Compendium

Management of Zebras and Zebra Hybrids (Zebroids)

Ellen B. Wiedner, VMD, DACVIM*
William A. Lindsay, DVM, DACVS
Ringling Bros. and Barnum & Bailey Center for Elephant Conservation
Polk City, Florida

Ramiro Isaza, DVM, MS, MPH, DACZM
University of Florida

Abstract: *Equine practitioners are sometimes asked to treat zebras or zebra-horse or zebra-donkey hybrids. Although these equids are subject to many of the same health issues as domestic horses, they cannot be handled like horses and generally require heavy sedation to full anesthesia, even for minor procedures. This usually necessitates the use of ultrapotent narcotics administered by remote delivery systems. This article discusses the handling, sedation, anesthesia, and common medical issues of zebras and zebra hybrids.*

Three of the eight species of wild equids are zebra species.[1] All zebra species are native to Africa and are distinguishable by their size and striping patterns. Because zebra taxonomy is controversial, to avoid confusion, this article uses the three common group names: plains zebra, Grevy's zebra, and mountain zebra (**TABLE 1**).

*Dr. Wiedner is now affiliated with the University of Florida.

Grevy's zebras are the largest, weighing 300 to 400 kg, and are recognizable by their elongated ears and very fine stripes. Mountain zebras weigh 250 to 350 kg and have a dewlap and crisscrossed stripes on their rumps. Plains zebras are the smallest, weighing 200 to 300 kg, and have thick stripes and a dark muzzle. Grevy's and mountain zebras are endangered.[2]

Although wild and domestic equids have very different numbers

Table 1. Common and Scientific Names of Zebra Species

Group	Common Name(s)	Currently Accepted Taxonomy	Older Published Name(s)
Mountain zebra group Two species; no subspecies	(Cape) Mountain zebra	*E. zebra*	*E. zebra zebra*
	Hartmann's zebra	*E. hartmannae*	*E. zebra hartmannae*
Plains zebra group One species; six subspecies	Grant's zebra	*E. quagga boehmi*	*E. burchelli boehmii*
	Burchell's zebra (Damara zebra)	*E. quagga burchelli*	*E. burchelli antiquorum*
	Crawshay's zebra	*E. quagga crawshayi*	*E. burchelli crawshayi*
	Quagga[a]	*E. quagga quagga*	*E. quagga*
	Chapman's zebra	*E. quagga chapmanni*	*E. chapmani*
	Selous' zebra	*E. quagga borensis*	*E. borensis*
Grevy's zebra group One species; no subspecies	Grevy's zebra	*E. grevyi*	*E. grevyi*

[a]*Quagga* has historically been used to refer to an extinct species of wild equid. The quagga is now thought to be the extinct subspecies *E. quagga quagga*, which is closely related to the neighboring (and living) subspecies *E. quagga burchelli*.
E. = Equus

Table 2. Number of Chromosomes in Wild and Domestic Equine Species

Species	Number of Chromosomes (2n)
Domestic horse	64
Przewalski's horse	66
Grant's zebra	44
Donkey	62
Grevy's zebra	46
Mountain zebra	32
Asiatic wild ass	54 or 56

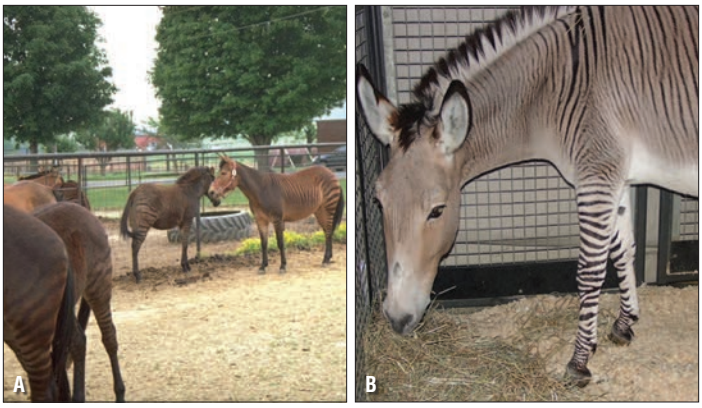

Figure 1. Commonly encountered zebroids: (**A**) zorses (from a plains zebra bred with a domestic horse) and (**B**) a zedonkey (from a Grevy's zebra bred with a donkey).

