Monthly Update
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Oxygen Therapy in Respiratory Distress

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Respiratory distress represents a true and sometimes frightening emergency to be faced with as a veterinarian. Given that respiratory disease is the number one cause of cardiopulmonary arrest in veterinary medicine, it also represents a time when the correct actions can save lives. Patients can present with respiratory distress caused from upper airway disease, lower airway disease, pulmonary parenchymal disease, or pleural space disease. Clinical signs may include weakness, tachypnea, open mouth breathing, coughing, orthopnea, and increased respiratory effort. They may also include anorexia, weakness, decreased mentation, vomiting, and gagging/retching.


Figure 1: Cat in respiratory distress.

When faced with a patient in respiratory distress, it is important to avoid stressing the patient. Stress naturally causes an increased oxygen demand in the body. A patient with respiratory distress may not have any reserve to meet the increased demand and this can rapidly lead to cardiopulmonary arrest. Clinically, this means that diagnostics such as radiographs and bloodwork may have to be delayed until the patient is more stable. Priority should be given to providing oxygen and lifesaving procedures to these patients.

Providing oxygen increases the patient's percentage of inspired oxygen (FiO_2). The goal of increasing the FiO_2 is to both increase the patient's arterial oxygen content (PaO_2) thus correcting hypoxemia and to decrease the work of breathing for that patient. For example, if a patient is taking 80 breaths per minute on room air to maintain its PaO_2, providing them an increased FiO_2 may decrease their respiratory rate 50 breaths per minute. Thus, we have decreased that patient's work of breathing. This makes the patient less likely to have respiratory arrest from respiratory muscle fatigue. An oxygen saturation (pulse oximeter reading or arterial blood gas SpO_2) of less than 95% warrants oxygen therapy. This correlates with a PaO2 of 80 mmHg. Oxygenation below this point is defined as hypoxemia. Clinically, there are several ways to provide patients with oxygen. Table 1 (attached) highlights these methods. As a point of reference, room air has an FiO_2 of 21%.

Flow By Oxygen

Flow by is often the first oxygen supplementation given to patients. The FiO_2 provided by flow by depends on the flow rate and how far the tube is from the patient's nose or mouth. The FiO_2 provided by this method can be increased by using a face mask to concentrate the oxygen as demonstrated above. It is important to not use a tight fitting mask as that will prevent proper elimination of CO_2. Flow rates of 5-6 L/min are recommended to achieve higher FiO_2.

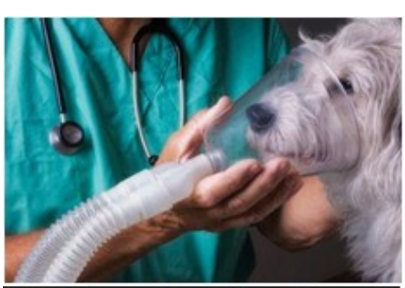
Figure 2: Oxygen face mask.

Continued next page

CT Scan Diagnostic

CCVS CT Scan Hours:

8:00 AM-6:00PM 7 days a week. 1-800-457-4900

The breakdown of CT charges are as follows:

1. CT Scan, In patient $905.00 (case already hospitalized at CCVS or referred to CCVS for work up and treatment and has a CT scan)
2. CT Scan, Additional image (if you add an additional scan site $300.00)
3. CT Scan, Out patient $985.00 **(case sent to CCVS exclusively for a CT; this includes charges for doctor overseeing case, IV catheter, and fluids post CT).
4. CT "Met Check" $590.00
5. CT STAT fee, $50.00 (on top of whatever you are doing).

These charges cover the CT, the contrast, radiologists read, rapid infuser, sevo anesthesia, and technician fee if we need to call someone in for the CT. It does not cover injectable drugs, if needed for IV anesthesia; estimated additional cost $50.00-$75.00.

A 3-D Reconstruction CT Image of this cat's heart with a vascular anomaly. 3-D reconstruction capability with a CT is very advantageous for preoperative planning. It can be done for either soft tissue or orthopedic surgery. It is especially helpful for pelvic canal masses, fracture repair, vascular surgery as seen here, or in liver shunts, to name a few of the applications. **See CT scans attached.**

Business Tip

VPG continues to provide BIG SAVINGS in Merck Animal Health Products.

Read more attached.

Oxygen Cage


Figure 3: Commercially available oxygen cage.

