INTRODUCTION

Respiratory distress represents one of the most stressful and time-dependent emergencies that a veterinarian will face in practice and commonly results from upper or lower airway obstruction. Regardless of the underlying condition, a respiratory emergency requires immediate alleviation of the sensation of difficulty breathing, rapid identification of the primary cause, and provision of information to the owners of the affected pet. Successful management of patients in respiratory distress is aided by “pattern recognition” of common conditions causing respiratory difficulty. Prompt recognition of the underlying condition will enable the provision of appropriate therapeutics to stabilize the patient and will ultimately improve outcome. A comforting fact is that all respiratory emergencies are initially handled identically until further information related to the underlying cause can be determined. Thus, if a veterinarian can recognize when a dog or cat is in respiratory distress and provide relief as soon as possible, these nerve-racking emergencies will become less stressful for everyone involved.

SIGNS OF RESPIRATORY DISTRESS

It is important first to ensure that all veterinarians and technicians in your practice easily recognize the signs of respiratory difficulty. Signs of respiratory distress include: extension of the head/neck, abduction of the elbows, open-mouth breathing (especially cats), retraction of the lips, flared nostrils, increased abdominal participation during breathing, paradoxical breathing (asynchrony of the thorax and abdomen), an increased respiratory rate, or an inability to sit/lie down.

INITIAL STABILIZATION

The first steps in handling a patient in respiratory distress include providing supplemental oxygen and administering appropriate sedation. The key is to provide the form of oxygen supplementation (outlined below) that gives the highest fraction of inspired oxygen (FiO₂) while causing the least amount of stress to the patient. Giving sedation to the patient will also help to relieve its anxiety and enable you to complete a physical examination without causing further distress. The sedation drug of choice is butorphanol (0.2-0.4 mg/kg IV or IM). If additional sedation is needed, a benzodiazepine (diazepam 0.25-0.5 mg/kg IV; midazolam 0.2-0.4 mg/kg IV or IM) can also be given. These drugs cause very little cardiopulmonary suppression and are extremely safe in all situations causing respiratory distress. Conversely, if the dog or cat is in respiratory distress due to traumatic injuries, a stronger opioid should be given (hydromorphone 0.025-0.05 mg/kg IV or IM; buprenorphine 0.01-0.02 mg/kg IV or IM).

OXYGEN SUPPLEMENTATION

Oxygen supplementation can be provided by several means, but must be regulated by a flow meter. Flow meters can be adapted to an oxygen tank to enable delivery of oxygen throughout a clinic. Ideally, oxygen should also be humidified when long term administration is anticipated. Humidification can be achieved by attaching a commercial humidifier (plastic bottle filled with distilled water) directly to the flow meter.

Flow-by oxygen is the administration of oxygen by holding the oxygen tubing near (1-2 cm) the nose and mouth of the dog or cat. The flow rate should be set to approximately 100
mL/kg/min. This form of oxygen administration is usually temporary as it necessitates someone physically holding the oxygen near the patient and re-directing the oxygen as the patient moves. It is also associated with large losses of oxygen to the environment and a limited $\text{FIO}_2$ delivered to the patient. This method is well tolerated in the short-term by most patients and easily performed upon arrival to the clinic, but might be difficult in an anxious or uncooperative dog or cat.

Oxygen can also be provided via facemask by placing a cone (with or without the black rubber dam) over the patient’s mouth and nose. The mask should allow escape of heat, humidity, and CO$_2$, and the oxygen flow should be at least 100 mL/kg/min to avoid re-breathing. Poorly fitted facemasks might require flow rates as high as 300 mL/kg/min. Most patients do not tolerate oxygen administration by this method unless they are recumbent; however, some cats or small dogs will allow their entire face to be placed into the mask for oxygen administration. The $\text{FIO}_2$ is typically 50% but may be up to 100% with a well-fitting mask.

To provide nasal oxygen, place a nasal cannula or nasal prongs and administer oxygen at a rate of 50-150 mL/kg/min. Nasal cannulas are placed to deliver oxygen directly into the nasal passage via the ventral meatus at the level of the distal nasal cavity or nasopharynx. As such, cannulas should be placed to the lateral canthus of the eye. An $\text{FIO}_2$ of 40-60% can be attained depending on the oxygen flow rate achieved. Typically, clear feeding tubes or red rubber catheters are used (cats: 3.5-5 F, dogs: 5-8 F).

