A 3-year-old female DSH cat is presented for 1 week of lethargy and increased respiratory effort. She is at 56 days of gestation. A similar episode occurred with the previous pregnancy and responded favorably to antibiotic therapy. This episode seems to be worse. Right lateral (3a) and DV (3b) thoracic radiographs are made.

i. What radiographic abnormalities are evident?

ii. What is the radiographic diagnosis?

A 9-year-old female Dalmation is presented because of a collapse episode earlier in the day. She has been less active lately and becomes winded easily when on walks. The dog appears anxious and slightly tachypneic. Mucous membranes are pink, femoral pulses are weak and of variable intensity, and the HR is rapid and irregular. There is a soft systolic murmur heard best at the right apex, but also heard at the left apex. Lung sounds are increased. You record an ECG. Simultaneous leads I, II, and III at 25 mm/s, 1 cm = 1 mV are shown (4).

i. What is the ECG diagnosis?

ii. How would you initially manage this case?

iii. What do you recommend next?
3 i. There is increased opacity in the ventral and right halves of the thoracic cavity. Only a short dorsal segment of the left crus of the diaphragm is distinct; the remainder is effaced by the increased thoracic opacity. The trachea is displaced dorsally, but remains mid-line in the DV view. The heart is shifted dorsally and to the left. Only the left lung lobes are well inflated with well-defined vessels. The increased thoracic opacity is a mix of solid soft tissue or fluid and mineralized opacity of fetal skeletal structures. A fetal skull is evident ventrally at the 5th intercostal space and a different fetal lumbar spine crosses the pleura-peritoneal junction ventrally.

ii. Right-sided diaphragmatic hernia with thoracic displacement of gravid uterus and probably liver. The degree of fetal skeletal mineralization is consistent with late-term gestation. No signs of fetal death are evident. Ultrasound would be valuable to determine fetal viability. In several reports, the most common organs to be herniated through a tear in the diaphragm are liver, stomach, and small intestine. Several case reports of diaphragmatic herniation of gravid uterus in dogs appear in the literature.

4 i. Paroxysmal ventricular tachycardia (at 300 bpm) is seen at the beginning of the strip, just after the middle, and at the right edge. Sinus tachycardia (at 180 bpm) is evident intermittently. Single ventricular premature complexes also occur, and are easier to distinguish in leads I and III. The sinus complexes indicate a normal mean electrical axis. P waves are slightly wide (0.05 second) consistent with LA enlargement; sinus QRS complexes are also wide (~0.08 second), suggesting myocardial disease and abnormal intraventricular conduction. Other complex measurements are normal. Each 1 mm box = 0.04 second at 25 mm/s.

ii. IV lidocaine is the initial drug of choice for acute treatment of ventricular tachyarrhythmias. An IV catheter is placed as soon as possible. Supplemental O2 may be helpful. The dog should be carried/carted if it must be moved; stress should be minimized.

iii. Identify underlying abnormalities as soon as possible; screen for electrolyte or other metabolic or hematologic abnormalities, obtain thoracic (and possibly abdominal) radiographs, as well as an echocardiogram to assess cardiac structure and function. Additional antiarrhythmic strategies are used if lidocaine is ineffective and for long-term therapy (see Further reading). Additional therapy depends on test results. This dog had dilated cardiomyopathy.

5 The owner of a 12-week-old kitten complains of ‘noisy breathing’. The kitten was adopted 4 weeks ago from the animal shelter and has always made a lot of noise with normal breathing. However, the sound has become more pronounced as the kitten has grown. Breathing is especially noisy when the kitten plays or is excited. Occasionally the kitten gags when eating, but otherwise has been normal. High-pitched inspiratory stridor and exaggerated inspiratory effort are the most obvious physical findings. The image was obtained with a bronchoscope camera after heavy sedation (5; 1 – swab lifting the soft palate, 2 – soft palate, 3 – epiglottis).

i. What abnormality is shown?

ii. What conditions could cause this?

iii. How would you manage this case?