of chromosomes (**TABLE 2**), all equine species can interbreed.[3] The resulting crosses—called *semiwild equids*, *zebroids*, or *zebra hybrids*—have been used as draft and riding animals and for exhibition (**FIGURE 1**). Usually sterile, they are commonly the offspring of a zebra stallion and a horse or donkey mare. The reciprocal cross (i.e., a zebra mare and a horse or donkey stallion) is rare and may not be fertile either.[4] Zebroid monikers blend the name of the sire species with the dam species. By convention, the sire's name comes first (e.g., zorse [zebra sire and a horse dam], zedonkey [zebra sire and a donkey dam]).[5]

Behavior

Zebras and zebroids generally become intractable by puberty. The behavior change can be abrupt, shocking inexperienced owners who have become used to an affectionate foal. Bottle-raised animals seem especially likely to become aggressive. Equine practitioners should be aware that zebras are generally unsuitable as pets and should not be handled by children, contrary to suggestions in movies and other media.

Nevertheless, some training of these animals is possible, as shown by their use in circuses and films. Some zebras and zebroids have been taught to enter stalls, chutes, and trailers and to accept specific nonpainful medical procedures without prior sedation.[6] Even with training, however, all these animals can be highly volatile, with a propensity for intense and unpredictable reactions that can lead to severe physical trauma of these animals—an unfortunately common cause of their death.[7] Collisions with fencing can cause skull and vertebral fractures; skidding and falling can result in long-bone fractures and soft tissue injuries. If herdmates also spook and stampede, the consequences can include major property damage, multiple injured animals and humans, and even fatalities. Although generally calmer than zebras, most zebroids are far wilder than domestic equids and prone to startle.

In general, all veterinary procedures, particularly painful ones, are highly alarming to zebras and zebroids. This precludes hand injection of any drugs. Physical or manual restraint is equally inadvisable, except for use in young foals. Equine chutes and stocks should be used only if the animals have been specifically trained to enter them.

Thus, most veterinary work on wild equids requires full anesthetization using ultrapotent narcotics by remote delivery techniques known as *darting*. In certain situations, standing sedation is possible using heavy doses of α_2-agonists and butorphanol, also administered by remote delivery systems.

Darting, Sedation, and Anesthesia

Equipment

All remote delivery systems consist of a projector and a dart[8] (**TABLE 3**). Pole syringes and jab sticks are not recommended for zebras. Projectors include blowpipes, compressed-gas projectors (blowguns), and powder charge–powered rifles. Blowpipes are hollow, narrow tubes with a mouthpiece. Compressed-gas projectors, which are available as pistols or rifles, have an attached hand trigger and are powered by carbon dioxide from a connected canister or by compressed air delivered via a foot pump. Powder-charged rifles use 22-caliber blanks of varying strengths and are best for long-range use. Local firearms regulations may apply to powder charge–powered equipment but generally do not apply to compressed-gas projectors or blowguns.

Different projectors require specific darts. The most commonly used darts are powder explosive-powered darts and two-chambered compressed-gas darts. Both dart types have an anterior chamber to hold the drugs and a posterior chamber containing either an explosive cap and weighted firing pin (for the powder-explosive type) or a valve to retain the compressed air. A tailpiece improves the dart's aerodynamics. Darting needles must be appropriate for the projector type and the animal's anatomy. Equine species are preferably darted in the heavy thigh musculature. The pectoral muscles and lateral neck are riskier because of their proximity to the head and the major vessels. The thorax and abdomen should be avoided. For adult zebras and zebroids, 16- or 18-gauge, 1.0- or 1.5-inch needles are recommended.

Before each use, the equipment's functionality should be checked. On systems with gauges, the firing pressure must be adjusted to the minimum force necessary to discharge the dart. Severe tissue trauma and even bone fractures can result from inappropriate dart selection and excessive impact force.

