

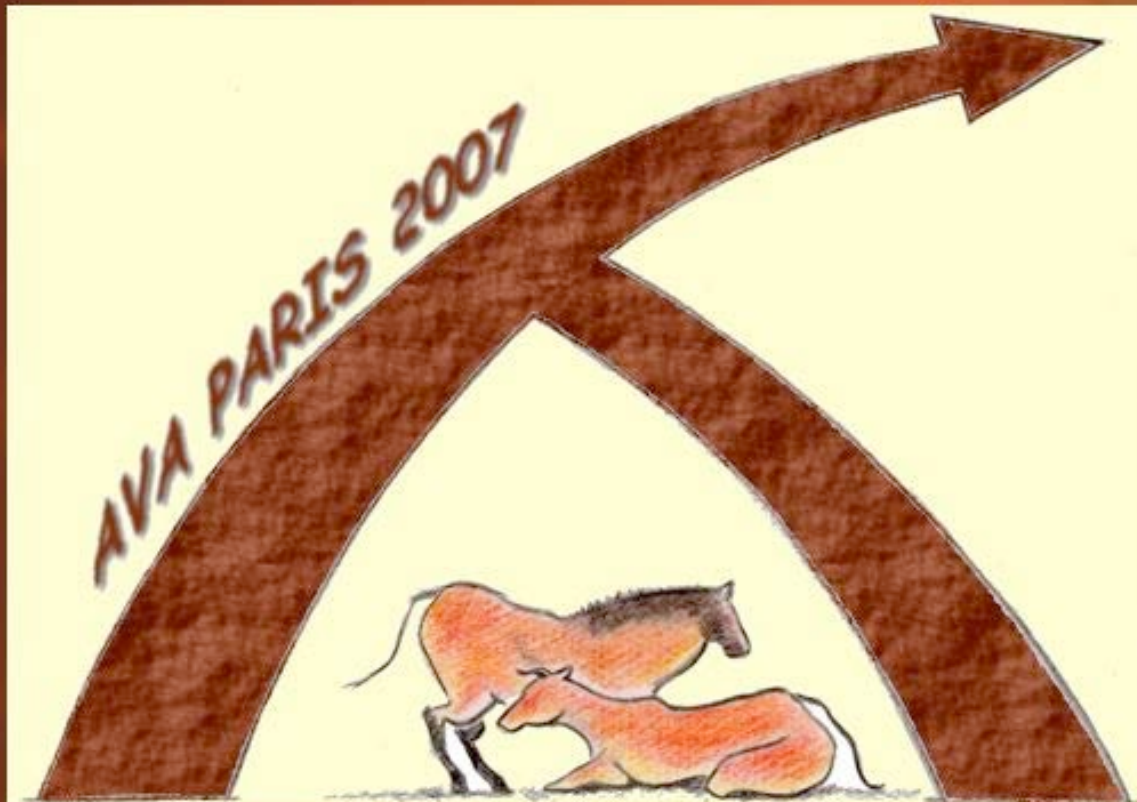


AVA - ECVA



SPRING MEETING 2007
on

VETERINARY EMERGENCY
& ANAESTHESIA



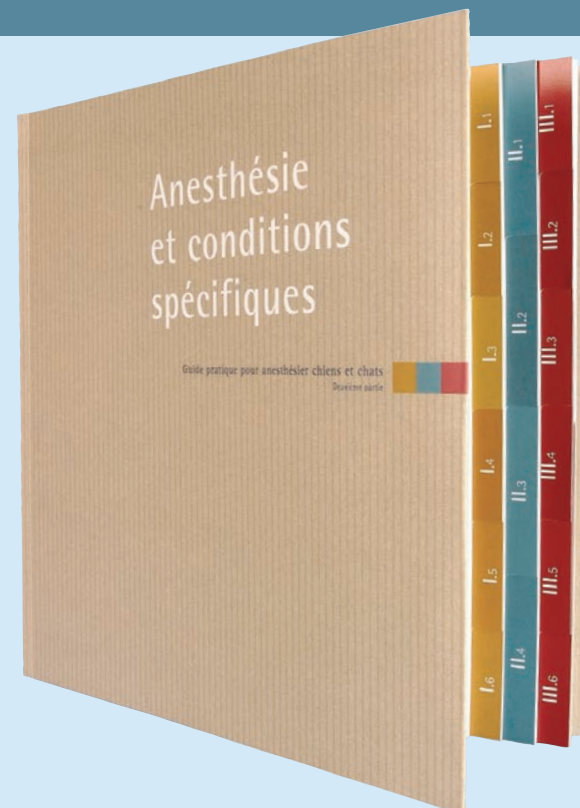
7 - 10 March 2007

PARIS , France

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PARIS 2007

On

VETERINARY EMERGENCY & ANAESTHESIA



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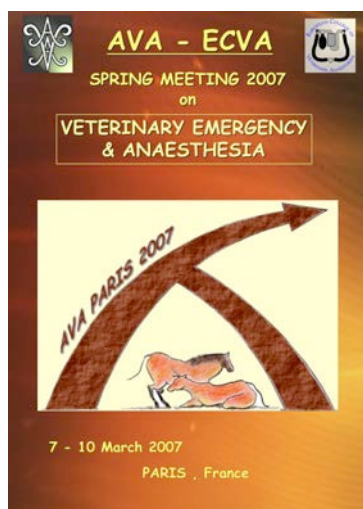
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The Organisations



AVA PARIS 2007 — Wednesday March 7th

RESIDENT DAY
RUMINANT ANAESTHESIA

Hyatt Regency Hotel, Roissy CDG, France

K OTTO, D HOLOPHERNE, G TOUZOT

8.30	REGISTRATIONS
9.00-9.45	Specific anatomo-physiology to consider for ruminant peri-anaesthetic period <i>K OTTO</i>
10.00-10.30	COFFEE BREAK
10.30-11.15	Post-anaesthetic and pain management in ruminants <i>K OTTO</i>
11.30-12.15	Physical restraint and sedation of ruminants <i>D HOLOPHERNE</i>
12.30-1.30	LUNCH
1.30-2.15	Anaesthesia of Lamas & Alpagas <i>G TOUZOT</i>
2.30-3.15	Regional & local anaesthesia for ruminants <i>D HOLOPHERNE</i>
3.30-4.00	COFFEE BREAK
4.00-4.45	Pharmacology and protocols for ruminant anaesthesia <i>G TOUZOT</i>

AVA - ECVA SPRING MEETING 2007 Wednesday March 7th Hyatt Regency Hotel CDG		
RESIDENT DAY : RUMINANT ANAESTHESIA		
9.00-9.45	✓ Specific anatomo-physiology to consider for ruminant peri-anaesthetic period	✓ K Otto Hannover, Germany
10.00-10.30	COFFEE	
10.30-11.15	✓ Post-anaesthetic and pain management in ruminants	✓ K Otto Hannover, Germany
11.30-12.15	✓ Physical restraint & sedation	✓ D Holopherne ENVN, France
12.30-1.30	LUNCH	
1.30-2.15	✓ Anaesthesia of lamas & alpagas	✓ G Touzot Colorado, USA
2.30-3.15	✓ Regional & local anaesthesia for ruminants	✓ D Holopherne ENVN, France
3.30-4.00	COFFEE	
4.00-4.45	✓ Pharmacology and protocols for ruminant anaesthesia	✓ G Touzot Colorado, USA

Specific anatomo-physiology to consider for ruminants peri-anaesthetic period

Klaus A. Otto

Institut für Versuchstierkunde und Zentrales Tierlaboratorium, Medizinische Hochschule Hannover, D-30623 Hannover, Germany

The suborder “ruminantia” includes members of the family “bovidae” such as cattle (*bos taurus*), sheep (*ovis* spp) and goats (*capra* spp). Members of the family “camelidae” (*camelus* spp, *llama* spp, *vicugna* spp) belong to the suborder “tylopodia” and therefore are not true ruminants. However, all the subspecies have a compartmental forestomach in common and, therefore, require peri-anaesthetic considerations that are different from those in “monogastric” animals.

Peri-anaesthetic considerations in these species will be primarily affected by their specific behaviour as herd animals and by their anatomical features especially of the digestive system. Attempts of a person to approach a ruminant can trigger an immediate flight response that may be harmful to the animal and to the person. Moreover, restraining may be very stressful to the animal. The specific attitude will be addressed more closely in the other manuscript (Post-anaesthetic and pain management in ruminants).

Most potential life-threatening conditions during the peri-anaesthetic period in ruminants, however, may arise from the special features of the digestive system. These conditions include ^{1, 13}

1. Regurgitation and pulmonary aspiration of ruminal contents
2. Respiratory and cardiovascular embarrassment arising from compression of the lungs and major blood vessels (aorta, caudal vena cava) by ruminal content and/or by bloat (tympany)
3. Continuous copious production of saliva
4. Muscle and nerve damage in large ruminants similar to complications reported in horses.

In adult cattle, sheep and goats the “stomach” is divided into four compartments: rumen, reticulum, omasum and abomasum. Unlike the first three compartments only the mucous membrane of the abomasum contains glandulae and thus is very similar to the monogastric stomach. Camelids, on the other hand, have a three-compartmental forestomach.^{7, 9} During ruminal digestion fibres (i.e. cellulose) are broken down into glucose by symbiotic bacteria and protozoa. Further products of the food fermentation include volatile fatty acids such as acetic, propionic and butyric acid and gases (i.e. methane, carbon dioxide, molecular hydrogen). In the awake ruminant, these gases are regularly expelled from the reticulorumen, a process called ‘eructation’.

Depending on the size and the breed of the individual ruminant, the approximate capacity of all forestomachs can range from 110 to 235 l in adult cattle and from 16 to 30 l in sheep and goats.⁷ In lateral or dorsal recumbency the rumen will be directed downward and forward by its weight exerting an enormous pressure on the diaphragm which in turn results in shallow, frequent ventilation. Moreover, abdominal pressure can also impede venous return to the heart resulting in reduced cardiac output and pulmonary perfusion. This compromise in

cardiopulmonary function may even occur in healthy, conscious cattle when positioned in lateral or dorsal recumbency.¹⁵ Left lateral, right lateral or dorsal recumbency for at least 30 minutes resulted in a significant decrease in arterial oxygenation caused by ventilation/perfusion mismatch. In addition, both pulmonary artery pressure and cardiac output were also significantly decreased in dorsal recumbency.

These respiratory and cardiovascular compromise has long been known and has led to the suggestion to perform most surgical procedures in sedated standing animals under various local anaesthetic techniques (i.e. infiltration anaesthesia, regional anaesthesia, retrograde intravenous anaesthesia) and to avoid general anaesthesia in ruminants whenever possible.^{3, 12}

However, specific surgical procedures such as fracture repair in adult cattle and extensive experimental surgeries in calves and small ruminants demand general anaesthesia and thus require adequate animal preparation.

In order to decrease the peri-operative risk of cardiopulmonary compromise during sedation and general anaesthesia in ruminants, the first step is the pre-operative withdrawal of food and water. The duration of pre-operative fasting depends on the size of the animal and the species ranging between 12 and 18 hours in llamas, 18 and 24 hours in small ruminants and up to 48 hours in adult cattle.^{1-3, 9, 13} Withdrawal of water in cattle has been recommended for about 6 to 18 hours.^{10, 13} Controversy exist on whether or not water should be withheld prior to anaesthesia in small ruminants. While some authors recommend deprivation of water for up to 10 hours before anaesthesia, others (including the author KO) recommend free access to water in sheep and goats.

While pre-anaesthetic withdrawal of food may help to decrease the ruminal contents and thereby the risks of regurgitation/aspiration and of bloat during the perioperative period, adverse effects of fasting such as bradycardia in cattle,⁴ irreversible pregnancy toxicosis in late term pregnant ewes³ or metabolic acidosis in sheep² may result from extended fasting of ruminants.

Moreover, regurgitation/aspiration may be less likely if orotracheal intubation and extubation, respectively, are performed whilst the ruminant is positioned in sternal recumbency.¹⁴ In addition, general anaesthesia should be deep enough during orotracheal intubation in order to prevent active regurgitation that could result from laryngeal stimulation. Additional insertion of a stomach tube into the rumen may also help to decrease the risk of intraoperative bloat and subsequent cardiopulmonary compromise.

Hypoventilation and pulmonary ventilation/perfusion mismatch during anaesthesia will be exaggerated if additional bloat occurs. Restraint of awake or anaesthetized ruminants in either lateral or dorsal recumbency can prevent the animal from belching gas that accumulates in the forestomach. The risk of intraoperative bloat can be minimized by pre-operative withholding of food, which reduces the rate of ruminal fermentation, by reduction of the duration the animal is kept in dorsal or lateral recumbency to a minimum and by insertion of a stomach tube. For the same reason the use of nitrous oxide during general anaesthesia in ruminants should be avoided as the net exchange between nitrous molecules (N₂) and nitrous oxide (N₂O) in air containing closed cavities may cause an increase in intraabdominal volume and pressure. If bloat occurs, pressure release by means of ruminocentesis may become necessary. For this purpose either a spinal needle (small ruminants) or a large bore trocar (cattle) can be used. In order to minimize haemodynamic side effects (i.e. hypotension) resulting from a

sudden decrease in intraabdominal pressure, ruminal gases should be released slowly and intermittently.

The use of anticholinergics (i.e. atropine, glycopyrrolate) for prevention of copious salivation in ruminants is controversial. Advantages of premedication with atropine include decreased quantity of saliva, improved visualisation of the larynx during orotracheal intubation and decreased risk of xylazine-induced bradycardia. However, pre-anaesthetic administration of atropine does not completely abolish saliva production but increases saliva viscosity and thus may cause obstruction of small airways. Unlike other species, high intramuscular doses of atropine (0.4 to 0.7 mg kg^{-1}) may be needed before anaesthesia followed by repeated doses of 0.2 mg kg^{-1} every 15 to 30 minutes for a markedly reduction in the volume of saliva in small ruminants which in turn may cause ruminal stasis.² Therefore, most authors recommend the use of atropine (0.02 - 0.04 mg kg^{-1} intravenously) or glycopyrrolate (0.022 mg kg^{-1} IM or SC) for therapeutic purposes only (i.e. bradycardia) while routine pre-anaesthetic use of anticholinergic drugs is discouraged.^{1, 2, 14}

In ruminants and other herbivores, exhalation of methane may highly affect the measurement of end-tidal anaesthetic concentration when gas analyzers are used that measure gas concentrations with infrared light at a wavelength of approximately 3.3 mm. The interference with methane can lead to erroneously high end-tidal readings especially for halothane.⁶ In anaesthetized, intubated sheep breathing room air, analysis of exhaled gases using a calibrated infrared gas analyzer erroneously indicated 0.2% end-tidal isoflurane concentration and up to 1.2% end-tidal halothane (KO).

Another important anatomic feature in ruminants affecting the perioperative period especially in neonates is the type of placentation. Ruminants have an epitheliochorial placenta.⁵ This type of placentation does not allow placental transfer of immunoglobulins rendering the neonate highly susceptible to neonatal infections if the uptake of maternal antibodies with the colostrum is impaired during the first 12 to 36 hours of life.⁸ Hence, neonatal uptake of colostrum has to happen as early as possible (within the first two hours of life) and the neonate should drink as much and as frequent as possible. This issue needs strong consideration when neonatal calves or lambs are anaesthetized for experimental surgical procedures (i.e. cardiovascular studies). Suckling neonates are still monogastric and pre-anaesthetic fasting extending approximately 30 minutes should be avoided in order to avoid hypoglycaemia, hypoglobulinaemia and hypothermia. Moreover, anaesthetic agents (i.e. isoflurane, propofol) may be the anaesthetics of choice in order to allow re-uptake of colostrum as early as possible after anaesthesia.

In contrast to most other species llamas do not have a jugular groove and the jugular vein lies deep to the sternomandibularis and brachiocephalicus muscles mostly protected by the cervical vertebral transverse processes.^{9, 10} An addition, for most of its length the jugular vein is in close vicinity to the carotid artery and to the vagosympathetic trunk thus making safe jugular venous puncture in this species difficult. Venipuncture can be performed rostrally near the jaw, at the jugular bifurcation into the maxillary and linguofacial veins or at a point slightly caudal to it. At this site, the vessel is quite superficial and remains separated from the carotid artery and the vagosympathetic trunk by the omohyoideus muscle. However, the skin in the upper cervical region is thick (up to one cm) and therefore must be incised or pierced with a needle in order to ease venipuncture.

Other interspecies differences that need to be considered include, for example, the innervation of the horns in cattle versus caprine. For dehorning in cattle the cornual branch of the

zygomaticotemporal nerve needs to be desensitized while in goats the cornual branches of the zygomaticotemporal and of the infratrochlear nerves need to be desensitized.¹¹

References

1. Dunlop CI, Hoyt RF Jr (1997). Anesthesia and analgesia in ruminants. In: Kohn DF, Wixson SK, White WJ, Benson GJ (eds.). *Anesthesia and Analgesia in Laboratory Animals*. San Diego, Academic Press, pp. 281-311.
2. Gray PR, McDonell WN (1986). Anesthesia in goats and sheep. Part II. General anesthesia. *Comp Contin Educ* 8:S127-S135.
3. Green CJ (1979). *Animal anaesthesia. Laboratory Animal Handbooks* 8. London, Laboratory Animals LTD, pp. 163-97.
4. McGuirk SM, Bednarski RM, Clayton MK (1990). Bradycardia in cattle deprived of food. *J Am Vet Med Assoc* 196:894-6.
5. Michel G (1977). *Kompendium der Embryologie der Haustiere*. 2nd edn. Stuttgart, Gustav Fischer Verlag, pp. 129-79.
6. Moens (1994). The reliability of modern monitoring in veterinary anaesthesia. *J vet Anaesth* 21:94-8.
7. Nickel R, Schummer A, Seiferle E (1975). *Lehrbuch der Anatomie der Haustiere*. Band II. 3. Aufl. Eingeweide. Berlin, Verlag Paul Parey, pp. 147-82.
8. Richter J, Götze R (1978). *Tiergeburtshilfe*. 3rd edn. (Rosenberger C, Tillmann H, eds.). Berlin, Verlag Paul Parey, pp. 135-60.
9. Riebold TW, Kaneps AJ, Schmotzer WB (1989). Anesthesia in the Llama. *Vet Surg* 18:400-404.
10. Riebold TW (1996). Ruminants. In: Thurmon JC, Tranquilli WJ, Benson GJ (eds.). *Lumb & Jones' Veterinary Anesthesia*. 3rd edn. Baltimore, Williams & Wilkins, pp. 610-26.
11. Skarda RT (1996). Local and regional anesthetic techniques: Ruminants and swine. In: Thurmon JC, Tranquilli WJ, Benson GJ (eds.). *Lumb & Jones' Veterinary Anesthesia*. 3rd edn. Baltimore, Williams & Wilkins, pp. 479-514.
12. Stöber M (1977). Beruhigung, Niederlegen und Schmerzausschaltung durch Medikamente. In: Rosenberger G (ed.). *Die klinische Untersuchung des Rindes*. Berlin, Verlag Paul Parey, pp. 32-57.
13. Trim CM (1981). Sedation and general anesthesia in ruminants. *California Veterinarian* 4:29-36.