**Instructions for placement of a nasal oxygen cannula:**

1) Administer proparacaine (ophthalmic anesthetic) drops (3-5 drops) or lidocaine (2%) injection (0.25 mL) into the nasal passage.
2) Pre-measure the cannula to the desired distance and mark the cannula with indelible marker or a piece of white tape.
3) Lubricate the tip of the nasal cannula with lidocaine (2%) jelly.
4) Direct the cannula ventrally and medially into the nasal passage (aiming for the base of the opposite ear in a cat or the opposite canine tooth in a dog).
5) The cannula should pass easily. An inability to pass the cannula past the medial canthus of the eye indicates placement within the dorsal meatus.
6) The cannula can be secured using a suture placed through tape immediately adjacent to the nare and again between the eyes on the forehead. Conversely, a very small amount of instant Krazy® glue may be applied.

**Oxygen hoods** are another form of oxygen supplementation that involve the placement of a plexiglass, plastic, or cardboard container, or an Elizabethan collar (3/4 of the front covered by cellophane), over the head or entire anterior portion of the animal’s body. Oxygen is then supplied into the hood at flow rates of 1-10 L/min. These hoods can achieve an $\text{FIO}_2$ of approximately 50-100% but vary dramatically. These hoods allow continued contact with the patient for auscultation, administration of medications, and performing procedures; however, they are not well tolerated by all patients. Additionally, these hoods can become warm and humid making them uncomfortable for long-term oxygen supplementation.

**Oxygen cages** are a means of providing oxygen using commercial cages that are designed to provide an $\text{FIO}_2$ of 40-60%. Many reputable cages are heat and humidity controlled. Patients tolerate this form of oxygen supplementation very well as they can be placed inside the cage and monitored from the outside until their anxiety subsides. Disadvantages of this form of oxygen supplementation are that they are often only available at large emergency clinics or referral
hospitals and that the FIO₂ will temporarily decrease each time the cage door is opened to assess
the patient.

**Intubation** allows immediate control of the airway and an FIO₂ of 100% to be provided. This form of oxygen supplementation is often necessary for patients with an upper airway obstruction, respiratory fatigue due to prolonged respiratory distress, respiratory failure, or respiratory arrest. Some patients will continue to breathe spontaneously once endotracheally intubated; however, others will require positive pressure ventilation using an AMBU bag or anesthetic machine. If long-term positive pressure ventilation is required, the patient must be referred to a hospital that offers critical care (mechanical) ventilation. Induction drugs are often required for patients needing endotracheal intubation, although sometimes butorphanol sedation is enough in very debilitated patients. Ketamine:diazepam (1:2) 0.1-0.2 mL/kg IV titrated to effect is recommended for safe and rapid induction of patients in respiratory distress. Propofol induction is not recommended due to its respiratory suppressant effects.

**GENERAL PHYSICAL EXAMINATION**

Handling of all patients in respiratory distress should be performed in an area of the hospital where oxygen supplementation is readily available and emergency procedures could be performed rapidly if necessary. The initial assessment of the dog or cat in respiratory distress must be quick and not worsen the animal’s condition. Sometimes even a cursory exam is not possible without the animal becoming more stressed. If this occurs, administer sedation (if not already given) or consider giving additional sedation, and continue oxygen supplementation with minimal restraint or handling of the patient. Once the patient tolerates handling, an exam should be performed focusing on the respiratory and cardiovascular systems including:

- Respiratory rate and character
- Thoracic auscultation (listen for increased/decreased lung sounds, crackles, wheezes)
- Cardiac auscultation (listen for murmurs, gallop rhythms, arrhythmias)
- Mucous membrane color and capillary refill time (CRT)
- Pulse quality and blood pressure (if tolerated)
- Extremity temperature
- Jugular vein assessment (for distension or pulses)
- Rectal temperature (if tolerated)

Although a complete physical examination is ideal, patients in respiratory distress are not candidates for a full physical examination including abdominal palpation, rectal examination, or neurologic or orthopedic assessments. Only when the patient is stabilized should an exhaustive physical examination be performed. Once the dog or cat tolerates a physical examination, placement of an intravenous (IV) catheter should be attempted. An IV catheter will enable the administration of additional sedation, induction medications if emergency intubation is required, or emergency medications in the face of cardiopulmonary arrest.

