Airway Management &Ventilation

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Introduction

- Animals under anesthesia increase the risk of developing airway complications as anesthesia induces a number of abnormal physiologic conditions.
- Most anesthetics obtund or abolish the swallowing reflex, a protective mechanism to prevent accidental inhalation of foreign materials that may be present in the mouth.
- Maintaining a secure airway during perianesthetic period comes as a primary requirement for safe anesthesia and is a fundamental responsibility of the anesthesia provider.
- Failure to do so can result in brain damage and death.
- In some situations, maintaining patent airway can be performed by a simple maneuver such as extending the neck of a patient.
- However, placing a tracheal tube into the trachea, without question, ensures a more secure airway.
- This lecture covers some basic anatomy and physiology of the respiratory system, the necessary devices required to perform endotracheal intubation and techniques of airway management, basic principles of the ventilator, and ways how best to apply such knowledge into clinical practice.) to and out of the body.
  is the total process of oxygen supply and carbon dioxide elimination.
- ***'Ventilation'*** is the movement of gases in and out of the alveoli.

Anatomic and Physiologic considerations

Airways

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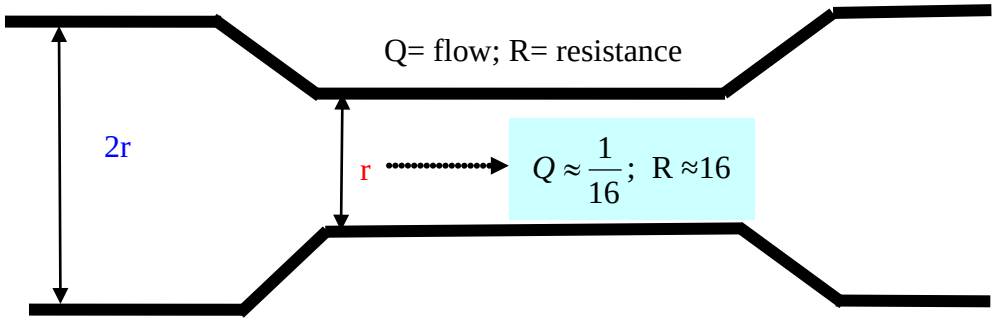
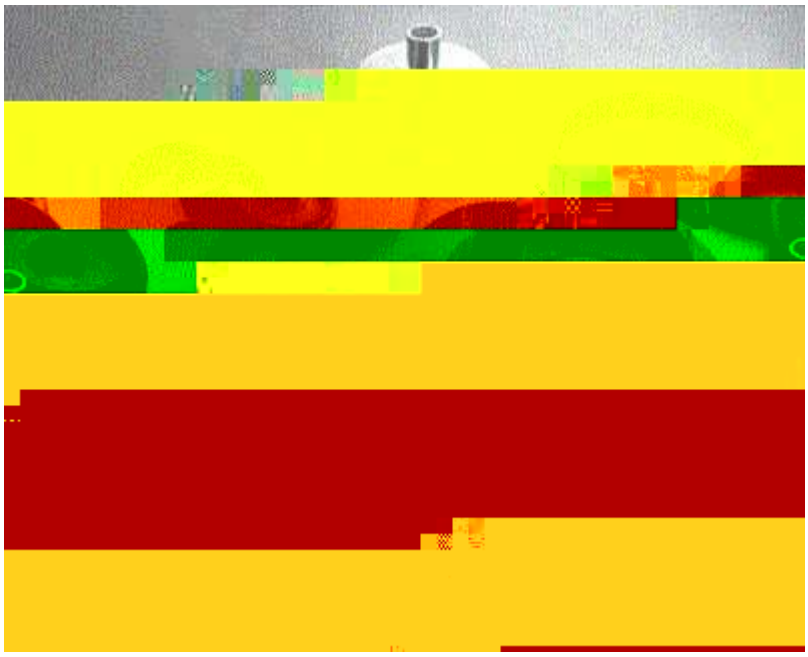
Changes of flow resistance in response to changes of radius



Face masks



- The photo above shows different sizes of masks.
- Clear plastic masks offer advantages of being able to see inside if a patient regurgitates.
- Use the smallest mask that will fit your patient - minimize dead space.
- They provide a means of administering oxygen and inhalant anesthetic, but important to recognize limitations:
  - They do NOT protect the airway from aspiration
  - They do NOT provide a patent airway
  - Limited ability to support ventilation if apnea or hypoventilation occurs

