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Small Animal Emergency Medicine Case Challenges for Advanced Practitioners Mini Series

Session 2: Dealing with respiratory emergencies

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Approach to respiratory distress:

Dyspnoea is a common presentation in small animal practice. It is a great idea to be prepared and a small little thing that could make dealing with these cases so much more less stressful is the availability of a crash cart. The cart should be mobile and contain all the things you need to deal with any urgent patient. This is a nice “blue peter” project if you don’t have one yet. Get a toolbox with loads of drawers and label them. A laminated A4 sheet with all the drug dosages according to body weight should be clearly visible attached to it (Free to download from www.acvecc-recover.org). You can cut out foam to put into the drawers to place items into the crash cart, this makes it easier to spot if anybody “accidentally borrowed” any item and after each use, the supply is fully restocked. There should be all items readily available for intubation (endotracheal tubes, laryngoscope, etc.), syringes with needles readily attached, drugs, etc. Also a long urinary catheter for the application of drugs intratracheally (just in case). Rarely, a “slash tracheostomy” is needed, but a small surgical kit should be stocked, also for open chest CPR. An alternative of supplementing oxygen directly into the trachea is a needle and syringe shell, which can be hooked up to oxygen if necessary, until you are ready for an additional procedure or other means of oxygen supplementation (discussed later).

The arrival of a dyspnoeic patient should be discussed at staff training sessions, it involves the entire veterinary team, including the receptionists, who often will be able to spot the patient that should be brought directly through to the treatment area, e.g. the open mouth breathing cat. Triaging, like always, has to be done in a very quick fashion => Is there a patent airway? Is the patient breathing (efficiently)? Is there any evidence of circulation? If any of the above questions is a “No”, CPR needs to be started. If the patient is stable enough to undergo a “major body system assessment”, then proceed to this, otherwise it is normally a good idea to think about oxygen supplementation.

Generally, dyspnoeic patients are already in a high sympathetic drive state, so we try to minimise additional stress if possible. This could mean that against all our intuition a prolonged “hands-on” approach might not be suitable. Immediate transfer into an oxygen-rich environment (incubator, oxygen tent, etc.) might decrease stress for the patient and additionally gives us the opportunity to observe the patient. If the patient is obstructing (upper respiratory noise, audible without stethoscope!), immediate action might be necessary. As a general rule, if the respiratory rate is within normal range and you don’t hear any sound, severe disease is unlikely. There are exceptions though and no matter what the respiratory rate is, if the breathing pattern is erratic, irregular or the patient is using severe effort, significant central disease is possible. Now look at the effort, is it expiratory or inspiratory? Some vets find it difficult to determine what kind of effort the patient is exhibiting, then mimicking the patients breathing might help to make a judgement, so try to imitate the patients breathing efforts and try to determine if the main effort is during the inspiratory or the expiratory phase. Also, is the pattern shallow or paradoxical? The nomenclature to describe a breathing pattern has been used differently in numerous publications and is somewhat confusing at times. Normally, thorax and abdomen expand together during inspiration, but if during inspiration the abdomen is “sucked in”, this would be consistent with a paradoxical breathing pattern and could indicate a ruptured diaphragm, for example. Another “paradoxical” movement of a part of the chest occurs in flail chest, but the pathophysiology is distinct. If more than one rib is fractured in more than one location, this rib segment is moving opposite to the rest of the chest wall, so “goes in” during inspiration (due to the increased negative pressure within the thorax) and out during expiration.

If you hear loud respiratory sounds, the localisation of the problem is most likely within the upper respiratory area. An expiratory effort generally occurs with lower respiratory disease, this can be accompanied by an abdominal push or wheezing (a good example would be severe asthma). If the lung parenchyma is affected, you could expect increased lung sounds; both, inspiratory and expiratory efforts

are possible in this scenario. If pleural space disease is present, you could expect decreased lung sounds/muffled heart sounds and/or a rapid, shallow breathing pattern.

So, as a general approach you would auscultate the thorax if there is no suspicion of an upper respiratory problem/obstruction and determine if the lung sounds are diminished, pointing towards pleural space disease, or increased, pointing towards lung parenchymal disease. Common cause of parenchymal disease after trauma are lung contusions, but obviously you could have concurrent, or in the absence of trauma, exclusive heart disease for example, leading to lung oedema. When I auscultate the thorax it helps me to virtually divide it into a tic-tac-toe grid to make sure, I am listening to all the areas, bilaterally. If you think the gut sounds are especially good to hear in the chest, double check for diaphragmatic rupture!

