

INJECTABLE (FIELD) ANESTHESIA

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Key Points:

- Injectable anesthesia should be carefully planned so that anesthetic time is minimized.
- A thorough preoperative assessment of the patient will help provide patient safety.

Pre-operative considerations

Pre-operative preparation of the horse may be fairly abbreviated when anesthesia and surgery are occurring in the field, however it is wise to conduct a brief physical exam. The cardiovascular system should be examined by auscultating the heart and palpating the pulse. Murmurs or heart block may or may not be normal, and should be recognized. An elevated heart rate may indicate stress or pain but can also indicate significant blood loss (eg, in the case of a horse with a laceration). The respiratory system should be examined by observing respiratory rate, presence of any nasal discharge, and auscultation of the lungs. Chronic obstructive lung disease may be common in older horses and could be a source of hypoxemia during anesthesia, while respiratory infections are fairly common in younger horses. Subclinical respiratory infections can still cause hypoxemia under anesthesia, so the owner should be questioned about the herd history.

Other abnormalities can be observed during a brief physical exam, which might impact on anesthesia. For example, is there any evidence of visual deficits, dehydration or myositis, or poor body condition? What is the medical history of the horse? Is there a history of a chronic problem requiring other medications (eg, hyperkalemic periodic paralysis)? Is the horse insured (which may require permission from the company before anesthesia)? What the horse is used for and the degree of fitness may affect how it responds to anesthesia. Certainly, it is important to assess the horse's temperament in deciding how best to anesthetize it. Other drugs given to the horse may affect anesthesia; fluphenazine (commonly used as a long-acting tranquilizer) can cause profound hypotension during anesthesia.

Pre-operative laboratory data should be conducted as is practical and as indicated by the physical exam. In many instances it may be possible to get a packed cell volume and estimate of total protein. For the horse with a pre-existing disease, it would be wise to have more baseline data. Newer, portable equipment is making it possible to conduct lab work in the field.

Generally, it is not recommended to exceed 60-90 minutes of anesthesia with injectables. The type and length of procedure and physical surroundings where you will be working may influence drug choice as well as other equipment needed. For instance, for a routine castration, padding the animal is probably not a consideration. But if you have a 2-hour procedure to conduct, some type of padding under the animal is probably indicated (eg, inner tubes, mats, mattresses, et al). If the horse is sick, then it may be wise to have oxygen and emergency drugs available. The same holds for preparation of the horse. Withholding feed for 12 hours is recommended for procedures longer than 20-30 minutes to prevent hypoxia caused by distention of the abdomen. While placement of an intravenous catheter is not absolutely essential for a routine castration, it certainly will save headaches for longer cases which will require repeated doses of anesthetics, and is essential in sick cases where complications may occur. Estimation of the horse's weight may be made more accurate by using a weight tape, thereby allowing more accurate drug dosing.

Drug combinations using thiopental

Although not as popular as once used for injectable anesthesia, thiopental has “stood the test of time” and is still indicated in certain situations. Inductions are more difficult to control, and recoveries may not be as smooth as with ketamine combinations. However, for horses which are “refractory” to ketamine (or xylazine/ketamine), thiopental is indicated. It should also be considered if there is a history of seizures or when an increase in intraocular pressure is contra-indicated (eg, corneal laceration). Adverse effects of using thiopental may include hypotension and apnea. An intravenous catheter is indicated because thiopental will cause sloughing if given peri-vascularly. Currently, thiopental is very difficult to obtain; it is not yet clear if it will be brought into production again.

Horses may be tranquilized with acepromazine (0.04-0.05 mg/kg IV or IM) given 20-30 min ahead **or** xylazine (0.04 mg/kg IV or 0.08 mg/kg IM) given 10-20 min ahead. Anesthesia is usually induced by administration of guaifenesin (5% solution) to effect (horse gets very wobbly), then thiopental is bolused (4.0-5.0 mg/kg IV). Alternatively, the thiopental can be mixed into the liter of guaifenesin and the mixture administered to induce the horse. Remainder of the liter can be used to maintain anesthesia by slow infusion. The longer anesthesia is maintained with this mixture (ie, if a 2nd bottle is used) the more likelihood that recovery will be prolonged or rough. It may be necessary to re-tranquilize the horse (if xylazine was used) or assist the horse to standing. Unfortunately, the manufacture of thiopental has been discontinued world wide. It is not clear at this time what will replace this invaluable drug.