Commercially available oxygen cages can be an easy way to supply patients with oxygen. They are generally well tolerated and can provide increased FiO_2. In order to provide the patient with the elevated FiO_2, the cage has to be a sealed chamber. Commercially available units, pictured above, provide control of humidity and carbon dioxide elimination. It is not advisable to place a plexiglass door onto a kennel to fashion an oxygen cage as this has no means of controlling these factors. Without that control, ventilation can be severely affected as the patient begins to rebreathe CO_2 and the patient will be at risk of overheating. The major downside to this type of oxygen supplementation is that every time the cage door is opened to access the patient, the FiO_2 concentration is decreased. Given this, patient access may be limited in severely dyspneic patients and as these are the sicker patients, patient access is very important.

Oxygen Hood

The oxygen hood can provide a high FiO_2, can be easy to use, and is well tolerated by patients. There are hoods that are commercially available. They resemble an Elizabethan collar that is worn around the neck and have a clear plastic cover that zips to form a seal. A portion of the cover must remain open to prevent buildup and resultant rebreathing of CO_2. When using an oxygen collar, care must be taken to ensure that the patient does not overheat as the hoods can become very humid. An oxygen collar works with the same concept as an oxygen hood and can be built with materials from around the clinic. An oversized Elizabethan collar is covered with plastic wrap from the top of the Elizabethan collar. A gap of approximately 2 inches is left open on the ventral aspect of the collar. An oxygen tubing line is fed into the bottom of the Elizabethan collar and secured there with tape. To help control the humidity build up in the cone, an oxygen flow rate of 1L/20lbs is recommended.

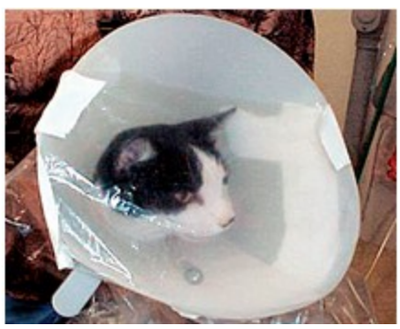

Figure 4: On top is a commercially available oxygen hood. Pictured below is an oxygen collar. It is important to note that the opening in the plastic wrap should be at the ventral aspect of the oxygen collar (NOT as depicted in this image) as oxygen will rise and CO2 falls. Thus, the opening at the bottom portion of the collar will more efficiently prevent CO2 buildup in the system.

Nasal Cannulas

Nasal cannulas are easily placed and a well-tolerated way to provide a patient with supplemental oxygen. They do not involve specialized equipment. They have the added benefit of being an open system so that CO_2 buildup is not an issue. The patient can remain mobile and very accessible for treatment while receiving oxygen support with nasal cannulas.

Continuing Education Opportunities

All our lectures provide 2 hours of Continuing Education Credits. You can register online through our websites, Boston Veterinary Specialists (www.bostonvetspecialists.com) and Cape Cod Veterinary Specialists (www.capecodvetspecialists.com). A meal is provided during each lecture. Your technicians are welcome as well.

June 2014 (date TBD)
Dr. Catherine Briere: *"Surgery on the Head"*

Supplies:
- Oxygen source
- Red rubber tubing
- Lubricating jelly
- Nonabsorbable suture
- Proparacaine drops

Figure 5: Supplies needed for nasal cannula placement. As a rule of thumb: for small pets, use a 3.5-5 fr red rubber tube, for medium pets use 5-8fr red rubber, and for large pets use an 8-10 fr red rubber tube.

Placement of nasal cannulas:
1. Numb nares with several drops of Proparacaine or 2% lidocaine.
2. Measure tube to the medial or lateral canthus of the eye and mark tube with marker.
3. Lubricate and feed tube into the ventral nasal meatus by entering the nares and guiding at a slightly ventral and medial direction. The tube should pass without resistance. If resistance is met, remove the tube and start over.
4. Feed the tube to the level of the mark you made in step 2.
5. Secure the tube to the nares with a finger trap suture of nonabsobable suture.
6. Secure the tube to the side or top of head with a butterfly tape and either single interrupted suture or skin staples.

Figure 6. Fingertrap suture securing nasal cannula.

Oxygen Flow Rates for bilateral nasal cannulas to achieve FiO_2 of 60-80%:
- Small Dogs
  - 0.25-0.5 L/min for 5lb dog
  - 0.5-1L/min for 10lb dog
- Medium Dogs
  - 1-2 L/min for 20lb dog
  - 2-4 L/min for 40lb dog
- Large Dogs
  - 3-5 L/min for 60lb dog
  - 4-8L/min for 80lb dog

IMPORTANT: 60-80% oxygen can only be used 24 hours to avoid oxygen toxicity!!!
Lower oxygen rates (safe for >24 hours) can be achieved by lowering the flow rate.

