1

Localization of Disease

Clinical signs that provide clues to the existence of respiratory disease include nasal discharge, cough, respiratory noise, tachypnea, difficulty breathing, or exercise intolerance. The first step in making a diagnosis is the accurate localization of the anatomic origin of disease within the respiratory tract: the nasal cavity, upper or lower airway, lung parenchyma, or pleural space. Achieving appropriate anatomic localization of the site of dysfunction will allow construction of an accurate list of differential diagnoses, will facilitate efficient diagnostic testing, and will allow rational empiric therapy while waiting for test results.

Nasal Discharge

History

Nasal discharge is almost always a sign of local disease within the nasal cavity. One exception is eosinophilic bronchopneumopathy, an inflammatory condition of the epithelium lining the airways and the lung that can also involve the nasal epithelium. Interestingly, cats with eosinophilic lower airway disease do not display this clinical finding. Nasal discharge can also accompany infectious lower respiratory tract disease in the dog (or occasionally the cat) that coughs airway material into the nasopharynx, which subsequently drains from the nose. Finally, some animals with vomiting or regurgitation will display nasal discharge because of nasopharyngeal regurgitation. This might be more common in brachycephalic breeds, which frequently develop pharyngeal collapse due to increased respiratory effort (Pollard et al. 2018). Brachycephalic animals also are prone to mishandling of food orally due to excessive pharyngeal folds and because of multiple gastrointestinal diseases, including hiatal hernia, gastroesophageal reflux, and mild inflammatory intestinal disease that leads to vomiting or regurgitation. All of these features contribute to nasal discharge in these animals.

The most common respiratory causes of nasal discharge include infectious, inflammatory, and neoplastic disorders as well as dental-related nasal disease and foreign bodies (Table 1.1). Additional clinical signs that can be seen in animals with nasal disease include sneezing or reverse sneezing, pawing or rubbing at the face, noisy breathing or mouth breathing, facial pain, or an unexplained odor near the head.

When evaluating the animal with nasal discharge, important considerations include the duration of signs, the type of discharge as well as changes in its character over time, and the presence of unilateral, bilateral, or progressive signs. Acute nasal discharge is often accompanied by sneezing and is most commonly associated with infectious upper respiratory tract disease or a foreign body. Affected animals can have signs that resolve within a week without treatment or they can be so severely affected that animals are rapidly evaluated by

Canine and Feline Respiratory Medicine, Second Edition. Lynelle R. Johnson.

Table 1.1 Causes of nasal discharge in dogs and cats.

	Dog	Cat
Infectious	Canine infectious respiratory disease complex[a] *Aspergillus* *Cryptococococcus* *Penicillium* *Rhinosporidium*	Acute upper respiratory tract disease complex[b] *Cryptococcus* *Aspergillus*
Inflammatory	Lymphoplasmacytic rhinitis	Feline chronic rhinosinusitis
Neoplastic	Adenocarcinoma Sarcoma Lymphoma	Lymphoma Adenocarcinoma Sarcoma
Local	Tooth root abscess Oronasal fistula Trauma Foreign body Nasal or nasopharyngeal polyp	Nasal or nasopharyngeal polyp Tooth root abscess Oronasal fistula Foreign body Trauma
Other	Primary ciliary dyskinesia Nasal mites Xeromycteria (dry nose syndrome)	Primary ciliary dyskinesia

[a] Reported causes include canine adenovirus-2, canine parainfluenza-3 virus, canine respiratory coronavirus, canine herpesvirus, canine distemper virus, *Bordetella*, *Mycoplasma*, and *Streptococcus equi* subsp. *zooepidemicus*. Canine influenza viruses and pneumovirus are new additions to the list of etiologic agents and novel viral organisms are continually being identified.
[b] Reported causes include feline herpesvirus-1, feline calicivirus, *Chlamydia*, *Bordetella,* and *Mycoplasma*.

a veterinarian to determine a plan for intervention. Occasionally, dogs with nasal foreign bodies will have resolution of signs despite the continued presence of organic matter within the nose. This represents a diagnostic and therapeutic dilemma in the dog that has an appropriate signalment and exposure history for a nasal foreign body, because failure to investigate signs and potentially retrieve a foreign body can have long-term consequences. The most frustrating cases are those with chronic, slowly progressive nasal discharge and sneezing over weeks to months to years before the severity of disease prompts veterinary care. Prioritizing empiric therapy requires an assessment of the top differential diagnoses and determining what treatment is least likely to worsen signs, to interfere with further diagnostic testing, or to hamper the owner from pursuing specific work-up.

