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Equine Field Anesthesia and Sedation

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Equine anesthesia carries a relatively high risk with reported mortality rates of up to 1%.¹ Careful preanesthetic preparation and a well-considered plan will help decrease the risk of complications. As well, the many advances in monitoring and supportive care will further decrease the risk of complications. Prolonged anesthesia (>45 minutes) of adult horses should, typically, be performed in a facility that can provide volatile anesthesia, appropriate padding, invasive pressure monitoring, and ventilatory and cardiovascular support. The facility should also have appropriate rooms for induction and recovery. Anesthesia on compromised horses can be a major challenge and should be performed by personnel with an advanced knowledge of equine anesthesia. This issue of *Large Animal Veterinary Rounds* discusses practical anesthesia and sedation of horses in general veterinary practice, with an emphasis on field anesthesia and sedation of the adult horse. Anesthesia in foals is also briefly covered. Practitioners who perform volatile anesthesia on adult horses and who require a more complete discussion may wish to refer to two excellent updated references.^{2,3}

Field anesthesia is best suited for short surgical procedures to minimize the risk of complications from ventilation/perfusion mismatch and hypoxemia. In addition, short-duration periods of anesthesia will also help decrease the risk of post-anesthetic myopathies resulting from compartment crush syndrome.

Preanesthetic considerations for adult horses

Horses should be fasted for 12 hours prior to anesthesia to allow for the reduction of abdominal fill in an effort to limit compression of the diaphragm by the hindgut and decrease ventilation/perfusion mismatching. Field anesthesia is best suited to healthy horses and particular attention should be given to hydration status and blood loss, since hypovolemic patients may decompensate during anesthesia. Horses should be maintained in lateral recumbency whenever possible and hard surfaces should be avoided to decrease the risk of myopathies and neuropathies. Recovery areas should be open and free of obstructions or debris, and the horse should be haltered to facilitate control of the head during induction and recovery.

Supplemental inspired oxygen should be considered in any procedure that exceeds 15–20 minutes in length. A discussion of oxygen therapy is included in the section detailing monitoring and supportive care.

Many of the techniques used for field anesthesia will only provide sufficient analgesia for minor procedures. Wherever possible, supplemental local anesthesia should be considered. The addition of local anesthesia will generally result in a smoother anesthetic period and, typically, will enhance postoperative pain control.



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Handler safety is always an important consideration during induction and recovery and sufficient help should be available, not only to restrain the animal during induction, but also to position the horse for surgery and assist with recovery. Operator safety is also a consideration and some clinicians use ropes to restrain limbs, especially during castration, to prevent injuries from a sudden kick if the anesthetic is too light.

Anesthesia of 10-20 minutes duration

Typically, short-term anesthesia can be achieved with alpha-2/ketamine combinations (Table 1). Xylazine/ketamine can be used alone, at a dose of 1 mg/kg of xylazine, combined with 2 mg/kg of ketamine, but muscle relaxation is not ideal with this mixture. Diazepam can be combined with ketamine at a dose of 0.05-0.1 mg/kg to improve muscle relaxation. The addition of diazepam will smooth induction and improve muscle relaxation during the anesthetic period. Diazepam will also extend “down time” slightly and may decrease the chance that a “top-up” is required. Butorphanol can also be added, at a dose of 0.025-0.05 mg/kg, to provide additional analgesia and prolong down time. If butorphanol is administered in addition to 1 mg/kg of xylazine, there is a risk of encountering significant ataxia. Some practitioners decrease the dose of xylazine to 0.5-0.75 mg/kg if butorphanol is coadministered and, although this will achieve good sedation, there is an increased risk that muscle relaxation may not be adequate following ketamine administration. If the alpha-2 dose is decreased, it is a good idea to include diazepam with the ketamine to ensure adequate muscle relaxation. Romifidine (80-100 µg/kg) or detomidine (10-20 µg/kg) may be substituted for xylazine in the above protocols.^{2,3} Both of these drugs will prolong down time by 5-10 minutes.