Endotracheal intubation

Endotracheal tubes

- Murphy (most commonly used)
  - Cuffed or uncuffed, hole at the tip (Murphy eye)
  - Murphy eye allows bypass of the air when

Ideal tube size

- Select the largest possible diameter without a danger to damaging larynx or trachea
- Length should be from the tip of the nose to the point of the shoulder (see photo below)
- Too long tube can result in endobronchial intubation and unintentional one lung ventilation
- Excessive tube length extending out of the oral cavity results in increased dead space ventilation (cut to the length if necessary)

Point of shoulder

Intubation techniques

- Direct visualization; dogs, cats, small ruminants, swine, etc. (laryngoscopy useful)
- Digital palpation; cattle (best performed with guide stomach tube)
- Blind; horses (easier than in most species)

Proper cuff inflation

- Overinflation of the endotracheal tube cuff may cause
  - Pressure necrosis of the tracheal epithelium
  - Collapse of the endotracheal tube and airway occlusion (more common with softer silicone type endotracheal tubes)
- To properly inflate the endotracheal tube cuff, the ‘minimal leak method’ should be employed
  - Intubate the patient
  - Administer a positive pressure breath, reaching a peak airway pressure of about 20 cmH_2

    - While administering the positive pressure breath, listen for an airway leak or sniff for trace of anesthetic gas at the level of your patient's mouth
    - If you do not hear any air leaking around the endotracheal tube, do not inflate the cuff
    - If you do hear an air leak around the endotracheal tube, inflate the cuff with a small amount of air (volume is relative to tube size)
    - Repeat the above process just until you no longer can hear a leak or smell anesthetic gas at a peak airway pressure of just under 20 cmH_2O pressure
- You may need to recheck cuff inflation
    - After 15 - 20 minutes of anesthesia - as your patient's anesthetic depth deepens, the laryngeal and tracheal muscles may relax, and an airway leak may develop

Special techniques for endotracheal intubation (difficult airways)

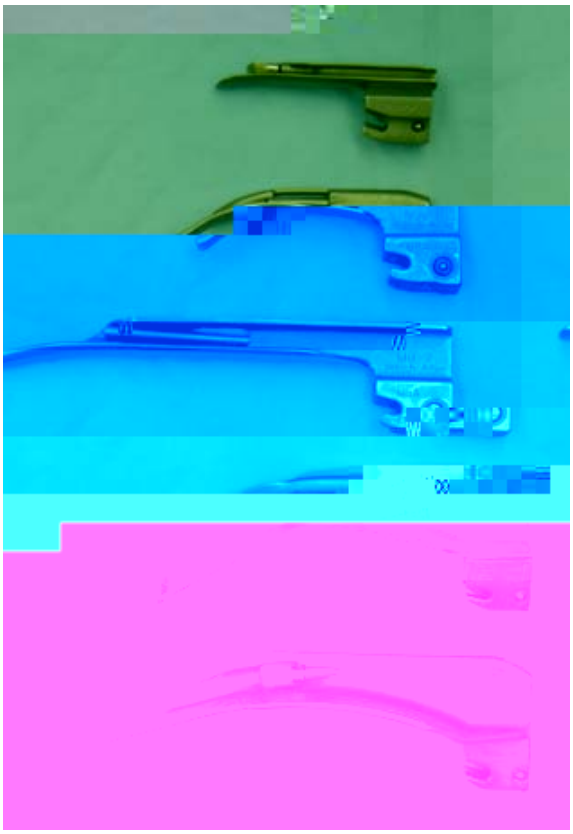
- Guide tube (stylet) technique
- Retrograde intubation technique
- Endotracheal intubation through nasal passage (nasotracheal intubation)
- Endotracheal intubation through lateral pharyngostomy
- Endotracheal intubation using a fiber-optic endoscope
- Endotracheal intubation by tracheostomy
- For full technical details of these techniques see pp528-531 of Veterinary Anesthesia (Thurmon et al. 1996).