With many causes of nasal signs including viral disease or foreign body, discharge is serous initially and then progresses to a mucoid character when inflammation induces mucus production or when secondary bacterial infection develops. Yellow-green nasal discharge can be an indicator of eosinophilic disease, but is also encountered in other infectious or inflammatory conditions, while brown-tinged discharge suggests the presence of blood within the mucus. Bright red blood can be found in combination with nasal discharge because of trauma to blood vessels associated with the primary disease process or due to the severity of sneezing. Epistaxis with or without nasal discharge has been associated with local causes of disease, including inflammatory rhinitis, canine aspergillosis, and neoplasia; however, in animals with pure epistaxis, systemic vascular disorders must

be considered, including coagulopathies and systemic hypertension.

Nasal discharge that is strictly unilateral is most suspicious for local disease due to a foreign body, trauma, tooth root abscess or oronasal fistula, or an early fungal infection or neoplasm. However, systemic vascular disease or a coagulopathy can also result in unilateral nasal bleeding. Also, inflammatory diseases such as lymphoplasmacytic rhinitis in the dog and feline chronic rhinosinusitis can present with lateralizing clinical signs, although in most cases imaging and histology reveal that both sides of the nasal cavity are affected.

Non-respiratory history that should be collected includes environmental exposure to foreign bodies, previous trauma, and evidence of vomiting or regurgitation. For animals with epistaxis, potential exposure to vector-borne diseases that can result in thrombocytopenia, thrombocytopathy, or vasculitis (such as Ehrlichia or Rocky Mountain Spotted Fever) should be identified along with systemic signs of diseases such as renal disease or Cushing's disease, which can result in hypertension.

Signalment

Young animals with nasal discharge are most often affected by infectious upper respiratory tract diseases. A nasopharyngeal polyp should be considered when discharge is accompanied by obstructed breathing. Primary ciliary dyskinesia is a defect of innate immunity that causes ineffectual mucociliary clearance, trapping of secretions, and recurrent infection. Therefore, this condition would be more frequently recognized in a younger animal. Affected dogs are often purebred, with an increased prevalence in the Bichon Frise, Old English Sheepdog (Merveille et al. 2014), and Newfoundland (Watson et al. 1999), although any breed of dog or cat can be affected. While neoplastic disease most typically affects older animals, it also occurs in young to middle-aged animals (2–5 years of age) and can be particularly aggressive, especially in dogs. Nasal aspergillosis is most often encountered in younger dogs and older cats. Cryptococcosis and inflammatory rhinitis can affect dogs or cats of any age.

Nasal disease of most types (fungal, neoplastic, and inflammatory, as well as dental-related and foreign body disease) is most commonly found in dolichocephalic dog breeds. An unusual combination of rhinitis and bronchopneumonia has been reported in the Irish wolfhound, where a genetic defect in respiratory immunity is suspected but has not been confirmed (Clercx et al. 2003).

Physical Examination

A complete physical examination is essential in every animal presented for evaluation of respiratory disease. In animals with nasal discharge, important features to focus on include the presence or absence of nasal airflow, changes in ocular retropulsion, ability to depress the soft palate easily into the dorsal nasopharyngeal wall, regional local lymph node enlargement, and facial asymmetry or pain. These parts of the physical examination are most important because they can help identify the space-occupying nature of some causes of nasal disease, particularly nasal neoplasia, feline cryptococcosis, feline aspergillosis, and nasopharyngeal polyps, and because these physical examination findings can indicate local extension or metastasis.