Anesthesia of 10-30 minutes duration

There are situations where induction drugs alone may not provide sufficient down time to complete the procedure. This may or may not have been anticipated when the procedure was initiated. The addition of diazepam, butorphanol, or a local technique, as noted above, may help to prolong down time. If the horse is too lightly sedated and an additional 5 to 10 minutes of anesthesia is required, it is possible to administer a top-up dose of the alpha-2 agonist and ketamine. Typically 30%-50% of the induction dose can be administered to achieve this effect (Table 1). The following are two practical suggestions, if a top-up of anesthesia is anticipated:

- Placing a capped intravenous (IV) catheter into the jugular vein is useful since anesthesia can be unpredictable. Horses can rapidly become lightly anesthetized and it may prove difficult to hit the vein of a rolling, half-awake horse (personal experience).
- A top-up of the induction drugs should be drawn-up and ready. This can be mixed in the same syringe to facilitate rapid delivery.

Anesthesia of 20-60 minutes duration

Field anesthesia can be maintained for up to 1 hour with a mixture of xylazine (X), ketamine (K), and guaifenesin (G). This mixture is prepared by mixing 500 mg of xylazine and 1000 mg of ketamine into a liter bag of 5% guaifenesin. Anesthesia is induced in the horse with XK (Table 1) and maintained with XKG at a constant rate of infusion (typically 2-2.5 mL/kg/hr). The horse should maintain an active palpebral reflex throughout the anesthetic period. The infusion rate should be increased if the horse swallows or vocalizes, or if movement is present. Guaifenesin toxicity manifests as extensor rigidity or opisthotonus and the infu-

Table 1: Drug combinations for equine field anesthesia

Preanesthetic (IV)*	Induction and 10-15 minutes of anesthesia (IV)	Top-up as needed (IV) typically q 10-15 min
Xylazine 1 mg/kg ± butorphanol 0.025 mg/kg	Diazepam 0.1 mg/kg combined with ketamine 2 mg/kg	Xylazine 0.3 mg/kg + ketamine 0.6 mg/kg
Detomidine 20 µg/kg ± butorphanol 0.025 mg/kg		Detomidine 5 µg/kg + ketamine 0.6 mg/kg
Romifidine 100 µg/kg ± butorphanol 0.025 mg/kg		Romifidine 30 µg/kg + ketamine 0.6 mg/kg

*Increase preanesthetic dose by 25%-50% in donkeys and mules, decrease preanesthetic dose by 25%-50% in draft horses

sion should be terminated immediately if opisthotonus occurs. Horses maintained on this mixture should receive supplemental oxygen. The mixture should be administered via an indwelling jugular catheter, since it is very irritating and may cause the tissues to slough with perivascular administration. Horses can be maintained on this mixture for up to an hour and, in some situations with appropriate supportive care, we have maintained horses for up to 90 minutes, but the risk of myopathy increases over time.

Recovery from this combination is typically quite smooth. Animals usually roll into sternal recumbency and stand when they are ready. This may take up to 45 minutes after 1 hour of anesthesia. In field situations, side lines attached from the halter may be used to facilitate a smooth recovery.

Supportive care becomes more vital if equine anesthesia is >15 minutes in duration. Generally, blood pressure is well maintained in horses anesthetized with the XKG mixture. Hypoxemia is the major complication encountered with this technique and attention must be given to appropriate oxygenation and padding.

Monitoring and supportive care during field anesthesia

The major complications encountered during equine field anesthesia are hypoxemia and post-anesthetic myopathies and neuropathies. Volatile anesthesia is often associated with hypotension, but this is a rare complication with injection techniques. Careful attention should be given to protecting pressure points over the shoulders or hips and, when possible, padding should be placed under these areas. Halters should be removed during anesthesia to reduce the likelihood of facial nerve paralysis and care must be taken to ensure that the eyes are well-lubricated and that the down eye is protected. A Doppler flow meter and a blood pressure cuff may be used on the tail to facilitate heart rate and blood pressure monitoring.