**HISTORY**

Obtaining an accurate history from the owner is very important for determining the underlying etiology for the respiratory distress. Although the precipitating cause of the respiratory distress might be obvious (e.g., trauma), there could be a more insidious underlying cause. Owners should be asked about the following:

- Signalment including age
- Duration of clinical signs
- Past medical history (e.g., cardiac disease, megaesophagus, allergies, neoplasia)
- Routine veterinary care (i.e., heartworm prevention)
- Travel history
- Events leading up to the respiratory distress (e.g., exercise, hot/humid weather)
- Presence of concurrent abnormal clinical signs (e.g., inappetence, coughing, vomiting, lethargy)

**PATTERNS OF RESPIRATORY DISTRESS**

Diagnostic tests such as radiographs, lab work, and ultrasound can pose a serious threat to dogs or cats with respiratory distress. The physical examination and history are almost always enough to localize the cause of the respiratory distress. The most important observations are the respiratory pattern (i.e., type of distress) and auscultation. These preliminary findings will enable rapid determination of the origin of the respiratory distress.

<table>
<thead>
<tr>
<th>Type of Respiratory Distress</th>
<th>Most Probable Cause</th>
<th>Observations</th>
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<tbody>
<tr>
<td>Inspiratory distress</td>
<td>Upper airway disease</td>
<td>Prolonged inspiratory phase Abnormal respiratory noises (e.g., stridor, stertor)</td>
</tr>
<tr>
<td>Expiratory distress</td>
<td>Lower airway disease</td>
<td>Prolonged expiratory phase Abnormal lung sounds (e.g., wheezes)</td>
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<tr>
<td>Rapid, superficial breathing</td>
<td>Pleural space disease</td>
<td>Fast expiratory phase Abnormal (i.e., dull, absent) lung sounds</td>
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<tr>
<td>Rapid superficial breathing</td>
<td>Pulmonary parenchymal disease</td>
<td>Abnormal lung sounds (e.g., increased, crackles)</td>
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**DIAGNOSTIC TESTS**

Only when the patient is considered stable should any diagnostic tests be performed. These tests might enable differentiating underlying causes of respiratory distress or monitoring response to treatment.

Thoracic radiographs should not be performed until the patient is undoubtedly stable. If the patient resists handling or transport of any kind, radiographs should not be attempted. Sedation is often essential for enabling radiographs. Thoracic radiographs are helpful for confirming the presence of lower airway disease, pulmonary parenchymal disease, or pleural space disease. Thoracic radiographs are also recommended following any traumatic episode to document injuries (e.g., pulmonary contusions, rib fractures, pneumothorax, hemothorax, diaphragmatic hernia).

Thoracic ultrasound is often tolerated prior to thoracic radiographs because it can be performed with minimal patient manipulation. Thoracic ultrasound can be used to quickly determine the presence of pleural space disease such as pleural effusion. Thoracic ultrasound can also help to identify pneumothorax, intrathoracic masses, pericardial effusion, or alterations in
cardiac chamber size or contractility. However, thoracic ultrasound is not typically helpful in patients with upper or lower airway obstruction.

**Pulse oximetry** is a non-invasive method for assessing oxygenation of dogs and cats. It measures the peripheral oxygen saturation (SpO$_2$), which is an indirect measure of SaO$_2$ and thus PaO$_2$ using the oxygen-hemoglobin dissociation curve. A SpO$_2$ of 90% corresponds to a PaO$_2$ of 60 mmHg (severe hypoxemia) and a SpO$_2$ of 95% corresponds to a PaO$_2$ of 80 mmHg (normal oxygenation). Pulse oximetry can be used for documenting hypoxemia and for monitoring the patient’s response to oxygen supplementation. In a normal dog or cat, the PaO$_2$ should be 4-5 times the FIO$_2$. For example, a patient breathing room air (FIO$_2$ = 21%) should have a PaO$_2$ of 80-100 mmHg (SpO$_2$ > 95%) and a patient on nasal oxygen (FIO$_2$ ~ 40%) should have a PaO$_2$ of 160-200 mmHg (SpO$_2$ ≥ 100%).