14. Trim CM (1987). Special anesthesia considerations in the ruminant. In: Chort CE (ed.). *Principles & Practice of Veterinary Anesthesia*. Baltimore, Williams & Wilkins, pp. 285-300.
15. Wagner AE, Muir WW, Grospitch BJ (1990). Cardiopulmonary effects of position in conscious cattle. *Am J Vet Res* 51:7-10.



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Hyatt Regency , Roissy CDG

NOTES

Post-anaesthetic and pain management in ruminants

Klaus A. Otto

Institut für Versuchstierkunde und Zentrales Tierlaboratorium, Medizinische Hochschule Hannover, D-30623 Hannover, Germany

Successful pain management in ruminants, like in other animal species, highly depends on the recognition of pain states and the treatment of pain with appropriate analgesic drugs. Unlike other species (e.g. pet animals), ruminants are herd animals and as such may not overtly demonstrate pain. In addition, most ruminants are food animals. Hence, many analgesic drugs normally used in small animals may not be licensed for use in ruminants. Although treatment of pain in ruminants with various non-steroidal anti-inflammatory drugs (NSAIDs), opioids and local anaesthetics has been reported in the international literature (Table 2), only a limited number of these drugs are actually licensed for use in ruminants in the European countries.

Pain assessment

Under natural conditions, herd animals such as ruminants are subjected to predation and abnormal behaviour may attract attention of predators. In order to survive, these animals will act as normal as possible and thus avoid overt demonstration of pain.¹⁵ This kind of protective (“stoical”) behaviour in painful situations has led to the assumption that ruminants may tolerate pain better than other mammals. Therefore, the question arises whether ruminants actually tolerate pain better (e.g. being less sensitive to a discrete stimulus) than other mammals such as human beings or predators or whether they just express pain differently?

Because of the lack of verbal communication, pain assessment in all mammals, including ruminants, can be based on the following items:

1. Similarities exist between anatomical (e.g. nociceptors, nerve fibres, brain regions) and functional (e.g. neurotransmitters) features of the pain processing systems in human beings and other mammals. Hence, it is reasonable to assume, that perception of a defined painful stimulus (e.g. skin incision) may induce the same sensory-discriminative, cognitive, affective as well as autonomic and somatomotoric components of pain in ruminants as in human beings.
2. Appearance (e.g., facial expression, abnormal swelling, lameness, posture).
3. Spontaneous behaviour (e.g. social behaviour, appetite, interest in the surroundings, type of vocalization, motor activity).
4. Provoked behaviour (e.g. response to being approached by an observer, response to offering food, response to wound palpation).
5. Physiological (“objective”) variables (e.g. heart rate, blood pressure, respiratory rate, pupil diameter, plasma cortisol and catecholamine concentrations, hormones, body temperature).
6. Response to analgesic treatment.

Changes in appearance and spontaneous behaviour may be detected most easily from the distance without attracting the animal's attention. A healthy sheep, for example, that is adapted to the surroundings and the personnel may represent a certain repertoire of behavioural signs and appearance during the pre- and post-operative period that can be considered quite typical for the species (Table 1). However, as soon as the animal becomes aware of the presence of an observer it may react with a flight response and typical signs of pain may be hidden, at least in low to moderate pain states.

By means of these behavioural signs, the intensity of postoperative pain (or the efficacy of analgesic treatment) may be scored either by using numerical rating scales (NRS) or visual analogue scales (VAS) that, however, must be adapted to a species-typical behavioural response pattern. Although the NRS and VAS scores are highly reproducible, the VAS is a continuous scale and, therefore, may be more sensitive than the discrete NRS.²²

When numerical rating scales are employed, grading of behavioural responses is sometimes performed by using terms such as “normal”, “moderate” or “severe”. However, the observer should be aware of the fact that utilisation of these terms may be already associated with a subjective interpretation of behavioural signs. Therefore, it might be more appropriate to assess pain by simply comparing behavioural signs collected before and after surgery in individual animals. This, however, may be possible only in laboratory animal facilities but not under clinical circumstances when a veterinarian is called to a farm animal that already suffers from pain.

Cardiovascular (e.g. heart rate, blood pressure), respiratory (e.g. respiratory rate) and hormonal (e.g. catecholamines, cortisol) parameters are sometimes called “physiological” or “objective” parameters while appearance or behavioural signs of an animal have been referred to as “subjective” parameters of pain. The reason for this may be that the so-called “objective” parameters can be graded by using metric scales while “subjective” parameters need to be scored. Based on the author's experience, there is no evidence that pain states can be recognized or assessed more “objectively” by means of haemodynamic changes than by behavioural changes. For example, increased heart and respiratory rates recorded in a restraint ruminant will primarily indicate a stress response. Although pain is also a major stressor, however, changes in these variables do not exclusively indicate that the animal is suffering from pain. Moreover, respiratory rate, depth of breathing and cardiovascular variables may be also affected by ambient temperature, previously administered drug effects (α_2 -agonists) or other disease states such as hypovolaemia, acid-base or electrolyte imbalances.

Pain assessment systems should be cheap, any time and anywhere applicable meaning the observer should be able to assess pain immediately before and after analgesic treatment. Under these circumstances some physiological measures (e.g., plasma hormone concentrations) may be neither practical nor affordable.

Analgesia

Mainly two treatment concepts such as pre-emptive analgesia and multimodal analgesia have been favoured during the past years in order to improve intra- and post-operative pain relief.

Preemptive Analgesia

Tissue injury can modify the responsiveness of the nervous system by peripheral sensitization as the reduction in nociceptor threshold and by central sensitization, defined as an activity-dependent increase in the excitability of spinal neurones.²⁴ Both, peripheral and central sensitization contribute to postoperative pain. Therefore, it was concluded that analgesic intervention with a local anaesthetic, nonsteroidal anti-inflammatory drug (NSAID) or opioid in advance of the development of pain (preemptively) rather than in reaction to it will be helpful in reducing the magnitude and duration of postoperative pain.

Multimodal Analgesia

The rationale for a multimodal approach is the achievement of potent analgesia due to additive or synergistic effects between different classes of analgesic drugs, with concomitant reduction in side effects due to resulting lower doses of each analgesic and differences in their side-effect profiles.¹² A combination of various analgesic drugs (e.g. local anaesthetic + NSAID + opioid for thoracotomy) can suppress or interrupt the transmission of nociceptive impulses at numerous peripheral and central sites including the wound area, peripheral nerves, spinal cord and brain.

Endpoints of analgesic treatment

The goal of peri-operative analgesic treatment is to make pain tolerable and thereby providing subjective comfort in addition to the suppression of the trauma-induced stress response that may cause catabolism. Analgesia is directed toward restoration of normal function such as normal breathing and moving by blunting autonomic and somatic reflex responses to pain without undue depression of the animal. The goal of postoperative analgesia, therefore, is not the total suppression of pain which, in turn, could be associated with profound mental depression, recumbency and anorexia. Analgesia should enable the individual animal to return to its normal behaviour at the earliest postoperative time point possible.

References

1. Benson GJ, Tranquilli WJ (1994). An introduction to the selection of medications for control of pain and / or distress. In: *Animal pain and its control*. Proceedings 226. University of Sidney, Post Graduate Committee in Veterinary Science, pp. 127-34.
2. Black-Schultz LL, Hanson PD, Wilson DG et al. (1993). Diaphragmatic hernia in a llama. *J Am Vet Med Assoc* 202:410-12.
3. Carrol GL, Boothe DM, Hartsfield SM et al. (2001). Pharmacokinetics and pharmacodynamics of butorphanol in llamas after intravenous and intramuscular administration. *J Am Vet Med Assoc* 219:1263-7.
4. Cheng Z, Welsh E, Nolan A et al. (1997). Pharmacokinetic and pharmacodynamic studies on phenylbutazone and oxyphenbutazone in goats. *Vet Rec* 140:40-3.
5. Flecknell PA (1987). *Laboratory Animal Anaesthesia*. London, Academic Press pp. 133-7.
6. Grant C, Upton RN, Kuckel TR (1996). Efficacy of intra-muscular analgesics for acute pain in sheep. *Austral Vet Journal* 73:129-32.
7. Jean GS, Bramlage LR, Constable PD (1989). Repair of fracture of the proximal portion of the radius and ulna in a llama. *J Am Vet Med Assoc* 194:1309-11.
8. Jenkins WL (1987). Pharmacologic aspects of analgesic drugs in animals: an overview. *J Am Vet Med Assoc* 191:1231-40.
9. Hendrickson DA, Kruse-Elliott KT, Broadstone RV (1996). A comparison of epidural saline, morphine, and bupivacaine for pain relief after abdominal surgery in goats. *Vet Surg* 25:83-7.
10. Kästner SBR (2006). A₂-agonists in sheep: a review. *Vet Anaesth Analg* 33:79-96.
11. Kaneps AJ, Riebold TW, Schmotzer WB et al. (1989). Surgical correction of congenital medial patellar luxation in a llama. *J Am Vet Med Assoc* 194:547-8.
12. Kehlet H, Dahl JB (1993). The value of “multimodal” or “balanced analgesia” in postoperative pain treatment. *Anesth Analg* 77:1048-56.
13. Landoni MF, Cunningham FM, Lees P (1995). Comparative pharmacodynamics of flunixin, ketoprofen and tolfenamic acid in calves. *Vet Rec* 137:428-31.
14. Livingston A, Waterman AE, Nolan A et al. (1992). Comparison of the thermal and mechanical antinociceptive actions of opioids and α_2 -adrenoceptor agonists in sheep. In: Short CE, van Poznak A (eds.). *Animal Pain*. New York, Churchill and Livingstone, pp. 372-7.
15. Livingston A (1994). Neurologic confirmation of the clinical signs of effective control or prevention of animal pain. In: *Animal pain and its control*. Proceedings 226. University of Sidney, Post Graduate Committee in Veterinary Science, pp. 241-6.

16. Mugge DK, Chambers JP, Livingston A et al. (1994). Analgesic effects of medetomidine in sheep.
Vet Rec 135:43-4.
17. Otto KA, Steiner KH, Zailskas F et al. (2000). Comparison of the postoperative analgesic effects
of buprenorphine and piritramide following experimental orthopaedic surgery in sheep. J
Exp
Anim Sci 41:133-43.
18. Thurmon JC, Tranquilli WJ, Benson GJ (1996). Perioperative pain and distress. In
Thurmon JC,
Tranquilli WJ, Benson GJ (eds.). *Lumb and Jones' Veterinary Anesthesia*. 3rd edn.
Baltimore,
Williams and Wilkins, pp. 40-60
19. Trim CM (1989). Epidural analgesia with 0.75% bupivacaine for laparotomy in goats. J
Am Vet
Med Assoc 194:1292-6.
20. Waterman AE, Livingston A, Ley SJ et al. (1992). Changes in nociceptive thresholds
associated
with chronic pain in sheep. In: Short CE, van Poznak A (eds.). *Animal Pain*. New York,
Churchill
and Livingstone, pp. 378-85.
21. Welsh EM, Baxter P, Nolan AM (1992). Pharmacokinetics of carprofen administered
intravenously in sheep. Res Vet Sci 53:264-6.
22. Welsh EM, Gettinby G, Nolan AM (1993). Comparison of a visual analogue scale and a
numerical
rating scale for assessment of lameness, using sheep as a model. Am J Vet Res 54:976-83.
23. Welsh EM, Nolan AM (1994). Effects of non-steroidal anti-inflammatory drugs on the
hyperalgesia to noxious mechanical stimulation induced by the application of a tourniquet
to a
forelimb of sheep. Res Vet Sci 57:285-91.
24. Wolff CJ, Chong MS (1993). Preemptive analgesia - treating postoperative pain by
preventing the
establishment of central sensitization. Anesth Analg 77:362-79.

Table 1: Pre- and post-operative behavioural responses in sheep

Normal healthy sheep	Possible signs after surgery
• standing, walking, looking for hay or straw, eating together with other animals of the flock, drinking • sternal recumbency, head and neck upright, ruminating • eyes opened, interested in the surroundings (looking to other sheep, responding to noise) • sternal recumbency, head and neck upright, eyes closed, sleeping • normal posture when urinating or defecating • respiratory rate is similar for all sheep in the flock • stands up, starts bleating, is coming to the barn door when an observer shows up with hay • etc.	• lying in sternal or lateral recumbency, head and neck towards the floor • not eating, not ruminating, eyes partially closed • depressed • standing separate from the other sheep, head and neck down • grinding of teeth, grunting, groaning, flemen (dorsal lip curling) • panting, forced respiration • not interested in the surroundings, no response to noise, staring without looking at a certain point • remains recumbent or stands up slowly, not bleating, not coming to the barn door when an observer • lameness • abnormal swelling • abnormal posture • tail wagging • biting, kicking at the abdomen • etc.

Table 2: Dose rates (mg kg⁻¹), route and frequency of administration for analgesic drugs reported in ruminants.*

Analgesic	Cattle	Calve	Sheep / Goat	Llama	Remarks	References
NSAIDs						
Aspirin	50-100 / 12 h PO		100 / 12 h PO			8, 18
Carprofen	1.4 IV, SC		4 / 24 h IV, SC then 2 / 24 h IV, SC		plus antibiotic	21, 23, PI, KO
Flunixin meglumine	2.2 / 24 h IV	2.2 IV	1 IV	0.25 / 8 h IV		2, 8, 13, 23
Ketoprofen		3.0 IV				13
Meloxicam	0.5 IV, SC					
Metamizol (Dipyrone)			25 IV			KO
Phenylbutazone			10 PO or 5 IV / 48 h 4.4 IV	4 / 12 h PO 15 IV		1, 4, 7, 11
Tolfenamic acid		2.0 IV				13
Opioids						
Fentanyl			0.005-0.010 IV (SH)		agitation	14, 20, KO
Pethidine (Meperidine)	2.0-4.4 SC, IM		up to 200 mg IM (total dose) 5 IV	2 IM / 4 h		5, 8, 11, 14, 18
Morphine			up to 10 mg IM / 4 h (total dose) 0.1 EP (GO)			5, 9
Piritramide			0.5 IM (SH)			17
Buprenorphine			0.005-0.01 IM			5, KO
Butorphanol			0.1 IV	0.1 IM	slow onset of action, agitation, bleating	3, 14
α₂-Agonists^{§10}						
Xylazine			0.05-0.1 IV, IM (SH)			6, 14, 18, 20
Clonidine			0.006 IV (SH)			14
Medetomidine			0.005 IV (SH)			16
Local Anaesthetics						
Lidocaine 2% (+epinephrine)			1 ml 5kg ⁻¹ EP (GO)			19
Bupivacaine 0.5%			1.5 EP (GO)			9
Bupivacaine 0.75%			1 ml 4 kg ⁻¹ EP (GO)		prolonged recovery to standing	19

Abbreviations: IV (intravenous), IM (intramuscular), SC (subcutaneous), EP (epidural), PO (oral), SH (sheep), GO (goat), KO (Author - data from experimental animals), PI (Pfizer - product information Rimadyl® Rind, IV / 1.07). [§]For more information see reference no. 10. *see recent guidelines from the European Community (Annex I-IV, 2377/90).



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NOTES

Physical Restraint and Sedation in Ruminants

Delphine Holopherne
Ecole Nationale Vétérinaire de Nantes, France.

As general anesthesia is usually not the first option in ruminants, most procedures, especially surgical procedures, are performed only using local anesthetic techniques associated with either physical restraint or sedation.

I PHYSICAL RESTRAINT

The importance of restraint must not be minimized: more than just physical labour, it requires skill, knowledge and strength. Its goal is to get the procedure done safely with minimal stress to the patient. Even if it is often realized by technicians or owners, it involves the veterinarian's responsibility and of course everyone's safety relies on it.

Restraint in cattle

Cattle are well domesticated animal, easily scared and generally are not aggressive. However, they can cause injury in several ways including horns (even if most calves are now dehorned shortly after birth to prevent injury to other cattle and humans), kicking with the hind limbs, which are usually side kicking (unlike horses), squeezing or stepping on people, especially when frightened.

Dealing with dairy cattle is generally quite easy as they are handled from birth and milked twice daily. Beef cattle, on the other hand, are usually seldom handled and most of the time for medical treatment. This makes handling these two classes of cattle different. Beef cattle for example are usually only worked in pens, chutes and head gates. They are driven from behind then moved down chutes individually and finally into stocks with head gates or squeeze chutes for treatment. To make a cow move forward when standing directly behind it, tail twist (grasping the tail at the base and twisting it) is usually effective and safe but more "persuasive" techniques such as whipping with sticks or flat plastic paddles may be needed. Electric devices are to be avoided as they generally are very stressful.

