FOAL ANESTHESIA
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Key Points:
- Foals are physiologically different from adult horses, which affects drug metabolism and distribution.
- Small animal anesthesia equipment is required for foals.
- Underlying disease in young foals must be carefully considered.
- “Hypos” (hypothermia, hypoventilation, hypoglycemia, hypotension) should be avoided.

The risk of anesthetic mortality in horses overall is 1%; this risk is greater in foals less than 6 months of age and greater yet in foals less than 1 month of age. Physiologic differences between adult horses and foals include: a higher percentage of body water (with resultant hypoalbuminemia), immature regulation of body temperature, glucose metabolism, immature renal and hepatic capacity, immature sympathetic nervous system and a high metabolic rate. Additionally, foals are dependent on heart rate to maintain cardiac output and have low body fat. Obviously, these physiologic differences will be greater in very young foals (< 1 month of age) compared to older foals (> 1 month of age).

It is not typical to anesthetize very young foals (< 1 month of age) unless they have a life-threatening problem (eg, ruptured bladder), so the underlying problem must be carefully evaluated. Hyperkalemia associated with uroabdomen must be stabilized before anesthesia and surgery proceed. In my experience, anesthetizing a foal with a serum potassium > 6 meq/dl is likely to be associated with serious arrhythmias or cardiac arrest, so preanesthetic management and fluid therapy is critically important. Even when properly stabilized prior to surgery, these foals will be at higher risk since they are more immature than an older patient. Older foals (3-6 months of age) are most commonly anesthetized for correction of orthopedic problems; they are usually healthy and much more mature. So, it is important to distinguish between very young and not so young foals when choosing the anesthetic protocol and management techniques. Pre-operative evaluation should also be thorough especially when congenital problems are apparent. Are you sure this foal is not positive for hyperkalemic periodic paralysis (QH, paints) or doesn’t have a collapsing trachea (most common in dwarf or miniature horses)?

Foals < 114 kg will require small animal anesthesia equipment; catheters, syringes, needles, endotracheal tubes and anesthesia machine. Small animal monitoring equipment (ie, non-invasive blood pressure) is very useful as are warming devices appropriate for small animals. It is also important to get an accurate weight (not just an estimate) to facilitate accurate drug dosing.

Foals < 1 month of age

My preference is usually to mask induce foals of this age with sevoflurane or isoflurane. I will generally premedicate with glycopyrrolate (0.005 mg/kg IM) to prevent bradyarrhythmias in very young foals. If sedation is needed, diazepam (0.1-0.2 mg/kg)
or midazolam (0.1-0.2 mg/kg) can be given IV or IM and will not produce excessive cardiovascular depression which might be seen with xylazine or detomidine.

If possible we usually like to bring the mare to the induction stall with the foal so that the foal is not agitated about being separated from mom. The mare can then be sedated and returned to her stall after induction of the foal.

Older foals (> 1 month)

If older foals are sick, mask induction with inhalants may still be indicated, but this technique becomes dangerous with larger, healthy foals. If older foals have not been handled, premedication with acepromazine (0.025 mg/kg), xylazine (0.4-1 mg/kg) or detomidine (0.005-0.01 mg/kg) can be given IM to facilitate further handling. Detomidine can also be given orally and has been shown to be absorbed when given at twice the usual IV dose.

It is not clear at what age a foal’s ability to metabolize drugs becomes fully competent and when they cease to be heart rate dependent. Clinically, we use a reduced dose of xylazine (0.4 mg/kg IV) with diazepam (0.1 mg/kg IV) and ketamine (2.2 mg/kg IV) for foals 1-2 months of age. Between 2-4 months of age, we increase the xylazine dose to 0.6 mg/kg IV and decrease the diazepam dose to 0.06 mg/kg while the ketamine dose remains the same. Healthy foals older than 4 months are induced with adult doses of xylazine (1.1 mg/kg, IV), diazepam (0.04 mg/kg, IV) and ketamine (2.2 mg/kg, IV).

Propofol (2.0 mg/kg IV) is another drug which can be used for induction of anesthesia in foals, following premedication with xylazine (0.4 mg/kg IV). A propofol infusion (0.2 mg/kg/min) can be used for maintenance of anesthesia; recoveries will be fairly rapid in foals as opposed to prolonged recoveries seen with the combination of guaifenesin-xylazine-ketamine in foals.

Monitoring and intraoperative support

Foals should be monitored very carefully because depth of anesthesia changes more rapidly than in adult horses; the time constant is smaller as the product of a smaller patient and smaller anesthesia circuit. Normal values for heart and respiratory rates and blood pressure are also different from adult horses. We consider normal heart rate to be 60-80 bpm in most foals while a mean blood pressure of 50 mm and greater is acceptable (although not optimal). Most foals need to be actively ventilated to prevent hypoventilation; respiratory rates of 12-15 bpm and tidal volumes of 12-15 ml/kg are needed to blow off the CO2 produced by their higher metabolic rates.

Direct blood pressure can be monitored as in adult horses but it is often very difficult to catheterize their smaller arteries; non-invasive blood pressure monitors (with cuff placed on tail or let) seem to be accurate enough to allow for trending of anesthetic depth. Hypotension should be treated as in adult horses; fluid administration, adjusting anesthetic depth and the use of inotropes or colloids may be indicated.

Maintenance of body temperature is important since a foal (especially one with open body cavity) will become hypothermic more rapidly than an adult horse. Hypothermia will decrease the MAC-value for inhalants by 5% for each degree Celsius. Blood glucose concentration should be checked in very young foals or foals which have been “off feed” to ensure that hypoglycemia doesn’t occur; fluids can be supplemented with 2.5% or 5% glucose if the foal is hypoglycemic.
Recovery from anesthesia

Recovery is usually fairly rapid if good intraoperative support has been provided. Most foals can be hand recovered and the endotracheal tube can be removed when a good swallow reflex is present. The mare can be returned to the recovery box as soon as the foal is standing and should be watched to make sure she re-accepts the foal; the foal may still smell of residual inhalant anesthetic, but usually this does not seem to cause a problem. Butorphanol (0.05 mg/kg IV or IM) can be used to provide analgesia when necessary. Some sedation may occur. Little information is available about other analgesics.