

Equine Anaesthesia and Sedation.

Smoothing Out the Challenge.

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Introduction.

Sedation and general anaesthesia form part of the daily routine of equine practice – this can be quite a challenge given the size of the horse, it's temperament, the environment we work in and the procedures to be performed. This presentation aims to provide an overview to some of the drugs and combinations available and the techniques used in general equine practice rather than referral centres. We will also cover resuscitation drugs and the contents of the "crash" box. A detailed pharmacological study of the drugs will not be provided, this information is available in texts and the aim here is to provide a practical overview.

Successful sedation and anaesthesia of the horse can be a significant challenge. In any species there is a risk of death or mishap – in the horse this is significantly higher compared to small animals and humans.

Factors that may contribute to this include:

1. Nature / temperament of the horse
2. Physical size
3. Obligate nasal breathers
4. Ventilation – perfusion mismatch
5. Myopathy and musculoskeletal issues
6. Issues with intestine
7. Variable and unpredictable response to some agents
8. Difficult to move a horse when anesthetized
9. May requires specific (expensive) equipment
10. Possible injury to people

Standing chemical restraint or general anaesthesia?

The decision whether to use standing restraint or general anaesthesia depends on:

- Horse temperament
- Age and condition
- Procedure to be performed
- Facilities and staff available

Usually chemical restraint is suitable if recumbency is not required and is usually sufficient for non painful diagnostic procedures (radiography and ultrasound) and for short interventions with little pain (routine dental work or lung washes). Standing chemical restraint in conjunction with local anaesthesia can allow certain surgical procedures to be performed (standing castrations or the suturing of lacerations). General anaesthesia is used for procedures requiring recumbency and more extensive surgery. Some short general anaesthetics may be performed in the field, longer and complicated procedures should be performed in a more controlled environment in a large animal hospital.

Preparation before Sedation and General Anaesthesia.

1. Check surroundings.

Make sure surroundings are safe for both the patient and the personnel. This is particularly important for the induction and recovery from general anaesthesia. The site should be free from debris and have reasonable footing for the horse. It should be flat and not near water. Ideally a level grass field but occasionally indoor inductions are necessary and in these circumstances the potential for injury against wall structures needs to be minimized. Ideally there should be one another person experienced in field anaesthesia as well as the veterinarian.

With standing sedation, the surroundings should also be considered. Preferably not on a hill and on a non slip surface. A quiet environment is also preferable with minimal disturbance from external stimuli. Horses under sedation can wake up very rapidly and without warning.

If safety cannot be ensured in the field then the horse should be transported to a safer environment.

2. History.

In all cases a history should be obtained. Important facts are:

- Has the horse been anaesthetised / sedated before? Were there any adverse reactions?
- Current drug therapy
- The vaccination status for tetanus
- Any known problems in the past with medications?
- Any known lung, muscle or heart issues
- Insurance details – if the horse is insured the insurance companies need to be informed before an elective procedure is performed

3. Clinical Examination.

Essential in all cases – may need to be restricted in an emergency situation or with a fractious animal that needs sedation

- Examine cardiovascular and respiratory systems.
- Pregnant mares, geriatric horses, debilitated cases and foals have special requirements.
- If there is a pre-existing condition then diagnostic testing may be required e.g. CBC and serum biochemistry.
- It is not usually necessary to withhold food or water for short field anaesthetics – this may be different for procedures performed in a hospital.
- Check for pre- existing lameness or injuries

4. Weight.

- Drug doses are calculated on the basis of body weight.
- Ideally use scales but not always available.
- In the field it is difficult to weigh the horse so calculated weights or girth tapes are useful, they are not as accurate.

5. Starving.

Starvation prior to general anaesthesia will reduce the volume of the gastrointestinal tract. This can influence the movements of the diaphragm especially when the horse is in dorsal recumbency.

Whether a horse is starved or not depends upon the anaesthetist, the surgeon and the procedure. Check with them!

6. Removal of water.

This is not necessary. If performed may result in dehydration

7. Removal of shoes.

Removing the shoes and cleaning the feet prior to horse entering induction area reduces contamination of the surgical area. The shoes may also cause trauma to the horse, staff or the floor of the induction area. Some practices use boots or bandage the feet up instead.

8. Grooming.

Grooming reduces the contamination of the surgical facilities.

9. Mouth washing.

The mouth is rinsed out before anaesthesia to remove the food debris to prevent it being pushed down into the trachea by the ET tube.