Drug combinations using ketamine

These combinations have become very popular for field anesthesia because of the (usually) predictable, smooth inductions and recoveries. The most common combination is to sedate the horse with xylazine (1.1 mg/kg IV; 2.0 mg/kg IM) given 5-10 min (longer for IM route) before induction of anesthesia with ketamine (2.2 mg/kg IV). It is important that the horse be adequately sedated (head to the knees) before giving the ketamine, since ketamine causes muscle rigidity and seizures in horses. If “adequate” sedation does not occur, it is important to recognize and deal with before ketamine administration. How can you “fix” this?

- 1). Redose xylazine: up to half the original dose
- 2). Add butorphanol (0.02-.04 mg/kg IV). Butorphanol can be given with the original xylazine if you suspect that the horse will be difficult to tranquilize (eg, high-strung Thoroughbreds) or added before the ketamine. This combination will improve induction, increase analgesia and increase recumbency time by about 5-10 min.
- 3). Diazepam (0.03-0.05 mg/kg IV). Mix the diazepam with the ketamine. This combination will improve induction when sedation is marginal, improve muscle relaxation during anesthesia and prolong anesthesia by about 5-10 minutes without causing significant additional cardiovascular depression.
- 4). Guaifenesin (5% solution administered IV to effect) can also be used to increase sedation and muscle relaxation.

Detomidine (Dormosedan) (0.02 mg/kg given 5-10 min before) can be substituted for the xylazine to produce sedation before induction of anesthesia. Inductions, recoveries and anesthesia time are approximately the same as with xylazine/ketamine. We have also evaluated detomidine with butorphanol, followed by ketamine; this combination is also very similar to xylazine/butorphanol/ketamine. Romifidine (Sedivet) (0.1 mg/kg) has also been used as a

premedication before ketamine induction.

Prolonging ketamine anesthesia - Triple drip

Prolonging any of the above combinations can be accomplished by infusing a combination of xylazine, ketamine and guaifenesin. So-called G-K-X or “triple drip” is made by using 1 liter of 5% guaifenesin, to which 500 mg xylazine and 1000 mg ketamine are added. This is administered at an approximate rate of 2 ml/kg/hr or “to effect” as dictated by monitoring the horse. Some recommend a higher dose of ketamine (2000 mg ketamine added to the bottle), which may produce deeper anesthesia with less total xylazine and guaifenesin being given. This works extremely well for donkeys and mules and for very large horses. Generally respiration, and blood pressure are well maintained with this mixture and recoveries are usually good, even after 60-90 minutes of maintenance. For longer procedures (> 1hr) insufflation of oxygen is recommended. Generally it is NOT advised to exceed 2 liters of guaifenesin; accumulation of the guaifenesin will occur which will produce rough recoveries. Protective reflexes (swallowing, blinking) are well maintained so respiratory rate, depth and pattern are the best way to monitor depth of anesthesia with this combination.

Drug combinations using tiletamine/zolazepam (Telazol)

The combination of tiletamine/zolazepam (Telazol) is very similar to diazepam/ketamine. It can be used to produce anesthesia following xylazine (1.1 mg/kg IV) sedation. Telazol is an equal parts mixture of tiletamine/zolazepam and is usually dosed as 1.1 mg/kg Telazol IV (each bottle contains 500 mg Telazol). Telazol provides good inductions with very good muscle relaxation during anesthesia. Occasionally, recoveries are difficult if the muscle relaxant effects are more prolonged than unconsciousness; the horse has difficulty standing, or is weak and wobbly once on its feet. Duration of anesthesia with xylazine/Telazol is 30-40 min and 40-50 min when xylazine/butorphanol (0.04 mg/kg IV)/Telazol is given.

Telazol has been used for IM (ie, dart) administration in many species including feral equids. The Telazol can be reconstituted with detomidine, or xylazine with or without butorphanol, and administered at 1 bottle Telazol/160-225 kg to produce recumbency in feral or unmanageable horses. This combination is not perfect, since the drugs take 10-15 min to have an effect, and a feral horse could travel quite a distance in this time. However it appears to be one of the best combination currently available.

Drug combinations using propofol

Despite the fact that propofol is not approved for use in horses, it has been investigated in several combinations in the horse. Although fairly expensive, the attraction has been rapid recoveries of exceptionally good quality from propofol, and the ability to change the depth of anesthesia quickly. Sedation with xylazine (0.4 mg/kg IV) or detomidine (0.03 mg/kg IV) has been followed by induction with propofol (2.0 mg/kg IV). The bolus of propofol should be given slowly over about 60-90 sec. This will produce only about 10 min of anesthesia, but propofol may be infused at 0.2 mg/kg/min to maintain anesthesia. In the adult horse excitement at induction and respiratory depression (high incidence of apnea) are significant problems. However, this combination seems to work well in young foals (for procedures such as joint flushes) or for induction of miniature horses.