Hypoxemia and hypoventilation are commonly encountered during field anesthesia. Hypoxemia tends to progress over time and its treatment becomes more crucial with longer procedures. A pulse oximeter is useful for monitoring hypoxemia and facilitating titration of supplemental oxygen. The pulse oximeter probe is typically placed on the tongue in the horse. Supplemental oxygen should be considered with any saturation <90% and should always be used if saturation drops to <85%. An ambulance-type flow meter (Easy Reg[®] Precision Medical, Inc.) is sturdy and easy to use in the field. These regulators can be purchased at any ambu-

Figure 1: Nasal insufflation of oxygen under field conditions



lance supply company. Aluminum E-cylinders are lightweight for field use, but steel cylinders may also be used. Supplemental oxygen can be delivered via a nasal cannula. The tip of the cannula is advanced via the nostril to the level of medial canthus of the eye. A flow of 10–15 liters/minute of oxygen is delivered via the nasal catheter. If a pulse oximeter is used, the flow can be adjusted down to the lowest flow required to maintain >95% hemoglobin saturation. Typically, a flow of 8–10 L/min is required (Figure 1). Oxygen should be available during any field anesthesia and it should be used in any procedure of >20 minutes.

Breed-specific considerations

The doses described above are applicable to most horse breeds, but donkeys and mules tend to require significantly higher anesthetic doses to achieve an effective level of sedation.² As a general rule, dosages should be increased by approximately 50% (ie, 1.5 mg/kg of xylazine). Muscle relaxation is typically poor following ketamine administration. The concurrent administration of diazepam will greatly improve muscle relaxation.

Draft breeds experience a more profound effect from tranquilizers and sedatives. If alpha-2 agonists are administered at the doses described in Table 1, the animal may become recumbent prior to ketamine administration. This is particularly undesirable if the intent is to induce standing sedation. As a general rule of thumb, the dose of alpha-2 agonist can be decreased by 25%–50% in draft breeds. Typically, we administer 50% of the dose in Table 1 and titrate up to 75%, based on the degree of sedation, as evident by head drop, and the degree of muscle relaxation, based on wobbling and buckling

of the legs. Once the desired degree of sedation has been achieved, the horse is induced to anesthesia with diazepam-ketamine.

Anesthesia of foals

Sick foals can be a major challenge to anesthetize. Experienced personnel with appropriate anesthetic and monitoring equipment should perform anesthesia on these young animals. Usually, very young foals are not fasted, while foals >3 months of age may have food withheld for 4-6 hours prior to anesthesia.² Very young foals (<3 months old) tend to experience profound sedation from alpha-2 agonists. Since young animals are dependant on maintaining their heart rate to preserve cardiac output, alpha-2 agonists are typically avoided because their administration is associated with bradycardia and decreased cardiac output. Foals aged <3 months can be deeply sedated with a combination of 0.05-0.1 mg/kg of diazepam IV, followed by 0.025 mg/kg of butorphanol IV. This combination will often induce recumbency. If a light degree of sedation is required, the diazepam-butorphanol can be followed with 2-4 mg/kg of ketamine IV.

Standing sedation

Equine sedation is typically achieved with intravenous administration of an alpha-2 agonist alone or combined with an opioid. As with pre-anesthetic administration, the choice of the alpha-2 agonist is usually based upon personal preference and experience with the drug. One of the major factors influencing drug choice is duration of action. Detomidine and romifidine are both longer acting than xylazine. If a prolonged duration of sedation is required, an infusion technique may be the best option. Romifidine induces less head drop than detomidine or xylazine. Some practitioners find this

desirable for dental procedures. Sedative dosages are shown in Table 2.

Administration of an alpha-2 agonist alone may not provide sufficient sedation for some procedures, particularly hind-limb or distal-limb procedures. Combination with an opioid analgesic will induce neuroleptanalgesia and more profound sedation and analgesia. Butorphanol is typically used for this purpose. To avoid excitement, it should be administered after sedation has been induced with an alpha-2 agonist. Morphine (0.15 mg/kg) may also be used in combination with an alpha-2 agonist.² It should be administered by slow IV injection and the horse should be monitored for excitement for up to 2 hours post-administration. Excitement may manifest as increased locomotor activity or anxiety. If excitement is observed, it can be treated with acepromazine or additional alpha-2 agonist.

Acepromazine can also be used in combination with alpha-2 agonists and opioids to potentiate sedation. Most avoid its use in stallions because there is a risk of priapism or penile injury.³ If acepromazine is used to potentiate sedation, caution must be exercised, since the horse can become ataxic.