Nasal airflow can be assessed by holding a chilled microscope slide in front of each nostril to show fogging of the glass or by using a wisp of cotton (from a cotton ball or swab) to watch for air movement. The mouth should be held closed during the procedure, and occlusion of the alternate nostril can be helpful for enhancing airflow through the side of the nasal cavity to be examined (Figure 1.1). Cats create minimal airflow and a very thin wisp of cotton should be used and held in front of the nostril from above and below to check for flow. Alternatively, the stethoscope can be used to listen for airflow from each nostril. An animal with a mass effect in the nasal cavity or

Figure 1.1 Nasal airflow can be assessed by occluding one nostril and assessing flow from the alternate nostril with a cotton wisp or chilled microscope slide.

nasopharynx will fail to fog the glass, move the cotton wisp, or generate a sound at the stethoscope, and will often object to having the nose partly obstructed because it inhibits airflow. Conversely, even animals with heavy mucus accumulation in the nasal cavity will typically retain nasal airflow.

Facial palpation is performed to assess for a pain response, to locate swellings and depressions in bony structures, and to check for symmetry of the skull. Neoplastic processes and fungal infections are most likely to result in abnormal findings. Ocular retropulsion is a part of the facial examination and is performed by placing each thumb over the closed lids and pressing gently backward, upward, medially, and laterally (Figure 1.2). Nasal lesions that are producing a mass effect behind the globe (primarily a neoplasm, fungal granuloma, or retrobulbar abscess) will cause a lateralizing difference in the resistance to depression. Altered retropulsion is difficult to assess in a brachycephalic animal. Palpation within the oral cavity can reveal bony abnormalities in the hard

Figure 1.2 Palpation during ocular retropulsion can suggest the presence of a mass lesion in the optic canal or retrobulbar space.

Figure 1.3 In the normal animal, palpation of the soft palate will readily depress tissue into the dorsal nasopharyngeal wall. The presence of a mass lesion in the nasopharynx will result in resistance to depression.

palate or might suggest a mass lesion above the soft palate. To perform this examination, the mouth is held open, and the roof of the mouth is palpated from the front of the hard palate through to the end of the soft palate. In the normal animal, the soft palate is readily depressed upward into the dorsal nasopharyngeal wall (Figure 1.3). A mass in this area (most commonly a neoplasm, fungal granuloma, or polyp) will resist depression. The dental arcade should also be evaluated during the oral examination, although it is important to remember that tooth root disease can be present in the absence of external signs.

Neoplastic disease or cryptococcosis within the nasal cavity leads to ipsilateral mandibular

lymph node involvement and the disease process can sometimes be identified by cytology of a lymph node aspirate, even when there is no palpable enlargement. Nasal aspergillosis can result in reactive lymphadenopathy, although no fungal elements will be found. Nasal depigmentation along the drainage path of nasal discharge is a relatively specific feature of canine nasal aspergillosis found in up to 40% of cases and is thought to result from elaboration of a dermonecrotic toxin by the fungus (see Chapter 4).

Loud Breathing

Definition

Loud breathing most commonly results from a disorder affecting the nasal cavity or upper airway (larynx, pharynx, or cervical trachea), although occasionally animals with lower airway disease will present for loud, audible breathing. Stertor and stridor are loud sounds resulting from narrowing of upper or large airways typically, and are often audible without a stethoscope, although subtle stridor can be missed without specific auscultation over the larynx. Importantly, some animals will suffer from both stertor and stridor, which can have important ramifications for documenting the extent and severity of the obstructive disease, as well as defining optimal treatment.

Stertor is a discontinuous gurgling or snoring sound that is produced as air flows past a soft tissue obstruction in the upper airway. It can be caused by narrowing within the nasal cavity, by elongation or thickening of the soft palate, or by edema or eversion of laryngeal saccules. Tonsillar enlargement or mass lesions in the oral cavity can also lead to stertor. In brachycephalic dogs and cats, it is not possible to localize the source of stertor on physical examination alone and stertor is often multi-factorial. Stertor varies in tone and pitch, and it can be audible on inspiration, expiration, or both.

In contrast, stridor is classically an inspiratory noise of a single, high pitch that results from rapid flow of air past a rigid obstruction, such as a paralyzed or collapsed larynx. Stridor can also be heard in an animal with a laryngeal mass or occasionally in an animal with nasopharyngeal stenosis. It can also be ausculted in an animal with a fixed large airway obstruction due to stenosis, hypoplasia, compression, or a mass effect. The airway obstruction can be anywhere from the larynx to the cervical or intrathoracic trachea. In severe cases where a large mass is obstructing airflow, stridor can be present on both inspiration and expiration. Finally, cervical tracheal collapse can also result in stridor typically on inspiration.