In dairy cows, either a real halter or a "homemade" rope halter can be applied.

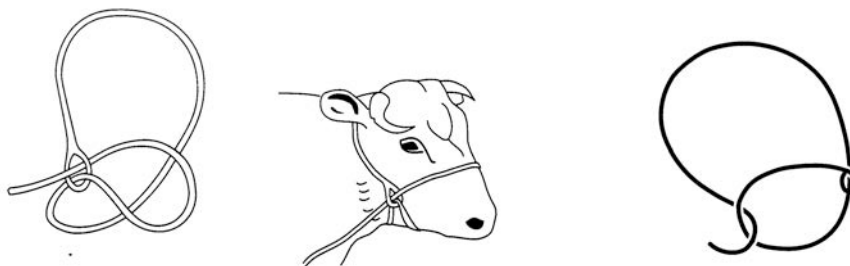


Figure 1: "Homemade" rope halters, starting on neck (1) or on muzzle (2) techniques.

Cattle can be attached but all knots must be easy and quick to release.



Figure 2: example of quick release knot.

Even if cattle are used to the halter, they are usually not trained to stand still for medical procedures and have to be placed in stocks, milking stanchions or squeeze chute. The squeeze chute is a series of panels with levers which control the width of the chute and position of body. The head catch or head gate is a device located at the front end of the stock or squeeze chute. It can be closed around the neck of the cow and the head can be positioned for blood samples or other procedures.

Nose tongs are a restraint device used to control the head of cattle. The tong is closed on the nasal septum which is a sensitive area in the cow and the head can be controlled and moved by placing pressure here. The best control is usually achieved by lifting the tong up, keeping the neck fully extended. Human nose tong can also be made, squeezing nasal septum between thumb and index finger.



Figure 3: nose tong

To prevent kicking and then improve safety, a rope can be used to immobilize the limbs. The hind limbs can be attached together by a hock twist or hobbles can be used to tie up both hind and fore limbs.

Casting is an old technique still used on occasion to force a cow to lie down without anesthesia. By placing ropes around the body at sensitive areas along spinal column, then tightening the rope and applying force to those points the cow can be forced down, there are different techniques used for casting.



Figure 4: Casting, “classical” (1) and “italian” (2) technique.

Restraint in small ruminants

These small ruminants are not as dangerous as cattle, but they can certainly hurt a person especially the males. Usually weighing less than 100kg, goats and sheep can not do as much damage by kicking as cows, but there have been serious injuries due to males charging and ramming with their heads and horns.

Like cattle they are herd animals and may panic when separated from the group. They can be moved in groups and worked in chutes and sometimes restrained in small stocks with small head catches.

Although it seems natural to hold and lead goats (or sheep) by the horns, they don't like it and will usually fight this technique of leading or restraint. Using a halter, a collar or a rope used as a collar to control and lead them is preferable and usually well tolerated, especially by goats. For medical treatments, they can be manually restrained against the handler using arms (like foals), against a wall or in a corner by placing a knee firmly in the flank or by backing them into a corner and straddling them at the shoulder and firmly restraining the head.

Sheep can also be held by sitting them up on their hind end, leaning back against the restrainers' legs, who holds the front feet. For some reason they usually will sit in this position and not struggle. But this "set up" can sometimes be difficult to achieve in large sheep.

Small ruminants and calves can be gently forced to lie down by bending the animal's neck laterally (bringing its head on its shoulder) and simultaneously grasping the skin around stifle joint on the same side.

II SEDATION

Drugs	cattle	calves	sheep	goat
Acepromazine (mg/kg)	0.025-0.05 IV		0.025-0.1 IV, IM	0.025-0.1 IV, IM
Diazepam (mg/kg)	0.02-0.1 IV (+ketamine)	0.1-0.2 IV	0.25-0.5 IV	0.25-0.5 IV
Midazolam (mg/kg)	0.02-0.1 IV (+ketamine)	0.1-0.2 IV, IM	0.1-0.4 IV, IM	0.1-0.4 IV, IM
Xylazine (mg/kg) Standing sedation	0.015-0.025 IM, IV	0.025 IV, IM	0.1 IM	0.05 IM
Xylazine (mg/kg) Deep sedation + recumbency	0.1 IV 0.2 IM	0.05 IV 0.1 IM	0.1-0.2 IV 0.2-0.3 IM	0.05 IV 0.1 IM
Romifidine (µg/kg)	5-10 IV, IM ± R		50 IV R	? 10-50 IV
Detomidine (µg/kg)	2.5-10 IV, IM 20 IV, IM ± R 40 IV R 60-80 IM R *	2.5-10 IV, IM	10-20 IV 30 IV R	5-10 IV 10-20 IM
Medetomidine (µg/kg)	? 5-20 IM	30 IM R	5-10 IM 10-30 IV, 40 IM R	5-10 IM 20 IV R
Butorphanol (mg/kg)	0.02-0.05 IV	0.05-0.2 IV	0.05-0.5 IM 0.05-0.1 IV	0.05-0.5 IM 0.05-0.1 IV

(**R** = induce recumbency; * = immobilization of free ranging cattle)

Table 1: sedative dosages for use in ruminants

Acepromazine

Acepromazine provides a mild sedation at least 20 minutes after IV injection and 30 to 45 minutes after IM injection. The effects usually last for 2 to 4 hours. It should not be used in bulls as it can induce penis prolapsus. It also induces cardiovascular depression (myocardial depression and hypotension) and is therefore contraindicated in old, young, debilitated or hypovolemic animals. Its time of duration, side effects and prohibited use in food animal in many countries may explain why acepromazine has been mainly replaced by alpha 2 agonists for sedation in ruminants.

Benzodiazepines

Diazepam and midazolam produce dose-dependant sedation and excellent muscle relaxation in small ruminants, with minimal cardiorespiratory depression. These effects usually last for half an hour. Those benzodiazepines are also really efficient and particularly useful in calves. In cattle, they are usually used for induction of anesthesia, associated with ketamine.

Alpha 2 agonists

- **Xylazine** is commonly used to provide sedation and analgesia in ruminants as it is 10 to 20 times more potent in these species than in others. The degree of sedation induced is dose-dependent but also depends on the route of injection and the animal's temperament. It can range from mild standing sedation to recumbency and seemingly light planes of general anesthesia. After IV injection, the sedation will be effective after 2 minutes, reaching a maximal effect in 5 minutes, and will last for 30 minutes to one hour according to the dosage. In cattle, some breeds seem to be more or less sensitive to the drug (Hereford>Hostein; special sensitivity in Brahman). Xylazine also induces some side effects
 - severe cardiovascular changes (bradycardia, AV blocks, decreased cardiac output)
 - respiratory effects (hypoventilation, respiratory acidosis, hypoxemia and pulmonary oedema, especially in sheep)
 - decreased GIT motility and bloating
 - diuresis
 - hyperglycemia
 - induction of uterine contractions
 - sweating
- Cheaper than xylazine, **detomidine** is more and more used to produce sedation in ruminants, especially in cattle, in which it seems to be less likely to induce undesirable recumbency. However, the depth of sedation depends, as with xylazine, on the dosage given and the route of injection. The sedation produced usually lasts for 30 to 60 minutes and side effects are comparable to those induced by xylazine, except the effects on uterine musculature. Thus detomidine seems to be a better choice when pregnant cows have to be sedated.
- **Romifidine** is commonly used as a sedative in horses and can be also suitable in ruminants. Its effects are similar to those of xylazine and detomidine, with apparently a longer duration.

- Commonly used for sedating dogs and cats, **medetomidine** has been shown to be an effective and powerful sedative in small ruminants and calves too. It produces a dose-dependent sedation for approximately one hour.
- Sedation following the use of alpha 2 agonists can be reversed with **alpha 2 antagonists** such as atipamezole, tolazoline or yohimbine. **Doxapram**, as a stimulant, has been shown to be effective for reversing xylazine sedation in cattle.

Butorphanol

Butorphanol as an opioid can be used in ruminants to provide analgesia but also has some sedative properties. However the degree of sedation produced is quite unpredictable and higher dosages can induce ataxia and behavioural changes (excitement, restlessness, bellowing), especially in sheep. It is generally associated with alpha 2 agonists to provide better sedation and analgesia. When given alone, it induces mild effects on cardiovascular and respiratory systems.

References:

- Short CE. Preanesthetic medications in ruminants and swine. *Vet Clin N Am – Food An Pract* Philadelphia: WB Saunders, 1986 (2): 553-566.
- Riebold TW. Anesthetic techniques in ruminants. In: JC Thurmon, WJ Tranquilli, GJ Benson, eds. *Lumb and Jones' Veterinary Anesthesia*, 3rd ed. Philadelphia: Lea and Febiger, 1996:610-626.
- Riebold TW. Anesthetic management of Cattle. In: Steffey EP (Ed.). *Recent advances in anesthetic management of large domestic animals*. IVIS, Ithaca NY, 2001: A0603.0201.
- Kästner SBR (2006). A₂-agonists in sheep: a review. *Vet Anaesth Analg* 33, 79-96.
- Guatteo R, Holopherne D. *Anesthesie des bovins*. Editions du Point vétérinaire 2006.



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NOTES

Anaesthesia of the South American camelids

Gwenola Touzot-Jourde, Diplomate ACVA, Ross University, St Kitts, West Indies
gtouzotjourde@rossvet.edu.kn

General Taxonomy

Order Artiodactyla (even-toe hoofed animals)

Family Camelidae

Genera

Camelus

Llama

Llama glama

Llama

Llama pacos

Alpaca

Llama vicugna

Vicuña

Llama guanicoe

Guanaco

Llamas and alpacas have been domesticated for a long time.

Guanaco and vicuñas live wild.

Neonate: birth to 2 weeks

Juvenile: 2 weeks to 6 months

Adult: 6 months and older

Life span 15-29 years for llama and 15-25 years for alpacas

Gestation: 331-359 days for llama and around 335 days in alpacas.

Pre-anaesthetic assessment

Hematology

South American Camelids are adapted to live in altitude. The ellipsoid shape of the red blood cells offers geometrical advantage for O₂ exchange and explains why the PCV is lower than in other species (29-39%) with a higher RBC count (Garry 1994, see table). Mean corpuscular hemoglobin concentration is high. Llama hemoglobin has a high affinity for oxygen. P₅₀ has been estimated to be 22.7 mmHg at sea level and 23.7 mmHg at altitude in llamas (Banchero 1971). It is even lower in alpacas: 17.8 mmHg at sea level and 19.7 mmHg at 3,300m (Silau 1970). The Hb-O₂ dissociation curve is shifted to the left compared to sheep, dog, cat or horse (Isaacks 1983) and has a peculiar shape, permitting great affinity of hemoglobin for oxygen at lung level and release of oxygen at the tissue level with facility (Reynafarje 1975). Llama hemoglobin has a low affinity for 2, 3 DPG (Reynafarje 1975, Banchero 1971). The particular shape of the Hb-O₂ dissociation curve has been associated with a high percentage of fetal hemoglobin (55%) and higher concentrations of myoglobin and RBC enzymes in the adult alpaca living in altitude (Reynafarje 1975). Exposure at 3420m resulted in a decreased PaO₂ from 87 mmHg to 51-53 mmHg but SaO₂ remained above 92% (Banchero 1971). Mechanisms of tissue O₂ extraction are very efficient explaining a lower mixed venous oxygen partial pressure (26-30mmHg) compared to other species (Banchero 1972, Silau 1970). The PaO₂ triggering the hypoxic drive has been estimated to be around 40 mmHg as a mean of adaptation to altitude (Brooks 1968). Pulmonary vasoconstrictive response to alveolar hypoxia is reduced, suggesting an evolutionary adaptation to living in altitude (Harris 1982). The adaptation of lamoids to situations of low oxygen may present an advantage during anesthesia in that they are able to keep higher hemoglobin saturation for a given

PaO₂ compared to other mammals without compromising oxygen unloading. They may tolerate better hypoxemic situations compared to other mammals.

Preliminary blood typing tests done on New World camelids (guanacos, llamas and 2 hybrids) didn't identify any naturally occurring isoantibodies (Miller 1985).

Preparation for anaesthesia

Fasting recommendations for the llama are food deprivation for 18 hours and water withdrawing for 8-12 hours (Riebold 1989). The stomach is divided in 3 compartments. Even though lamoids are not taxonomically classified as ruminants, they are functional ruminants (Fowler 1998). Fermentation takes place only in the forestomach and ingesta is relatively homogeneous and dry without stratification in layers (gas, solid, liquid) like in ruminants. These characteristics result in little gas formation and very rare bloating. Under anaesthesia, gas accumulation in the first compartment doesn't appear to happen (Riebold 1996). Regurgitation, aspiration of gastric content and subsequent pneumonia are of concern like with the ruminants.

Physical restraint (Fowler 1989, 1998)

Llamas and alpacas are docile animals and fairly easy to handle. They don't like eye contact and their head to be touched. Contact with the animal is taken at level of the withers or thorax. They rarely kick but if they do, they kick like cows, sweeping forward and outward one hindleg. They tend to swing their head side to side to avoid contact so the handler should be careful not to be too close from the head. Some lamoids may bite and should be muzzled when manipulated (Riebold 1989). Most adult lamoids (pet or bred for wool) are halter broken and rope lead. Crias accept being carried in arms of the handler or in rolling carriers. Light restraint can be applied grasping wool on each side of the thorax, the handler hovering over the back of the camelid. The smaller individuals can be restrained like foals, arm around the neck and grasping of the tail. If the animal decide to "cush" (sternal recumbency), the position can be maintained by apply gentle pressure on the back caudal to the withers. Grasping the ears is helpful on more difficult individuals. Special stocks are made for lamoids with two narrow vertical bars immobilizing the head and neck. They are really well tolerated.

Venous access (Riebold 1996, Fowler 1998)

Camelids don't have a jugular groove. The jugular vein is superficial to the carotid artery and the vagosympathic trunk (and the esophagus on the left side). It is separated from the carotid artery at level of the upper third of the neck by the omohyoideus muscle. The vein is difficult to palpate due to a thick skin and a muscle layer (sternomandibularis and brachiocephalicus muscles) intercalated between the skin and the vein except on its very rostral end where it is in the vicinity of the parotid gland. Four or five valves in the jugular vein prevent back flow and may render venous distension unsuccessful when compressing the vein before venipuncture. The proximal part of the jugular vein is usually the most distensible and palpable part of the vein and the most suitable site for catheterization. Catheter insertion is facilitated by full thickness skin incision after a lidocaine bleb. Because of the close proximity of the carotid artery to the vein, care must

be taken not to mistake the artery for the vein. The venous blood is very red and looks alike oxygenated blood seen in other species. Pulsatile flow from the artery allows identification of the artery versus the vein. However, recumbency will hinder the identification. On hypovolemic patient, localizing the vein and its depth by ultrasound can save a lot of time. Venipuncture is also possible at the third distal of the vein.

Physical examination (Fowler 1989, 1998)

Rectal temperature: 37.5-39°C/99.5-102°F up to 40°C/104°F in hot humid climate.

Heart rate: 45-90 bpm in llamas (Boon 1994), 50-110 bpm in alpacas (Ferasin 2005).

Respiratory rate: 10-30 bpm.

Cardiorespiratory auscultation may be difficult with the heavy fiber fleece.

It is important to get a weight on the scale because it is easy to overestimate camelid body weight due to their voluminous fiber. Adult llamas weigh 100-200 kg and alpacas 50-100 kg. (Riebold 1996). Body condition can be assessed palpating the thorax caudal to the withers. The muscles should be filled out but firm. Obese animals develop a fluctuating fat pad over the upper rear limbs and have a thickened groin.

Premedication

Camelids are prone to vagal stimulation during intubation or following a nociceptive stimulation if the anesthetic plane is too light (Riebold 1989). An anticholinergic agent like atropine (0.01-0.02 mg/kg IV or 0.02-0.04 mg/kg IM) can be given as part of the premedication.

Benzodiazepines given IV (0.1-0.2 mg/kg) induce good tranquilization especially if combined with an opioid. Sternal recumbency can be attained. Recovery may be prolonged if anaesthesia is short (less than 60 minutes). Reversal with flumazenil (0.5-1 ml IV per animal) results in rapid regain of neck muscle tone and swallowing (personal observation).

Opioids in lamoids provide good analgesia and sedation. Doses tend to be extrapolated from small animal practice or small ruminant experience. Butorphanol and morphine have been investigated. Both of them produced sedation. However IV morphine at 0.5 mg/kg and butorphanol at 0.1 mg/kg triggered excitement and muscle tremors on certain individuals (Uhrig 2007, Carrol 2001). Morphine at 0.25 mg/kg IV resulted in the most consistent increase of tolerance to electric stimulation on llama (Uhrig 2007). Pharmacokinetic data obtained in that study were very similar to data in cats with the exception of a longer terminal half life for the llama. The suggested administration protocol is 0.25 mg/kg IV every 4 hours. The IM administration of 0.5 mg/kg showed excellent bioavailability and a prolonged half-life compared to the IV route (more than twice as long). Heart rate was not affected, respiratory rate was decreased and body temperature increased with escalating doses. Butorphanol at 0.1 mg/kg was found to have a very short elimination half-life after IV administration in llamas ($\sim 16 \pm 10$ min). However IM route has good bioavailability and a longer elimination half-life (~ 70 min). It was associated with sedation or excitement, somatic analgesia, decreased heart rate and increased body temperature. The study concluded also that clinical useful analgesia may occur at lower plasma concentrations than the one reported. IV route may be useful combined with a tranquilizer or sedative for short standing procedures or premedication of anesthesia but probably not for intra-operative analgesia if administration is not

repeated or followed by an infusion. Administration with a tranquilizer or sedative should diminish the likelihood of excitement reaction. Butorphanol (0.1 mg/kg IM) with intratesticular lidocaine provided analgesia and decreased anxiety for llama castration in a stock without recumbency (Barrington 1993).

