Respiratory emergencies - Helping our patients catch their breath

Julie Antonellis, LVT, VTS (ECC)
Technician Supervisor
Animal Emergency Critical Care
A Life Centre Partner Practice

Objective:
No matter how long folks have been working in the veterinary field, the one emergency that makes everyone anxious is the respiratory emergency. It can be very difficult to find the balance in treating our patients and not harming them in the process. Watching a patient struggle with one of the basic bodily functions necessary for survival can be extremely difficult for the veterinary team. This lecture will address many of the concerns we all face when handling dyspneic patients and provide useful tips on ways to ease the process. Attendees will learn the importance of recognizing different breathing patterns and how they can be used to aid in the diagnosis of their patients. They will gain an understanding of some of the more common respiratory emergencies we see in emergency medicine and how they are treated. Attendees will learn the value of diligent nursing care in these patients as well as advanced procedures that technicians can perform to help them. This lecture will briefly touch on one of the more advanced therapies available for treating severe respiratory emergencies, critical care ventilation. Real life cases will be used to bring the information discussed together in a very practical way.

Defining terms
- **Hypoxia**
  - Hypoxia refers to a condition in which the whole body or a region of the body is deprived of adequate oxygen supply
- **Hypoxemia**
  - Hypoxemia refers to a decrease in the amount of oxygen dissolved in the blood
  - Think emia - blood
- **Hypocapnia**
  - Lower than normal levels of carbon dioxide in the blood, associated with hyperventilation
- **Hypercapnia**
  - Higher than normal levels of carbon dioxide in the blood, associated with hypoventilation
- **SpO2**
  - The non-invasive measurement of peripheral capillary oxygen saturation we
obtain when using pulse oximetry
  ○ Reflects the percent of hemoglobin binding sites in the blood stream occupied by oxygen

● PaO2
  ○ Allows us to determine how well a patient’s blood is oxygenated
  ○ Measurement of the partial pressure of oxygen dissolved in plasma
  ○ Does not indicate total body oxygen content
  ○ Indicates how much oxygen is available in the alveoli that can be dissolved into the blood

● SaO2
  ○ The percent of oxygen bound to hemoglobin in the blood
  ○ Measured invasively using an arterial sample on a co-oximeter
  ○ Can be extrapolated using the PaO2 value

Let’s talk cyanosis
● Blue to purple color of tissues caused by an increased amount of deoxygenated hemoglobin or a reduced amount of hemoglobin in the tissues
● Is either central or peripheral
  ○ Central cyanosis indicates respiratory disease
  ○ Peripheral cyanosis indicates increased amount of deoxygenated hemoglobin to a specific area of the body, usually due to decreased blood flow
● Indicates severe hypoxia
● Cyanosis occurs when a patient with a normal packed cell volume (PCV) has an SaO2 of 73-78% or a PaO2 of 39-44 mm Hg.
● Anemic animals must have much lower SaO2 for cyanosis to be seen

Handling the dyspneic patient
● Dyspneic patients are fragile
  ○ Any stress can cause decompensation which could lead to respiratory arrest
  ○ Stress from diagnostic testing should be minimized
  ○ Cats can compensate with lower PaO2 in a non-stressful environment. As soon as something happens to disturb their equilibrium they can decompensate rapidly.
● Minimal stress in restraint
  ○ Practice toweling techniques for cats
  ○ Do not hold mouth closed
  ○ Consider use of e-collar so head can move more frequently but you still have a barrier of protection
  ○ Consider sedation if patient is panicked and unable to be handled safely
    ■ Be prepared to intubate if necessary
• Flow by oxygen or oxygen via oxygen cage should be administered
• May need to perform treatments or obtain diagnostics in stages
• Form a game plan with your support staff to allow you to work efficiently and smoothly
  ○ Explain what you want to accomplish and what you feel the best method to use is
  ○ Discuss you have of the patient with your team and how you think the patient will respond to what you need to do
  ○ Let them know what to look for to tell you the patient has had enough
  ○ Listen to their concerns

Initial Stabilization
• Administer oxygen supplementation
  ○ Will increase dissolved oxygen in the blood
  ○ Will increase oxygen saturation of hemoglobin
• Make sure airway is patent
  ○ Observe for evidence of airway obstruction
  ○ If unable to improve tissue oxygenation with oxygen supplementation consider immediate sedation, intubation and ventilation
• Intravenous catheter if possible for the administration of emergency medications
• Pain medication if indicated
• Sedation for those animals who are panicked and thus exacerbating their condition
• Induction and intubation for animals in severe distress when concerned they may go into respiratory failure
• Prepare for chest tap if pleural effusion or pneumothorax are suspected