Epiglottic retroversion is a cause of intermittent airway obstruction in dogs in which respiratory distress is present in conjunction with stridor or stertor. Although rarely reported, it is increasingly recognized as a cause of serious clinical disease (see Chapter 5).

Signalment

Stertor is commonly encountered in brachycephalic dog breeds such as bulldogs (English and French), Pugs, and Boston Terriers, and is also seen in Himalayan and Persian cats. Loud breathing is often present early in life and becomes worse with the development of additional respiratory disease or with weight gain. Some animals are not presented for evaluation of stertor and respiratory difficulty until late in life because of the perception that noisy respiration is "normal" for the breed.

Animals with stridor due to congenital laryngeal paralysis are usually young (6–12 weeks) when the clinical signs are first apparent, although some breeds show signs at 4–6 months and others at 1–2 years of age. Affected breeds include the Dalmatian, Rottweiler, Great Pyrenees, Bouvier des Flandres, Siberian Husky, White German Shepherd, and some cats (see Chapter 5). Acquired laryngeal paralysis is most commonly found in older large breed dogs such as Labrador and Golden Retrievers as part of a generalized polyneuropathy. Brachycephalic breed dogs that develop laryngeal collapse are usually older at the time

of diagnosis; however, because this is an end-stage manifestation of airway obstruction, the age at which the condition is recognized varies depending on the severity of the obstruction.

Physical Examination

In a normal animal, breathing is quiet at rest. Stertor and stridor can be heard without the use of a stethoscope; however, in some instances, careful auscultation over the neck region is needed to confirm stridor. Increasing respiratory flow rate by gentle exercise can improve detection of stridor; however, panting must be discouraged. In the normal animal, auscultation over the larynx and trachea will reveal loud, hollow sounds that are heard equally on inspiration and expiration. Because upper respiratory noises are typically loud and can obscure lung sounds, auscultation of the larynx and tracheal region is recommended in all patients prior to thoracic auscultation to improve differentiation of upper from lower respiratory sounds, as well as to enhance detection of heart sounds and murmurs. This is particularly helpful in brachycephalic breeds (Figure 1.4).

Figure 1.4 Prior to thoracic auscultation, the laryngeal and cervical tracheal regions are ausculted to define upper airway sounds.

Brachycephalic breeds commonly have visible stenotic nares as part of the disease complex, and excessive oropharyngeal folds can be evident, although it is difficult to assess palate length in the awake animal due to breed conformation and presence of excessive froth in the back of the throat. Confirming an appropriate gag reflex is important in evaluating the patient with stridor, because swallowing abnormalities can potentiate aspiration. Finally, the presence of bilateral nasal airflow assists in ruling out the nasopharynx as the site for generation of stridor.

Cough

History

Cough occurs because of activation of irritant receptors that lie between epithelial cells lining the airways and can be triggered by inflammatory products of neutrophils or eosinophils, by the presence of excess secretions, and by airway compression or collapse (Table 1.2). Important historical features to determine include the onset and duration of cough, the character of the cough, and environmental features that appear to trigger cough.

The character of the cough described by the owner is occasionally helpful when prioritizing differential diagnoses, although substantial overlap exists among the causes of cough. Animals with a wet- or moist-sounding cough can have excessive airway secretions due to infectious or inflammatory airway disease or as a result of parenchymal disease. Observant owners of the animal with a productive cough may note that the animal swallows after coughing or retches to remove secretions from the airway. However, diseases of the airway can also result in a dry cough when secretions are minimal or early in the course of disease. Cough in animals with airway disease is often harsh and can be chronic, intermittent, or paroxysmal in nature. Infectious respiratory disease in young puppies typically results in a

Table 1.2 Respiratory causes of cough in dogs and cats.