Alpha-2 agonists are commonly used for light to deep sedation in lamoids. As in other species, their use is directed toward healthy patient without cardiovascular compromise. Their potency is rarely necessary on sick patients and their cardiovascular effects are undesirable. Camelids are between ruminants and horses for their sensitivity to xylazine (0.3-0.5 mg/kg IV, 0.5-1 mg/kg IM), llamas being more sensitive than alpacas. Heart rate after xylazine premedication decreased to 28-48 bpm (Riebold 1996). The dose can be reduced by 30 to 50% if combined with an opioid (butorphanol 0.1-0.2 mg/kg IV or hydromorphone 0.025-0.05 mg/kg IV). Xylazine (1.1 mg/kg IV) has been reversed with a combination of 4-aminopyridine (0.3 mg/kg IV) and yohimbine (0.125 mg/kg IV) 15 minutes after the sedation (Riebold 1989). Llamas recovered in 11 minutes. Heart and respiratory rates increased after the reversal administration.

Xylazine (0.25-0.35 mg/kg IM) and ketamine (6-10 mg/kg) given 15 minutes later provide 20-60 min of restraint (Riebold 1996). Xylazine at 0.44 mg/kg mixed with ketamine at 4 mg/kg IM gives 15-20 min of restraint (Heath 1989). Restraint to anaesthesia allowing intubation can be reached depending on individual temperament. Two doses of IM xylazine-ketamine have been compared in llamas (0.4-4 versus 0.8-8 mg/kg) (Dubois 2004). Immobilization was rapid, within 5 minutes for both treatments. Lateral recumbency was achieved with both doses. Intubation was possible in half of the llamas with the low dose and all the high dose individuals. Duration of recumbency was 30-40 minutes and 60-100 minutes in the low and high dose groups. The high dose provided at least 30 minutes of anesthesia but was associated with respiratory depression and hypoxemia during the first 10 minutes of recumbency. Supplemental oxygen is indicated. Heart rate decreased and arterial blood pressure measured by oscillometry were unchanged from baseline. Tolazoline at 2 mg/kg IM was administered 30 minutes after immobilization and resulted in standing 5-15 min after the injection. A suspicion of tolazoline toxicosis has been reported (Read 2000). Neurologic signs were seen after an administration of 5.3 mg/kg IV and 1 mg/kg IM over a period of 45 minutes to reverse 1 mg/kg IM of xylazine. Anxiety, trembling and hyperesthesia with tachypnea and profuse salivation preceded convulsions, tachycardia, hypotension then profuse diarrhea, hypermotile gastrointestinal tract, nasal edema and upper airway obstruction. The recommendation is not to exceed the dose of 2 mg/kg slowly IV or IM.

Xylazine (0.03 or 0.04 mg/kg), butorphanol (0.3 or 0.4 mg/kg) and ketamine (3 or 4 mg/kg) administered IM in llamas (low doses) and alpacas (high doses) resulted in a 70% rate of recumbency in less than 5 minutes for the llamas and less than 7 minutes for the alpacas (Mama 2000). Induction was of good quality. Llamas appeared more deeply anesthetized than alpacas and had longer recovery as standing took an average of 63 minutes versus 22 minutes in alpacas. Hypoventilation was minimal but hypoxemia (study done at 1500m, 640 mmHg) was encountered ($\text{PaO}_2 = 45\text{-}55 \text{ mmHg}$).

Medetomidine at 0.01 mg/kg IM in llamas induced light to moderate sedation with or without recumbency and strong response to needle pricks on the flank and perineal area (Waldridge 1997). Increasing the dose to 0.02 mg/kg IM resulted in moderate sedation, sternal recumbency and moderate analgesia. Profound sedation with lateral recumbency

was achieved with 0.03 mg/kg IM with good analgesia and muscle relaxation. Duration of sedation was around 40, 60 and 110 min for the low, medium and high dose. Analgesia when produced was less than 50% of the sedation time. Heart rate diminished. Respiratory rate was not significantly altered. Blood gases on recumbent llamas after 0.03 mg/kg IM were unchanged from baseline. Recovery was smooth. Polyuria or bloating was not observed. Injection of atipamezole (0.125 mg/kg IV) 30 minutes after the high dose of medetomidine hastened the recovery, the llamas regaining standing position in 5 to 25 minutes.

Tiletamine/zolazepam at 4 mg/kg IM has been evaluated for immobilization of llamas (Klein 1990). It provided up to 2 hours of restraint. Duration of recumbency was not shortened by administration of flumazenil indicating that the recovery is more likely to depend on tiletamine elimination. Cardiovascular system was stable. Hypoventilation and hypoxemia happened on some individuals. At 2 mg/kg IV, restraint is shortened to 15-20 minutes and recumbency to 25-35 minutes.

Tiletamine/zolazepam has been used to immobilize male guanacos (Sarno 1998). A mean of 5 mg/kg injected in a dart induced sufficient immobilization for physical examination and blood sampling. Immobilization lasted 15-156 minutes (mean of 60 minutes) and recovery included stumbling for a few minutes. Ataxia persisted several hours after standing.

Induction and maintenance of anaesthesia

Endotracheal intubation

Orotracheal intubation is performed after visualization of the larynx with a laryngoscope. A Miller blade 4 is long enough for alpacas and young llamas. A modified prolonged blade is necessary for adult llamas (modified Wisconsin blade 28-45 cm long, www.vetland1.com). Oral cavity is narrow and long making larynx visualization difficult. Head-neck position is critical. Full extension is required to get a good view of the larynx and to successfully introduce the tube. Visualization can be lost when the endotracheal tube is passed over the laryngoscope blade due to the narrowness of the mouth so the use of a long stylet can be helpful. Once the stylet is introduced in the trachea, the laryngoscope is removed and the tube is fed over the stylet. Endotracheal tube sizes needed are 5-12 mm ID in alpacas and 7-16 mm ID in llamas depending on their age and body weight. Attempts to intubate with too light anaesthetic plane can trigger regurgitation. Digital pressure on the esophagus has been suggested to prevent regurgitation (Riebold 1989).

Nasotracheal intubation via the ventral meatus is possible in llamas and alpacas. One size smaller compared to the orotracheal route is needed. Long tubes like nasotracheal tube for foals are suitable (Bivona 7-12 mm ID, 55 cm long, www.smiths-medical.info/veterinaryproducts/). The intubation is done blindly. Lubricating gel is necessary and can be mixed with lidocaine. Extended position of head and neck is necessary to avoid introducing the tube in the nasopharyngeal diverticulum (Riebold 1994). Air condensation on clear tube, Air flow on the operator cheek and capnography will help introducing and confirming appropriate placement of the tube.

Drugs protocols and effects

Ketamine, thiopental, propofol and etomidate are suitable for induction of anaesthesia in llamas. Mask induction is not recommended in adult llamas as they may resist application of the mask and respond by spitting (Riebold 1989)

Thiopental 8.8-11 mg/kg IV provides 10 to 15 minutes of anaesthesia and muscle relaxation suitable for intubation (Riebold 1989). A combination of guaifenesin (5% solution with thiopental 2 mg/ml administered IV to effect up to 2.2 ml/kg IV provides 15-20 minutes of anaesthesia with better muscle relaxation and faster recovery compared to thiopental alone.

Propofol induction (2 mg/kg) followed by an infusion (0.2 or 0.4 mg/kg/min) for 60 minutes in llamas resulted in minimal cardiovascular and respiratory depression: cardiac output was maintained around baseline value, heart rate increased (from 55 to 80-110), MAP slightly decreased from baseline (100-150 mmHg), PaCO₂ increased slightly (40-50 mmHg, baseline 27-37 mmHg) and PaO₂ decreased but stayed in the normal range (80-93 mmHg on room air without intubation) (Duke 1997). Some llamas were prone to nasal passage obstruction. Induction was smooth and reliable although 2 mg/kg without premedication appeared to be the minimal induction dose. The low infusion rate resulted in inadequate depth of anaesthesia. Recovery was short with standing in 13 to 22 minutes.

Inhalant MAC at sea level (760 mmHg) have been found to be 1.05 ± 0.17 % for isoflurane in llama (Mama 1999), 2.29 ± 0.14 % in llamas and 2.33 ± 0.09 % in alpacas for sevoflurane (Grubb 2003), 7.99 ± 0.58 % in llamas and 7.83 ± 0.51 % in alpacas for desflurane (Grubb 2006). Llamas anesthetized for 6 hours with increasing MAC multiple of isoflurane showed a dose-dependent cardiovascular and respiratory depression (Mama 2001). Arterial blood pressure decreased, heart rate and PaCO₂ (40-57 mmHg) increased with increasing anesthetic dose. Cardiac output was slightly lower when ventilation was controlled. Recovery took in average 15 minutes to sternal recumbency and 36 minutes to standing. Following an induction with by xylazine (0.25 mg/kg IV) and ketamine (2.5 mg/kg IV), deep halothane anaesthesia for 120 minutes in dorsally recumbent llamas provoked increasing respiratory depression with anesthetic time (PaCO₂ at 120 min 73 ± 11 mmHg) (Gavier 1988). Cardiac output decreased during controlled ventilation. Recovery was slow with return to sternal recumbency in an hour and persistence of sedation for a few hours after the end of anaesthesia. Some individuals presented severe respiratory depression with apnea and irregular breathing after induction at the beginning of halothane administration. The authors speculated that llamas like bovids may be prone to respiratory depression following xylazine-ketamine induction. Another study looked at effect of recumbency on cardiorespiratory parameters during halothane anaesthesia after xylazine-ketamine induction in llamas (Lin 1997). Vaporizer setting was lower than in the previous study. Moving from lateral to dorsal recumbency resulted in decreased blood pressure and a small decrease in PaCO₂. In both position, no hypoventilation was noted. Insufflation of the abdomen with 10-12 mmHg of CO₂ led to an increase in heart rate and blood pressure as well as in PaCO₂ that stayed under 55 mmHg. No hypoxemia was seen. A case of hepatic necrosis following a 135 min halothane anaesthesia has been reported in a 3 month old alpaca cria (Groom 1995). The microscopic lesions of acute periarterioles to massive hepatic degeneration and necrosis resembled changes seen in halothane-associated hepatitis in humans.

Recommended doses for atracurium in llamas are an initial dose of 0.15 mg/kg followed by boluses of 0.08 mg/kg or an infusion of 0.4 mg/kg/hr (Hildebrand 1993). The hind limb digital extensor tension was used to monitor depth of blockade. Maximum twitch reduction occurred in 4 minutes. The authors noted that recovery time for muscle strength was subject to individual variations. Edrophonium at 0.5 mg/kg IV with atropine (0.01 mg/kg IV) was effectively used to reverse the blockade.

Monitoring and support during anaesthesia

Assessing the palpebral reflex in South American camelids is not a reliable mean of determining depth of anesthesia. Ventral eyeball rotation in lamoid is inconsistent. The eye moves from on canthus to the other or to a central position. Deeper anesthesia (2 MAC) is likely to result in a central eyeball (Mama 2001). Nystagmus is associated with light planes of anesthesia. Palpebral reflex, spontaneous blinking and movement of the nictitant membrane can be present at any depth. Eyelid aperture seems to increase as the anesthesia is getting deeper (Mama 2001). Dorsal eyelid movements can happen at any depth of anaesthesia and spontaneous ventral eyelid movement has also been identified as a sign of light plane (Riebold 1996). Jaw tone diminishes with increasing depth but offers a crude assessment of depth (Mama 2001). Swallowing and regurgitation may still happen at 2 MAC.

Doppler probe can be placed on the median artery with the cuff above the carpus. The tail works too, however cuff sizing and postionning are challenging due to voluminous fiber and short tail. Oscillometry is usable on the brachial artery (above the carpus) or on the median artery on the metacarpus (below the carpus). Readings are fairly close to invasive blood pressure monitoring (personal experience). Arterial catheter can be introduced in auricular, medial saphenous or median arteries. A 24 to 22 G catheter is suitable for alpaca ear. A standard 20G fits llama arteries.

ECG is used with a standard limb leads or a base-apex lead. QRS complex configuration is very variable. Configurations seen in llamas are qRsr, qrs, qR, QS, Qr, qrS (Boon 1994) and rS, RS, Rs, QS in alpacas (Ferasin 2005). The distribution of Purkinje fibers in lamoids is likely to be similar to that of horses and ruminants with a wavefront spreading towards heart base. T waves can be positive, negative or biphasic. Respiratory sinus arrhythmia is common.

Llamas and alpacas tend to ventilate well on their own unless abdominal distention exists or high dose of opioids are used. Capnography and blood gases are useful.

Body positioning aims at limiting likelihood of regurgitation and aspiration with promoting saliva drainage from the mouth. Eyes are protruding in the South American camelids and stay open during anaesthesia. Care should be provided to avoid corneal ulceration with good lubrication. If GI content from regurgitation gets in the eye, an eye wash should be performed before relubrication. Warm water circulating pads and warm forced air blankets are efficient in maintaining body temperature. Fluidtherapy and inotrope support is similar to those used in small animal patients or small ruminants.

Recovery

Delirium emergence is very rare in camelids who tend to recover slowly and quietly. Sternal position is maintained at all time. The neck in the initial phase of recovery flexes backward to let the head rest on the thorax. This head position favors regurgitation so head should be kept elevated and aligned with the neck until muscle tone is regained. Late extubation will preclude upper airway obstruction from nasal edema as camelids are obligate nasal breathers (Riebold 1994). Oral cavity flushing is necessary before extubation with cuff inflated if regurgitation happened during anaesthesia. Neck strength must be regained before extubation. Nasotracheal extubation offers the advantage of being very well tolerated once the animal awakes. The tube can remain in place as long as needed. Dorsal displacement of the soft palate can persist after extubation and obstruct airways. Triggering a swallow usually results in a return to normal position.

Hypothermia will result in prolonged recovery. Crias and small alpacas, as well as patients with large clipped areas, are particularly prone to hypothermia. During anaesthesia, a combination of warm water circulating blanket placed underneath the patient and a warm air forced blanket on the top is efficient in maintaining body temperature. Means of rewarming should be continued during the recovery period.

Peri-operative analgesia

Epidural anaesthesia

Caudal epidural anesthesia with lidocaine (0.22 mg/kg) or xylazine (0.17 mg/kg) and the combination of the two at the sacrococcygeal space was evaluated in 6 adult llamas (Grubb 1993). Onset was fast for the injection containing lidocaine (< 3.5 min) and significantly longer with xylazine only (> 20 min). Perineal anesthesia was achieved for 70 minutes with lidocaine, 190 minutes with xylazine and 325 minutes with the combination. Some sedation was seen with the xylazine and xylazine-lidocaine epidural injections. Castration in alpacas with epidural anesthesia showed that IM xylazine sedation with a lidocaine epidural was superior to a lidocaine or xylazine-lidocaine epidural injection alone and that the adjunct in a spermatic cord of a lidocaine injection was reducing the risk of discomfort when applying the emasculator (Padula 2005).

Epidural anaesthesia at the lumbosacral space (L7-S1) is feasible. The spinal cord ends at the level of S2 in llamas so arachnoid puncture and CSF leakage may happen (Fowler 1998).

Fentanyl patch

Application of 4 patches of 75 µg/h on 130-170 kg llamas antebrachium has been shown to provide consistent, sustained serum concentration with in 12 h and for 72h without sedation (Grubb 2005). Patches were stapled to the skin to remain firmly in place. Hair was clipped. Analgesia was not tested. Serum concentrations obtained were lower than values range suggested efficient in other mammals (dog, cat, horse, rabbit, sheep and goat).

NSAIDs (Navarre 2001)

Phenylbutazone (5 mg/kg IV) has a short half-life and high clearance intermediate between those of donkeys and horses. Bioavailability after 5 mg/kg PO is around 70% with a large inter-individual variation and is similar to that in cattle and goats. Flunixin meglumine (2.2 mg/kg IV) has a shorter half-life, lower volume of distribution and lower clearance in llamas than sheep, cattle and horses. The therapeutic window is not known in lamoid. Ketoprofen (4.4 mg/kg IV) had a longer half-life, lower clearance and smaller volume of distribution compared to calves and horses for both isomer (R, S). Llamas appeared not to convert metabolically the R-isomer to the active S form.

Flunixin 1 mg/kg IM q 12h

Pharmacodynamic data are lacking in lamoid.

Analgesic protocols commonly used at Colorado State University

Flunixin at 1.1mg/kg IV q12-24 hr

Ketoprofen at 2.2mg/kg IV q24h.

Etodolac at 5mg/kg PO q24h.

It is possible that camelids may be susceptible to ulcers in C3 when given NSAIDs. It is probable that also high stress environments and diseases play a key role in GI ulceration. Even though the mechanism of ulcer development is not known, some clinicians use kapectate at 0.5 to 1 ml/kg PO q 6h. Other anti-ulcer medications don't work well in camelids. H₂ blockers don't significantly alter gastric pH in ruminants (Ahmed 2001) and oral omeprazole has poor bioavailability (Poulsen 2005).

High dose of opioids in camelids in the post-operative period may sedate them too much, which can interfere with their ability to regain their normal body temperature and their feeding behavior. Morphine at 0.1 mg/kg IV q 6h provides good analgesia with limited sedation or GI problems. Butorphanol (0.1 to 0.2 mg/kg IV q4-6h) seems to give more sedation and maybe less analgesia clinically. It is questionable if either of these provides a full 6 hours of efficacy. The intramuscular and subcutaneous routes may allow higher dosage without the profound sedation effect. However when an IV catheter is in place, IV injection is less invasive than repeated IM/SQ administration.