Table 3. Comparing Remote Projector Systems

Projector Type	Characteristics	Cost	Advantages	Disadvantages
Blowpipe	Pipe with a mouthpiece	$	Very accurate; results in minimal tissue trauma; silent	Maximum range of 10 m; risk to operator from dart leakage when using ultrapotent narcotics
Gauged, compressed-air blowgun	Pistol or rifle models available; foot pump or compressed-gas canister models available	$$$$	Variable range; accurate	Complicated to use
Nongauged, compressed air– powered gun	Pistol or rifle models available; usually powered by carbon dioxide	$$	Simple to use	Does not allow control of pressure, so it is prone to causing significant tissue trauma when used at short range
Gunpowder– powered rifle	Powered by 22-caliber blanks	$$$	Reliable and versatile	Cannot be used at short range; subject to local regulations regarding firearms

Regardless of the system chosen, the practitioner should be comfortable with its use through sufficient practice. Continuing education courses on darting are available through private companies and veterinary conferences. Equine practitioners may benefit from establishing relationships with zoo and wildlife veterinarians experienced in these techniques. In turn, these veterinarians may appreciate the knowledge that an equine clinician can share.

Darting

The darting area should be inspected and cleared of hazards, such as uneven ground, debris, and pools of water. Fencing should be secure. Nonessential personnel should leave the area. Preferably, the darting enclosure should be no larger than a standard round pen to limit the animal's running once it is darted. A dark, quiet, empty stall is ideal. This is important for keeping a darted animal from escaping and for preventing capture myopathy. Capture myopathy clinically resembles exertional rhabdomyolysis and is treated similarly. It can develop immediately or up to 2 weeks after capture or handling. The etiology is poorly understood, and unfortunately, even with aggressive therapy, fatalities are common.[9]

After the dart is fired, the veterinarian should determine that the dart is lodged adequately in the animal's muscle and has discharged its contents completely. The dart usually falls out on its own but can be removed once sedation takes effect, usually within 20 to 25 minutes. Premature handling can awaken the animal, overriding much of the drug's effect. Sedation can also fail because of incomplete discharge of the dart's contents, underdosing due to underestimation of the animal's weight, or excessive agitation of the animal.

The animal's exposure to noise and other kinds of external stimulation should be minimized: blindfolds and earplugs crafted from rolled-up gauze squares can be applied to the animal after sedation. A portable oxygen tank with tubing can facilitate administration of nasal oxygen, which should be provided at a rate of 10 to 15 L/min. Battery-powered pulse oximeters, capnographs, and electrocardiograph machines enable additional monitoring. The patient's temperature, pulse, and respiration should be checked frequently. Hypothermia and hyperthermia should be treated promptly.[10] If possible, darting should be avoided during the heat of the day.

Whatever the reason for the sedation, the clinician should use the opportunity to perform an overall health assessment. At a minimum, the skin should be checked for parasites and sarcoids (the most common tumor in zebras),[11] the joints flexed, the hooves inspected, and the oral cavity and mucous membranes visualized. The examination should be efficient without unduly prolonging the anesthesia.

Ultrapotent Opioids

Full immobilization of zebras and zebroids is difficult and not advisable without the use of ultrapotent opioids, which include etorphine (formerly M-99) and carfentanil. Etorphine is preferred for use in zebras and can be helpful in zebroids.[12,13] *Immobilization* refers to establishment of a moderate surgical plane of anesthesia in a field situation and *not* to the use of muscular depolarizing agents, which are inappropriate as anesthetics in wild animals. The federal government categorizes ultrapotent opioids as Schedule II narcotics, which require special licensing by the Drug Enforcement Agency (DEA) and are subject to additional regulations regarding purchase, storage, and use compared with Schedule III narcotics, which most practitioners have approval to use under their DEA license.[14]

Ultrapotent opioids should be administered in combination with α_2-agonists to facilitate induction and anesthesia[15] (**TABLE 4**). Adverse effects of ultrapotent opioids include excitation, tremors, thermoregulatory difficulties, ileus, severe respiratory depression or arrest, bradycardia, tachycardia, and renarcotization.