Nasal cannulas can easily be connected to centralized oxygen systems or to an anesthetic machine to provide oxygen flow. The adaptor from the end of an endotracheal tube will connect the red rubber to the anesthetic machine. A size 6 endotracheal tube connector is the appropriate connector for an 8fr red rubber tube. If you have centralized oxygen in your practice, the red rubber tube can be connected to the oxygen with a large christmas tree adaptor and a trimmed red rubber. Nasal cannulas can be placed unilaterally or bilaterally. An FiO2 of 30-70% (depending on flow rate from 20ml/min/lb - 90ml/min/lb) can be achieved with a unilateral cannula.

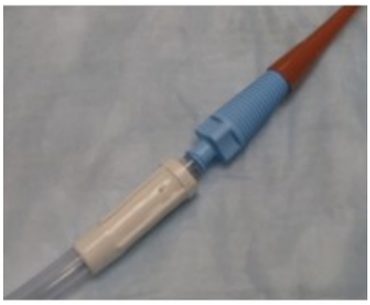

Figure 7: Connecting nasal cannulas to oxygen sources. Left: an endotracheal tube connector is used to connect the red rubber to an anesthetic machine. Right: a trimmed 1mL syringe and large Christmas tree adaptor are used to connect the red rubber to centralized oxygen.

Transtracheal Catheter
Transtracheal catheters are useful in upper airway obstruction when the patient cannot be intubated. They can provide the patient with lifesaving oxygen until another solution, such as possible obstruction removal or temporary tracheostomy can be performed. Transtracheal catheters are a generally temporary means to provide oxygen as they can be easily dislodged and placement is similar to a transtracheal wash. As you are providing oxygen directly into the trachea, a high FiO2 of 60-80% can be achieved with a low flow rate of 1-2 L/min of oxygen.

Placement of transtracheal catheter:
1. Clip and surgically prep the ventral neck.
2. Isolate the trachea.
3. Sterilely pass an IV catheter or hypodermic needle into the trachea.
4. Using an IV extension set, connect the transtracheal catheter to an oxygen source.

Providing oxygen supplementation is a vital, lifesaving treatment in veterinary patients. Hypoxemia and respiratory fatigue can easily lead to cardiopulmonary arrest if left untreated. The methods of oxygen support outlined above can be implemented in any setting to assist assessment, stabilization and treatment of patients with respiratory disease.

It is with great sadness that we issue this newsletter as it represents the final publication of Dr. Kimberly Bebar. It was written in the days prior to her death in an automobile accident on March 11, 2014. Kim was a gifted teacher and this newsletter serves as a perfect example of her ability to take something we all take for granted, break it down to its pathophysiologic source and relay it back to us in a way that is accessible for everyone. In her senselessly short life, she made a mark on veterinary medicine through her teaching of technicians, externs, junior residents and veterinary general practitioners. CCVS wishes to thank Kim for all that she taught us.

Dr. Kimberly Bebar, DVM
Third Year Resident, Emergency Critical Care, CCVS

Tech Tip

Editors Note: This is an abridged version of a paper given at the ACVS Symposium 2013 Veterinary Technicians Program. We have many years of experience with surgical lasers. Recently medical lasers have become more widely used in general veterinary practices. The LASER acronym can be confusing because there are many types of lasers used in general industry and medicine. This article gives a quick review the types, uses, and safety precautions of the lasers currently used in veterinary medicine.

LASER SAFETY, USE, AND MAINTENANCE
Danielle Browning LVMT, VTS (surgery) UT VMC Knoxville, TN

Lasers are known to some as the "Standard of Care" in veterinary medicine. They can be utilized for both their therapeutic (healing) and surgical (cutting /coagulation) capabilities. Laser, which is an acronym for Light Amplified by Stimulated Emission of Radiation is: "any device which can be made to produce or amplify electromagnetic radiation in the wavelength from 180nm to 1mm."
Lasers are divided into 4 categories and classified according to their potential to cause damage to biological tissues.

Class I cannot cause biological tissue damage under normal operating conditions, examples are CD players and laser printers.

Class II lasers have a visible range of light and have the potential to cause optical damage if viewed directly for long periods, such as a bar code scanner.

Class III lasers are divided into two subcategories: IIIa which have 1-5mW of radiant power and are not hazardous if viewed briefly by the unprotected eye, such as a laser pointer. Class IIIb have 5-500mW of radiant power and will create optical damage if viewed directly, many low level laser therapy units are Class IIIb.