Blood work values from Colorado State University (Garry 1994)

Variable	Range
PCV (%)	29-39
Hb (g/dL)	12.8-17.6
RBC ($\times 10^6/\mu\text{L}$)	11.3-17.5
MCV (fL)	21-28
MCHC (g/dL)	43.2-46.6
Reticulocytes ($\#/\mu\text{L}$)	12,000-79,000
Serum iron concentration ($\mu\text{g/dL}$)	70-148
Total WBC ($\#/\mu\text{L}$)	7,500-21,500
Segmented neutrophils ($\#/\mu\text{L}$)	4,600-16,000
Band neutrophils ($\#/\mu\text{L}$)	0-350
Lymphocytes ($\#/\mu\text{L}$)	1000-7500
Monocytes ($\#/\mu\text{L}$)	50-800
Eosinophils ($\#/\mu\text{L}$)	0-3300
Basophils ($\#/\mu\text{L}$)	0-400
Fibrinogen (mg/dL)	100-400
Glucose (mg/dL)	90-140
BUN (mg/dL)	13-32
Creatinine (mg/dL)	1.5-2.9
Calcium (mg/dL)	7.7-9.4
Phosphorus (mg/dL)	4.6-9.8
Total Protein (g/dL)	5.5-7.0
Albumin (g/dL)	3.5-4.4
Globulin (g/dL)	1.7-3.5
A/G ratio	1.4-3.3
Na^+ (meq/L)	147-158
K^+ (meq/L)	4.3-5.6
Cl^- (meq/L)	106-118
TCO_2 (meq/L)	14-28
AG (meq/L)	14-29
Total Bilirubin (mg/dL)	0-0.1
ALP (U/L)	30-780
AST (U/L)	110-250
GGT (U/L)	5-29
SDH (U/L)	85-740
CK (U/L)	30-400

Venous blood gas (Garry 1989)

pH	7.35-7.5
PO_2	28-34 mmHg
PCO_2	39-45 mmHg
HCO_3	23-32 mEq/L
BE	0 - +4 mEq/ml
SO_2	56-60 %

References

Ahmed AF, Constable PD and Misk NA. Effect of orally administered cimetidine and ranitidine on abomasal luminal pH in clinically normal milk-fed calves. *Am J Vet Res.* 2001; 62: 1531-1538.

Banchero N, Grover RF, Will JA. Oxygen transport of the llama (lama glama). *Resp Physiol.* 1971; 13: 102-115.

Barrington GM, Meyer TF, Parish SM. Standing castration of the llama using butorphanol tartrate and local anesthesia. *Equine Pract.* 1993;15:35-39.

Boon JA, Knight AP, Moore DH. Llama cardiology. *Vet Clin North Am Food Anim Pract.* 1994; 10 (2): 353-370.

Brooks JG, Tenney SM. Ventilatory response of llama to hypoxia at sea level and high altitude. *Resp Physiol.* 1968; 5: 269-278.

Carroll GL, Boothe DM, Harstfield SM, Martinez SM, Spann AC, Hernandez A. Pharmacokinetics and pharmacodynamics of butorphanol in llamas after intravenous and intramuscular administration. *J Am Vet Med Assoc.* 2001; 219: 1263-1267.

Dubois WR, Prado TM, Ko JCH, Mandsager RE, Morgan GL. A comparison of two intramuscular doses of xylazine-ketamine combination and tolazoline reversal in llamas. *Vet Anal Anesth.* 2004; 31: 90-96.

Duke T, Egger CM, Ferguson JG, Frketic MM. Cardiopulmonary effects of propofol infusion in llamas. *Am J Vet Res.* 1997; 58: 153-156.

Ferasin L, Ogden DM, Davies RJ, D'Alterio GL. Electrocardiographic parameters of normal alpacas (lama pacos). *Vet Rec.* 2005; 157: 341-343.

Fowler ME. Feeding and nutrition. In: Fowler ME editor. *Medicine and surgery of South American camelids.* 2^d edition, Ames Iowa: Iowa State University Press; 1998: 12-48.

Fowler ME. Restraint and handling. In: Fowler ME editor. *Medicine and surgery of South American camelids.* 2^d edition, Ames Iowa: Iowa State University Press; 1998: 49-68.

Fowler ME. Clinical diagnosis: examination and procedures. In: Fowler ME editor. *Medicine and surgery of South American camelids.* 2^d edition, Ames Iowa: Iowa State University Press; 1998: 69-88.

Fowler ME. Physical examination, restraint and handling. *Vet Clin North Am Food Anim Pract.* 1989; 5 (1): 27-35.

Garry F, Weiser MG, Belknap E. Clinical pathology of llamas. *Vet Clin North Am Food Anim Pract.* 1994; 10 (2): 201-209.

Garry F. Clinical pathology of llamas. *Vet Clin North Am Food Anim Pract.* 1989; 5 (1): 55-69.

Gavier D, Kittleson MD, Fowler ME, Johnson LE, Hall G, Nearenberg D. Evaluation of a combination of xylazine, ketamine and halothane for anesthesia in llamas. *Am J Vet Res.* 1988; 49: 2047-2055.

Groom S, Checkley S, Crawford B. Hepatic necrosis associated with halothane anesthesia in an alpaca. *Can Vet J.* 1995; 36: 39-41.

Grubb TL, Schlipf JW, Riebold TW, Cebra CK, Poland L, Zawadzka X, Mailhot N. Minimum alveolar concentration of desflurane in llamas and alpacas. *Vet Anesth Analg.* 2006; 33: 351-355.

Grubb TL, Schlipf JW, Riebold TW, Cebra CK, Poland L, Zawadzka X, Mailhot. Minimum alveolar concentration of sevoflurane in llamas and alpacas. *J Am Vet Med Assoc.* 2003; 223: 1167-1169.

Harris P, Heath D, Smith P, Williams DR, Ramirez A, Krüger, Jones DM. Pulmonary circulation of the llama at high and low altitudes. *Thorax.* 1982; 37: 38-45.

Heath RB. Llama anesthetic programs. *Vet Clin North Am Food Anim Pract.* 1989; 5 (1): 71-80.

Hildebrand SV, Hill T III. Neuromuscular blockade by use of atracurium in anesthetized llamas. *Am J Vet Res.* 1993; 54: 429-433.

Isaacs RE, Harkness DR. Erythrocyte organic phosphates and hemoglobin function in domestic mammals. In: Agar NS and Board PG, editors. *Red blood cells of domestic mammals.* Elsevier Science publishers; 1983: 315-335.

Klein LV, Tomasic M, Olsen K. Evaluation of teazol in llamas. [abstract] *Vet Surg.* 1990; 19:316-317.

Lin HC, Baird AN, Pugh DG, Anderson DE, Gaughan EM. Effects of carbon dioxide insufflation combined with changes in body position on blood gas and acid-base status in anesthetized llamas (*Llama glama*). *Vet Surg.* 1997; 26: 444-450.

Mama KR. Anesthetic management of camelids. In: Recent advances in anesthetic management of large domestic animals. Steffey EP editor. *International Veterinary Information Service* (www.ivis.org). 2000; Document A0608-0900.

Mama KR, Wagner AE, Steffey EP. Circulatory, respiratory and behavioral responses in isoflurane anesthetized llamas. *Vet Anesth Analg*. 2001; 28: 12-17.

Mama KR, Aubin ML, Johnson MW. Experiences with xylazine, butorphanol and ketamine for short-term anesthesia in llamas and alpacas. In: *Proceedings of World Congress of Veterinary Anesthesia*. 2000;

Mama KR, Wagner AE, Parker DA, Hellyer PW, Gaynor JS. Determination of the minimum alveolar concentration of isoflurane in llamas. *Vet Surg*. 1999; 28: 121-125.

Miller WJ, Hollander PJ, Franklin WL. Blood typing South American camelids. *J Hered*. 1985; 76: 369-371.

Navarre CB, Ravis WR, Campbell J, Nagilla R, Duran SH, Pugh DG. Pharmacokinetics of ketoprofen in llamas following intravenous administration. *J Vet Pharmacol Therap*. 2001; 24: 223-236.

Navarre CB, Ravis WR, Nagilla R, Simpkins A, Duran SH, Pugh DG. Pharmacokinetics of phenylbutzone in llamas following single intravenous and oral doses. *J Vet Pharmacol Therap*. 2001; 24: 227-231.

Navarre CB, Ravis WR, Nagilla R, Deshmukh D, Simpkins A, Duran SH, Pugh DG. Pharmacokinetics of flunixin meglumine in llamas following a single intravenous dose. *J Vet Pharmacol Therap*. 2001; 24: 361-364.

Padula AM. Clinical evaluation of caudal epidural anaesthesia for the neutering of alpacas. *Vet Rec*. 2005; 156: 616-617.

Poulsen KP, Smith GW, Davis JL and Papich MG. Pharmacokinetics of oral omeprazole in llamas. *J Vet Pharmacol Ther*. 2005; 28: 539-543.

Read MR, Duke T, Toews AR. Suspected tolazoline toxicosis in a llama. *J Vet Am Med Assoc*. 2000; 216: 227-229.

Reynafarje C, Faura J, Villavicencio D, Curaca A, Reynafarje B, Oyola L, Contreras L, Vallenas E, Faura A. Oxygen transport of hemoglobin in high altitude animals. *J Appl Physiol*. 1975; 38: 806-810.

Riebold TW. Ruminants. In: Thurmon JC, Tranquilli WJ, Benson GJ, editors. *Lumb and Jones' veterinary anesthesia*. 3rd edition, Baltimore: Williams & Wilkins; 1996: 610-626

Riebold TW, Engel HN, Grubb TL, Adams JG, Huber MJ, Schmotzer WB. Orotracheal and nasotracheal intubation in llamas. *J Am Vet Med Assoc*. 1994; 204: 779-783.

Riebold TW, Kaneps AJ, Schmotzer WB. Anesthesia of the Llama. *Vet Surg*. 1989; 18: 400-404.

Riebold TW, Kaneps AJ, Schmotzer WB. Reversal of xylazine-induced sedation in llamas, using doxapram or 4-aminopyridine and yohimbine. J Am Vet Med Assoc. 1986; 189: 1059-1061.

Sarno RJ, Hunter RL, Franklin WL. Immobilization of guanacos by use of tiletamine/zolazepam. J Am Vet Med Assoc. 1998; 208: 408-409.

Silau AH, Cueva Svalenzuela A, Candela E. O₂ transport in the alpaca (lama pacos) at sea level and at 3,300 m. Respir Physiol. 1970; 27: 147-155.

Uhrig SR, Papich MG, KuKanich B, Mama, KM, Wagner AE, Chapman PL, Hellyer PW. Pharmacokinetics and pharmacodynamics of morphine in llamas. Am J Vet Res. 2007; 68: 25-34.

Waldridge BM, Lin HC, DeGraves FJ, Pugh DG. Sedative effects of medetomidine and its reversal by atipamezole in llamas. J Am Vet Med Assoc. 1997; 211: 1562-1565.
Dr Trim's book.



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NOTES

LOCAL & REGIONAL TECHNIQUES IN RUMINANTS

Delphine Holopherne

Ecole Nationale Vétérinaire de Nantes, France.

Many techniques... in 45 minutes! Here is a selection of my favourites, of the smartest or the most useful...

FLANK ANESTHESIA IN CATTLE

At least six different techniques...

1. Direct infiltration or line block

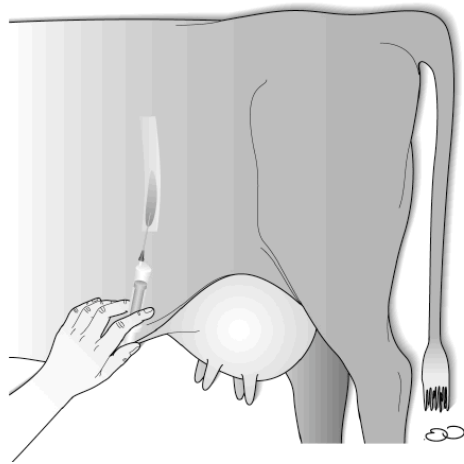


Figure 1: Line block

Material

- 20G needle, 25 x 0,9 mm (facultative)
- 14G needle, 80 x 2 mm
- 1 or more 20 mL syringes
- 50 to 100 mL 2% lidocaine

Techniques

- Skin clipping and disinfection
1. « Academic » technique
 - Several 1mL SQ injections of 2% lidocaine (small needle) on incision line, 2cm apart
 - Several 10 mL SQ continuous injections on the incision line, starting from the already desensitized points.
 - Deep IM injections with 14G needle (80 x 2 mm) : large volumes of 2% lidocaine.
 2. Everyday technique
 - Use one long needle
 - From one insertion point, several 10mL continuous injections of 2% lidocaine in different directions (from SQ to deep IM) but remaining in the incision plane.

Result

- Onset 5-15min
- Duration 1h

Advantages

- Easy! Most commonly used...

Limits

- Large volumes of lidocaine (economic?)
- Incomplete analgesia of the deep layers of the abdominal wall (peritoneum)
- No muscle relaxation
- Haematomas, delayed/impaired healing
- Toxicity

2. Indirect infiltration; inverted 7 or L block

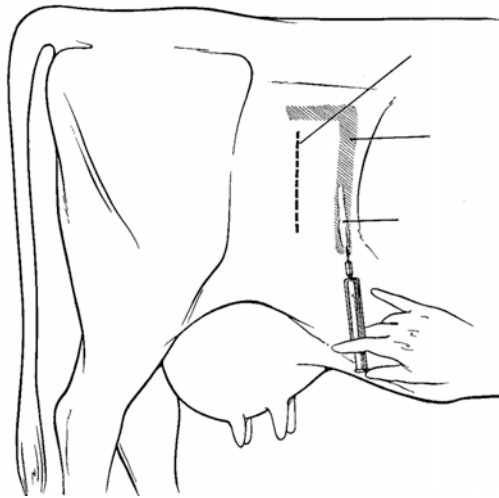


Figure 2: inverted L block

Principle

Blocking all nerves entering the surgical field by local anesthetics continuous injections cranial and dorsal to the area.

Result

- Onset 10-15min, sometimes more to have a complete analgesia of surgical area
- Duration 1h

Advantages

- Easy!
- No excessive bleeding on surgical area

Limits

- Larger volumes of lidocaine (economic?) than line block
- Delayed onset of effects
- Sometimes disappointing result ...
- Incomplete analgesia of the deep layers of the abdominal wall (peritoneum)
- No muscle relaxation
- Toxicity

Material

- 14G needle, 80 x 2 mm
- 1 or more 20 mL syringes
- At least 100 mL 2% lidocaine

Technique

- Skin clipping and disinfection
- Continuous 1mL injections of 2% lidocaine on a line bordering the caudal aspect of the last rib and ventrolateral aspect of the lumbar transverse processes (to L4).

3. Proximal paravertebral block (*Farquharson, Hall or Cambridge Technique*)

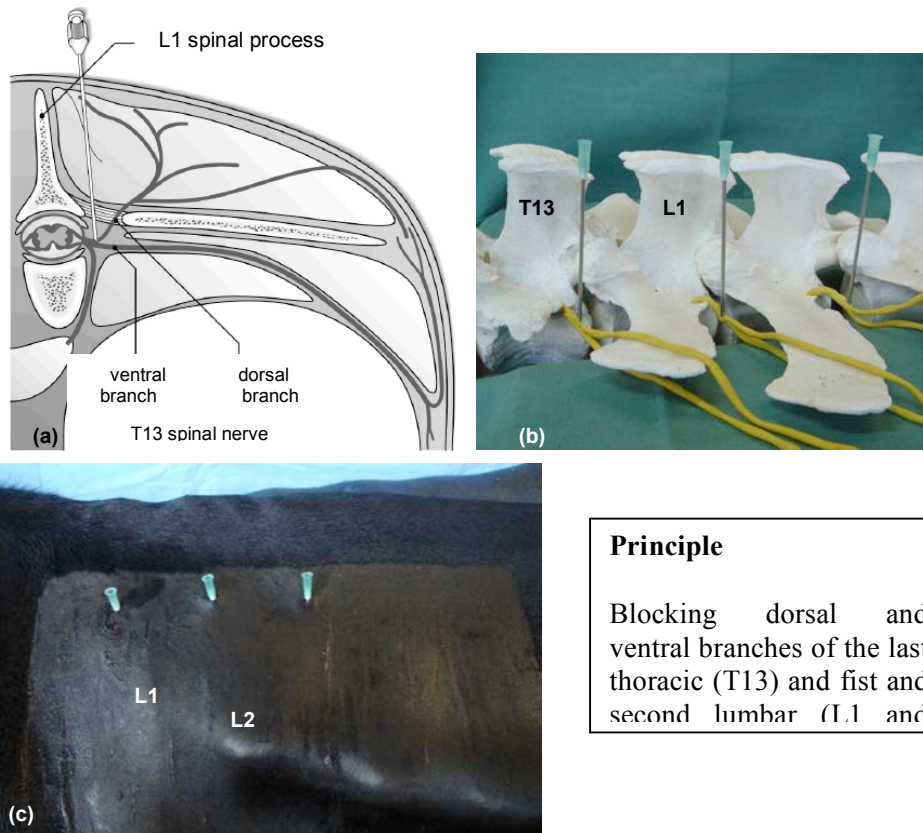


Figure 3 (a, b, c) : needle placement for a proximal paravertebral block in cattle

Material

- 20G needle, 25 x 0,9 mm
- 14G needle, 38 x 2 mm used as a cannula
- A 18G, 150 x 1.2 mm spinal needle or a 18G, 110 x 1.2 mm catheter needle (or 16G, 105 x 1.6 mm)
- 5 and 20 mL syringes
- 3 x 2 mL and 3 x 15-20 mL of 2% lidocaine

Technique

- Identification of 3 sites : at the most cranial border of the transverse processes of L1, L2 and L3, 2.5 to 5 cm from the dorsal midline
- Skin clipping and disinfection
- Skin desensitization with 3 x 2mL SQ injections of 2% lidocaine
- Insertion of the cannula first with a 90° angle through the desensitized skin then the spinal needle through it
- Progression to encounter the transverse process of L1, L2 or L3 (or intertransverse ligament), passed cranially to go through the intertransverse fascia (resistance)
- 10 to 15mL injection of 2% lidocaine to desensitize the ventral branch of the spinal nerve
- 5mL injection of 2% lidocaine while the needle is withdrawn, above the transverse process, to desensitize the dorsal branch of the spinal nerve.