With the use of etorphine mixtures, anesthesia of zebras lasts generally less than 1 hour. If additional time is needed, the animal can be intubated and maintained on gas anesthesia or supplemented with intravenous ketamine or propofol.[16] When procedures are completed, ultrapotent narcotics should be reversed with naltrexone or naloxone even if the animal awakens naturally.[17] Reversing other sedatives used for the procedure may also be

Table 4. Drug Doses for Immobilization and Standing Sedation and Their Reversal in Zebras and Zebroids

Use	Drug Combination	Zebra Dose	Zebroid Dose	Route	Antagonist Dose	Route	Notes	Reference(s)
Standing sedation	Detomidine plus butorphanol	0.1 mg/kg 0.01 mg/kg	— —	IM	2 mg atipamezole per 1 mg detomidine 5 mg naltrexone[a] per 1 mg butorphanol[b] or naloxone[c] 0.01 mg/kg	IV, IM IV, IM IV	• May need to administer in two darts • Used in Grevy's zebras • Authors[d] have used this in Grant's zebras • Reversal may not be needed	20 17, Plumb[h]
Standing sedation	Detomidine plus butorphanol	— —	0.05–0.1 mg/kg 0.05–0.1 mg/kg	IM	2 mg atipamezole per 1 mg detomidine 5 mg naltrexone per 1 mg butorphanol or naloxone 0.01 mg/kg	IM IM	• May need to administer in two darts • Reversal may not be needed • Used in calm, trained zebroids • This dose is too low for zebras	Authors[d]
Standing sedation	Detomidine plus butorphanol plus acepromazine	0.15 mg/kg 0.07–0.1 mg/kg 0.15–0.25 mg	— — —	IM	2 mg atipamezole per 1 mg detomidine 5 mg naltrexone per 1 mg butorphanol	IM IM	• May need to administer in two darts • Reversal may not be needed • Used in calm plains zebras	Authors[d]
Immobilization	Etorphine[e] plus detomidine	0.01–0.015 mg/kg 0.03–0.05 mg/kg	Same Same	IM	25 mg naltrexone per 1 mg etorphine 2–5 mg atipamezole per 1 mg detomidine	IM IM	• May need to administer in two darts • Used in plains and Grevy's zebras and zebroids • Ultrapotent (class II opioid; risk of renarcotization; safety risks for clinicians)	Authors[d]
Immobilization	Etorphine plus acepromazine plus xylazine	0.01 mg/kg 0.05 mg/kg 0.1 mg/kg	— — —	IM	25 mg naltrexone per 1 mg etorphine 1 mg atipamezole per 10 mg xylazine	IM IM	• Ultrapotent opioid (class II opioid; risk of renarcotization; safety risks for clinicians)	Plumb[h], Wiesner[i]
Immobilization	Etorphine plus medetomidine[f]	0.01 mg/kg 0.08–0.1 mg/kg	— —	IM IM	25 mg naltrexone per 1 mg etorphine 2 mg atipamezole per 1 mg medetomidine	IM IM	• Ultrapotent opioid (class II opioid; risk of renarcotization; safety risks for clinicians) • Recommend concentrated medetomidine • Used in Grevy's zebras	Authors[d]
Prolongation of anesthesia	Propofol[g]	0.3–1.1 mg/kg (0.005 mg/kg/sec)	—	IV	None	—	• Risk of apnea; may need to ventilate • Used in Grevy's zebras	16
Prolongation of anesthesia	Ketamine	Boluses (100–200 mg)	Same	IV	None	—	—	25, Wiesner[i], Authors[d]

[a]Naltrexone HCl, ZooPharm, Fort Collins, CO.

[b]Naloxone HCl (ZooPharm, Fort Collins, CO) can be used in place of naltrexone for reversal: 25 mg naloxone per 1 mg etorphine.

[c]Naloxone HCl, ZooPharm, Fort Collins, CO.

[d]Ellen Wiedner, VMD, DACVIM ; William A. Lindsay, DVM, DACVS; Ramiro Isaza, DVM, MS, DACZM.

[e]Etorphine HCl, ZooPharm, Fort Collins, CO.

[f]Medetomidine HCl (10 mg/mL or 20 mg/mL), ZooPharm, Fort Collins, CO.

[g]PropoFlo (propofol), Abbott Animal Health, Abbott Park, IL.

[h]Plumb DC: *Veterinary Drug Handbook*. 6th ed. Hoboken, NJ: Wiley-Blackwell; 2008.

[i]Wiesner H. Chemical immobilization of wild equids. In: Fowler ME, ed. *Zoo and Wildlife Medicine*. 3rd ed. Philadelphia, PA: WB Saunders; 1993:475-476.

