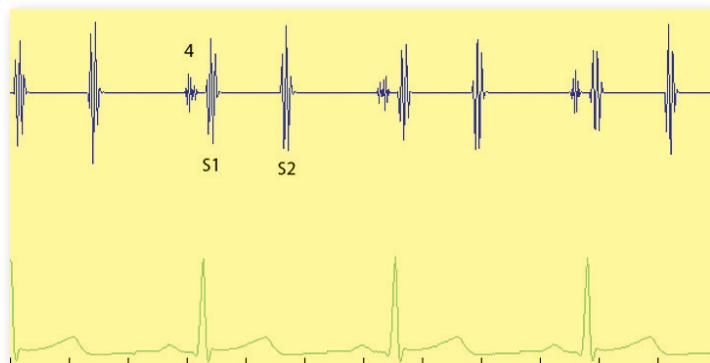


FIGURE 12

**First and Second Heart Sounds //** Both S1 and S2 are relatively high-frequency sounds. The first is associated with vibrations near the time of atrioventricular (AV) valve closure, while the second sound is caused by vibrations at the time of closure of the aortic and pulmonic valves. These normal transient sounds may be abnormal in certain conditions. Pericardial or pleural effusions or myocardial failure from dilated cardiomyopathy can decrease the intensity of the first heart sound. Both heart sounds tend to be loud in healthy animals under high sympathetic drive or those with thin body conformation. Arrhythmias often lead to variable intensity of the first and second heart sounds. Splitting of the sounds may be detected with asynchronous ventricular activation as with ventricular ectopia or bundle branch block, though these splits are challenging to identify. Severe pulmonary hypertension increases the intensity of S2 or leads to audible splitting of this sound should left and right ventricular ejection times become very disparate.

**Gallops //** Diastolic sounds or gallops are abnormal in dogs and cats and represent audible manifestations of the third and fourth heart sounds (that are normal sounds in large animals). Gallops are lower-frequency and associated with vibrations surrounding either termination of early ventricular filling (S3) or atrial contraction and end-diastolic ventricular filling (S4) as shown in FIGURE 12. These sounds indicate diastolic dysfunction when detected in dogs or cats.

While it may be difficult to separate the timing of a gallop sound, especially in cats, there are different considerations with ventricular (third) versus atrial (fourth) sounds. A third sound is typical of a very diseased ventricle with poor compliance that is filling under high venous pressures (generally due to heart failure; hence, it is sometimes considered a heart failure sound). An atrial sound is typical of impaired ventricular relaxation (as occurs with feline hypertrophic cardiomyopathy) and probably represents the brief, compensatory increase in atrial pressure needed to fill the ventricle. If both sounds are present and the heart rate is rapid, the gallops may be superimposed producing a summation gallop.

In general, an atrial gallop (S4) indicates less severe disease than an S3 gallop and some healthy old cats have this sound when hospital-stressed, likely related to normal aging changes in ventricular relaxation. However, often gallop sounds are the only auscultatory abnormality of cardiomyopathy or hypertensive heart disease, so hearing gallops will often prompt additional diagnostic studies. Gallops can vary with both heart rate and venous filling pressures.

**Clicks //** Systolic clicks are high pitched sounds. Systolic clicks are common in dogs with mitral or tricuspid valve disease and are probably indicative of prolapse from abnormal chordae tendineae or valve redundancy. Isolated clicks suggest early and very mild disease. However, clicks also can be superimposed over murmurs in dogs with advanced mitral valve degeneration. These clicks often come and go and move from early to late systole, though the classic mitral click is mid-systolic (FIGURE 13). Ejection clicks are infrequently detected with valvular

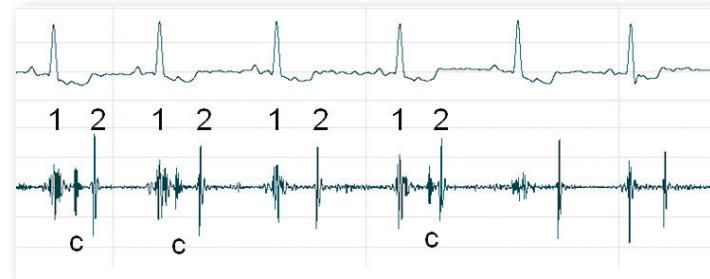


FIGURE 13

pulmonic stenosis and pulmonary hypertension. Clicks have also been reported in cats with mitral dysplasia and with hypertrophic cardiomyopathy (and must be distinguished from true gallop sounds).

Thus, the differential diagnosis for "extra sounds" should include gallops (atrial and ventricular) and clicks as well as split sounds and premature beats. Although a cardiac murmur is often considered the hallmark auscultatory finding in heart disease, some CV conditions may not be associated with a heart murmur at all. However, transient sounds may be abnormal in these patients and the clinician should be vigilant for these abnormalities.

**Arrhythmias //** Auscultatory findings in arrhythmias and conduction disturbances include: abnormal heart rate, irregular cadence, irregular intensity of the heart sounds, extra or absent heart sounds, or splitting of S1 or S2. A typical example is atrial fibrillation wherein a rapid erratic rhythm, with varying intensity of heart sounds, is often heard ("tennis shoes in a dryer"). These findings indicate the need for an ECG.

In cats it is common to hear the pause following a premature ventricular beat as opposed to the premature heart sound. While a cyclically irregular rhythm is very normal in dogs (usually indicating respiratory sinus arrhythmia), this rhythm is uncommon in cats within the hospital setting. Thus any irregularity of rhythm in a cat can represent an indication for an ECG.

## Summary

Effective cardiac auscultation requires knowledge of normal heart physiology, a careful use of the stethoscope, and attention to other examination findings. Normal first and second sounds set the reference platform for auscultation. Abnormal transient sounds include loud or soft first/second sounds; clicks; split sounds; irregular and variable intensity sounds typical of arrhythmias; and extra sounds in diastole (gallops). Heart murmurs are often heard in veterinary patients and are the subject of the next Circulations article on Auscultation.

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