**Blood gases** are often helpful in assessing the ventilation capacity of animals with upper or lower airway obstruction. Due to their airway obstruction, these patients can develop hypercapnia, due to their inability to exhale carbon dioxide. Because venous and arterial CO$_2$ is approximately equal (PaCO$_2$ < PvCO$_2$ by ~ 5 mmHg), either a venous or arterial CO$_2$ can give an indication of the ventilatory capacity of a patient with upper or lower airway obstruction. A venous CO$_2$ > 55 mmHg or an arterial CO$_2$ > 50 mmHg suggests that carbon dioxide exchange is significantly altered and intervention with intubation (for upper airway obstruction) or bronchodilators (for lower airway obstruction) are emergently needed. A venous or arterial CO$_2$ > 60 mmHg will cause cerebral vasodilation and ultimately result in elevated intracranial pressure causing altered mentation and possibly brain herniation and death of untreated.

**DIFFERENTIAL DIAGNOSES AND TREATMENT OF AIRWAY OBSTRUCTION**

The initial treatment of every dog or cat with respiratory distress is the same regardless of the underlying cause. However, once the location of the airway obstruction is identified, differential diagnoses can be narrowed down and more specific treatment can be provided.

**Obstruction of the Upper Airways**

**Characteristics:** If the obstruction is complete, there is a total absence of airway sounds and intense effort is needed to breathe. If the obstruction is partial, breathing still requires intense effort but loud respiratory noises (i.e., stridor or stertor) are common. Patients almost always breathe with their mouths open and inspiration is generally prolonged. Affected dogs commonly present in respiratory distress after exercise or during hot/humid weather. A common concurrent finding is an elevated rectal temperature, because panting becomes a less efficient form of thermoregulation.

**Differential diagnoses:** Brachycephalic syndrome; mass/foreign body in the pharynx, larynx, or trachea; laryngeal edema; laryngeal paralysis; laryngeal collapse; tracheal collapse; nasopharyngeal polyps (cats)

**Specific treatments:** Sedation is highly effective for dogs and cats with upper airway obstructions as sedation relieves anxiety and improves breathing. In addition to butorphanol, acepromazine (0.01-0.02 mg/kg IV or IM) can be helpful. If relief of the distress is not provided by sedation, induction and rapid endotracheal intubation or emergent tracheotomy might be required. Examine the oropharynx and larynx for the presence of foreign bodies or masses and, if intubation is performed, be sure to evaluate the laryngeal function. It is very important to monitor and control hyperthermia and provide active cooling (i.e., cool water/towels, fans, ice packs, IV
fluids) if needed. The administration of corticosteroids (dexamethasone 0.1-0.15 mg/kg IV) can also effectively decrease upper airway inflammation.

**Obstruction of the Lower Airways**

**Characteristics:** These patients typically present with a history of coughing or allergies and exhibit a prolonged expiratory phase of breathing. During auscultation, wheezes might be heard due to bronchoconstriction. Once performed, thoracic radiographs will reveal a bronchial pattern characterized by “doughnuts”, “railway tracks”, or “tram lines”.

**Differential diagnoses:** Asthma (most common); bronchitis; foreign bodies; neoplasia

**Specific treatments:** The stress of handling a patient (especially cats) with asthma will often cause decompensation. Sedation and oxygen are highly effective in providing initial relief from respiratory distress. The main objective is then to enable bronchodilation using inhalant or injectable medications. Salbutamol (inhalant) can be provided using a meter-dose inhaler (MDI) and pediatric mask and given as often as 1-2 puffs every 30-60 minutes during the initial crisis. Injectable bronchodilators include aminophylline (5-10 mg/kg IV slowly, every 12-24 hours) and terbutaline (0.01-0.05 mg/kg IV, IM, SQ every 4-12 hours). Corticosteroids are often very effective in reducing inflammation due to airway inflammation (dexamethasone 0.1-0.15 mg/kg IV, IM or prednisone 1 mg/kg PO every 24 hours).