Thoracic trauma can be life-threatening and blunt versus penetrating trauma needs to be distinguished. It is also helpful to know everything about the trauma, if there is no direct evidence of the main location of the injury (pleural space, mediastinum, parenchymal, etc.). I suspect a pneumothorax in any of my patients that had a road traffic accident, until proven otherwise. An extreme presentation, where timely intervention is even more crucial than usual, is a tension pneumothorax. It develops as a form of penetrating chest injury in which the patient is drawing air into the pleural space with every inspiration, but the air is unable to exit the chest due to the wound acting as a one-way-valve. The lungs are getting increasingly compressed due to the raise in pleural air pressure and the thorax can appear to be barrel shaped as a consequence. Emergency intervention requires quick release of this air from the pleural space and subsequent placement of an thoracic drain. In comparison to a tension pneumothorax, a “conventional” pneumothorax is much more benign, can nevertheless lead to death though, especially if not diagnosed! Thoracocentesis is indicated as soon as you suspect pleural space disease. If you can afford the time and you are worried about centesis, ultrasound can help! For ages, diagnostic imagers have blocked us from putting a probe on the chest, but not anymore! With the arrival of TFAST (discussed later) we are all now able to check for pneumothorax and/or “wet lung”. Nevertheless, even without ultrasound machine, complications of a properly performed thoracocentesis are rare and the benefit of this procedure (nearly always diagnostic and often therapeutic!) when suspicion of pleural space disease has been raised, outweigh the risks by far. (thoracocentesis procedure and placement of a small-bore chest drain using a modified seldinger technique will be demonstrated by video clip during the seminar).

TFAST (Thoracic Focussed Assessment by Sonography after Trauma):

TFAST is a great way to explore the thorax further. The abdominal version (AFAST) has been around for ages and has been readily utilised by practitioners worldwide to look for “free fluid”. TFAST follows the same principle, but also might be able to further confirm you suspicion after clinical examination for pneumothorax or parenchymal disease (“wet lung”). Like AFAST, it is non-invasive and even if you have not had special training, you can pick up the skills very quickly. In a nutshell, TFAST uses three locations, the diaphragmatico-hepatic (DH) view is shared with AFAST. One is located in the area where you would perform a pericardiocentesis (approx. 4-5 intercostal space) and one in the area where you would insert a chest drain (8-9 intercostal space). The normal appearance is the “gliding” of the pleura against the chest wall and if this movement ceases, pneumothorax might be present. If you see “comet-tail” artifacts, the lung tissue might have increased water content, indicating oedema and/or contusion.

(More info and literature including papers to download at www.fastvet.com):

Practical pointers:

- If at all possible, keep the dyspnoeic patient in sternal recumbency (but don't restraint!). Studies found improved oxygenation values in comparison to lateral recumbency (even in healthy patients!).
- If you suspect that a dyspnoeic patient is suffering from upper respiratory tract disease (noise audible without stethoscope) and the character of that sound is changing, become very alert! This change in stridor (normally from lower to high pitched) could indicate increasing/imminent obstruction and most often needs immediate attention. ("Stertor is more a snoring/pharyngeal sound, "stridor" is more an airway sound)
- Remember, inferred noise is possible. If you hear a very loud "thoracic" noise, make sure it is not inferred from an upper respiratory tract problem.
- Thoracocentesis is the bee's knees! A procedure that is therapeutic and diagnostic! Wow! (Although radiographs of severe pneumothoraces are extremely impressive, they should not exist! If you have a suspicion of pleural space disease (diminished lung sounds, breathing pattern, etc.), perform a thoracocentesis BEFORE performing radiographs. Radiographs could decompensate a patient severely!)
- Muffled heart sounds can also occur in a patient with pericardial effusion; check the jugular vein for distention (due to congestion from inappropriate diastolic filling), the ECG for electrical alternans (normal ECG does not exclude pericardial effusion) and/or perform an echocardiogram.
- On auscultation note any arrhythmias also. As lungs can be contused, so can the myocardium. Myocardial contusions can sneak up on you (like pulmonary contusions!), so monitor for them after trauma (continuous ECG).
- If history of trauma is uncertain, check the ear canals for bleeding (or clear fluid=>skull fracture/CSF!), anisocoria, scuffed nails and search for any other evidence of trauma (in the absence of a coagulopathy, bruising around the umbilical area could be indicative of a haemoabdomen => Cullen sign).
- Some diaphragmatic ruptures can be difficult to diagnose; you could inject 1-2mls/kg of sterile iodine based contrast diluted 1:1 with saline into the peritoneal space (caudal to umbilicus) to see if there is any communication between thorax and abdomen (and be aware of the "mirror artefact" when using ultrasound. The mirror image is an imposter and can make you think you are seeing a ruptured diaphragm, but you really are not!