10. Clip the operation site before induction.

This helps to minimise anaesthetic time.

11. Placement of intravenous catheter.

Some anaesthetists like to place a catheter prior to induction for the administration of the appropriate drugs.

Sedation.

Sedation is often used for many husbandry and veterinary procedures when the other methods of restraint are not suitable.

The aim of sedation is that the horse stands quietly and comfortably with minimal movement.

Unfortunately there is not one magic drug that covers all situations so often a combination of different drugs is used. These include alpha 2 adrenergic agonists, opiates, phenothiazine and local anaesthetic drugs.

These drugs also have undesirable side effects including ataxia and dropping blood pressure – excessive doses therefore need to be avoided.

Drugs used for sedation.

Below are some of the effects and clinical uses for the different drugs used for sedation

Acepromazine.

- A phenothiazine
- Produces tranquilisation / mild sedation
- Minimal analgesic properties
- Horses can be aroused from sedation easily

- Uses: premedication prior to anaesthesia or where mild sedation is required
- Side effects: reduction in blood pressure (so should be used with care in old, debilitated, dehydrated or horses with haemorrhage), hypothermia. In stallions can cause permanent prolapse of the penis.
- Duration of action is 4 – 6 hours.
- May be used in combination with other drugs

Adrenergic Alpha 2 -Agonists

- Xylazine, romifidine and detomidine
- Provide dose dependant sedation, analgesia and muscle relaxation
- The 3 drugs have different potencies, duration of actions and level of ataxia and therefore have different uses/indications. Veterinary surgeons often have preferences!
- Characteristic stance – base wide with head down “5 point stance”.
- Uses: for standing sedation and preanesthetic premedication. Also commonly sed for analgesics in colic cases. May also be used in epidurals
- Side effects: reduce heart rate, arrhythmias, reduce blood pressure, reduce cardiac output and decreased respiratory rate - care is therefore needed in horses with heart disease, old horses and dehydrated horses. They also cause diuresis, sweating, ataxia and laryngeal relaxation. They may also be associated with abortion.
- Horses that have received these drugs may look deeply sedated but they can still strike and kick so be vigilant when working around sedated horses. It is important to warn owners who often get lulled into a false sense of security!
- If a sedated horse is in a crush / stocks they often lean on the front bar, this can lead to airway obstruction or reduced blood flow to the brain and cause the horse to collapse.
- Often used in combination with an opioid such as butorphanol
- Detomidone can also be used as a constant rate infusion for prolonged standing procedures.

Opioids.

- Most commonly used is butorphanol but also used are morphine, pethidine and meperidine.
- Effective analgesics. Horses are susceptible to the excitatory effects of opioids so they are often used in combination with acepromazine or the adrenergic agonists.
- Uses: standing chemical restraint in combination with the alpha 2 agonists and premedication for general anaesthesia.
- Side effects: slow heart rate, reduced blood pressure, depressed respiration, reduced gut activity, sweating and euphoria.

Benzodiazepines.

- Diazepam and midazolam
- These are not sedatives but provide muscle relaxation and anticonvulsant activity.
- Side effects: minimal cardiovascular or respiratory side effects
- Uses: for restraint of young foals and in combination with ketamine for adult horses.

Local anaesthetic Techniques in horses.

Local anaesthesia is often used with sedation and general anaesthesia.

Local anaesthetics block the transmission of action potentials along nerve fibres – involves the blockade of sodium channel preventing depolarisation of the cell membrane.

Different types of local anaesthetics block.

- Topical Analgesia – direct application to the skin or mucous membranes e.g. to facilitate eye examination
- Intrasynovial anaesthesia – agent is injected into the synovial structures
- Infiltration – direct infiltration into tissue to affect local nerve endings e.g. wound repair
- Regional analgesia – the blockade of specific sensory nerves e.g. distal limb blocks
- Spinal analgesia – the injection of local anaesthetic into some part of the spinal cord – e.g. epidural.

General Anaesthesia.

Tends to be used for more complex procedures – some short procedures are performed in the field and others require a large animal hospital.

Has several phases:

- Premedication
- Induction
- Maintenance
- Recovery

Premedication.

This is the administration of medication prior to anaesthesia to facilitate induction, maintenance and recovery.

Aims.