Other combinations using propofol which have been investigated include: sedation with xylazine (0.75 mg/kg IV) followed by guaifenesin infusion (75 mg/kg of 10% soln), then

propofol (2 mg/kg IV). Anesthesia was maintained with 1 or 2 boluses of propofol (150-250 micrograms/kg/min) for 60 min. In this study no surgery was performed (1). Aguiar, *et al* (2) premedicated horses with detomidine (0.015 mg/kg IV) and induced anesthesia with guaifenesin (100 mg/kg 7.5% soln IV) mixed with propofol (0.5 mg/kg). This combination provided anesthesia for short surgical procedures (8-16 min) and recovery from anesthesia was short (approx 30 min). By minimizing the dose of propofol, respiratory depression was minimized and cost of the propofol was minimal. Since thiopental is no longer available, further investigation of this combination seems worthwhile.

Adjuncts to anesthesia

In many cases a local block can be used to improve anesthesia and extend the duration of anesthesia. This will allow less injectable to be used, thereby reducing complications. Either lidocaine or carbocaine can be used to block the wound (or cord, for castrations). If a longer block is indicated, bupivacaine (Marcaine) can be used, which will have a 4-6 hr duration. Local blocks can be accomplished by line block, local infiltration or anatomic nerve blocks.

Monitoring and support

Regardless of what anesthetics are used, there is always the risk of morbidity or mortality if the patient is not carefully monitored during anesthesia. For very short procedures, evaluation of eye signs (eg, nystagmus, palpebral reflex), rate and depth of respiration and pulse or heart rate, is adequate. For longer and more involved procedures (esp. when the surgeon may be more involved in the surgery and less able to make observations) some type of mechanical monitor may be helpful. There are several monitors available which are very portable and hardy in field situations. The use of a pulse oximeter provides an audible signal of pulse rate and hemoglobin saturation, and can indicate when insufflation with additional oxygen is advisable (when SpO₂ falls below 90%). Blood pressure can be monitored inexpensively using an aneroid manometer connected to an arterial catheter. This will provide an estimate of mean blood pressure, which should be maintained above 60-70 mm of Hg. Hypotension may precede cardiovascular collapse and is associated with post-operative myositis. Blood pressures can also be monitored non-invasively with portable monitors (such as the Protocol Propaq) which use a cuff; the Propaq also gives an ECG and temperature read-out and may have a printer. A Doppler Ultrasonic Flow Detector may also be used in the field to monitor systolic blood pressure (which should be maintained > 90 mm of Hg).

Respiration should be monitored by attention to rate and depth of respiration, as well as color of mucous membranes. Respiratory rate should be greater than about 6 breaths/min. Hypoxemia can occur very quickly after the horse becomes recumbent. This is generally tolerated for short procedures, but should be treated if a long procedure is planned. A small oxygen tank can be used to deliver oxygen by insufflation, or the horse can be intubated and a demand valve can be used to ventilate. New, portable blood gas machines (such as Diametrics IRMA) make it possible to evaluate ventilation more precisely in the field.

Attention to details to prevent neuropathies is also important. Nerve paralysis can occur following a short anesthetic if the horse is lying on very hard ground. Using padding, removing halters and pulling the under legs forward (both fore and hind) will help prevent neuritis.

Recovery

Recovery from short procedures is generally smooth, but it is probably wise to think

ahead to causes of rough recovery and try to prevent problems. In my experience the commonest causes of rough recovery are: pain, hysteria, and hypoxia. Pain and hysteria can easily be treated with a sedative/analgesia such as xylazine (start with 0.1-0.2 mg/kg). Hypoxia or difficulty breathing (such as might occur after an airway procedure, or where there is edema of the head or nasal region) may require intubation and oxygenation. Nasal edema can sometimes be treated with intranasal phenylephrine (Neosynephrine nasal spray). In some cases a horse may need assistance to stand (eg, older, sicker horses) in the form of head and tail ropes. Generally, if the horse is comfortable (ie, shaded and not bothered by flies) and personnel are patient, it will recover well on its own.

References

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2. Mama, KR, Pascoe, PJ, Steffey, EP, *et al.* (1998) Comparison of two techniques for total intravenous anesthesia in horses. *Am J Vet Res.* **59**:1292-1298.