6 A 12-year-old spayed female Springer Spaniel develops lethargy and respiratory distress. Physical examination findings include weakness, labored respiration, muffled heart sounds, jugular vein distension, and abdominal distension with a pronounced fluid wave. Pericardial effusion with cardiac tamponade is suspected based on radiographic findings and the electrical alternans evident on an ECG. Echocardiographic examination is desired, but not readily available at present. In view of the patient’s urgent status, pericardiocentesis is done to relieve the tamponade. Approximately 300 ml of red, turbid pericardial effusion is removed. The fluid is grossly bloody, with a cell count of 6110/µl, pH of 6.4, protein content of 57 g/l (5.7 g/dl), and PCV of 0.73 l/l (73%). A cytospin preparation of the effusion is shown (6, Wright’s stain, 50× oil).

i. What cytologic features reveal this to be pathologic rather than iatrogenic hemorrhage?

ii. What etiologies are most likely for the hemorrhagic pericardial effusion in this dog?
5 i. This image of the larynx was taken during inspiration. It shows failure of the laryngeal arytenoid cartilages and vocal folds to abduct. This finding is the hallmark of laryngeal paralysis.
ii. Laryngeal paralysis was suspected to be congenital in this case. Congenital laryngeal paralysis has been most commonly reported in dogs, especially Siberian Huskies, Bouvier des Flandres, and Bull Terriers. Paralysis could occur as a result of trauma to the cervical region; the earlier history in this kitten was unknown. Acquired laryngeal paralysis usually occurs in older animals and may be idiopathic (such as with the Labrador Retriever) or secondary to a polyneuropathy (e.g., myasthenia gravis, hypothyroidism), anterior thoracic neoplasia, or other mass lesion. (Note: Other potential causes for upper airway obstruction in cats include nasopharyngeal polyp, laryngeal lymphoma, or other mass lesions.)
iii. A unilateral arytenoid lateralization surgical procedure is the best method to alleviate the upper airway obstruction. Good results are usually obtained. Aspiration pneumonia can sometimes be a complicating factor after repair.

6 i. The presence of phagocytized erythrocytes within the cytoplasm of macrophages (erythrophagia) and lack of platelets in this sample are indicators of pathologic hemorrhage. Hemosiderin (seen in the image as deep blue-black pigment within the cytoplasm of macrophages) is an additional indicator of pathologic hemorrhage. Hemosiderin is an intracellular iron storage complex resulting from erythrocyte breakdown. Hematoxin, a yellow crystal that forms secondary to hemoglobin degradation, is another indicator of pathologic hemorrhage.

With iatrogenic hemorrhage, platelets are present and erythrophagia is not evident unless a prolonged time has occurred between sample acquisition and analysis. Hemosiderin and hematoidin are not seen with iatrogenic hemorrhage.
ii. Neoplastic effusion is most likely in a dog of this age. Hemangiosarcoma and, less often, chemodectoma are the tumors most commonly associated with pericardial effusion in the dog. A thorough echocardiographic examination often reveals the mass lesion in such cases. Mesothelioma and occasionally other neoplasms are other potential causes of pericardial effusion. Although idiopathic pericardial effusion also occurs frequently in dogs, it usually affects younger individuals. In this case, hemangiosarcoma involving the right auricle was found at necropsy.

7 A dog of unknown age is presented because the owner thinks its exercise tolerance has decreased. Physical examination is unremarkable except for a murmur, which is loudest on the left side.

i. When a murmur is auscultated, what characteristics are the most important to identify?
ii. What are the main causes of a systolic murmur heard best over the left chest wall?

8 An 11-year-old spayed female Cocker Spaniel is presented for coughing episodes that began a week ago, after a hiking trip to the mountains. The cough is becoming more severe and is worse in the morning and after periods of rest. The dog was referred for suspected congestive heart failure, but initial furosemide treatment has not improved the cough. Prior medical history includes a patent ductus arteriosus (closed at 3 months of age), pyometra (resolved after spay 2 years ago), mammary gland adenocarcinoma and mammary mixed-cell fibrosarcoma (removed 1.5 years ago, with no evidence of metastasis), early degenerative AV valve disease, hypertension, and occasional second degree AV block. She is being treated with oral cyclophosphamide, piroxicam, and enalapril. A grade 1/6 systolic murmur is heard over the tricuspid region and a clicking sound is noted on inspiration; otherwise, the physical examination is unremarkable. Thoracic radiographs reveal a singular pulmonary nodule in the periphery of the right caudal lung lobe. The nodule appears distant to the major lobar bronchus. No other radiographic abnormalities are evident. Bronchoscopy is performed to evaluate the airways and collect samples for cytology and culture. Images are from the right caudal bronchus (8a, b).