	Dog	Cat
Infectious tracheobronchitis	Canine infectious respiratory disease complex[a]	*Mycoplasma* *Bordetella*
Pneumonia	Bacterial Aspiration Foreign body Fungal Interstitial[b]	Bacterial Aspiration Foreign body Fungal[b] Interstitial[b]
Inflammatory disease	Chronic bronchitis Eosinophilic bronchopneumopathy	Asthma/chronic bronchitis
Neoplasia	Primary Metastatic	Primary Metastatic
Structural disorders	Bronchiectasis Airway collapse	Bronchiectasis

[a] Reported causes include canine adenovirus-2, canine parainfluenza-3 virus, canine respiratory coronavirus, canine herpesvirus, influenza viruses, and canine distemper virus along with *Bordetella*, *Mycoplasma*, and *Streptococcus equi* subsp. *zooepidemicus*.
[b] More commonly a cause of tachypnea than cough.

hoarse, seal-bark cough and this is often ascribed to bordetellosis. A honking cough is frequently described in dogs with tracheal or airway collapse and a brisk snapping sound on expiration is suggestive of large airway collapse. Animals with pneumonia might have a softer cough along with a vague history of illness characterized by anorexia and lethargy. Dogs with heart disease also can have a soft cough associated with tachypnea, exercise intolerance, or lethargy. With severe or fulminant pulmonary edema, a dog might expectorate pink foam if pulmonary edema has flooded the alveolar space and entered the airways. However, the common association of cough with congestive heart failure has been called into question (Ferasin et al. 2013).

Determining environmental and travel history is important for animals with cough. Exposure to a high-density dog population should raise concern for disease associated with canine infectious respiratory disease complex. If the cough is harsh and dry, *Bordetella* should be considered, while a soft, chronic cough could be suggestive of canine influenza virus infection. Sporting dogs that develop an acute onset of cough or have a chronic, antibiotic-responsive cough could have foreign body pneumonia. Fungal pneumonia should be suspected in animals with cough that have traveled to endemic regions. In those animals, cough is usually accompanied by tachypnea and systemic signs of illness. Finally, environmental history is important, because exposure to pollutants and airway irritants can exacerbate upper or lower airway diseases in both dogs and cats, although it remains unclear whether or not exposure to second-hand smoke is an important factor in worsening cough in animals (Hawkins et al. 2010).

Signalment

In general, younger animals might be more likely to develop infectious or foreign body pneumonias, while older animals develop bronchitis, neoplasia, airway collapse, and perhaps aspiration pneumonia. Dogs with

eosinophilic or fungal pneumonia also tend to be young to middle-aged. Asthma/bronchitis seems to affect cats of all ages, although perhaps the eosinophilic form is more common in younger animals. Cervical tracheal collapse might affect younger dogs, while older dogs get both tracheal collapse and bronchomalacia.

The breeds affected depend on the underlying case of cough. For example, an older Retriever-type dog is likely to develop laryngeal paralysis and subsequent aspiration pneumonia, while aspiration in a brachycephalic breed often happens at a young age. Tracheal collapse affects toy and small breed dogs, while chronic bronchitis and bronchomalacia can affect any size breed of dog.

Physical Examination

One of the more difficult challenges in assessing animals with respiratory disease is the development of good auscultation skills. Practice and patience are required because audible sounds are altered by age, body condition score, conformation, respiratory pattern, and the presence of disease. As mentioned earlier, careful examination should include the larynx and trachea, followed by auscultation of all lung fields. The anatomic origin for lung sounds has not been fully established; however, normal lung sounds are usually designated as bronchial, vesicular, or bronchovesicular. Bronchial sounds are loud and are heard best over the large airways near the hilus. Typically, they are louder and longer during expiration than inspiration and have a tubular character. Vesicular lung sounds are soft, heard best on inspiration, and can be detected over the periphery of the chest in normal animals. The sound resembles a breeze passing through leaves on a tree. Bronchovesicular sounds (a mixture of bronchial and vesicular qualities) are typically louder on inspiration than expiration.

Lung sounds in animals with airway or parenchymal disease are often increased in loudness or harshness, and harsh bronchovesicular sounds can be the only physical examination finding in animals with marked bronchopulmonary disease. Adventitious (abnormal) lung sounds (crackles and wheezes) are discontinuous noises and are not found as commonly as expected in respiratory patients, but should always be taken as an indicator of disease. Adventitious lung sounds can be enhanced by inducing a cough or a deep breath, or by exercising the patient. In normal animals, it is difficult to induce a cough by palpating the trachea; however, animals with airway or parenchymal disease usually have increased tracheal sensitivity due to activation of irritant receptors by infection or inflammation.