Result

- Onset 10 min
- Duration 90 min
- Anesthesia of the skin, increased skin temperature, scoliosis toward the desensitized side

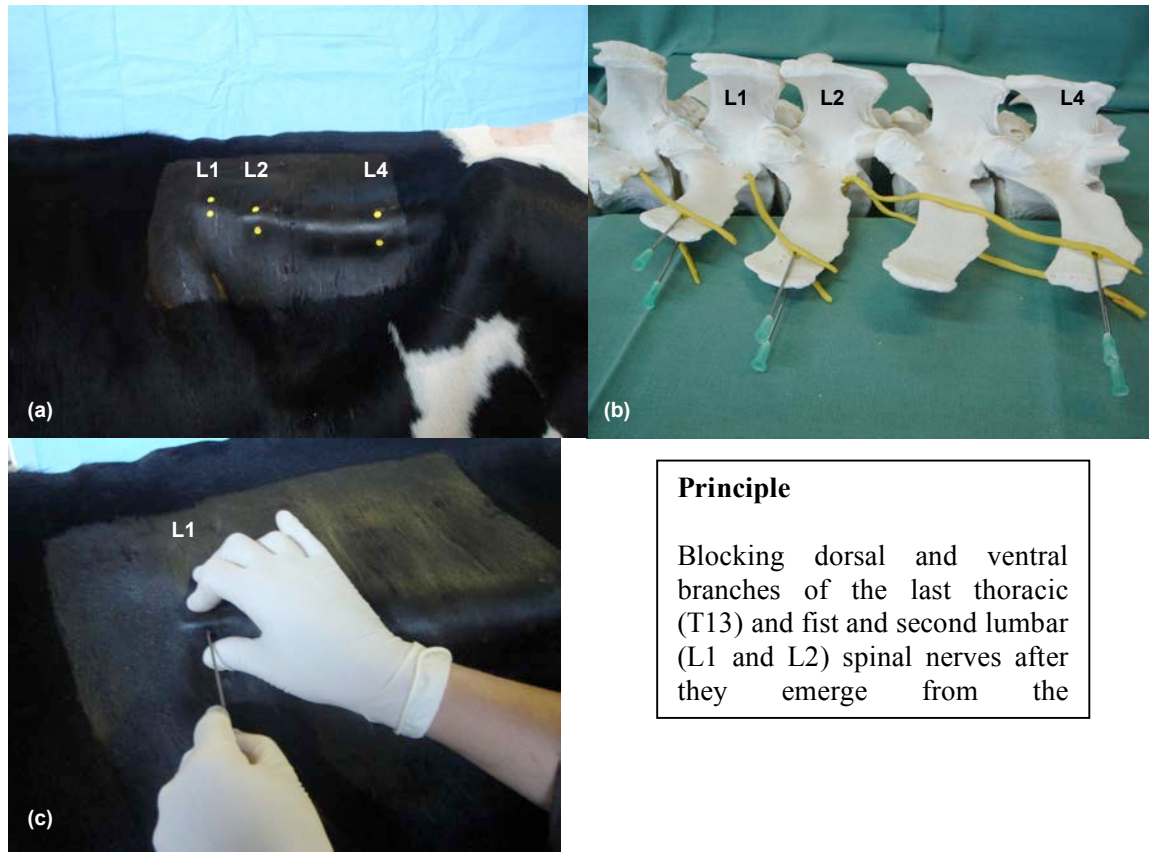
Advantages

- Smart technique!!!
- Easy and quick in dairy cattle
- Better anesthesia and analgesia than infiltration techniques

Limits

- Accidental penetration of aorta, vena cava or thoracic longitudinal vein
- Loss of motor control of the pelvic limb and recumbency (accidental anesthesia of L3)
- Scoliosis that can make sutures more difficult
- Landmarks palpation on beef cattle

1. Distal paravertebral block (*Magda, Cakala or Cornell technique*)



Principle

Blocking dorsal and ventral branches of the last thoracic (T13) and first and second lumbar (L1 and L2) spinal nerves after they emerge from the

Material

- 14G needle, 80 x 2 mm (60 x 2 mm)
- 1 or more 20mL syringes
- 3 x 25mL 2% lidocaine

Technique

- Skin clipping and disinfection
- Insertion of the needle at the distal end of the transverse processes of L1, L2 and L4
- 10 to 20mL fan-shaped infiltration of 2% lidocaine ventral to each transverse process (6-7cm depth)
- 5mL additional injection of local anesthetic dorsal and caudal to the transverse process after needle reorientation.

Result

- Onset 10 min
- Duration 90 min
- Anesthesia of the skin, increased skin temperature, mild scoliosis

Advantages

- = proximal technique
- Less scoliosis
- Less ataxia and risk of recumbency

Limits

- Larger volumes of lidocaine than in the proximal technique
- Variations in efficiency

2. Caudal epidural anesthesia



Figure 5 (a & b): sacrococcygeal space location

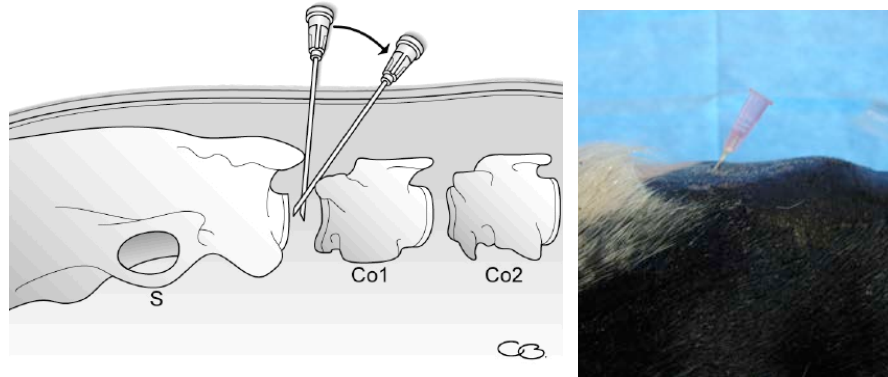


Figure 6 (a&b): needle placement for a caudal epidural in cattle



Figure 7: hanging drop test

Material

- 18G needle, 40 x 1.2 mm
- 5 to 20mL syringe according to the protocol (Table 1)
- 5 to 150mL of 2% lidocaine and/or 1 to 5mL of 2% xylazine according to the protocol

Technique

- Location of the sacrococcygeal (S5-Co1) or first coccygeal interspace (Co1-Co2) by moving the tail (figure 5)
- Skin clipping and disinfection
- Facultative skin desensitization by 2mL SQ injection of 2% lidocaine
- Insertion of the needle in the median plane, at a right angle to the surface of the croup or directed cranioventrally at an angle of 10 to 30° to vertical (figure 6), until contacts the floor of the vertebral canal
- After needle is 0.5cm withdrawn, check right needle placement in the epidural space by “hanging drop” test (figure7)

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- Injection of local anesthetic solution (table 1)

Result

- Onset 5 to 15 min, maximal effect after 20 min
- Depends on the injected drugs

Advantages

- Easy even in fat beef cattle

Limits

- Ataxia and accidental recumbency
- General effects (sedation, cardiovascular and respiratory depression...) when alpha 2 agonists are used

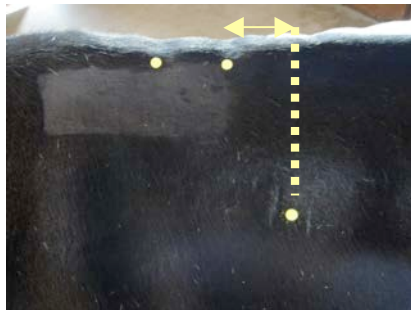
Drugs	Dosage	Onset	Duration	Desensitized area	Anesthetized organs	Standing	Side effects
2%lidocaine	1mL / 100kg	5-10 min (analgesia) 10-20 min (max)	30 min to 2h	mid-sacrum forward inner aspect of thigh ventrally	Pelvic viscera and genitalia , tail paralysis and abolition of abdominal contractions	YES	
2%lidocaine	5-8mL/100kg	10-15 min	30 min à 2h30	Lumbar area but inadequate analgesia of the flanks scrotum/udder ventrally	Pelvic viscera and genitalia , tail paralysis and abolition of abdominal contractions	NO	
2% xylazine + Saline	0.25-0.5mL / 100kg + 1mL / 100kg	5-10 min (analgesia) 10-20 min (max)	45 min to 3 h	mid-sacrum forward inner aspect of thigh ventrally	Pelvic viscera and genitalia , tail paralysis and abolition of abdominal contractions	YES	Mild sedation and ataxia, bradycardia, hypotension, respiratory acidosis, hypoxemia, ruminal amotility
2% xylazine + 2%lidocaine	0.15mL / 100kg + 1mL / 100kg	3- 4 min (analgesia) 10 min (max)	Approx. 2 h	T13 - L1 cranially Including tail, perineum, udder and flanks	All organs in this area	YES	Moderate sedation and ataxia, bradycardia, mild hypotension, ruminal amotility
2% xylazine + 2% lidocaine	0.35mL / 100kg + 0,9mL / 100kg (ie complete to 1,25mL / 100 kg)	3-4 min (analgesia) 10 min (max)	2 to 3 h	T13 - L1 cranially Including tail, perineum, udder and flanks	All organs in this area	YES	Marked sedation and ataxia, bradycardia, hypotension, respiratory acidosis, hypoxemia, ruminal amotility

Table 1 : Epidural anesthesia protocols in cattle

1. Thoracolumbar epidural anesthesia

Material

- Skin desensitization : 3-5mL of 2% lidocaine, 21G, 25 x 0,8 mm needle
- 14G, 38 x 2 mm needle used as a cannula
- 20G, 152,4 x 0,91 mm spinal needle
- 5 to 10mL syringe
- Either 1 to 1.5mL of 2% lidocaine / 100 kg BW (6 to 9mL for a 600 kg cow)
- Or 0.5mL of 2% lidocaine + 0.125mL of 2% xylazine/ 100 kg BW (3mL lidocaine + 0.75mL xylazine for a 600 kg cow)



Principle

Injection of local anesthetic into the epidural space between L1 and L2 (less commonly between T13 and L1)

Figure 8: landmarks for thoracolumbar epidural anesthesia in cattle

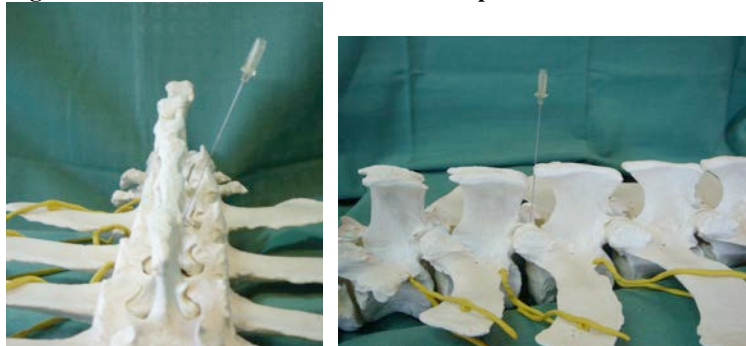


Figure 9: needle placement for a thoracolumbar epidural anesthesia in cattle

Technique

- Location of the first lumbar (L1-L2) intervertebral space, 2cm caudal to an imaginary line drawn across the back from the cranial edge of the transverse process of L2 (figure 8)
- Skin clipping and disinfection, contralateral to the flank region to desensitize
- Superficial desensitization by 3 to 5mL injection of 2% lidocaine subcutaneously and, deeper, adjacent to the interspinous ligament
- Insertion of the cannula then the spinal needle through it for a distance of approximately 10cm, directed ventromedially at an angle of 10-20° to vertical (walks off bony arches and passes through interarcuate ligament)
- Stylet is withdrawn
- Epidural space identification by “hanging-drop” technique or “loss-of-resistance” method
- Slow injection of local anesthetic solution (see in *material*)

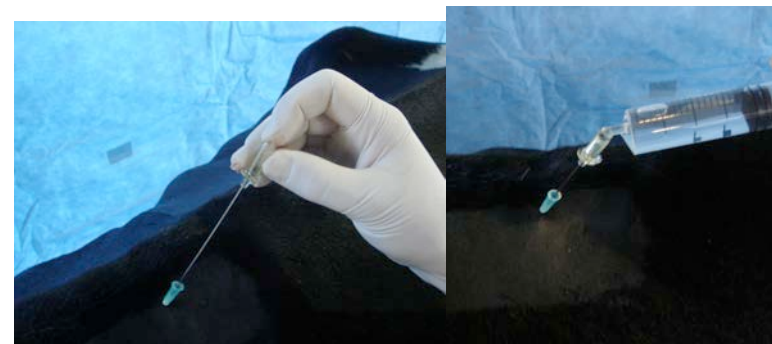


Figure 10: thoracolumbar epidural anesthesia: (a) guide needle placement, (b) spinal needle insertion, (c) hanging drop technique

Result

- Onset 10 to 20 min
- Duration up to 2 hours
- Size of the desensitized area and duration depends on the administered drugs and volumes, but also influenced by age, extradural fat, pregnancy, venous circulation, positioning, site of puncture or orientation of the needle bevel.

Advantages

- Good anesthesia and analgesia of the animal's trunk while maintaining the control of the hind limbs

Limits

- Not easy!!
- Usually difficult to realize in old cows (>8 yo) because of the ossification of the interarcuate ligament.
- Ataxia and accidental recumbency if excessive volume or subarachnoidal injection
- General effects (cardiovascular and respiratory depression, neurological signs) if excessive volume or subarachnoidal injection
- Risk of spinal damage (direct puncture or venous sinus puncture)

LUMBOSACRAL SUBARACHNOIDAL ANESTHESIA IN CALVES AND SMALL RUMINANTS



Figure 11: landmarks and needle placement for lumbosacral epidural and subarachnoidal anesthesia in calves

Material

- 18G, 50 x 1.2 mm needle if BW < 60kg ; 19G, 90 x 1,1 mm spinal needle if BW >60kg
- 5 to 20mL syringe according to the animal's size
- 1mL/10kg of 2% lidocaine +/- 0.05 to 0.1mL/10kg of 2% xylazine

Technique

- Location of the lumbosacral (L6-S1), on the animal restrained either in sternal or in lateral recumbency (figure 11)
- Skin clipping and disinfection
- Skin desensitization by 2mL SQ injection of 2% lidocaine
- Insertion of the needle in the median plane, at a right angle to the surface of the back (figure 11), until CSF drips.

- Injection of local anesthetic solution

Result

- Immediate onset (max 2 min);
- Subumbilical anesthesia/analgesia (abdominal wall, viscera, hind limbs, perineum...)
- Block duration 1 (lidocaine) to 2 hours (lidocaine+xylazine)

Advantages

- Easy location and realization
- Good anesthesia, analgesia and restraint for subumbilical surgeries

Limits

- General effects (sedation+, cardiovascular and respiratory depression) when alpha 2 agonists are used

SOME USEFUL TECHNIQUES ON THE HEAD

Cornual nerve block in small ruminants vs cattle

In small ruminants

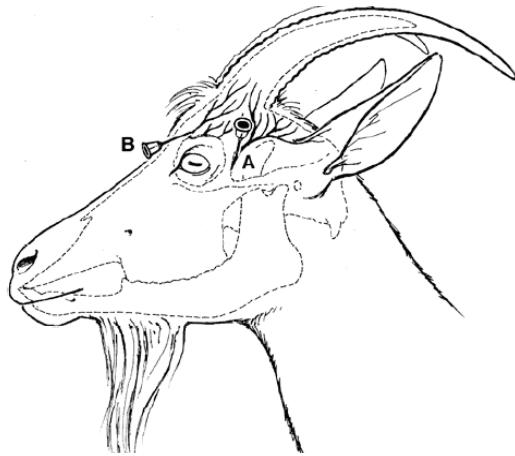


Figure 12: needle placement for desensitizing the cornual branches of the zygomaticotemporal (A) and infratrochlear nerve (B) in the goat (from Tranquilli et al)

Material

- 22G needle, 25 x 0.7 mm
- 5 mL syringe
- 2 x 2-3mL of 2% lidocaine (adult)

Technique

- First 2-3mL injection to desensitize the **cornual branch of the zygomaticotemporal nerve** half way between the lateral canthus of the eye and the lateral base of the horn, as close as possible to the caudal ridge of the supraorbital process, and 1-1.5cm deep.
- Second injection to desensitize the **cornual branch of the infratrochlear nerve** half way between the medial canthus of the eye and the medial base

of the horn, the needle being inserted dorsal and parallel to the dorsomedial margin of the orbit.

In cattle



Figure 13: needle placement for infiltration of the cornual branch of the zygomaticotemporal nerve (A)

Material

- 20G needle, 25 x 0.9 mm
- 10 mL syringe
- 5-10mL of 2% lidocaine

Technique

- One injection to desensitize the **cornual branch of the zygomaticotemporal nerve**, under the lateral edge of the frontal bone, 2/3 caudally (2-3cm in front of the base of the horn) and 1.5cm deep
- Aspiration test!!!