Box 1. Safety Precautions When Using Ultrapotent Narcotics

Before darting

- Don protective gear: face shield or goggles, rubber gloves or two pairs of latex gloves, long sleeves, and long pants.
- Review safety protocols and contents of the emergency kit with a teammate.
- Confirm availability of naltrexone/naloxone on premises. Naltrexone is usually preferred for human emergencies.
- Alert nearby personnel that a dart is being filled. Fill the dart just before use.
- Consider using a portable glove box when loading darts or needles.
- Use safe handling techniques when loading syringes or darts.
- Discard used syringes and needles immediately into a sharps container. Do not recap needles.
- Once a dart has been filled, hold it facing upward and away from yourself. Cover the tip of the dart with an empty syringe case. Never point a filled dart, a needle, or a loaded dart gun toward yourself or anyone else.

During procedures

- Do not use blowpipes to deliver ultrapotent narcotics.
- Don rubber gloves or two pairs of latex gloves before retrieving a used dart and needle. Avoid touching the needle.
- Use a marking device to draw a circle around the area of penetration on the immobilized animal. Caution personnel not to touch the circled area unless wearing gloves.
- Be prepared to contact 911 or other emergency medical personnel if accidental human exposure occurs.

Cleanup

- Separate the needle and the dart using hemostats.
- Store the needle in saline until it can be resterilized.
- Flush the dart with a copious amount of saline, or discard the dart entirely in a sharps container.

Box 2. Regulatory Agencies That Oversee Zebras and Zebroids

International/Federal

Ownership and transport regulations of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) apply to *Equus grevyi* and *Equus zebra.*

Federal

All US Department of Agriculture regulations for domestic equids—including regulations for importation, interstate movement, quarantine, and exhibition—apply to wild and semiwild equids.

State

All state-specific regulations for domestic equids apply. Minimum requirements for interstate movement include a current health certificate and a current negative Coggins test result. Testing for other diseases (e.g., piroplasmosis) and administration of specific vaccines are performed on a state-by-state basis.

Local

Zebras and zebroids may be designated as exotic hoof stock in some jurisdictions, requiring special permits or licenses for ownership. Local agencies may specify fencing, housing, and minimum space requirements. Identification of animals by microchip (which should be placed in the nuchal ligament under anesthesia) is often required.

desirable if possible. For the next 24 hours, the animal should be monitored for signs of renarcotization, which can result from either enterohepatic recirculation or delayed drug release from body fat into the blood.[18] Signs include pacing, head pressing, ataxia, tremors, and stupor. Respiratory arrest and death are also possible. Treatment requires additional doses of naltrexone or naloxone. Naloxone is less expensive but is shorter acting and often requires multiple doses, whereas naltrexone usually requires only a single dose. At this point, drugs can sometimes still be injected by hand, but ataxic zebras can be dangerous if they rouse suddenly or fall; therefore, remote injection may be preferred.

In humans, ultrapotent opioids can be rapidly fatal, and all accidental exposures are dangerous.[19] Signs of toxicosis can occur within 60 seconds of injection. Therefore, extensive safety precautions are needed when using these drugs (**BOX 1**). For example, it is essential to work with at least one other individual when handling ultrapotent opioids. Most zoologic facilities that use ultrapotent opioids have written emergency protocols and require team members to be trained in human cardiopulmonary resuscitation. If the drugs are ingested or injected, 911 should be called immediately. If skin contact occurs, the area should be copiously flushed with cool water. Before an animal is darted, practitioners should check that they have adequate amounts of the human opiate antagonist naltrexone in a first-aid kit. If accidental exposure occurs, instructions for using naltrexone in a person should be obtained from emergency medical personnel by calling 911.

Standing Sedation

Standing sedation, an alternative to immobilization, uses high-dose combinations of α_2-agonists and butorphanol. Although standing sedation avoids the safety and regulatory issues of ultrapotent narcotics and the risks of renarcotization, it is highly unpredictable. Complete and partial sedation failures are common, and the animal may become dangerously ataxic. Sedation failures are more likely with zebras that are older, dominant, stallions, agitated, or very painful. Redosing rarely helps and can precipitate dangerous adverse effects. Further attempts at sedation should involve an etorphine–α_2-agonist combination. Standing sedation should be limited to short, minor procedures in calmer animals.