Laryngoscopy

- Laryngoscopes are composed of two parts; laryngeal blade and handle (see photo below).
- The laryngoscope's light source is the main benefit of laryngoscopy, but the blade can be used to manipulate the tongue, soft palate, and epiglottis to view the glottis. NB. Use the laryngoscope to depress the base of the tongue, not the epiglottis. Depressing the epiglottis directly with the laryngeal blade increases the risk of traumatizing the epiglottis inducing airway complications.
- Blades come in different sizes and types, size ranging from 0 (small) to 5 (large) adequate for most small animals.
- Customized blades with extra length are available for use in some species including pigs, llamas, and big cats.
- Two most common types available in the market are the Miller (straight) and the McIntosh (curved), and there are numerous modifications based on these two.

Laryngeal blade

Laryngoscope handle



(Type)	(Size)
Miller	0
McIntosh	1
Miller	2
McIntosh	3
McIntosh	4

Species specific problems and troubleshooting

- Ruminants carry greater risk of aspiration of the gastric contents during anesthesia: adequate cuff inflation of the endotracheal tubes is essential.
- In ruminants, particularly in cattle, under general anesthesia the breathing is characterized with rapid and shallow in pattern, but the exact cause of this is unclear, and this poses little clinical significance.
- Postanesthesia laryngospasm is a significant cause of postanesthetic airway complication in the cat, usually trauma induced. Topical administration of lidocaine may help prevent it, but in severe cases, reintubation is necessary to deal with the complication.
- Horses are obligatory nasal breathers and common incidence of nasal swelling and congestion following general anesthesia is a major cause of airway obstruction. A short nasal tube is commonly placed at recovery which serves to provide a patent airway.

Control of respiration

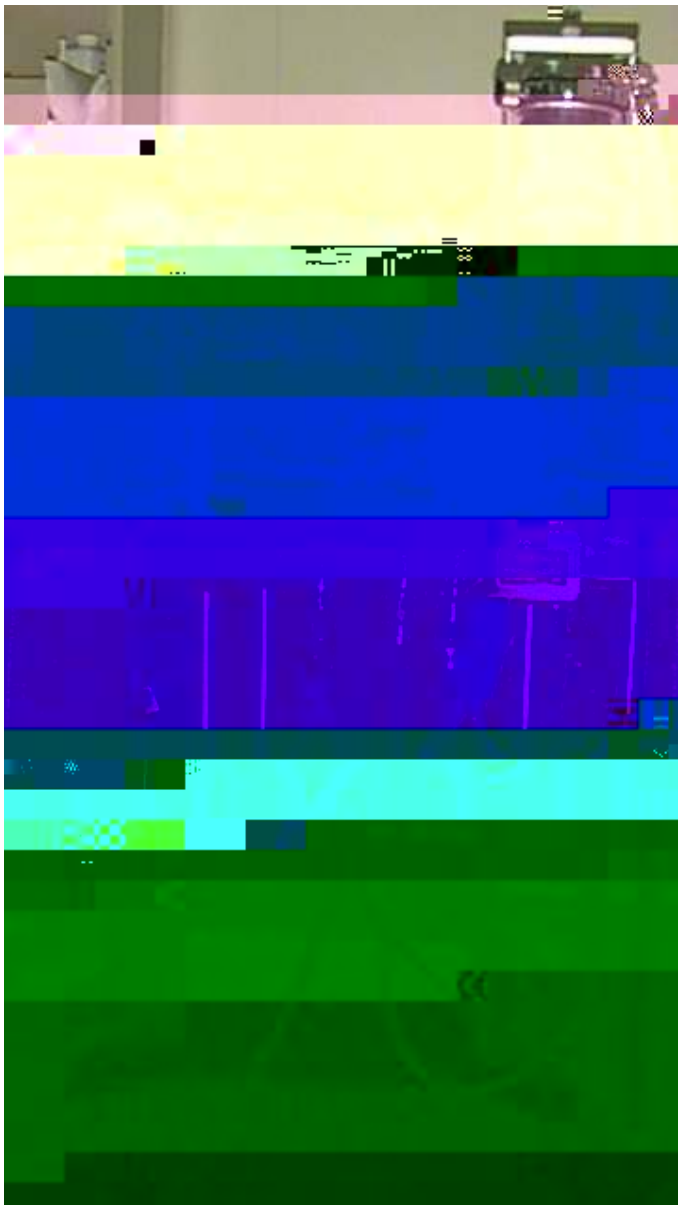
- Respiratory function is controlled by central respiratory centers, central and peripheral chemoreceptors, pulmonary reflexes and non-respiratory neural input.
- Blood gas tensions and hydrogen ion concentration are monitored by central and peripheral chemoreceptors that return signals to central neural controller to provide necessary feedback adjustments in ventilation.
- Central neural control mechanism regulate the activity of the primary and accessory