Peterson eye block

Material

- Skin desensitization : 5mL of 2% lidocaine, 21G, 25 x 0,8 mm needle
- 14G, 38 x 2 mm needle used as a cannula
- 18G, 110 x 1.2 mm catheter needle (or 16G, 105 x 1.6)
- 20mL syringe
- 15mL of 2% lidocaine

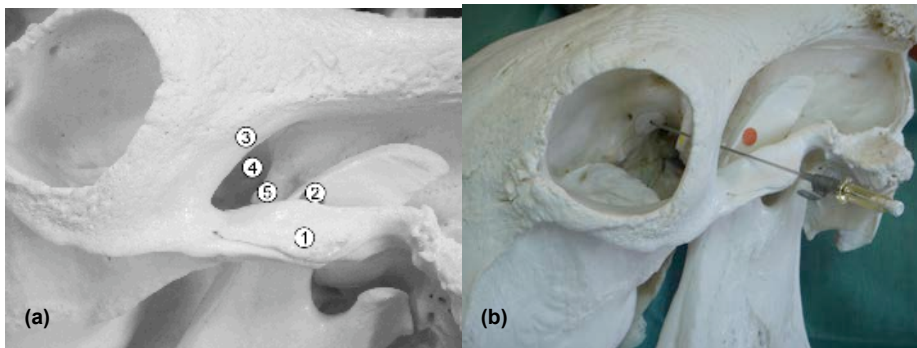


Figure 14: landmarks and needle placement for a Peterson's eye block in cattle

Technique

- Identification of the angle formed by the supraorbital process (figure 14a-3) of the frontal bone and the zygomatic arch (14a-1)
- Skin clipping, disinfection and desensitization (5mL of 2% lidocaine)
- Insertion of the cannula at this angle, as cranial and ventral as possible, with a right angle to the surface of the skin (figure 15a).
- Insertion of the needle through the cannula in an horizontal and slightly caudal direction to encounter the coronoid process of the mandible (14a-2)
- Reorientation of the needle to pass medially around the coronoid process then cranially around the pterygoid crest (14a-5) to reach the pterygopalatine fossa, rostral to the foramen orbitotundum(14a-4), 7.5 to 10cm deep.
- 15mL injection of 2% lidocaine



Figure 15: Peterson's eye block : cannula (a) and needle (b) placement

Result

- Onset 10-15 min
- Desensitization of all the important nerves emerging from the foramen orbitotundum (oculomotor, abducens, trochlear and three branches of the trigeminal nerve ie ophthalmic, maxillary and mandibular)
- Sensory and motor block of all the eye structures ("eyeball relaxation") except eyelids
- Sensitive block duration around 1 hour. Prevent blinking for hours!

Advantages

- Smart and relatively easy if adequate restraint
- Safer (for the eye and the optic nerve) and more effective than retrobulbar anesthesia for eye surgeries. Less inflammation and bleeding than when local infiltrations are performed.

Limits

- Accidental anesthetic injection in the optic nerve meninges and nasopharynx (hyperexcitability, lateral recumbency, opisthotonos, convulsions, cardiorespiratory arrest)
- Corneal damage (no blinking)

- No eyelid anesthesia so perform an auriculopalpebral nerve block by injection of 5-10mL of lidocaine along the zygomatic arch from the
- INTRAVENOUS REGIONAL ANESTHESIA**

Material

- 20G, 25 x 0.9 mm needle (or winged venipuncture set)
- An elastic bandage or a tourniquet of stout rubber tubing or an inflatable cuff
- 5 to 20mL syringes
- 20mL of 2% lidocaine in cattle; 3-10mL in small ruminants or calves

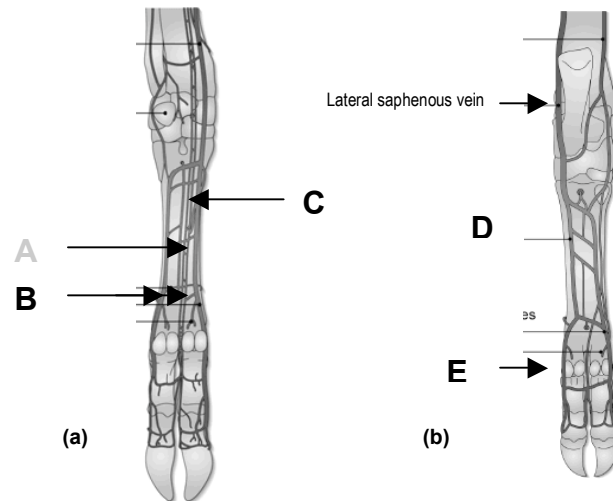


Figure 16: veins for use in IVRA of the fore (a) and hind limb (b)

same skin puncture used for the Peterson's block.



Figure 17: location of the lateral plantar digital vein



Figure 18: IVRA injection in the palmar metacarpal vein

Technique

- Physical restraint (standing in a chute or cast for cattle, lateral recumbency in calves and small ruminants)
- Tourniquet placed on fore or hind limb, proximal or distal to the carpus or tarsus respectively.
- Identification of either the **common dorsal metacarpal vein (16a-A)**, the **palmar metacarpal vein (16a-B)** or the **radial vein (16a-C)** for the fore limb
- Identification of the **cranial branch of the lateral saphenous vein (16b-D)** or the **lateral plantar digital vein (16b-E)** for the hind limb
- Skin clipping and disinfection
- Injection (as rapid as possible) of local anesthetic in the most appropriate vein according to the surgical site. If the cow is standing, the foot should be lifted during injection
- Digital pressure and gentle massage after needle removal

Result

- Onset 5 min(max 10 min);
- Duration as long as the tourniquet is in place, 10 min after tourniquet removal (analgesia may last for a little longer)

Advantages

- Relatively easy, quick
- Reduction of bleeding by the tourniquet
- More effective and reproducible than limbs nerve blocks techniques.
Less traumatic too.
- Almost no side effect if tourniquet left in place more than 20 min and less than 2 hours

Limits

- Ischemic necrosis, severe lameness and oedema if the tourniquet is left in place more than 2 hours
- Anecdotic lidocaine toxicity signs when the tourniquet is removed
- Some inexplicable failures...

References:

- Bouisset S. Technique de l'anesthésie intra-veineuse sous garrot. Bull GTV 1999 ; 1 : 11-12.
- Bouisset S. Les anesthésies paravertébrales. Bull GTV 1999 ; 3 : 157-159.
- Bouisset S. Les anesthésies locorégionales : L'anesthésie du nerf auriculopalpebral. Bull GTV 1999 ; 4 : 15.
- Bouisset S. Les anesthésies locorégionales : L'anesthésie de l'œil. Bull GTV 2000 ; 5 : 13-15.
- Bouisset S. L'anesthésie des membres pelviens. Bull GTV 2000 ; 6 : 13-14.
- Bouisset S. L'anesthésie des membres thoraciques. Bull GTV 2000 ; 7 : 13-14.
- Bouisset S. Les anesthésies péridurales chez les bovins. Bull GTV 2000 ; 8 : 11-13.
- Bouisset S. Anesthésies de la mamelle et des trayons. Bull GTV 2000 ; 9 : 7-9.
- Desrochers A, Cuvelliez S, Troncy E. L'anesthésie épidurale caudale chez les bovins. Point Vét 1999 ; 30 ; 451-456.
- Guatteo R, Holopherne D. Anesthésie des bovins. Editions du Point vétérinaire 2006.
- Muir WW, Hubbell JAE and Skarda R. In : Handbook of Veterinary Anesthesia, 3rd Ed. CV Mosby 1998.
- Skarda RT. Local and regional anesthesia in ruminants and swine. Vet Clin North Am Food Anim Pract. 1996 ; 12 : 579-626.
- Thurmon JC et al. Local and regional anesthetic techniques: ruminants and swine. In : WJ Tranquilli, GJ Benson, eds. Veterinary Anesthesia, 3rd ed. Philadelphia : Lea and Febiger, 1996 :479-512.



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NOTES

Clinical pharmacology of injectable anaesthetic drugs in Ruminants

Gwenola Touzot-Jourde, Diplomate ACVA, Ross University, St Kitts, West Indies
gtouzotjourde@rossvet.edu.kn

Drug	Cattle	Calves	Sheep	Goat	
Acepromazine	0.1 mg/kg IM		0.03-0.05 mg/kg IV 0.05-0.1 mg/kg IM		Not commonly used, mild sedation, Delayed recovery ⚠risk of regurgitation
Xylazine	0.015-0.025 mg/kg IV/IM standing sedation 0.05-0.2 mg/kg IV/IM Down in 10-20 min, deep sedation for 20-30 min, recovery 7 h or more Hereford more sensitive than Holstein. Brahman very sensitive	0.1-0.2 mg/kg IV/IM	Breed variation in analgesia 0.1-0.2 mg/kg IV, 0.2-0.3 mg/kg IM recumbency	More sensitive than sheep 0.05 mg/kg IV, 0.1 mg/kg IM recumbency	Hypotension, bradycardia, Hyperglycemia, oxytocin-like action Hypoxemia, hypercarbia Pulmonary edema
Detomidine	2.5-10 mcg/kg IV standing sedation for 30-60 min 10-20 mcg/kg IV 20-30 mcg/kg IM		10-20 mcg/kg IV standing sedation for 30-60 min 30 mcg/kg IV/IM		Hypertension, bradycardia, hyperglycemia ⚡CO ⚡PaO ₂
Medetomidine	5 mcg/kg IV (= Xylazine 0.1 mg/kg IV), profound sedation, standing 10 mcg/kg IV, recumbency 40 mcg/kg IV reversed by atipamezole 400 mcg/kg IV at 60 min, relapse at 80 min after atipamezole	20 mcg/kg IV	10 mcg/kg IV 5-10 mcg/kg IM	20 mcg/kg IV , recumbency in 2-3 min, for 2 h	
Dexmedetomidine			5 mcg/kg IV		
Romifidine		10 mcg/kg IV	50 mcg/kg IV		
Alpha-2 reversal agents	Yohimbine 0.125 mg/kg + 4- aminopyridine 0.3 mg/kg (for Xylazine 0.2-0.3 mg/kg)	Idazoxan 0.05 mg/kg IV Atipamezole 20-	Yohimbine 0.5-2 mg/kg IV/IM Idazoxan 0.05	Atipamezole 100 mcg/kg IV 25 min after medeto 20	Possible hyperesthesia, hyperexcitability

	Tolazoline 0.2 mg/kg reverses GI atony Idazoxan 0.01-0.1 mg/kg (xylazine in calves) Atipamezole 25-50 mcg/kg IV/IM	60 mcg/kg IV	mg/kg IV	mcg/kg, standing in 2-3 min	
Diazepam		0.1-0.3 mg/kg IV	0.25-0.5 mg/kg IV, sedation: 30 min 0.1-0.25 mg/kg IV		Sedation or excitement
Midazolam			0.1 mg/kg		
Butorphanol	0.05 mg/kg IV	0.1-0.5 mg/kg IV/IM	0.05-0.5 mg/kg IM 0.05 mg/kg no behavior effect 0.1-0.2 mg/kg IV possible excitement 0.4 mg/kg IV ataxia		
Hydromorhone			0.05-0.1 mg/kg IV		
Morphine			Up to 1 mg/kg		
Buprenorphine			6 mcg/kg IV, 5-10 mcg/kg IM q4h		
Fentanyl			5 mcg/kg IV bolus, 5-20 mcg/kg/h		Possible prolonged recovery & respiratory depression

Drug	Cattle	Calves	Sheep	Goat	
Pentobarbital	Prolonged narcosis up to 2 days	> 1 month 20-29 mg/kg IV , Sx:30 min, standing <3h	20-25 mg/kg 28-33 mg/kg IV ~ 15 min	30 mg/kg 20-60 min 6-36 mg/kg/h	
Thiopental	11 mg/kg IV alone 5-6 mg/kg after Xylazine or GG		8-15 mg/kg IV		Smooth induction No excitement with subanesthetic dose Quick, quiet recovery Sx: 3-5 min after single

					dose Sternal 20 min Standing 45 min
Ketamine	2 mg/kg IV, recovery in 20-30 min Top up bolus: 0.75-1.25 mg/kg IV for extra 10-15 min	1 week-1 year 10 mg/kg IM + xylazine 0.2 mg/kg 35 min, standing 80-90 min 0.5 mg/kg IV after medetomidine 20 mcg/kg IV 5 mg/kg IV after romifidine 10 mcg/kg IV	2-10 mg/kg IV 10-20 mg/kg IM 7.5 mg/kg IV after xylazine 0.1 mg/kg or diazepam 0.375 mg/kg IV, anesthesia for 25 min, ∇ CO, 2 mg/kg after medetomidine 10 mcg/kg or dexmedetomidine 5 mcg/kg IV	11 mg/kg IM with Xylazine 0.22 mg/kg 4 mg/kg IV with diazepam 0.2 mg/kg	Satisfactory induction if used alone (no excitement, seizure) Improved muscle relaxation with α_2 , benzodiazepines and GG
			10-15 mg/kg IM after xylazine 0.1-0.2 mg/kg IM, 45 min of anesthesia 4.5 mg/kg IV after diazepam 0.1 mg/kg IV, 15-20 min of anesthesia, recumbency up to 30 min		
Saffan			2-3 mg/kg IV then 0.23-0.24 mg/kg/min Sx: 10 min, standing ~ 20 min, standing 30 min after stopping CRI 4.4 mg/kg IV Sx: 15 min, standing 30 min		Dose-dependent ∇ HR, BP, RR Possible initial apnea then mild respiratory depression Good muscle relaxation
Guaifenesin	Recumbency 80-100 mg/kg GG 50 mg/ml + Thiopental 5 mg/ml, CRI 1-2 ml/kg/h	2-3 mg/ml or Ketamine 1-2 mg/ml	mg/ml $\pm$ Xylazine 0.1 mg/kg		
Telatamine/ Zolazepam		4 mg/kg IV alone, minimal cardiovascular depression, anesthesia: 45-60 min 4 mg/kg IM after xylazine 0.1 mg/kg IM,	Up to 12 mg/kg IV, anesthesia: 45-60 min at high dose 6.6 mg/kg IV with ketamine 6.6 mg/kg IV $\pm$ xylazine 0.1 mg/kg, analgesia 30 min for TK, 60-100 min TKX 5.5 mg/kg IV then 0.5-1 mg/kg top-up		∇ CO, BP, apnea & hypoxemia at high dose

Telatamine/ Zolazepam		4 mg/kg IV alone, minimal cardiovascular depression, anesthesia: 45-60 min 4 mg/kg IM after xylazine 0.1 mg/kg IM,	Up to 12 mg/kg IV, anesthesia: 45-60 min at high dose 6.6 mg/kg IV with ketamine 6.6 mg/kg IV ± xylazine 0.1 mg/kg, analgesia 30 min for TK, 60-100 min TKX 5.5 mg/kg IV then 0.5-1 mg/kg top-up	⚠ CO, BP, apnea & hypoxemia at high dose
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Carroll
GL,
Hartsfi

eld SM, Champney TH, Geller SC, Martinez EA, Haley EL. Effect of medetomidine and its antagonism with atipamezole on stress-related hormones, metabolites, physiologic responses, sedation, and mechanical threshold in goats. *Vet Anaesth Analg*. 2005; 32: 147-157.

Carroll GL, Hartsfield SM, Hambleton R. Anesthetic effects of tiletamine-zolazepam, alone or in combination with butorphanol, in goats. *J Am Vet Med Assoc*. 1997; 211: 593-597.

Carroll GL, Hooper RN, Slater MR, Hartsfield SM, Matthews NS. Detomidine-butorphanol-propofol for carotid artery translocation and castration or ovariectomy in goats. *Vet Surg*. 1998; 27: 75-82.

Celly CS, McDonnell WN, Young SS, Black WD. The comparative hypoxaemic effect of four alpha 2 adrenoceptor agonists (xylazine, romifidine, detomidine and medetomidine) in sheep. *J Vet Pharmacol Ther*. 1997; 20: 464-471.

Hall LW, Clarke KW. Anaesthesia of the ox. In *Veterinary anaesthesia*, 9th edition, London: WB saunders; 1991: 236-259

Hall LW, Clarke KW. Anaesthesia of the sheep, goat and other herbivores. In *Veterinary anaesthesia*, 9th edition, London: WB saunders; 1991: 260-274

Howard BW, Lagutchik MS, Januszkiewicz AJ, Martin DG. The cardiovascular response of sheep to tiletamine-zolazepam and butorphanol tartrate anesthesia. *Vet Surg*. 1990; 19: 461-467.

Kastner SB. A2-agonists in sheep: a review. *Vet Anaesth Analg*. 2006; 33: 79-96.

Kastner SB, Kutter AP, von Rechenberg B, Bettschart-Wolfensberger R. Comparison of two pre-anaesthetic medetomidine doses in isoflurane anaesthetized sheep. *Vet Anaesth Analg*. 2006; 33: 8-16.

Kastner SB, Von Rechenberg B, Keller K, Bettschart-Wolfensberger R. Comparison of medetomidine and dexmedetomidine as premedication in isoflurane anaesthesia for orthopaedic surgery in domestic sheep. *J Vet Med Physiol Pathol Clin Med*. 2001; 48: 231-241.

Kronen PW, Levionnois OL, Eckstein FS, Moens YP. Prolonged recovery and respiratory depression after fentanyl infusion in a sheep undergoing mitral valve reconstruction. *Lab Anim*. 2005; 39: 428-434.