Breathing patterns
• Normal
  ○ Relies almost completely on the diaphragm with minimal aid from some of the intercostal muscles
  ○ Almost undetectable
  ○ Expiration is passive and occurs without muscular assistance
• Inspiratory effort
  ○ Clinical signs
    ■ Noisy
    ■ Deep breaths
    ■ Slow respiratory rate
    ■ Open-mouth breathing
    ■ Flared nostrils
    ■ Neck and head extended
    ■ Sucking in noted at the thoracic inlet
• Commissures of the lips pulled back
  ○ Possible causes
    ■ Typically upper airway disease
      ● Obstructed nares
      ● Elongated soft palate
      ● Laryngeal paralysis
      ● Pharyngeal or laryngeal edema
      ● Airway obstruction

• Expiratory effort
  ○ Clinical signs
    ■ Wheezing
    ■ Deep breaths with active abdominal component
    ■ Normal or slow respiratory rate
  ○ Possible causes
    ■ Lower airway disease
      ● Pulmonary parenchymal disease
      ● Asthma
      ● Bronchial abnormalities or inflammation

• Paradoxical breathing
  ○ A portion of the chest wall or the entire chest wall moves inward during inhalation rather than expanding outward. The abdomen may appear to increase in volume at the same time due to the displacement of the abdominal contents by the contraction of the caudal ribs.
  ○ Possible causes
    ■ Flail chest
    ■ Pleural space disease
      ● Pleural effusion
      ● Pneumothorax

Advanced procedures
• Nasal oxygen catheter placement
  ○ Benefits
    ■ Allows you to effectively administer oxygen to your patients
    ■ Supplies needed are readily accessible at most veterinary clinics
    ■ Inexpensive
    ■ Usually well tolerated
    ■ Allows you to access the patient easily while they are receiving oxygen
  ○ Possible complications
    ■ High flow rates can cause trauma to the nasopharyngeal mucosa
- Gastric distention
- Epistaxis

○ Supplies needed
  - Red rubber catheter or other feeding tube
  - Nonabsorbable suture with 22g or 25g needle
  - Numbing and lubricating solutions
    - Tetracaine hydrochloride ophthalmic solution 0.5%
    - Viscous lidocaine 2%
    - Lidocaine 2.5% and Prilocaine 2.5% cream
  - Oxygen line
  - Adapter to fit catheter to oxygen line
  - Oxygen source
  - Flow meter
  - Humidifier to attach to flowmeter

● Nasotracheal oxygen catheter placement
  ○ Benefits
    - Beneficial for patients with upper airway disease or tracheal collapse
    - Can achieve high FiO2 with very low flow rate
    - Inexpensive
    - Allows you to access the patient easily while they are receiving oxygen
  ○ Possible complications
    - May not be tolerated as well as nasal oxygen catheter
    - May irritate the patient’s trachea causing them to cough
    - Patient is unable to eat or drink due to risk of aspiration
    - Patient usually requires sedation for placement
  ○ Supplies needed
    - Red rubber catheter or other feeding tube
    - Nonabsorbable suture with 22g or 25g needle
    - Numbing and lubricating solutions
      - Tetracaine hydrochloride ophthalmic solution 0.5%
      - Viscous lidocaine 2%
      - Lidocaine 2.5% and Prilocaine 2.5% cream
    - Laryngoscope
    - Forceps or hemostats to guide catheter down the trachea
    - Oxygen line
    - Adapter to fit catheter to oxygen line
    - Oxygen source
    - Flow meter
    - Humidifier to attach to flowmeter
Nursing care

- Maintain a stress free environment
- Encourage sternal recumbency to allow for best chest excursion
- Monitor patient temperature and adjust environmental temperature accordingly
- Humidified oxygen
- Encourage movement for patients with pneumonia
- Allow for eliminations
  - Walk on oxygen if able
- Make sure readings from monitors match what your patient looks like clinically
- Frequently reassess patient status even if just observation from afar
- Communicate concerns or changes to clinician
- Provide extra comforts to encourage rest
  - Dog or cat beds
  - Extra padding
  - Pillows or rolled blankets to rest head on

Critical care ventilation

- When should we ventilate?
  - Severe hypoxemia despite therapy
  - Severe hypoventilation despite therapy
  - Excessive respiratory effort with concern that the patient will fatigue and go into respiratory failure
  - Severe respiratory distress that is causing panic in your patient
- What is the benefit to our patients?
  - Normalizing oxygenation
  - Normalizing CO2 levels
  - Prevention of respiratory failure
  - Allowing damaged lungs the time they need to heal without having the patient struggle to breath
- Possible complications?
  - Cardiovascular compromise due to impaired venous return due to positive pressures in the chest
    - Positive intrathoracic pressures created by the ventilator collapse the caudal vena cava
  - Upper airway complications
    - Sinusitis
    - Pharyngitis
    - Tracheal necrosis
    - Airway occlusion from mucous or blood
  - Lower airway complications
- Pneumothorax from overinflation
- Ventilation-acquired pneumonia

○ Renal complications
  - Decreased glomerular filtration rate
  - Decreased urine output
  - Water and sodium retention
References


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