- Calm the horse
- Provide analgesia and muscle relaxation
- Decrease anaesthetic requirements
- Minimise side effects of the GA agents
- Promote a smooth recovery

The drugs used are discussed above in the sedative section – acepromazine, alpha2 agonists, opioids and benzodiazepines.

General Anaesthesia.

Drugs and their effects.

The drugs used for induction and maintenance of anaesthesia in the horse are:

Injectable Anaesthetic Drugs.

- Ketamine
- Thiopentone
- Propofol
- GGE

Inhalational Anaesthetic Drugs.

- Halothane
- Isoflurane
- Nitrous Oxide

Anaesthetic drugs produce major physiological changes in the horse:

CNS

- Cause reversible depression of the CNS
- As a result the control of the respiratory and cardiovascular systems are depressed

Respiratory System

- Hypoxia occurs during general anaesthesia
- The respiratory drive response to CO₂ is reduced
- Ventilation perfusion mismatch is a problem in the horse (possibly related to recumbency and large size).

Cardiovascular System

- Drugs depress myocardial activity and some cause vasodilation
- Cardiac output is therefore reduced

Renal Function

- Blood flow and GFR are reduced

Liver Function

- Decreases blood flow to liver
- Many drugs are metabolised by the liver thus the action can be prolonged

Injectable Drugs.

Ketamine

- Dissociative anaesthetic
- Alters CNS response to sensory input with minimal depression of brainstem
- Used as an induction agent and in total intravenous anaesthesia (TIVA)
- Side effects: may cause excitement during induction and recovery, poor muscle relaxation and slow onset of anaesthesia
- Usually used with diazepam

Thiopentone

- Potentiates GABA mediated CNS depression
- Used as a induction agent
- Side effects: hypoventilation and apnoea after bolus injection, very irritant if given perivascular and hypotension

GGE (Glycerol guaiacolate ether)

- Centrally acting muscle relaxant with sedative and hypnotic properties
- Used as an induction agent with ketamine or thiopentone. Also used as TIVA in a triple drip combination
- Side effects: haemolysis at high concentrations and very irritant if given perivascular

Inhalational Drugs

Administered via anaesthetic machine in oxygen.

Halothane

- Commonly used in equine practice for maintenance
- Side effects: myocardial depression causing hypotension, cardiac arrhythmias, muscle tremors in recovery and risk of liver toxicity

Isoflurane

- Becoming increasingly used
- Less potent than halothane
- More rapid recovery than halothane
- Side effects: respiratory depression and vasodilation

Nitrous Oxide

- Weak anaesthetic agent
- Is used in some centres in combination with agents above
- Side effects: can cause hypoxia, accumulates in gas filled viscera and body cavities

There are many different combinations of anaesthetic drugs used – depends upon the individual anaesthetist, the horse the facilities, and the procedure.

A common combination used here in Australia is premedication with xylazine, induction with ketamine and diazepam and maintenance with halothane or isoflurane. TIVA usually involves the triple drip (xylazine, GGE and ketamine).

Induction.

In the field a flat grassy environment is preferable.

Padded boxes reduce the risk of injury to the horse during induction. These are also used for recovery. There are several types that are used, some places use crush doors. In a simple system one person restrains the head by a rope attached to the head collar. Usually a smoother induction is achieved when the restraint is minimal. There are several other techniques used and depends upon the temperament of the horse and the anaesthetist.

Some hospitals use tilt tables – the horse is sedated and positioned adjacent to the table which is in a vertical position – they are attached to the table by belly bands and when the horse is anaesthetised the table tilts into the horizontal position.

An intravenous catheter should be placed prior to induction of anaesthesia

- Prevents perivascular injection of drugs
- Reduces trauma to the jugular vein due to repeat injections
- Provides rapid venous access

The head collars worn during induction should be padded over the cheek pieces and the poll to prevent trauma to the facial nerve and the bony prominences of the face.

In field anaesthesia the procedure is performed where the horse has "landed". In the hospital environment the horse is usually moved to the operating table via a hoist once the horse has been tubed.

Maintenance of anaesthesia.

In the hospital environment inhalational anaesthetic agents are usually used for the maintenance of anaesthesia. They are administered via an orotracheal tube (some procedures may require nasal intubation) and an anaesthetic machine. Most anaesthetic machines used in horses are circle systems.