In some situations, prolonged sedation may be desirable. Detomidine can be administered as an infusion to produce standing sedation for several hours.⁴ The horse is initially sedated with 10 µg/kg of detomidine and 0.02 mg/kg of butorphanol. The infusion is often initiated at 0.3-0.5 µg/kg/min for the first 15-30 minutes and tapered to 0.15 µg/kg/min for maintenance. The practical way to achieve the maintenance dose is to add 50 mg of 1% detomidine to 495 mL of saline, which results in a concentration of 100 µg/mL. In the average 500 kg horse, the infusion is initiated at 2.5 mL/min for the first 15 min, tapered to 1.5 mL/min for the next 15 minutes, and maintained at 0.5-1 mL/min.

Table 2: Drug combinations for standing sedation of horses

Mild sedation (IV)	Moderate sedation (IV)	Profound sedation (IV)
Xylazine 0.5 mg/kg	Combine any drug in column 1 with butorphanol 0.025 mg/kg	Add acepromazine 0.025 mg/kg to any of the previous alpha-2 agonist + butorphanol combinations or administer detomidine-butorphanol and initiate a detomidine infusion at a dose of 0.3-0.5 µg/kg/min for the first 15-30 minutes. Followed by 0.1-0.2 µg/kg/min for maintenance
Detomidine 10 µg/kg		
Romifidine 50 µg/kg		

On occasion, it may be necessary to use intramuscular (IM) sedation in fractious horses. This may be delivered via remote delivery equipment, such as a blow dart or pole syringe. In this situation, a combination of 20–40 µg/kg of detomidine plus 0.1–0.2 mg/kg of morphine ± 0.025 mg/kg of acepromazine is often sufficient.² After the drugs have been administered, the horse should be observed from a distance for 15–20 minutes until the drug has taken full effect. Even if they appear to be very sedated, fractious horses should always be approached with a great degree of caution.

Equine analgesia

Provision of appropriate analgesia is an important consideration during, and following, any surgical procedure. A variety of techniques may be considered and, typically, several techniques used together will produce the best results. The concept of “balanced analgesia” incorporates the use of analgesics with different mechanisms of action to treat pain via multiple mechanisms. The use of balanced analgesic techniques has been shown to be beneficial in many species.

Intraoperative analgesia

All of the anesthetic techniques described above will provide a degree of analgesia. Alpha-2 agonists are potent analgesics. Ketamine will provide additional somatic analgesia. However, the use of alpha-2 agonist/ketamine combinations alone may not provide sufficient analgesia for invasive procedures. Butorphanol is synergistic with alpha-2 agonist drugs and enhances sedation and analgesia when used in combination with alpha-2 agonists. Butorphanol is useful in the intraoperative and immediate postoperative period. Even with the addition of butorphanol, it is not uncommon to see some response during painful manipulations under light anesthesia. Local anesthesia is a good option to provide excellent intraoperative and postoperative pain control.

Local anesthesia

It is beyond the scope of this article to provide a complete discussion of local anesthetic techniques and, therefore, this section will focus on general principles and common techniques. Local anesthetic techniques should be used whenever possible during field anesthesia. Lidocaine HCl and mepivacaine

are commonly used for equine anesthesia. Mepivacaine has approximately twice the duration of lidocaine neat (without epinephrine) and will last for ≥2 hours. The simplest way to administer local anesthesia is by infiltration, performed either on the edges of an existing wound or into the field of a surgical site.

This technique can be used to enhance surgical anesthesia during castration. The scrotum is infiltrated with 5–10 mls of local anesthetic at each incision site to provide anesthesia during scrotal incision. Once the testicular cords are exposed, they can be infiltrated with 2–3 mLs of local anesthetic to enhance analgesia during emasculation. This technique is beneficial and will help to maintain a good level of surgical anesthesia, although animals may still respond during testicular traction.

Epidural anesthesia is useful for standing procedures on the perineum or tail. Anesthesia can be accomplished with a local anesthetic alone at a dose of 1 mL/100 kg of 2% lidocaine or mepivacaine,² or with a combination of lidocaine (0.66 mL/100 kg) and xylazine at a dose of 0.17–0.22 mg/kg.² The lidocaine-xylazine has the benefit of a longer duration of action and possibly less risk of recumbency. Epidural “analgesia” can be provided by injection of 0.1 to 0.2 mg/kg of morphine into the epidural space. Morphine and sodium chloride are mixed to a volume of approximately 30 mLs in the mature horse. This is administered by slow injection into the epidural space. Epidural morphine will induce analgesia of the perineum, flank, forelimbs, and hindlimbs. Analgesia will last for 12–24 hours. A more complete discussion of epidural anesthesia and analgesia can be found in the following references.^{2,3}