Standing sedation often requires large drug volumes. Thus, the $\alpha_2$agent is usually injected first in one dart followed by butorphanol in a second dart, 10 to 15 minutes later.[20] Highly concentrated versions of butorphanol, medetomidine, and ketamine are available commercially. These formulations are expensive, but the advantages

of using a single, low-volume dart can be worth the cost. Reversal agents can be given if desired, but recovery without reversal usually occurs within 60 to 90 minutes.

Routine Care

Regulatory Issues

Zebras and zebroids are regulated at all levels of government. At a minimum, these animals are subject to any laws governing domestic horses. The regulatory agencies that oversee zebras and zebroids are listed in **BOX 2** .

Transport

Transporting sedated animals is not recommended. Standing sedation can help in loading animals for transport, but the drugs should be reversed before transit. Training animals for shipping can decrease their stress and risk of injury. Unhandled wild equids can be acclimated over several weeks to an open transport crate in their environment with food inside.[9]

Feeding and Housing

In the wild, zebras are grazers and eat while browsing. In captivity, feeding recommendations for domestic horses can be used. Pasture feeding, grass hay ad libitum, and low-protein equine pellets are appropriate feeds.[21] An equine salt or mineral block can be provided. Adequate dietary vitamin E and selenium are required because white muscle disease and equine degenerative myeloencephalopathy have developed in captive zebras.[22,23] Lack of pasture access is a risk factor for myeloencephalopathy and for obesity. Visual body condition scoring should be done periodically.[24] Access to pellets should be restricted in overweight animals. Poisonous plant matter, including wilted red maple leaves and acorns, has caused toxicosis in captive zebras.[25,26]

In warm environments, zebras can be kept outdoors in a fenced-in area with areas for shade and protection from inclement weather. In colder environments, a run-in shed that blocks wind and cold is needed at a minimum. Trained animals can be individually stalled in standard horse barns.

As herd animals, zebras and zebroids need equine companions. In zoos, they are generally pastured in small herds. Separating a zebra from its companion(s) or changing the herd structure can be extremely stressful for all animals.

New animals should be quarantined for at least 28 days.[27] Initial introductions should be visual only, with a sturdy fence separating new and established herd members. Both wild and captive zebras can show severe intraspecies aggression, especially following alterations in the herd or environment. Because of the hierarchical social system of zebras, some animals will never be accepted into an existing herd and will be constantly bullied. Zebra mares with foals are often targets of extremely violent attacks from herdmates, so separation of mares from the herd before foaling should be considered.[28]

Vaccinations and Anthelmintics

Because no vaccine data exist specifically for zebras, private owners and zoos usually follow recommended protocols for domestic horses in their area. Infectious diseases can spread from zebras to horses and vice versa, and most pathogenic organisms affecting domestic horses can cause clinical disease in captive zebras.[29] Vaccination against tetanus toxoid and eastern equine encephalitis is suggested at a minimum.[30,31] For transportation, states may have specific vaccination requirements, which are identical to those for domestic horses. Equine herpesvirus (EHV) types I and IV have caused disease and death in multiple captive zebra herds, and transfer of EHV from nonequine species to zebras has also occurred.[32] Thus, EHV vaccinations may sometimes be warranted. Vaccines can be administered with darting equipment.

Wild and domestic horses are also susceptible to the same parasites[33] and therefore require regular fecal examinations and deworming. Individual portions of oral horse dewormers or a daily medicated feed pellet containing ivermectin can be dosed according to the animal's presumed weight, mixed with feed, and

Figure 2. (**A**) Trimming a hoof of a fully anesthetized, blindfolded plains zebra. (**B**) Picking up a foot of an unsedated, well-trained zedonkey.

Figure 3. (A) Poor-quality hooves of a captive plains zebra. (B) Overgrown hooves of a captive, previously foundered plains zebra.

given to each animal separately.[34] Medicating large quantities of feed for multiple animals is not recommended because zebras eat according to rank, possibly resulting in under- and/or overdosing and toxicosis.[35]

Routine Blood Work

Blood can be drawn from the jugular, facial, medial saphenous, and cephalic veins in anesthetized animals. Laboratory values for complete blood counts and serum blood chemistries in zebras and zebroids are comparable to those of domestic horses.[36]

Foot Care and Wound Management

The hoof anatomy of zebras and zebroids is akin to that of domestic equids. However, zebras seldom require hoof trims as frequently as domestic horses. Aggressive reshaping and rasping should be avoided because they can cause lameness in zebras and zebroids. Varying ground substrates can help smooth hooves naturally, decreasing the need for trimming to once or twice annually. Anecdotally, captive Grevy's and mountain zebras require more frequent trimming. The foot angles of plains zebras differ from those of domestic horses: in plains zebras, front hoof angles measure 58° and hind hoof angles measure 55°.[37] Shoes are used rarely for fixing orthopedic problems. Most animals need anesthesia before trimming (**FIGURE 2**). Medical conditions of the hooves of zebras and zebroids are comparable to those of domestic horses (**FIGURE 3**).