Class IV lasers have an output range if > 500mW and direct exposure to the beam or one reflected off a surface, such as a stainless steel table or reflective jewelry, will cause injury to the eye. Medical lasers are typically classified as class IIIb or class IV lasers.

LASER SURGICAL UNITS: Laser surgery can decrease inflammation, provide hemostasis, and reduce pain. The CO2 laser was the first and still is the most widely used laser in veterinary medicine for general surgery. The CO2 far-infrared wavelength (10,600nm) is only superficially absorbed into the tissue (0.2µm). The energy is absorbed by water in the tissues. The CO2 laser has an articulating arm that is attached to a hand piece. There are a variety of tips available, cutting occurs from a smaller, more focused tip, and the diffused tip will provide better coagulation. Char may accumulate on the tips during use, this is easily removed using a saline soaked surgical sponge.

THERAPEUTIC LASERS: Therapeutic lasers do not cut through the tissues like surgical lasers since the energy is distributed over a broader surface area. Photobiomodulation therapy and photosimulation therapy are terms used to describe the use of lasers in wound healing. Laser can be used to provide analgesia, reduce inflammation, enhance tissue repair, or as an alternative to acupuncture therapy. They are reported to enhance leukocyte infiltration, increase macrophage activity, promote neovascularization, increase proliferation of fibroblast and keratinocytes, promote early epithelialization, increase the concentration of growth factors, and increase the tensile strength. The diode laser is most commonly used therapeutic laser and may be used along with conventional wound management techniques to help accelerate healing.

PROPER TRAINING: Proper training is essential before operating any class IIIb or class IV laser. Every facility should designate a "Laser Safety Officer" to ensure that the staff is adequately trained and SOP (Standard Operating Procedures) are created. It is recommended by the ANSI that the SOP are laminated and placed with each operating laser unit.

LASER SAFETY, SURGICAL UNITS: Laser safety is paramount and should NEVER be ignored. Damage can be a result of the laser's output energy or power, wavelength of the energy produced, duration of the exposure beam, and the cross-sectional area of beam at the point of interest. The cornea, lens and the vitreous cavity are most at risk of damage from both visible and near-infrared radiation. The collimated beam of a laser light makes optical damage more of a risk than with an ordinary light. It is IMPERATIVE to wear eye protection that meets ANSI standards, and is comfortable to the operator. Optical density is the degree of eye protection needed for use of a particular laser wavelength. The CO2 laser is almost entirely absorbed at the corneal surface of the eye, reducing the risk to the retina. Most traditional eyeglasses and plastics offer effective eye protection from the CO2 laser. According a study by Sliney et al. J Laser Application 1992, it was demonstrated that "clear, 2.4mm-thick polycarbonate lenses was an effective eye protector, and was no penetration until the beam irradiance exceeded 100W/cm2 when using the CO2 laser." Inhaling the smoke resulting from vaporized tissue is not advised and local exhaust units should be utilized. Fire is another risk associated with laser use. Alcohol should NEVER be used to prep a feline onychectomies when using the laser. During general surgery aseptic skin preparation, be sure to let the area dry for at least 3 minutes if alcohol has been used. Endotracheal fires have been reported and are easily avoided when the proper precautions are taken. When using combustible anesthetic gases, and/or 100% oxygen during oral surgery, such as a staphylectomy, ensure a tight seal of the endotracheal cuff and pack moistened gauze around endotracheal tube. Do not use electrocautery with a CO2 laser. Laser calibration should be performed before each procedure. Read manufacturers' instructions for calibration instructions, maintenance schedules and troubleshooting.

LASER SAFETY, MEDICAL UNITS: Fire, explosions are not however the case for medical lasers, such as the diode (670-950nm). Low power laser will damage the retina. Eye protection is mandatory for the patient, therapist, and any people within five feet of an operating therapeutic laser. There is minimal risk to the skin, and with common sense and proper use, the risk is virtually non-existent.

To avoid accidental exposure to the laser beam, clearly post warning signs at the entrance of the treatment area when therapy is in session. Warning signs MUST contain the words DANGER or CAUTION, have a red sunburst beam, and indicate which class and type of laser being used (see Fig 1.1 below). Treatment areas should be free from clutter and have a door that remains shut during treatments.

Organizations /LASER training
ANSI - American National Standards Institute

Z163.1 document "Safe Use of Lasers" first published 1973, "...in Health Care Facilities" published 1988. In 2005 ANSI added language to
include veterinarians.

OSHA-Occupational Safety and Health Administration
ASLMS - The American Society for Lasers on Medicine and Surgery LIA - Laser Institute of America

Fig:1.1 from www.ehs.washington.edu