Procedures:

Emergency Tracheotomy

This procedure as described is performed to gain control of the airway in an emergency patient that has severe upper airway obstruction and in which intubation is not possible. This procedure uses a modified endotracheal tube rather than a standard tracheostomy tube.

Equipment

- Sandbags or bags of fluids, and towels
- V-stand to assist in positioning in dorsal recumbency
- Electric clippers
- Scalpel handle with #15 or #11 blade
- Large or medium curved haemostats
- Needle holders and thumb forceps
- Allis tissue forceps or Gelpi retractor
- Mayo scissors
- Endotracheal tube one size smaller than you would use to intubate this patient
- 4 metric (USP 0) monofilament nylon on a taper needle
- Sterile gloves
- Gauze bandage roll
- Gauze swabs
- Skin preparation solutions
- Large fenestrated surgical drape

Patient Preparation and Positioning

1. Use electric clippers to do a WIDE clip of the hair on the neck if time permits - leave hair only on the back of the neck if at all. You do NOT want hair tangled up in this tube.
2. Perform an aseptic preparation of the skin if time permits
3. Position the patient in dorsal recumbency – a V-stand will be useful here
4. Use sandbags under the neck to bring the neck up in an arch
5. Tape or tie the front legs down towards abdomen

- In a life-or-death emergency – it is more important to access the airway than to do the perfect skin prep. Use alcohol to wet the hair down if there is no time to clip and prep. Definitive skin preparation can be accomplished after the procedure if necessary.

Surgical Technique

1. Put on sterile gloves
2. Make a 4-6 cm skin incision beginning at the caudal aspect of the larynx. Continue with scalpel down through subcutaneous tissue and platysma (superficial) muscle, until the cervical ‘strap’ muscles can be seen
3. Spread skin with fingers, and place a Gelpi retractor or Allis tissue forceps on each skin edge to pull the incision open
4. Use curved haemostats to begin blunt dissection longitudinally through ‘strap’ muscles - make the first stroke on the midline, to part the muscles.
5. Then continue blunt dissection both longitudinally and transversely, to spread the muscles off of the trachea
6. Once the trachea is visible, use haemostats to continue blunt dissection down beside the trachea, sufficient to get the haemostats partly underneath it and lift it up. Leave the haemostats in place and have an assistant steady them to keep the trachea slightly elevated.
7. Make scalpel incision with 15 or 11 blade (small!) transversely across trachea, between the tracheal rings approximately 2 cm caudal to the larynx.

8. Reverse the scalpel and insert the handle between the tracheal rings as a place-holder. Rotate handle slightly to part the tracheal rings –this will open the airway.
9. Insert the endotracheal tube into the tracheal incision while simultaneously removing the scalpel
10. Connect the patient to an oxygen source
11. Use the nylon suture to place a 4-6 cm stay suture loop around the first tracheal ring on each side of the incision.

Securing the Tube

An endotracheal tube is used here because its length can be customized to each patient and a wide variety of suitable diameters are available in most veterinary clinics.

Once the patient is stable and breathing well, you can take the time to modify the tube and secure it. Make sure that the distal end of the tube reaches no farther than the thoracic inlet, avoiding any chance of bronchial intubation.

Remove the anaesthetic circuit adapter from the endotracheal tube and cut the tube along its length from the proximal end to the point at where it enters the skin, to make two halves

Use the scissors to cut a small hole in the proximal end of each half and thread a length of roll gauze through it.