i. Would a single peripheral lung mass be expected to cause severe paroxysmal coughing?
ii. What other problems should be considered?
iii. What does bronchoscopy reveal?
7 i. Timing (e.g. systolic, diastolic, continuous), point of maximal intensity (PMI), and intensity (loudness) at the PMI. A murmur’s timing within the cardiac cycle helps identify its origin. Knowing what events generate normal heart sounds (S₁ and S₂), and understanding the timing of systole (between S₁ and S₂) and diastole (after S₂ until the next S₁) in each patient is important. PMI is described by the hemithorax and valve area (or terms ‘apex’ or ‘base’) where the murmur is loudest. Murmur intensity is usually graded on a 1–6 scale.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Murmur</th>
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<tbody>
<tr>
<td>1</td>
<td>Very soft murmur; heard only in quiet surroundings.</td>
</tr>
<tr>
<td>2</td>
<td>Soft murmur, but easily heard.</td>
</tr>
<tr>
<td>3</td>
<td>Moderate intensity murmur.</td>
</tr>
<tr>
<td>4</td>
<td>Loud murmur, but no precordial thrill.</td>
</tr>
<tr>
<td>5</td>
<td>Loud murmur with palpable precordial thrill.</td>
</tr>
<tr>
<td>6</td>
<td>Very loud murmur with precordial thrill; also heard when stethoscope lifted slightly away from chest wall.</td>
</tr>
</tbody>
</table>

The murmur’s ‘shape’, radiation, quality, and pitch are other characteristics. 

ii. Left basilar systolic murmurs usually are ejection-type (crescendo–decrescendo) murmurs, often caused by ventricular outflow obstruction. Physiologic murmurs (as with fever, exercise, hyperthyroidism, anemia) occur from increased ejection velocity or turbulence. Increased flow volume can cause a murmur of ‘relative’ valve stenosis. A soft (innocent or functional) murmur sometimes occurs in structurally normal hearts. Mitral regurgitation produces a holosystolic (or decrescendo) murmur loudest near the left apex. Causes include mitral degeneration, infection, congenital malformation, and LV dilation.

8 i. Given the peripheral location of this nodule, and its apparent distance from a major airway, the dog’s violent coughing episodes seemed unusual. Primary disease involving a large airway was thought more likely. Therefore, bronchoscopic examination with BAL was done prior to surgical mass removal (right caudal lobectomy).

ii. Major airway collapse, infectious or allergic bronchitis, airway foreign body (such as inhaled plant material), as well as neoplastic invasion of the airways.

iii. A smooth fleshy bump is seen on the approach to the right caudal bronchus (8a). The pale mass is seen more clearly within this bronchus (8b). Although not evident radiographically, the pulmonary nodule had invaded the right caudal bronchus, triggering the cough. The remaining airways were normal. Histopathology of the surgically-excised mass revealed a poorly differentiated pulmonary sarcoma. Late metastasis from the dog’s previous mammary mixed-cell fibrosarcoma was suspected, although a primary lung tumor could not be ruled out.

9 A 16-year-old male Poodle is referred for evaluation of a long-term intermittent cough with excitement that has been more persistent in the last month. Over the last several days the dog has developed trouble breathing, and on presentation has dyspnea with marked inspiratory effort and cyanosis. An emergency lateral radiograph is taken (9a).

i. Is a cause for the dyspnea evident?

ii. What are the etiologic differential diagnoses?

iii. What is the explanation for the shape of the ventral thoracic-to-abdominal body wall contour?

10 An 8-year-old intact male Basenji is presented for chronic coughing. A dry, non-productive cough is observed during the physical examination and is easily elicited with tracheal palpation. Thoracic auscultation reveals normal heart sounds and increased breath sounds, with pulmonary crackles heard ventrally. A diffuse bronchointerstitial pattern is seen on thoracic radiographs. BAL is performed. A cytospin preparation of bronchoalveolar fluid (10a, Wright’s stain, 100× oil) and a direct smear from BAL fluid (10b, Wright’s stain, 20×) are shown.

i. Describe the findings in 10a.

ii. Identify the structure visible in 10b and describe its significance in a BAL sample.

iii. Are additional diagnostic tests indicated? If so, what would you recommend?