- Orotracheal intubation
 - Lubricate tube
 - Open mouth with gag
 - Tongue pulled to side of mouth
 - Slide tube between dental arcades to the pharynx
 - Head is extended to pass tube through the larynx
 - Inflate cough – care with over inflation
 - Adult horse – usually 20 – 25 mm tube

Total intravenous techniques are often used in the field and are best suited for procedures of less than an hour e.g. top up with injectable anaesthetic agents or use triple drip.

During maintenance the horse is closely monitored (see below).

Positioning the horse during anaesthesia.

Careful positioning of the horse is crucial to prevent the risk of anaesthetic myopathy and neuropathy. The anaesthetist will pay very close attention to this!

- Lateral Recumbency
 - Lower forelimb is pulled forward so that the shoulder musculature is not compressed
 - Padding or supports are used between the limbs so the upper limb is supported
 - The limbs should not be in full extension or flexion
 - Neck and head should be elevated slightly to prevent nasal engorgement

- Dorsal Recumbency
 - Square positioning on the table so that the weight distribution is even. Some anaesthetists prefer a slight angle.
 - The legs should be relaxed and slightly flexed
 - Neck should be straight but not over extended
 - Head is slightly elevated with care not to compress the jugular veins

Recovery.

Horses are placed in a padded box for recovery to minimise injury to themselves. Ideally there should be a human escape hatch and an observation window. The padding should be adequate to prevent injury but the floor should also provide a secure footing. The recovery should be monitored and there should be a “crash box” located in the vicinity and a facility to provide oxygen supplementation.

Factors affecting recovery.

- Temperament of the horse
- Drugs administered
- Speed of recovery
- Design of recovery box – size and padding on floor
- External stimulation – light and noise
- Surgical procedure performed
- Peri operative pain
- Length of surgery / recumbency

Goals of recovery

- Quiet
- Controlled return to standing
- Minimal exertion or stress

Positioning the horse in recovery.

- There should be adequate space around the horse to allow it to sit up into sternal recumbency and then stand
- Place horse in the same lateral recumbency that it was in for surgery
- Pull lower limb forward
- If limb surgery has been performed the operated limb should be upper most

Extubation

- Cuff of tube is deflated
- Usually wait until the horse is able to swallow
- Sometimes the tube is left in situ (e.g. airway surgery)
- If there is evidence of respiratory obstruction a nasal tube may be placed
- Oxygen may be given in recovery for some cases

Sedation during recovery

- This may be administered if the horse attempts to stand too early or is excitable in recovery
- Usually a low dose of an alpha-2 agonist is used

Assisted recoveries

- Assisting the horse to standing can help reduce the incidence of complications
- Human safety is paramount
- Temporary restraint can be achieved by extending head and neck
- Head ropes and holding onto the tail can help the horse when standing
- May be used for recovery following some orthopaedic procedures

Monitoring Anaesthesia.

The key to good anaesthesia is monitoring – this enables problems to be recognised early and treated promptly.

Anaesthetic record.

This is a legal document. It should include

- Information relating to the patient
- Pre anaesthetic examination
- Drugs administered, the times and by whom

- Intraoperative monitoring – visual record of
 - CV parameters (heart rate, MM, BP)
 - Respiratory parameters (respiratory rate)
 - Drugs used and amounts
 - Any adverse responses

Parameters to monitor.

Eye.

- Palpebral reflex is elicited with a finger along margin of upper eyelid. It should be retained but sluggish under GA
- Corneal reflex is the closing of the eyes in response to touch on the cornea. Only use a sterile swab. Not routinely used but should be retained
- The eye is usually displaced medially but may slowly wander during anaesthesia
- Lacrimation and nystagmus are associated with lightening of the anaesthetic
- With ketamine the eye reflexes are “lively” – spontaneous lacrimation, nystagmus and a strong palpebral reflex. This should not be interpreted as a lightening of anaesthesia.

Muscle Tone.

- Movement means light anaesthesia (and an angry surgeon!)
- Changes in muscle tone provide a crude indication of depth
- A tightening of the neck musculature is often an early indication of lightening and occurs prior to limb movement

Cardiovascular System.

- Manual palpation of pulse – rate and quality
 - Reflects peripheral perfusion
 - Pulse pressure is the difference between systolic and diastolic blood pressure
- MM and CRT
 - Crude measure of CV function
 - Under halothane – usually pale with prolongation of CRT as depth increases
 - Brick red – hypercapnia
 - Cyanosis – hypoxia
- ECG
 - Useful for diagnosis of arrhythmias
- Blood Pressure
 - One of the more important techniques used in monitoring
 - Indirect – using a cuff around tail or distal limb. Less accurate than direct methods but the trend can be observed.
 - Direct – catheterisation of a peripheral artery (facial, transverse facial or metatarsal arteries). A manometer or direct monitor is then used.
 - Mean BP > 70mmHg should be maintained

Respiratory System.