Lameness can be difficult to assess because zebras cannot be trotted in hand, flexed, or hoof tested. Laminitis appears to be rare. Laminitic zebras tend to lie down frequently but rarely show the posturing typical of laminitic domestic horses.

Bandages, casts, sutures, and pads are often chewed off by patients or herdmates and are therefore difficult to maintain.[38] Wound healing by second intention is preferred when possible. Cold hosing of wounds may be tolerated. If sutures are needed, they should be buried, and bandaging should be minimized. Analgesics should be provided preemptively to animals with indisputably painful conditions (e.g., laminitis, trauma) because zebras rarely display clear signs of pain.

Dentistry

Zebras and horses share the same dental formulae. The frequency of dental disease in zebras is unknown.[39] Some zebras require annual floating; others require less. Floating requires anesthesia. Wolf teeth are not pulled unless pathology exists.

Reproduction

Male zebras reach puberty later than domestic horses. Permanent descent of the testicles occurs between 3 and 5 years of age, and spermatogenesis generally begins around 4 or 5 years of age.[40] However, some colts exhibit studdish behavior long before they are reproductively viable. Cryptorchidism is rare.[41] Rudimentary teats are often present cranial to the scrotum. These are normal and do not require removal. Captive zebras can be trained to ejaculate into an artificial vagina, although electroejaculation under anesthesia is more common.[42] Standard castration techniques can be used on fully anesthetized animals.

Female zebras, in contrast, reproductively resemble domestic mares in almost all regards. Artificial insemination and embryo transfer have been used in zebras. Equine species can carry extraspecific pregnancies, and both horse and donkey brood mares have successfully delivered implanted zebra embryos at term.[43] Dystocia appears to be uncommon.[44]

Neonates

Because zebras are sometimes bottle-fed from birth with the false hope of imprinting them on people, failure of passive transfer and its consequences are not infrequent. Colostrum from domestic horses appears to be safe and effective for use in zebras,[45] and foal replacer is generally well tolerated. Orphans should be given an animal companion (an equid is ideal, but small ruminants and camelids are also acceptable) and should be weaned from replacer around 4 to 5 months of age. Neonatal isoerythrolysis is unreported in zebra or zebroid foals. However, based on research on the blood groups of wild equids, crossmatching should be performed before plasma or blood transfusions.[46]

Medical and Surgical Issues

In general, zebras, zebroids, and domestic horses share the same health issues. However, the scarcity of zebras and zebroids in captivity, coupled with a dearth of published reports, prevents accurate estimation of disease frequency. Entire categories of disease, including

Key Facts

- All species of domestic and wild horses can interbreed despite having different numbers of chromosomes. In addition, mares can carry extraspecific implanted embryos to term.
- Zebras and zebra hybrids often do not exhibit recognizable signs of disease or pain, even with serious medical conditions such as laminitis or surgical diseases of the abdomen.
- Surprisingly, many common diseases of domestic horses have never been reported in zebras. However, this may reflect incomplete documentation or scarcity of zebras in captivity rather than a true absence of disease; therefore, practitioners should be aware of the potential for any equine disease to develop in wild equids.

endocrine, respiratory, ophthalmic, and cardiovascular diseases unrelated to infectious causes, are virtually absent from the zebra-related literature.

Nevertheless, two disease groups (neurologic disease and colic) are disproportionately represented in zebras and zebroids. In zebras, neurologic disease includes *Sarcocystis neurona* infection,[47] epilepsy,[48] motor neuron disease, and cervical instability (wobbler syndrome,[49] which has been reported as an inherited condition in several captive plains zebra herds). Published causes of colic in zebras include enterolithiasis[50] and large-colon volvulus.[51] Anecdotally, most of the common causes of equine acute abdomen have been seen in zebras. Affected animals do not usually show obvious signs of pain. In general, animals with painful surgical conditions may be found dead without having shown any clinical signs. Painful animals only occasionally exhibit anorexia or depression, which emphasizes that even slightly unusual behavior should be evaluated. As with equine colic, early recognition and treatment are essential. Exploratory surgeries and surgical repairs are performed as in domestic horses.