Crackles are thought to result from rapid opening of airways, but could also arise from equalization in pressure as air passes through fluid or mucus-filled airways. They can be heard at any point during inspiration or expiration. Fine or soft crackles are suggestive of pulmonary edema, particularly if ausculted in the hilar region of a dog, whereas coarse crackles are more suggestive of airway or parenchymal disease. Dogs or cats with pulmonary fibrosis can display either fine or coarse crackles that are ausculted diffusely across the chest. Auscultation in dogs with airway collapse can reveal diffuse crackles because of the presence of concurrent bronchitis, or because of small airways that open and close during the phases of respiration. In the latter case, crackles are often present during both inspiration and expiration. A loud snapping sound over the hilar region at end expiration is suggestive of collapse of the intrathoracic trachea, carina, or mainstem bronchi. Wheezes result from air passing through airways narrowed by intraluminal mucus, extraluminal compression, or by collapse or constriction, and are usually heard on expiration.

Tachypnea

History

Tachypnea is most often associated with parenchymal or pleural disease, although in the cat tachypnea can also be encountered

with bronchial disease. Parenchymal diseases that lead to tachypnea are primarily pneumonia and pulmonary edema. Pneumonia (infectious, aspiration, fungal, or interstitial) can be acute or chronic and insidious in onset. Both pneumonia and pulmonary edema are typically associated with systemic signs of illness such as lethargy, anorexia, and weight loss.

Tachypnea due to pneumothorax is usually acute; however, pleural effusive disorders can result in either an acute presentation with respiratory distress or a more chronic development of signs due to slow accumulation of fluid. Usually, the degree of respiratory distress is associated with the rapidity of fluid or air accumulation rather than with the specific volume present. Cats seem to be particularly sensitive to addition of a final, critical volume of fluid that overcomes their ability to compensate.

Physical Examination

Cervical and thoracic auscultation, as described for evaluation of animals with cough, is important for animals that present with tachypnea, because many diseases will result in both cough and tachypnea. In addition to listening for increased sounds, it is important to determine if there is an absence of lung sounds, which might indicate the presence of fluid or air in the pleural space.

A notable clinical sign associated with parenchymal or pleural disease is a rapid, shallow breathing pattern, although with pleural disease, exaggerated chest wall motion or hyperpnea can sometimes be present in conjunction with a rapid respiratory rate. In animals with severe respiratory distress, elbows are abducted and the neck is extended to facilitate movement of air into the alveoli. Parenchymal diseases are characterized by increased lung sounds or detection of adventitious sounds. When pleural effusion is present, lung sounds are ausculted in the dorsal fields only and muffled sounds are heard ventrally; heart sounds are also muffled. Pneumothorax leads to an absence of lung sounds dorsally due to compression by air, and lung sounds are present in the ventral fields only. In some cases, a line of demarcation can be ausculted between normal and abnormal lung sounds, indicating a fluid line or the boundaries of air accumulation.

Figure 1.5 Each region of the thorax should be percussed to detect regional differences in the air/soft tissue sounds that are created. One hand is placed against the thorax and is rapped quickly and sharply with the curved fingers of the alternate hand.

In addition to auscultation, thoracic percussion aids in determining if pleural disease is present. Percussion can be performed using a pleximeter and mallet or by placing the fingers of one hand on the chest and rapidly striking them with fingers of the opposite hand (Figure 1.5). The sound that develops will vary depending on whether an air or fluid density is present within the thoracic cavity. Percussion of the chest in a region filled with fluid reveals a dull sound, while in an animal with pneumothorax or air trapping, percussion results in increased resonance. This technique is somewhat limited in a cat or small dog because of the small size of the thoracic cavity.