Postoperative analgesia

All of the above techniques will extend into the immediate postoperative period. Field anesthesia is typically used for minor surgical procedures and, in general, postoperative analgesia should be provided for 24–48 hours. Nonsteroidal anti-inflammatory drugs (NSAIDs) are generally used to provide postoperative pain control. In Canada, several options are available: Flunixin meglumine (Banamine®) 1 mg/kg IV or IM, or ketoprofen 2 mg/kg IV can be used if an injectible drug is desired, while phenylbutazone 2–4 mg/kg is a good choice for oral administration. A complete discussion of equine analgesia can be found in the following references.^{2,3}

Conclusion

Equine anesthesia is always a challenge even in the most controlled situations. Anesthesia under field conditions presents even greater challenges. Appropriate patient selection, a careful anesthetic plan, close monitoring, and the provision of supportive care, all help in decreasing the risks of morbidity or mortality during equine field anesthesia.

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References

1. Johnston GM, Eastment JK, Taylor PM, Wood JLN. The confidential enquiry of perioperative equine fatalities (CEPEF-1): mortality results of phases 1 and 2. *Vet Anaesth Analg* 2002;29:159-170.
2. Doherty T, Valverde, A, eds. *Manual of Equine Anesthesia and Analgesia*. Ames, IA: Blackwell Publishing; 2006.
3. Taylor PM, Clarke KW, eds. *Handbook of Equine Anaesthesia, 2nd Edition*. Philadelphia, PA: Saunders Elsevier; 2007.
4. Wilson DV, Bohart GV, Evans AT, et al. Retrospective analysis of detomidine infusion for standing chemical restraint in 51 horses. *Vet Anaesth Analg* 2002;29:54-57.

Abstract of Interest

Comparison of morphine and butorphanol as pre-anaesthetic agents in combination with romifidine for field castration in ponies.

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OBJECTIVE: The aim of this study was to compare two different alpha-2 agonist-opioid combinations in ponies undergoing field castration.

STUDY DESIGN: Prospective double-blind randomized clinical trial.

ANIMAL POPULATION: Fifty-four ponies undergoing field castration.

MATERIALS AND METHODS: The ponies were randomly allocated to receive one of three different pre-anaesthetic medications [intravenous (IV) romifidine 100 microg kg(-1) and butorphanol 50 microg kg(-1); romifidine 100 microg kg(-1) and morphine 0.1 mg kg(-1) IV, or romifidine 100 microg kg(-1) and saline IV] before induction of anaesthesia with ketamine 2.2 mg kg(-1) IV. Further doses of romifidine (25 microg kg(-1)) and ketamine (0.5 mg kg(-1)) were given when required to maintain anaesthesia. Quality of sedation, induction of anaesthesia, maintenance of anaesthesia, recovery, and surgical condition were assessed using a visual analogue scale scoring system and compared. The

effects of the different drug combinations on heart and respiratory rate were evaluated and the recovery time was recorded.

RESULTS: Anaesthesia was considered adequate for surgery in all ponies. No anaesthetic complications were observed. Quality of sedation was significantly better in the butorphanol group compared with the control group ($p=0.0428$). Overall quality of anaesthesia was better in the butorphanol group compared with morphine ($p=0.0157$) and control ($p<0.05$) groups. Quality of induction of anaesthesia and recovery were not significantly different between groups, nor were the surgical conditions, recovery time and the number of repeated anaesthetic doses required during the procedure. Muscle twitches were observed in both the control and morphine groups. Maintenance of anaesthesia was judged to be smoother in the butorphanol group compared with the morphine and control groups ($p=0.006$). Heart rate decreased significantly ($p<0.01$) in all groups after administration of sedatives but did not differ significantly between groups at any time point.

CONCLUSION: The combination of butorphanol and romifidine was found to provide better sedation compared with the other drug combinations.

CLINICAL RELEVANCE: The combination of butorphanol and romifidine provided better sedation, but morphine was found to be a suitable alternative to butorphanol. Use of morphine and butorphanol in combination with alpha-2 agonists should be further investigated to assess their analgesic effects.

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