Congenital cardiac disease is one of the common causes of death in young dogs, though often remain undiagnosed. The prevalence of congenital heart disease is often not recognized in small animals due to lack of cardiac auscultation skills (Constable et al 1994). Congenital defects can be recognized by the finding of an incidental murmur when a pup is presented for the first vaccination. While the owner of a new pet needs a diagnosis and prognosis, such advice on the basis of clinical examination alone is fraught with problems. In many cases detailed and expensive investigations to provide a diagnosis may not suit the owner’s requirements. Hence detailed physical examination is a must in field practice. Phonocardiography is one of the affordable tools in the practitioner’s armamentarium for an accurate auscultatory diagnosis and best possible patient care in small animal practice.

**Basics of Stethoscopy**

Careful auscultation is necessary to detect cardiac vibrations that are audible. The stethoscope must be properly used by employing a device of acceptable tube length (not too long), directing the biaurals and ear pieces, so that their orientation is rostral and aligned with the ear canals, inserting the earpieces snugly but comfortably to obtain an airtight seal, and applying the chest pieces properly. The diaphragm side of stethoscope is used to hear high frequency sounds such as first and second heart sounds (S1 & S2) and the bell side of stethoscope is used to hear low frequency sounds. Bell can also be used to hear lung sounds. 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 (S3 & S4) and some diastolic murmurs.

**Thoracic Auscultation: How to do?**

The room must be quiet, the patient gently restrained, and the examiner relaxed. It is preferable for the animal to stand in order to locate the valve areas accurately. A cat can be gently restrained with one hand under the abdomen; this encourages the cat to stand 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. The Physician 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 sounds); 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 Practices**

The entire precordium needs to be examined, with particular attention directed to the cardiac valve areas. While the exact anatomic location of the valve areas depends on the species, chest conformations, 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. It is best to first palpate the left apex beat, where mitral sounds radiate and the first heart sound is best heard. The other valve areas are easily identified from this point.
Once started auscultating

- Check for radiation of murmurs e.g. Aortic-thoracic inlet and PDA to top of the head.
- Identify and characterize the heart sounds
- Normal (S1 & S2) and abnormal (S3 & S4)

**S1**
- Louder, Longer, duller and lower pitched than S2
- Heard loudest over the mitral area
- Its intensity may:
  - Increase in tachycardia, fever, fear & cachexia
  - Decrease in obesity, pericardial or pleural effusions, thoracic masses, DH, bradycardia & insufficient ventricular fillings. Vary with arrhythmias e.g. A-fib., V-Tach., APC, VPC and marked sinus arrhythmias
  - May split in large breeds, RBBB or VPC
- Occurs at the down stroke of QRS

**S2**
- Short high pitched & sharp
- Heard loudest over base of the heart at aortic area
- Splitting caused by
  - Delayed closure of pulm. valve over aortic valve. Seen in pulm. hypertension as in heart worm disease. RBBB, VPC originating from left ventricle, ASD and Pulm. Stenosis
  - Delayed (paradoxical) aortic valve closure though uncommon e.g. LBBB, VPC from Rt.vent, sybaritic stenosis, severe systemic hypertension and LV failure
- Occurs near the end of T wave

**S3**
- Occurs during diastole, between S2 & S1 before the P wave
- Best heard over mitral area. of lower pitch than S2
- Presence indicates HF, dilated vent., congestive cardiomyopathy or decom. mitral insuff.

**S4**
- Heard best at the L-base, often at L-apex too
- Occurs due to ventricular diasystolic dysfunction e.g. HCM or vent hypertrophy
- Is generated by atrial contract in the P-R interval Gallop Rhythm:
  - Is the presence of S3 or S4 or both in the diastole
  - Is of low frequency, use the bell of the stethoscope
  - Is an early sign of HF & may precede clinical signs

**Systolic Clicks:** Sounds like additional heart sounds
- Occurs in systol between S1-S2
- Unknown etiology a benign finding
- Deteriorates in to mitral insuff./murmur in 6-12M
- Can be confused with gallop rhythm

**Computerized Phonocardiography(PCG)**
The human ear perceives higher-frequency noises as being louder than those of the same amplitude but of lower frequency. The frequency or pitch of the murmur over each of the heart valves and at the thoracic inlet needs to be characterized. The

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<td>Pulmonic</td>
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<td>L 2-3;ICS; junction. upper &amp; mid. 3rd</td>
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<tr>
<td>Aortic</td>
<td>L4;ICS above Costo-chond.</td>
<td>L 2-3;ICS dorsal Junc. to pulm. area</td>
</tr>
<tr>
<td>Mitral L5;ICS at CCJ</td>
<td>L5-6;ICS lower</td>
<td>1/4 of chest</td>
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Selvaraj and others

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PCG - Murmur Studies
other aspect of characterization of a murmur is the modulation or shape of the murmur. The location of the murmur where the intensity is loudest and the area of radiation should be succinctly described (Smetzer, 1970). To enable such a detailed diagnostic examination a phonocardiogram is necessary to study the murmurs and to confirm the modulation of many murmurs (Detweiler and Patterson, 1965). The possibility to study a graphic recording (PCG) of auscultatory findings in Small Animal Practice is often a helpful diagnostic tool for the clinicians. The classification of systolic murmurs into systolic ejection murmurs and holosystolic (regurgitant systolic) murmurs is of clinical value (Detweiler and Patterson, 1967).

**PCG: How to do?**

Phonocardiography is a graphic recording of heart sounds and murmurs picked up by a microphone or sensor that is placed on the chest wall. The recorded sound may be filtered and printed on paper or displayed on the screen of a computer. Each filter amplifies sounds around a certain frequency (so called nominal frequencies) and dampens other sounds (Haggstrom et al., 1995).

The use of filters with different nominal frequencies of 50, 100, 200, 400 Hz and an aural filter (50-500 Hz) is useful to determine if a murmur has low, medium or high frequency components, and to remove disturbing background noise and respiratory sounds (Smetzer and Breznock, 1972). To record ECG simultaneously with PCG is essential for timing the sounds and murmurs to the electrical activity of the heart (Haggstrom et al., 1995). This timing may not be needed if S1 can be correctly identified. However, this is not always the case, especially not in cases with tachycardia or gallop rhythms. PCG has previously been recorded on multichannel ECG machines equipped with a PCG amplifier. Nowadays, recording with a sensor based electronic stethoscope connected to a battery operated computer is possible and for several reasons it is more practical for the routine usage.

A practical advantage with PCG is that it is instructive to have a graphic display of the heart sounds and murmurs at hand during discussion and explanation of diagnosis, and sometimes prognosis, with students and clients. For the practitioner PCG offers the opportunity to file heart sounds that may be useful for legal or insurance purposes. Evaluation of the timing, shape and frequency components of the heartbeat can be done objectively from the recording (Haggstrom et al., 1995). For example, ejection murmurs may especially, at high heart rates, be very difficult to distinguish from holosystolic murmurs by auscultation but can easily be distinguished by phonocardiography. Time intervals on the PCG can also be measured, filed and compared with recordings from other animals or from consecutive examinations.

Nowadays, a new interesting option is available with the Meditron PCG analysing system, where in it is possible to perform two or three-dimensional spectral analyses of recorded murmurs, which will aid in diagnostic precision.. Future research will presumably develop this form of heart sound analysis, further improving the diagnostic possibilities of phonocardiography.

**References**


Smetzer and others
