GASP! RESPIRATORY EMERGENCIES

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Introduction

Respiratory emergencies are commonplace in the veterinary emergency hospital. Patients with everything from collapsing tracheas to a pneumothorax need to be triaged and treated promptly and appropriately. For whatever reason patients with acute respiratory distress tend to succumb quickly and easily to fatigue, respiratory arrest, and subsequent death. Hasty examination and treatment of these patients must occur rapidly to ensure a positive outcome.

Anatomy

The respiratory system encompasses all structures from the mouth to the diaphragm. At the back of the mouth, the pharynx houses the larynx, arytenoid cartilages and trachea. As the trachea proceeds into the chest it bifurcates at the carina, splitting off into right and left mainstem bronchi. These bronchi eventually turn into bronchioles and alveoli, where gas exchange directly takes place. The right lung lobe has two lobes: the cranial and caudal lobes, while the left has four: the cranial, middle, caudal, and accessory lobes. In addition to the trachea, bronchioles and alveoli, the capillaries that surround the alveoli and the tissue covering the alveoli (parenchyma) are also considered part of the lung. The diaphgram is the large sheet of muscle the separates the thoracic cavity from the abdominal cavity. In addition to the=e structures the last structure of the respiratory system is the pleural cavity/space. This is a thin lining of all the respiratory structures. All of these can become infected, get air/blood/pus inside, or collapse and fail. This means that it is extremely important to rapidly differentiate the upper airway, lower airway or pleural space disease patient from one another.

Physiology

The function of the respiratory system is to get rid of metabolic waste and oxygenate the blood. The system does this by exchanging carbon dioxide for oxygen at the level of the capillary and alveolus. Ventilation is the process of moving carbon dioxide out of the blood stream and carbon dioxide levels are what drive the brain to "breathe." Thus, ventilation drives oxygenation. When CO2 levels rise, the brain begins the process of "respiration"- the diaphragm contracts drawing the lungs caudally. This increases the negative pressure in the thorax and stimulates air to be drawn in. Then, passive, the CO2 and O2 molecules are exchanged, and the CO2 within the alveolus is exhaled. Hypoxia is the lack of oxygenation at the tissue level. Hypoxemia is the lack of dissolved oxygen within the bloodstream. As oxygen levels can be problematic if quite low, high or low CO2 levels can also cause problems in the body such as altered cerebral blood flow and acidosis.

Triage and Initial assessment

Patients with respiratory dysfunction may present with a variety of symptoms. Patients with upper airway disease typically have noisy sounding respiration, whether it's a honk, or a cough, or a hack. Patients may also present cyanotic, indicating severe hypoxemia. Hypoxemic patients, in earlier stages, may be tachycardic, tachypneic, have pale MM's before they are cyanotic. Patients with respiratory distress should not only have a respiration rate, but the character of the respiration should be evaluated. Does the patient have stridor/stertor? Does the patient have an increased effort on inspiration? Expiration? Abdominal effort? Is the patient sticking their neck out, and abducting their elbows? [Called orthopnea]. If it is a cat, panting is

almost always a sign of severe illness, respiratory or not. In addition to these visual assessments the patients pulse should be felt and the patient's chest should be thoroughly auscultated for any clues to disease.

Upper airway disease

The two classic upper airway disease are laryngeal paralysis and collapsing trachea.

Laryngeal paralysis: Typically a disease of older large breed dogs, this disease is characterized by the failure of the arytenoids to properly perform during respiration. Typically the arytenoids should abduct (move away) on inspiration and adduct (move together) on expiration. If the muscles or nerves that support these structures fail this movement is not uniform and the patient often finds themselves breathing through a closed glottis. This creates an "obstruction' and can lead to severe respiratory distress and cyanosis. These patients often need sedation to calm them down and may even need rapid sequence induction and intubation to control their airway. In addition, they are often hyperthermic and may need treatment for this. There is no definitive cure for this disease other than a unilateral cricoarytenoid lateralization ("tie-back") where one arytenoid is adducted permanently to facilitate breathing. Often times these patients can be stabilized with oxygen and sedation, but intubation may be necessary.

Collapsing trachea: This disease typically afflicts smaller breed dogs, who begin to show signs during exercise or play. These patients have a characteristic "goose honk" indicating they are attempting to breathe through a collapsed tube creating resistance and a musical sound. in these patients the circular cartilaginous rings of the trachea fail to hold their form and collapse. The collapse can be extra or intrathoracic in nature. There can be extraluminal or intraluminal masses that cause this as well. Typically these patients require sedation and oxygen supplementation. Rarely do they require emergency intubation. However, they also can present hyperthermic and must be monitored closely.

Lower airway disease

Structures of the lower airway consist of the bronchi, bronchioles and alveoli. This also includes the lung tissue (parenchyma). Common respiratory emergencies in this category include: pulmonary contusions, pneumonia, and pulmonary edema from a cardiogenic or non-cardiogenic source.