Tie the lengths of gauze in a bow around the back of the patient's neck.

Inflation of the cuff is optional – it is only really necessary for positive pressure ventilation. The cuff should not be blown up at all unless it is a low pressure, high volume cuff. Tracheal necrosis may occur with prolonged inflation of a low volume, high pressure cuff.

If the tube is being connected to an anaesthetic machine or ventilator, replace the endotracheal tube adaptor in the tube opening and connect to the circuit.

If the tube is being left open, remove the adaptor.

Lay a sterile non-adherent dressing pad around tube site

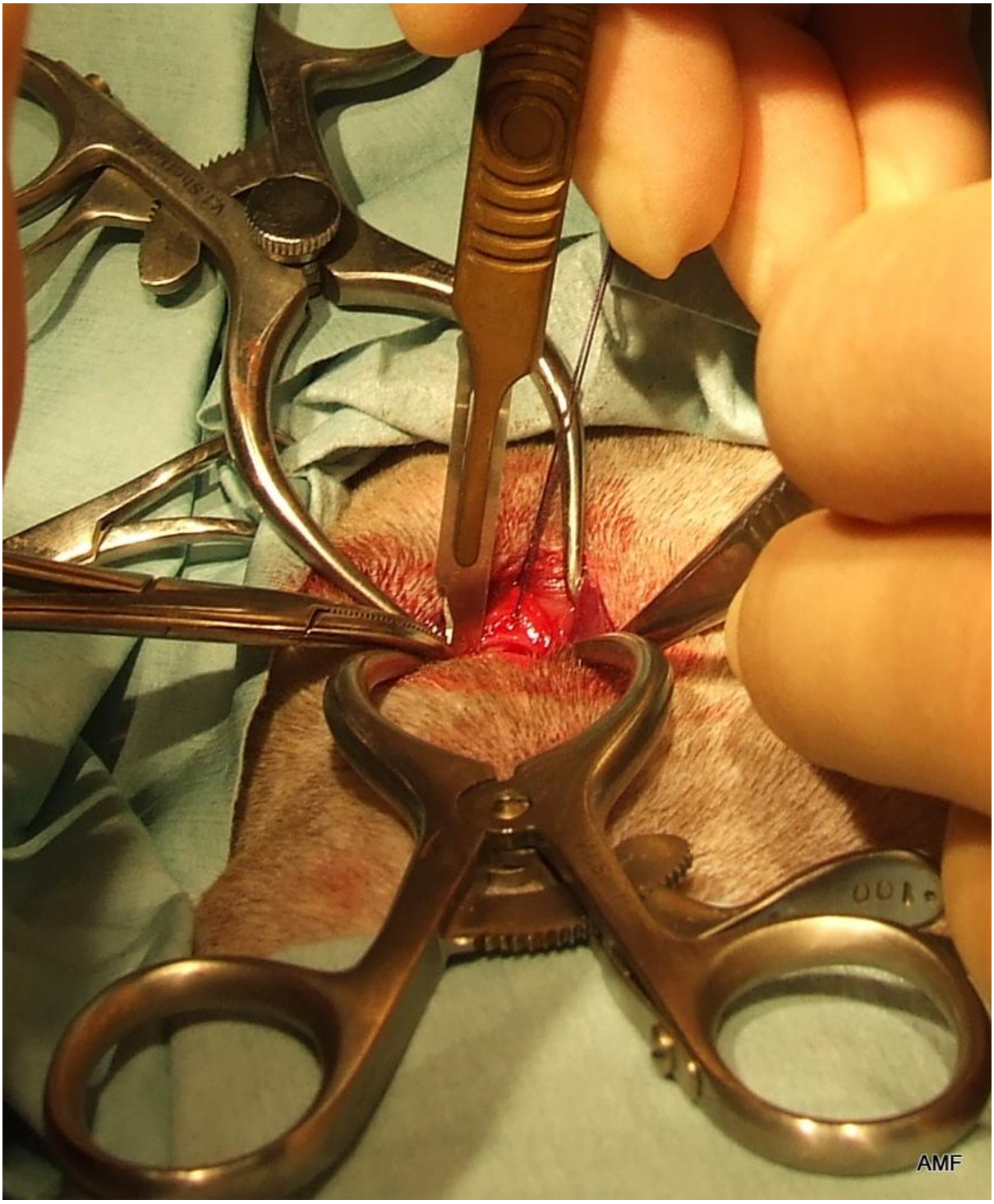
Tie tube in place around back of neck

Finish clipping hair away and re-do the prep

Avoid wrapping the neck in bandages – it is much easier to keep the tracheostomy site clean and dry if it is open to the air.