Exercise Intolerance

History

In general, exercise intolerance can result from respiratory, cardiac, musculoskeletal, neurologic, or metabolic diseases. Respiratory disorders

that result in exercise intolerance usually do so through airway obstruction in diseases such as laryngeal paralysis in the dog, asthma in the cat, or chronic bronchitis in either species, or through hypoxemia associated with parenchymal disease. Historical features in animals with airway obstruction can include loud breathing noises as well as progressive tiring and a reduced level of activity. Upper airway obstruction due to laryngeal disease can be accompanied by reports of dysphonia, decreased vocalization, gagging, or retching, while lower airway obstruction due to bronchoconstriction or inflammation is usually associated with cough.

Physical Examination

In the older, large breed dog presented for evaluation of exercise intolerance, careful attention should be paid to laryngeal auscultation for stridor suggestive of laryngeal paralysis. Increased tracheal sensitivity and loud or adventitious lung sounds in cats or dogs with exercise intolerance but no systemic signs of illness suggest that bronchial narrowing, collapse, or inflammation could be responsible for exercise intolerance. Animals that display tachypnea on physical examination, abnormal lung sounds, and systemic signs of illness likely suffer from some form of pneumonia.

Differentiating Cardiac from Respiratory Disease

It can be difficult to distinguish animals with heart failure from those with respiratory disease because of the similarity in clinical signs, physical examination findings, and sometimes even radiographic changes. In addition, some animals suffer from heart and lung or airway diseases concurrently, although in most situations one clinical disease predominates as the cause for clinical signs. It is also important to understand that the presence of disease in one organ can lead to secondary disease in the other thoracic organ. Disorders of the respiratory tract that cause clinical complaints similar to those found in cardiac disease include asthma in cats and bronchitis in dogs, and pneumonia, pulmonary edema, and interstitial diseases in both species. In addition, respiratory or systemic causes of pleural effusion must be distinguished from hydrothorax due to biventricular heart failure.

History

As suggested earlier, the presence and character of cough can sometimes be helpful in distinguishing cardiac from lung or airway disease. Typically, the cough in dogs with airway disease is chronic, harsh, paroxysmal, and can be dry or productive. In contrast, dogs in congestive heart failure will have a soft, moist cough, as do some dogs with pneumonia. Cats with bronchial disease virtually always have a history of cough, while only 5–25% of cats with congestive heart failure might have cough in the history (Dickson et al. 2018). Cats with airway disease can present with rapid breathing, although in a study of cats presented to the veterinarian for respiratory distress, severe tachypnea was more common in cats with cardiac disease (Dickson et al. 2018). Pulmonary edema is often associated with an acute onset of clinical signs referable to the respiratory tract in association with constitutional signs of lethargy, inappetence, and depression. Animals with pneumonia frequently have a vague history of illness that can be acute or chronic but is also characterized by anorexia, malaise, and weight loss. Dog with cardiac disease are often cachectic and lethargic, while dogs with chronic bronchitis are typically robust or obese and have a healthy appetite. Dogs or cats with pulmonary fibrosis generally display a gradual deterioration in exercise tolerance, and tachypnea or difficulty breathing is noted later during the course of disease.

Signalment

Signalment can be an important clue to determining whether heart or lung disease is more likely in a given case. A young animal with a heart murmur and clinical signs of cardiopulmonary disease is a likely candidate for congenital heart disease. Young to middle-aged cats can be affected by hypertrophic cardiomyopathy or feline bronchial disease. The presence of a gallop sound or arrhythmia makes cardiac disease more likely. It is more difficult to identify the primary cause of clinical signs in middle-aged to older small breed dogs, because they can be affected by airway collapse, chronic bronchitis, and degenerative valvular disease concurrently. Exacerbation of any of these disease processes could be the cause for clinical presentation to the veterinarian.

Dobermans, Golden Retrievers, and giant breed dogs are commonly affected by cardiac disease, while primary respiratory conditions are less common in these dogs, with the exception of aspiration pneumonia associated with laryngeal paralysis, which is common in Retriever breeds. It is also important to recall that large breed dogs can be affected by airway collapse, chronic bronchitis, and pneumonia. Idiopathic pulmonary fibrosis is most commonly reported in older West Highland White terriers, but other terrier breeds can be affected as well as cats, and younger dogs can also occasionally develop interstitial lung disease. A Maine Coon or Ragdoll cat is more often affected by hypertrophic cardiomyopathy, while a Siamese cat would be more likely to develop chronic airway disease.