Pulmonary Contusions: Blunt force trauma to the chest can result in burst capillaries that surround alveoli. This can lead to hemorrhage into the alveoli and bronchioles resulting in respiratory difficulty, hypoxemia and altered ventilation. Respiratory difficulty following blunt trauma is indicative of pulmonary contusions. It is important to note that radiographic signs, alveolar or interstitial infiltrates, may not be present until 6-12 hours after the traumatic incident. Treatment usually consists of oxygen supplementation. Severe cases may require mechanical ventilation.

Pneumonia: Pneumonia is an inflammatory process of the pulmonary parenchyma which results in exudative effusion into the alveoli and lower airways. Pneumonia can be resultant from infections (bacterial, viral, protozoal, fungal), aspiration of GI contents, or chemical/smoke inhalation. Immunocompromised patients may be at great risk to develop pneumonia; patients with conditions such as: diabetes mellitus, hyperadrenocorticism, or patients on immunosuppressive therapy. Diagnosis is typically made from clinical signs of infection (fever, etc), radiographic signs (pulmonary infiltrates, alveolar/interstitial patterns, or air bronchograms), and clinicopathologic signs such as leukocytosis, left shift, etc. Treatment

usually consists of oxygen supplementation, anti-microbial medications, nebulization and coupage therapy, and rarely mechanical ventilation.

Pulmonary edema: Pulmonary edema is fluid accumulating in the pulmonary parenchyma that spills over into the alveoli and bronchioles. The edema can be blood, pus, or fluid. A common cause of pulmonary edema is congestive heart failure and the edema is like water. Treatment typically involves diuretic therapy, treatment of the underlying cause (cardiac insufficiency, etc) and oxygen therapy as needed.

Pleural space disorders

The pleural space surrounds the entire thoracic cavity and envelops the lungs, heart, trachea, and esophagus. Disease can develop in this negative space as well in the form of a pneumothorax or pleural effusion.

Pneumothorax: The development of air within the pleural cavity is a serious condition requiring immediate treatment. An open pneumothorax occurs when air leaks from the lung into the pleural cavity and then either escapes through damage to the external thoracic cavity (communicating with the outside) or back through the lung itself. This type of pneumothorax may be self-limiting and require little treatment. A closed pneumothorax represents a situation where the damaged lung forms a one-way valve that leaks air into the pleural space but allows no way for it to get out. The air builds pressure within the thorax collapsing the lungs further, and eventually putting a strain on the heart and great vessels. This, subsequently, lowers blood pressure and can certainly cause death. Initial treatment of a pneumothorax is thoracocentesis to evacuate the air from the pleural space. If the pneumothorax continues to occur, chest tube placement may be necessary for continual evacuation of the pleural space.

Pleural effusion: Effusion into the pleural cavity can be of a transudate or exudative nature. Blood or pus may occur secondary to coagulation disorders or neoplasia present in the chest. Congestive heart failure may result in increased hydrostatic pressure within the great vessels and lead to a transudative ("water") effusion. As with a pneumothorax, the increasing pressure will collapse the lungs affecting breathing. In addition, a hemothorax may cause anemia affecting the patients ability to deliver oxygen to its organs. Treatment for pleural effusion typically starts with thoracocentesis. After this is completed and the type of effusion is identified, further treatment can be initiated.

Treatment modalities for respiratory emergencies

Tracheostomy: A tracheostomy is indicated when a patient is suffering from an upper airway obstruction blocking air flow through the trachea. An incision is made through the skin and into the tracheal rings. Two rings are separated from each other and a shortened tube (tracheostomy tube) is placed into the trachea. This tube is then secured and the patient may breathe through the tube which must be caudal to the obstruction.

Thoracocentesis/Chest tube placement: Thoracocentesis involves placing a needle or catheter into the pleural space to evacuate fluid or air found within. Typically a needle and extension set or a butterfly needle set is used. The veterinarian typically performs this procedure but the technician must be ready to assist with a three-way stopcock and a syringe and bowl to empty the fluid in. Placement of chest tubes requires sedation/anesthesia and involves a semi-permanent tube that is secured in the pleural space for repeated evacuation of the effusion or pneumothorax.

Oxygen supplementation: Oxygen can be supplemented in a variety of different ways including: anesthesia mask, "flow-by," oxygen hoods, oxygen cages, and nasal cannulas. if a patient tolerates it, oxygen can be delivered via an anesthesia machine or oxygen humidifier with an anesthesia mask or simply by holding the end of the breathing circuit near the patients face. The flow-rate should be kept quite high when using this method. An oxygen hood consists of an elizabethan collar with plastic wrap covering the front part of it. An oxygen tube is put into the hood and oxygen administered. An oxygen cage allows the animal to be confined within a closed space and a finite amount of oxygen administered. commercial oxygen cages often allow temperature and humidity to be controlled as well. Lastly, nasal cannula placement involves securing a catheter in the nasal cavity from the nares to the medial canthus, and delivering a set flow of oxygen.