Summary

Zebras and zebroids are challenging patients, but with appropriate anesthetic protocols and remote darting equipment, they can be successfully managed by equine practitioners. Understanding the physiologic and behavioral differences between wild and domestic equids can help equine clinicians provide better care to these rare and beautiful animals.

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CE
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1. **Which statement is not true regarding ultrapotent narcotics?**
   - **a.** They are class I opiates.
   - **b.** They require special licensing by the Drug Enforcement Agency.
   - **c.** They are exceptionally dangerous to humans if accidental exposure occurs.
   - **d.** They are not recommended for use with blowpipes.

2. **Which statement is true regarding remote delivery systems?**
   - **a.** They should be used only with ultrapotent narcotics.
   - **b.** They can cause serious injury if the firing pressure is set too high.
   - **c.** All systems are subject to local firearms regulations.
   - **d.** Blowpipes are ideal at long distances.

3. **Which statement is incorrect regarding capture myopathy?**
   - **a.** It can be delayed, occurring up to 2 weeks after capture or handling.
   - **b.** Its occurrence can be decreased by limiting an animal's space for running.
   - **c.** It has the same etiology as exertional rhabdomyolysis.
   - **d.** Its treatment is similar to that of exertional rhabdomyolysis.

4. **Parasite control in a herd of captive zebras requires**
   - **a.** special attention to ectoparasites and daily use of a pour-on formulation.
   - **b.** medicating large quantities of feed, which is then distributed to the herd.
   - **c.** regular fecal examinations and deworming with anthelmintics commonly used in domestic horses.
   - **d.** immobilization for administration of anthelmintics.

5. **Which of the following is true regarding equine reproduction?**
   - **a.** The estrous cycle of zebras and zebroids is unusually long.
   - **b.** Male zebras are generally not reproductively viable until they are older than 4 years.
   - **c.** The term zebroid is most commonly used to describe zebra foal embryos that are transferred into domestic horse mares.
   - **d.** Semen collection inevitably requires complete immobilization.

6. **Which statement is true regarding infectious disease in captive zebras?**
   - **a.** Infectious causes of neurologic disease are unreported in captive zebras.
   - **b.** New animals entering a herd rarely require quarantine because zebras are resistant to most equine diseases.
   - **c.** Zebras can contract EHV from species other than horses.
   - **d.** Most equine vaccines have been specifically tested in zebras.

7. **Which statement is true regarding standing sedation of zebras and zebroids?**
   - **a.** It consists of a single injection of butorphanol and an α_2-agonist dosed using domestic horse guidelines.
   - **b.** It generally lasts approximately 15 minutes.
   - **c.** It is associated with renarcotization.
   - **d.** Sedation failures should not be managed with additional injections of butorphanol and α_2 agents.

8. **Zebra foals**
   - **a.** are susceptible to failure of passive transfer due to management techniques.
   - **b.** will not become aggressive if they are bottle raised.
   - **c.** require zebra colostrum only if failure of passive transfer is documented.
   - **d.** often present with neonatal isoerythrolysis due to extremely antigenic blood groups within each zebra species.

9. **Which statement is correct regarding gastrointestinal disease in captive zebras and zebroids?**
   - **a.** Animals with surgical diseases of the abdomen may not show any signs of pain.
   - **b.** In wild equids, colic is most often caused by feeding low-protein, pelleted equine feed.
   - **c.** Abdominal surgery requires techniques different from those used in horses.
   - **d.** Renal disease is far more common than gastrointestinal disease in zebras and zebroids.

10. **Which statement is true regarding regulations for zebras?**
    - **a.** CITES rules apply to all zebra species but do not apply to zebroids.
    - **b.** The US Department of Agriculture does not regulate zebras or zebroids.
    - **c.** Zebras and zebroids require a negative Coggins test result and health certificate, at minimum, for interstate travel.
    - **d.** If microchips are needed for identification, they should be placed at the base of the ear.