Physical Examination

Body temperature can be somewhat helpful in distinguishing cardiac from respiratory disease at least in cats, as low body temperatures are more typical with cardiac disease (Dickson et al. 2018), although substantial overlap can be found. Heart rate is helpful in differentiating cardiac from respiratory disease in the dog, because dogs with respiratory disease often have elevated vagal tone, which leads to a slower heart rate and an exaggerated respiratory arrhythmia. In congestive heart failure, activation of the sympathetic nervous system leads to an increased heart rate, and the presence of a tachyarrhythmia would make cardiac disease more likely in a dog. One exception to this rule might be the Miniature Schnauzer, which can have a low heart rate in heart failure because of concurrent sinus node disease. Heart rate is less helpful in differentiating cardiac from respiratory disease in cats, because they rarely develop a sinus arrhythmia and are more likely to be tachycardic due to stress, but there is a general trend toward higher heart rates in cats with cardiac causes of respiratory distress (Dickson et al. 2018).

Murmurs in dogs and cats are not highly sensitive or specific for confirming congestive failure as a cause for clinical signs, although murmur intensity as well as progressive increase in intensity appears to be an important indicator of clinically significant cardiac disease in dogs with myxomatous mitral valve disease (Lord et al. 2010, 2011).

Dogs with pulmonary hypertension as a consequence of primary lung disease can also display a prominent heart murmur. Heart murmurs in cats are neither sensitive nor specific for heart disease, because a substantial proportion of cats with hypertrophic cardiomyopathy lack a heart murmur and the physiologic murmur of right ventricular outflow tract obstruction is very common in cats.

Detection of a gallop sound is highly suggestive of substantial cardiac disease, particularly hypertrophic cardiomyopathy in the cat and dilated cardiomyopathy in the dog. Arrhythmias, and especially tachyarrhythmias, with pulse deficits would be much more commonly encountered in an animal with heart disease than in an animal with a respiratory cause of signs.

Tachypnea or hyperpnea can be found in animals with disease of cardiac or respiratory origin. Pneumonia, pulmonary edema, and

interstitial fibrosis result in restrictive lung disease due to stiffening of the pulmonary parenchyma that leads to rapid, shallow breathing. Pleural effusion of cardiac, respiratory, or systemic origin will also result in an elevated respiratory rate. In some dogs and cats with chronic bronchitis and in dogs with tracheobronchomalacia, increased expiratory effort, prolonged expiratory time, and abdominal effort on expiration can be seen. Wheezes might be ausculted on expiration in these animals or inspiratory and expiratory crackles heard in dogs. The crackles detected in animals with bronchial disease are generally harsher and moister than those heard in dogs or cats with pulmonary edema. In many animals with heart failure, lung sounds are relatively normal or only very fine, soft crackles can be ausculted. Crackles on inspiration can be prominent in dogs with pulmonary fibrosis, and these adventitious lung sounds can be ausculted over the entire thorax in animals with pulmonary fibrosis. Crackles in animals with pneumonia are sometimes localized to certain lung regions. In an animal with aspiration pneumonia, abnormal lung sounds may be localized to the cranioventral lung regions or the middle lung lobes.

If pleural effusion is present due to pulmonary, cardiac, or systemic causes, heart and lung sounds will be dampened ventrally, while lung sounds are heard in the dorsal lung regions. Pleural effusion due to right heart disease is generally associated with distention of the jugular veins due to increased venous pressure. A hepatojugular reflux, enlarged liver, or ascites may also be detected. In cats, pleural and pericardial effusion can occur due to left-sided heart disease. Pleural effusion associated with infectious etiologies (pyothorax in the dog and cat or feline infectious peritonitis in the cat) is more likely to result in fever than non-infectious causes.

Additional Considerations

A complete physical exam is warranted in all patients presenting with signs of respiratory disease, including cough, tachypnea, or difficulty breathing. Abdominal palpation might reveal the presence of ascites or an abdominal mass. A dilated fundic exam is important for investigating infectious diseases as the cause for respiratory signs, including feline infectious peritonitis, canine distemper virus, and fungal infections.

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