Do not close the skin incision! When the tracheostomy tube is eventually removed, the incision should be lightly bandaged but left to heal by second intention. Closing the skin incision tightly with sutures can lead to development of a fatal pneumomediastinum. Do not let other vets close the skin incision either, even days later.

Gelpi retractors in place



Scalpel incision

Place stay sutures

Low pressure, high volume cuff

High pressure, low volume cuff

Thoracocentesis:

Equipment list:

- Clippers
- Surgical scrub materials
- Sterile gloves
- Needle:
  - Butterfly needle: typically 21-23 gauge for adult cat or small dog; or
  - Over-the needle intravenous catheter and extension tubing: 14-20 gauge depending on patient size
  - Appropriate needle or catheter size depends on patient size and nature of material to be aspirated
- Sterile 3-way tap or 'centesis valve'
- Syringe: typically 20 mL for cats and small dogs, 60 mL for larger dogs
- Sample pots: sterile EDTA, serum and additive-free containers
- Kidney dish, jug or similar
- Three people (ideally)

Procedure:

1. Allow the patient to stand or to sit in sternal recumbency as preferred, and restrain gently; minimal restraint often works best (see above).
   - Lateral recumbency may be acceptable for pneumothorax

2. Provide flow-by/mask oxygen supplementation (if tolerated)

3. Clip a patch of fur in the 7^{th}-9^{th} intercostal space on both sides of the chest and scrub the area on one side
   - The choice of which side to start with should be guided by auscultation, ultrasonography (or a dorsoventral radiograph if one has been taken).
   - If pneumothorax is suspected, use an area in the dorsal third of the thorax
   - If pleural fluid is suspected, use an area in the ventral third of the thorax
   - If pleural air or fluid has not yet been confirmed, use an area half-way up the thorax

4. Wearing sterile gloves attach the butterfly needle to the 3-way tap or centesis valve and attach the 3-way tap/centesis valve to the syringe. Note that the 3-way tap/centesis valve is therefore located away from the patient. In larger animals an intravenous catheter is attached to extension tubing that is then attached to the 3-way tap/centesis valve.

5. Insert the needle gently but swiftly into the pleural cavity at a right angle to the chest wall and with the bevel facing dorsally; apply gentle suction to the syringe as the needle is inserted:
   - The needle should be inserted just in front of (cranial to) the rib to avoid hitting the intercostal nerves and vessels that lie behind/caudal to each rib.
   - Once in the pleural cavity the needle can be angled caudally or ventrally to lie flat against the thoracic wall thereby keeping the needle away from the lung surface.

6. Continue to aspirate until negative pressure is reached or it feels like the lung is being scratched by the needle.
   - With (pocketed) pleural fluid in particular, it is often necessary to reposition the needle (and sometimes the patient) to remove as much as possible.

7. Record the total volume of air or fluid removed from the pleural cavity; aseptically transfer samples of pleural fluid into the sample pots

8. Aspiration may need to be repeated on the other side of the thorax. This will depend on:
    - Whether the patient has improved adequately after aspiration on the first side
    - Individual patient considerations, e.g.
        - Is residual fluid or air likely to be reabsorbed?
        - Is additional fluid or air likely to form?
        - Are there other thoracic abnormalities (e.g. pulmonary contusions) that would make the patient less able to cope with residual fluid or air?
        - How well did the patient tolerate the procedure on the first side?

Complications:

Clinically significant complications associated with thoracocentesis are rare; it is typically a simple and safe procedure that is potentially life-saving. Reported complications include pneumothorax and haemorrhage from laceration of the intercostal vessels.

Notes:

Excessive manual restraint is contraindicated in all dyspnoeic animals including those in which thoracocentesis is being performed; this is especially the case for cats. Many animals with severe dyspnoea due to pleural space disease will allow thoracocentesis to be performed with minimal manual restraint and without any chemical restraint. It is important to allow the patient to direct the procedure to some extent – work with the patient rather than try and force him/her into submission!