- Respiratory rate and pattern.
 - Tidal volume can be assessed crudely by chest and rebreathing bag movement
 - Monitor rate
 - Usually < 6 breaths a minute indicates hypoventilation
- Arterial Blood Gas Analysis
 - Not always available
 - Gives information upon respiratory and metabolic function
 - Looks at HCO₃, pCO₂, pH and pO₂
- Pulse Oximetry
 - Relatively cheap and simple to use
 - Non invasive
 - Measure pulse rate and provide information about arterial oxygenation and peripheral perfusion
- Capnometry
 - Measures CO₂ in the gas at end of ET tube

Temperature.

- Adult horses rarely become hypothermic during anaesthesia
- Can be a problem in air conditioned surgeries though!
- Critical in neonates especially during long procedures

Anaesthetic Complications and Emergencies.

The CEPEF study (a study looking at peri – operative incidents in many institutional facilities) demonstrated a mortality rate of 0.9 % at 7 days post operatively. This is high compared with other species.

The complications can be intraoperative or peri operative. Therefore careful monitoring of the patient even after surgery is important. It emphasises the importance of the vet nurse recognising deviations from the normal and being able to perform a good basic clinical examination.

Complications include:

Intraoperative.

- Hypoxaemia
- Hypercapnia
- Hypotension
- Inadequate Anaesthesia
- Cardiac arrhythmias
- Hypoventilation
- Malignant Hyperthermia
- Cardiac arrest
- Respiratory Obstruction in Recovery

Peri operative.

- Pulmonary oedema
- Post anaesthetic myopathy / neuropathy

- Haemorrhagic Myelopathy
- Post operative choke and colic
- Diarrhoea
- Pleuropneumonia

The “Crash Box” and cardiopulmonary resuscitation.

The intraoperative complications that may occur need to be dealt with promptly. It is a team effort with everyone knowing their role.

Cardiac arrest occurs when the heart no longer has output and the cardiopulmonary systems fail to provide support to the CNS and cardiac tissue.

Clinical signs of cardiac arrest.

- No palpable pulse
- No heart sounds
- Apnoea or terminal gasping ventilation
- Cyanosis or pale mucous membrane colour
- Altered CRT
- Central eye position
- Pupillary dilation
- Absent palpebral and corneal reflexes

Objectives of CPR

- Maintain oxygen delivery to tissues
- Prevent the development of metabolic changes that cause irreversible tissue damage
- Restore normal heart activity

The principles and techniques are the same as in small animals – the ABC system:

- A Airway**
- B Breathing**
- C Circulation**
- D Drugs**
- E Electrical defibrillation**
- F Follow Up**

To perform in the horse –

- Place in right lateral recumbency
- Airway
 - Intubated if not already
 - Check no occlusion of tube
 - Check anaesthetic machine and oxygen supply
- Breathing
 - Instigate IPPV
 - Switch off vaporiser
 - Use 100% oxygen
- Circulation
 - Cardiac Massage
 - Left side of rib cage – use knees and the force of the body

- Difficult in large horses
- Fluid therapy is required
- Drugs
 - See crash box contents below
 - Should include dose rates based on body weight in mls for ease of administration
- Electrical Defibrillation
 - Unlikely to be available or effective in the horse
- Follow Up
 - Monitoring after successful CPR is vital
 - Support of the CV, respiratory and renal function is required.

It is important that all events are documented with times on the anaesthetic records.

Crash Box Contents.

A `crash box` containing all the drugs and equipment required for the treatment of such complications should be located within the operating theatre. It must be checked and updated regularly.

- Kit
 - Intravenous Catheters
 - Fluid Administration sets
 - Needles
 - Syringes
 - Tracheostomy Kit
 - Slate and pencil or notebook
 - ET tube
 - Stethoscope
- Drugs
 - Adrenaline
 - Atropine / glycopyrrolate
 - Dobutamine
 - Dopamine
 - Lignocaine
 - Calcium gluconate
 - Fluids (Hartman's, saline and bicarbonate)