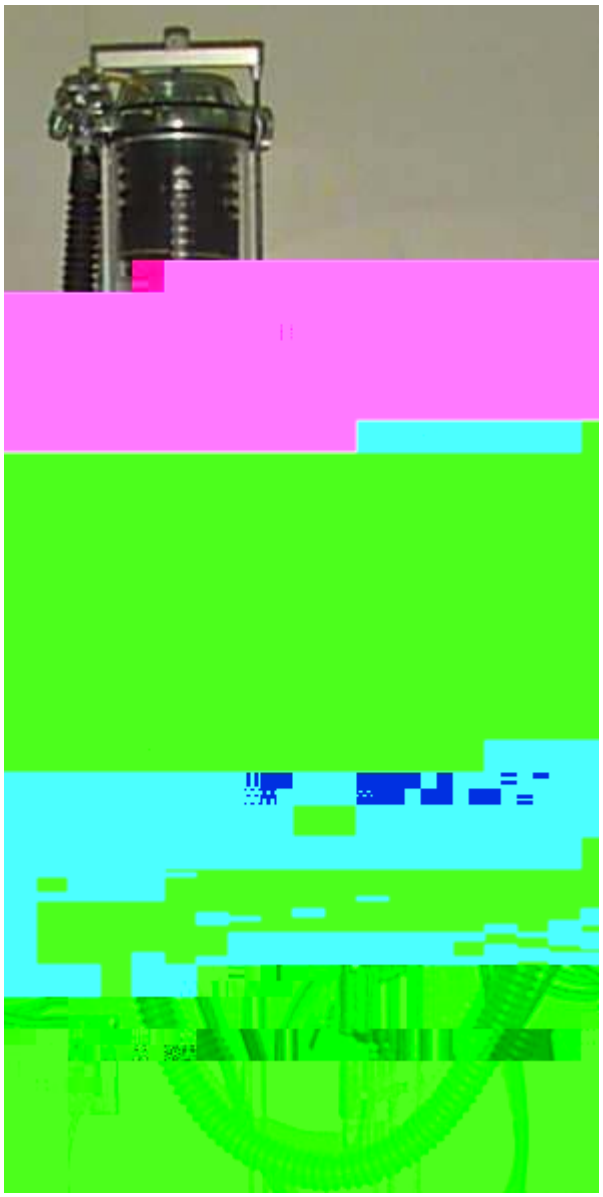
Changes of ventilation-perfusion (V/Q) relationship during anesthesia

- PaO_2 decreases more dramatically during general anesthesia in large animals than smaller animals. The primary attributor is believed to be increased V/Q mismatches.
- Hypoxic pulmonary vasoconstriction (a protective mechanism) re-directs blood flow to better ventilated area in the lung. Anesthetics cause marked reduction in this protective response, resulting in further V/Q mismatch.

Ventilator

- Anesthesia ventilators provide controlled ventilation to patients under general anesthesia
- Simply, anesthesia ventilator is a reservoir bag (a bellow or concertina bag) in a closed





- Note drive gas is oxygen (see above photo on the left) – an important safety feature!
- If a leak develops in the bellows, oxygen will enter the bellow and be delivered to the patient; this prevents delivering a hypoxic gas mixture
- Beware! Running a ventilator off of an E cylinder will deplete the cylinder fairly rapidly
- A ventilator is nothing more than a mechanical rebreathing bag
- Therefore, the ventilator always attaches where the rebreathing bag attaches to a breathing circuit! (see above photo on the right)

Respiratory assist devices

- Manual resuscitator (ambu-bag; see photo below): inexpensive and portable.

- Demand valves: mostly used in horses (see photo on the right)

Clinical considerations to ensure adequate ventilation in respiratory distressed patients

- Establish and secure a good airway
- Increase inspiratory O_2 fraction of delivered gas
- Control or assist ventilation using desirable devices (mechanical ventilator, ambu-bag)
- Antagonize, when available and indicated, an overdose of respiratory depressants with reversal agents (e.g. opioid antagonist)