A low dose of a pure opioid (e.g. 0.1 mg/kg morphine) may be administered prior to the procedure both as an anxiolytic and to provide some analgesia. However this delay is not appropriate in patients with very severe dyspnoea or considered to be in imminent danger of death.

Conservative sedation (e.g. 0.3 mg/kg butorphanol ± 0.01 mg/kg acepromazine) may be required to allow thoracocentesis to be performed in one smooth and successful procedure and judicious chemical restraint is safer than excessive manual restraint in all cases. Drugs with potentially significant respiratory or cardiovascular depressive effects at clinical doses must be avoided.

It is generally necessary to remove approximately 10-20 mL/kg or more of air or fluid from the pleural cavity to make a significant difference to an animal's breathing. In animals with multiple causes of respiratory compromise (e.g. concurrent traumatic pneumothorax and pulmonary contusions), it should be noted that removal of smaller volumes of air or fluid may result in clinical improvement as even some increased expansion may be of benefit to already compromised lungs.

<u>Nasal Canula for Oxygen Administration</u>

Equipment List :

- 5-8-10 Fr soft, closed-end tube , 15-25 cm long
- Sterile water-soluble lubricant
- Local anaesthetic
- 2 ml syringe with 19-20 ga needle
- Adhesive tape, 2 pieces of 5cm each
- 20 g hypodermic needle

- 2 pieces of 3 metric (2-0 USP) nylon, 20 cm long
- Superglue
- Marker pen

This procedure can be done on either a conscious or unconscious patient.

Administer topical anaesthesia at least 3 minutes before starting this procedure. Draw up 0.5-1ml of lidocaine (with or without adrenalin) into a 2 ml syringe. Remove the needle from the syringe. Place the tip of the syringe into the patient's nostril and quickly inject the lidocaine into the nostril, so as to aerosolize the anaesthetic. Laryngeal sprays can also be used. No matter what is used, a conscious patient will sneeze and react, so keep your face back to avoid any backsplash.

Place the patient in either sternal or lateral recumbency. Have an assistant hold the head, with a hand behind the head. Measure the length of tube to be inserted from the patient's nose to the lateral canthus of the eye. Using the permanent marker or a piece of adhesive tape, mark the necessary length. Lubricate the tip of the tube with sterile water-soluble jelly. Hold the patient's muzzle firmly in your non-dominant hand, using your thumb to press upward on the nasal planum. Hold the tip of the catheter in your dominant hand, as if you were throwing darts. Aim the catheter at a steep ventro-medial angle, not straight into the nose. Use the angle of the mandible on the opposite side as your aiming point. Flick the catheter in with successive 'throws,' letting go of the catheter quickly after each advance. If the tube will not advance after the first few centimeters, it is caught up in the dorsal meatus. If this happens, pull the tube back to just inside the nares, redirect it more ventrally and advance it again. Advance the tube to its pre-marked position at the level of the patient's lateral canthus, where it will be sitting on top of the soft palate.

Securing the Catheter

There are two different methods of securing the tube, either with superglue or sutures. Superglue is quick and easy but may occasionally cause permanent hair loss. Use with caution in young animals and show animals. Surgical tissue glues are variable in their holding power and must be evaluated on an individual basis. Sutures are more difficult to place in awake patients but cause no hair loss.

(1) Using superglue - Place a tape tab around tube at corner of nares. The first tape tab should be right at the edge of the nares, where the hair starts, not any further back. Dot superglue onto tape - not the patient. Press tape onto dog hair.

(2) Using sutures - Place tape tab around tube at corner of nares. Insert hypodermic needle through tape, skin fold and back through tape on other side of the tube. Run a piece of suture material (monofilament, non-absorbable) through needle. Pull the needle out, leaving the suture material in place. Tie the suture material with a handtie.

Secondary attachment points will need to be made further back along the muzzle. Once the catheter is connected to an oxygen source, use a lightweight adhesive tape to make a tape collar that encircles both the oxygen connection and the patient's neck. A Buster collar should be placed to prevent the patient from pawing at its nose.

Oxygen flow rates of 50-100 ml/kg/min are usual. If you can hear any hissing in the patient's nose, then the flow rates are too high.