- Lagutchik MS, Januszkiewicz AJ, Dodd KT, Martin DG. Cardiopulmonary effects of a tiletamine-zolazepam combination in sheep. *Am J Vet Res.* 1991; 52:1441-1447.
- Lin HC, Riddell MG. Preliminary study of the effects of xylazine or detomidine with or without butorphanol for standing sedation in dairy cattle. *Vet Ther.* 2003; 4: 285-291.
- Larenza MP, Bergadano A, Iff I, Doherr MG, Schatzmann U. Comparison of the cardiopulmonary effects of anesthesia maintained by continuous infusion of ketamine and propofol with anesthesia maintained by inhalation of sevoflurane in goats undergoing magnetic resonance imaging. *Am J Vet Res.* 2005; 66: 2135-2141.
- Lin HC, Wallace SS, Tyler JW, Robbins RL, Thurmon JC, Wolfe DF. Comparison of tiletamine-zolazepam and tiletamine-zolazepam-xylazine anaesthesia in sheep. *Aust Vet J.* 1994; 71:239-242.
- Nolan A, Livingston A, Waterman AE. Investigation of the antinociceptive activity of buprenorphine in sheep. *Br J Pharmacol* 1987; 92: 527-533.
- Prassinis NN, Galatos AD, Raptopoulos D. A comparison of propofol, thiopental or ketamine as induction agents in goats. *Vet Anaesth Analg.* 2005; 32: 289-296.
- Raekallio M, Tulamo RM, Valtamo T. Medetomidine-midazolam sedation in sheep. *Acta Vet Scand.* 1998; 39: 127-134.
- Ranheim B, Arnemo JM, Ryeng KA, Soli NE, Horsberg TE. A pharmacokinetic study including some relevant clinical effect of medetomidine and atipamezole in lactating dairy cows. *J Vet Pharmacol Ther.* 1999; 22: 368-373.
- Riebold TW. Ruminants. In: Thurmon JC, Tranquilli WJ, Benson GJ, editors. *Lumb and Jones' veterinary anesthesia*. 3rd edition, Baltimore: Williams & Wilkins; 1996: 610-626
- Schauvliege S, Narine K, Bouchez S, Desmet D, Van Parys V, Van Nooten G, Gasthuys F. Refined anaesthesia for implantation of engineered experimental aortic valves in the pulmonary artery using a right heart bypass in sheep. *Lab Anim.* 2006; 40: 341-352.
- Sharma AK, Kumar N, Dimri U, Hoque M, Maiti SK, Gupta OP, Shahi A. Romifidine-ketamine anaesthesia in atropine and triflupromazine pre-medicated buffalo calves. *J Vet Med A Physiol Pathol Clin Med.* 2004; 51: 420-424
- Waterman AE, Livingston A, Amin A. Further studies on the antinociceptive activity and respiratory effects of buprenorphine in sheep. *J Vet Pharmacol Ther.* 1991; 14: 230-234.



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NOTES

Legal aspects in drug usage for ruminants in the European Community

Gwenola Touzot-Jourde, Diplomate ACVA, Ross University, St Kitts, West Indies
gtouzotjourde@rossvet.edu.kn

The basic rule governing the marketing of veterinary medicinal products within the European Union is contained in codified Directives adopted by the European Parliament and Council. There is a community code relating to veterinary medicinal products. There is also a community procedure for the authorisation and supervision of medicinal products for human and veterinary use. The EU has established a European Medicines Agency to protect and promote public and animal health in the context of a continuing globalisation. The summaries of legislation site contain summaries and publication references for the measures adopted by the European Union in each sphere of its activity, as well as preparatory work and related reports. It also offers regularly updated summaries of ongoing legislative procedures.

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The European Medicines Agency (EMA) is a decentralised body of the European Union with headquarters in London.

- Its main responsibility is the protection and promotion of public and animal health, through the evaluation and supervision of medicines for human and veterinary use.
- The EMA is responsible for the scientific evaluation of applications for European marketing authorisation for medicinal products (centralised procedure). Under the centralised procedure, companies submit one single marketing authorisation application to the EMA.
- The safety of medicines is monitored constantly by the Agency through a pharmacovigilance network. The EMA takes appropriate actions if adverse drug reaction reports suggest changes to the benefit-risk balance of a medicinal

product. For veterinary medicinal products the Agency has the responsibility to establish safe limits for medicinal residues in food of animal origin.

- The Agency is also involved in referral procedures relating to medicinal products that are approved or under consideration by Member States.

<http://www.emea.europa.eu/index/indexv1.htm>

The EMEA publishes information on the products assessed by the Committee for Medicinal Products for Veterinary Use (CVMP). Any positive opinion given by the Committee is published in the first instance as a Summary of Opinion. More detailed information is published later, following the granting of a Marketing Authorisation by the European Commission as an European Public Assessment Report (EPAR).

The European Public Assessment Report (EPAR) reflects the scientific conclusion reached by the Committee for Medicinal Products for Veterinary Use (CVMP) at the end of the centralised evaluation process.

The EPAR provides a summary of the grounds for the CVMP opinion in favour of granting a marketing authorisation for a specific medicinal product. It results from the Committee's review of the documentation submitted by the applicant, and from subsequent discussions held during CVMP meetings. The EPAR is updated throughout the authorisation period as changes to the original terms and conditions of the authorisation (i.e. variations, pharmacovigilance issues, specific obligations) are made. EPARs also contain a summary written in a manner that is understandable to the public.

<http://www.emea.europa.eu/htms/vet/epar/z.htm>

In order to protect public health, the legislation on foodstuffs of animal origin regulates veterinary medicinal products availability and use for animals. The regulation 2377/90/CE lays down a community procedure for the establishment of maximum residue limits for veterinary medicinal products in foodstuffs of animal origin.

Maximum Residue Limits

<http://ec.europa.eu/enterprise/pharmaceuticals/mrl/index.htm>

MRL

Maximum Residue Limits of veterinary medicinal products in foodstuffs of animal origin

[EudraLex Volume 8 >>](#)

[Council Regulation \(EEC\) N° 2377/90 of 26 June 1990 laying down a Community procedure for the establishment of maximum residue limits for veterinary medicinal products in foodstuffs of animal origin. \(Official Journal L 224 , 18/08/1990 p. 1 - 8; Finnish special edition: Chapter 3 Volume 33 p. 117; Swedish special edition: Chapter 3 Volume 33 p. 117\).](#)

- Official consolidated version of Council Regulation (EEC) N° 2377/90, including annexes I to V, updated until 11 May 2005

CS DA DE EL EN ES ET FI FR HU
IT LT LV MT NL PL PT SK SL SV

- The Publications Office will proceed to publish an updated consolidated version in all official languages once all Regulations amending Regulation 2377/90 have been translated into the new languages and published.
- [Unofficial consolidated version of the Annexes I to IV of Council Regulation \(EEC\) N° 2377/90 Updated up to 12.10.2005](#)
This document is not an official version and is only intended for use as a search tool. No liability for its content is assumed. In case of doubt, consult the Official Journal. If mistakes are identified, please give [feedback](#).

[Council Regulation \(EC\) No 1308/1999 of 15 June 1999 amending Regulation \(EC\) No 2377/90 laying down a Community procedure for the establishment of maximum residue limits of veterinary medicinal products in foodstuffs of animal origin.](#)

[Council Regulation \(EEC\) No 2377/90 of 26 June 1990 laying down a Community procedure for the establishment of maximum residue limits for veterinary medicinal products in foodstuffs of animal origin.](#) (Official Journal L 224 , 18/08/1990 p. 1 - 8; Finnish special edition: Chapter 3 Volume 33 p. 117; Swedish special edition: Chapter 3 Volume 33 p. 117).

[Substances considered as not falling within the scope of Council Regulation \(EEC\) No 2377/90. Updated version \(revision 9 October 2006\) from the Committee for Veterinary Medicinal Products.](#)
The Committee for Veterinary Medicinal Products (CVMP) having reviewed all applications for the establishment of MRLs for "old substances" to be considered under Council Regulation (EEC) No 2377/90, considered that some substances were normal components of human food, biologically inert when orally taken, or not classified as chemicals. An up-to-date list of substances that are considered by the CVMP as not being within the scope of Council Regulation 2377/90 is now available. (Currently revision 5 of 27/5/2003)

Maximum limits for residues of veterinary medicinal products which may be accepted in foodstuffs of animal origin in accordance with Regulation (EEC) N°- 2377/90.

An updated consolidated version of Annex I to IV of Council Regulation 2377/90 is now available in English.

This document is not an official version and is only intended for use as a search tool. No liability for its content is assumed. In case of doubt, consult the Official Journal. If mistakes are identified, please give feedback. The Publications Office will proceed to publish an updated consolidated version in all official languages once all Regulations amending Regulation 2377/90 have been translated into the new languages and published.

[Complete series of Commission and Council regulations modifying Annexes I to IV of Council Regulation 2377/90](#)

[Reflection Paper on Residues in foodstuffs of animal origin and Summary of Comments](#)

Useful Links for MRL

- [Scad Plus : Veterinary medicinal product residues in foodstuffs of animal origin](#)
- [EMA : Veterinary Medicines](#)

The regulation classifies pharmacologically active substances used in veterinary medicinal products in four categories:

- those for which maximum residue limits have been established (Annex I);
- those for which it is not necessary for the protection of public health to establish a maximum residue limit (Annex II);
- those for which provisional maximum residue limits may be established (Annex III);
- those for which no maximum residue limits can be established because, at whatever limit, in foodstuffs of animal origin they constitute a hazard to the health of the consumer (Annex IV).

All the pharmacologically active substances authorized in food producing animals are listed in the annexes I to III and information on the active principle is available in the EPARs.

[Background](#)

[A-Z Listing of EPARs](#)

EPARs for authorised medicinal products for veterinary use

Please click on a letter to view an indexed list of products:

[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

[Z](#)

Drugs pertaining to the practice of anaesthesia in ruminants:

Annex I: MLR are defined for target tissues (muscle, fat, liver, kidney, milk)

Clenbuterol	Bovine
Carprofen	Bovine (muscle, fat, liver kidney)
Flunixin	Bovine
Tolfenamic acid	Bovine
Diclofenac	Bovine
Dexamethasone	Bovine, Caprine

Annex II: no MLR needed

Inorganic and organic compounds

Calcium chloride, gluconate	All food producing species
Magnesium sulphate	All food producing species
Acetylsalicylic acid	All food producing species
Atropine	All food producing species
Benzylalcohol	All food producing species
Benzocaine	All food producing species
Brotizolam	Bovine
Butorphanol	Equidae
Butylscopolaminium bromide	All food producing species
Chlorhexidine	All food producing species
Detomidine	Bovine, Equidae
Furosemide	Bovine, Equidae
Heptaminol	All food producing species
Isoflurane	Equidae
Ketamine	All food producing species
Ketoprofen	All food producing species
Levomethadone	Equidae
Lidocaine	All food producing species
Lobeline	All food producing species
Mepivacaine	Equidae
Neostigmine	All food producing species
Procaine	All food producing species
Propylene glycol	All food producing species
Romifidine	Equidae
Tetracaine	All food producing species
Theophylline	All food producing species
Xylazine	Bovine, Equidae

Substances generally recognised as safe

DMSO	All food producing species
Epinephrine	All food producing species
Formaldehyde	All food producing species
Mannitol	All food producing species
Sodium chloride	All food producing species

Anti-inflammatory agent

Carprofen	Bovine (milk only)
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Annex IV: No MRL can be fixed

Chloroform, chlorpromazine

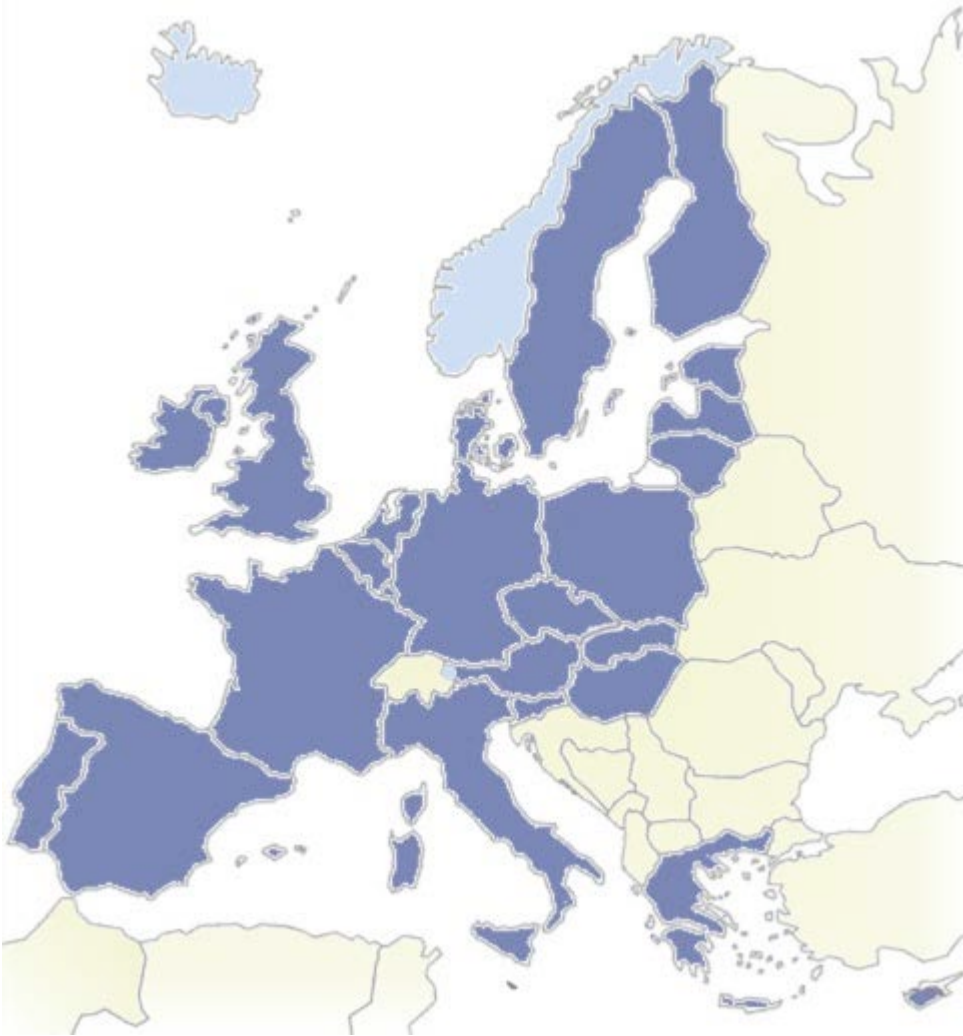
**Substance considered as not falling within the scope of council regulation
2377/90/CE**

Oxygen

Availability of each drug in the different EU member states is dependent on the existence of a drug presentation and marketing authorisation. With the procedure of mutual recognition, the marketing authorisation application can be done with a reference state member and extended to all the EU state members. Link between the reference member and the others is done by a coordination group. So list of available medications for a species is still member state dependent and is regulated by state medicines agency. Agencies are regrouped in the Heads of European Veterinary Regulatory Authorities for medicinal products. <http://www.hevra.org/>

Mission Statement

Competent Authorities for Veterinary Medicines in the European Economic Area working together to optimize use of resources and to ensure integrated and cohesive action on the regulation of veterinary medicines aimed at protecting and advancing public health, animal health and welfare and safeguarding the environment.



The National Procedure

Until 1998, the pharmaceutical industry could apply for a national approval. The product can then only be sold in that particular EU country. A marketing authorisation (MA) is valid for five years and after the first renewal, the MA is valid for an unlimited period. In order to obtain an approval the product must be submitted with an SPC (Summary of Products Characteristics) which is the basis for the marketing of the product. For some products, i.e. products intended for national use in one Member State only, it will be possible to use the national procedure also after 1998.

The Mutual Recognition Procedure

Mutual recognition means that EU countries may approve the decision made about a medicinal product by another EU country. The pharmaceutical company submits their application to the country chosen to carry out the assessment work, which then approves or rejects the application. The other countries have to decide within 90 days whether they

approve or reject the decision made by the original country. Two groups are working for the facilitation of the Mutual Recognition Procedure : for human medicinal products, the CMD(h) (Coordination Group for mutual recognition and Decentralised procedures (human)), and for veterinary medicinal products, the CMD(v)(Coordination Group for mutual recognition and Decentralised procedures (veterinary)). If a member state cannot approve the assessment report, the summary of product characteristics, the labelling and the package leaflet on grounds of potential serious risk to human and animal health or to the environment, a pre-referral procedure should be issued by the relevant Co-ordination Group. If the Member State(s) fail to reach an agreement during the 60-day procedure of the pre-referral, a referral to the CPMP/CVMP for arbitration may be made through its secretariat at the EMEA.

The Decentralised Procedure

The decentralised procedure should be used for products that have not yet received authorisation in an EU country. The applicant may request one or more concerned Member State(s) to approve a draft assessment report, summary of product characteristics, labelling and package leaflet as proposed by the chosen reference Member State in 210 days. The two groups, CMD(h) and CMD(v), also work for the facilitation of the decentralised procedures. If a member state cannot approve the assessment report, the summary of product characteristics, the labelling and the package leaflet on grounds of potential serious risk to human and animal health or to the environment, a pre-referral procedure should be issued by the relevant Co-ordination Group. If the Member State(s) fail to reach an agreement during the 60-day procedure of the pre-referral, a referral to the CPMP/CVMP for arbitration may be made through its secretariat at the EMEA.

The Centralised Procedure

An approval for a medicinal product intended for use in all EU countries may be obtained by applying to the EMEA (European Medicines Agency) in London. Within the EMEA two scientific committees have been established: for human medicinal products, the CPMP (Committee for Proprietary Medicinal Products) and for veterinary medicinal products, the CVMP (Committee for Veterinary Medicinal Products). These committees prepare an opinion preceeding the formal approval by the Commission. The member states have one representative in each committee. The assessment work of the application is done by any of the EU countries. When EMEA has received a centralised application the responsible committee appoints a rapporteur/co-rapporteur. On the basis of the opinion from the scientific committees the Commission (or the Council) issues the formal decision to authorise a product in the centralised procedure. The Commission is assisted in the decision-making procedure by a Standing Committee with representatives from each Member State.

Welcome to the
Veterinary Mutual Recognition Index
hosted by www.hevra.org

This index includes veterinary medicinal products approved in the Member States of the European Union according to the procedure for Mutual Recognition.

Please read the [note on disclaims and liability](#) before use the VMRI

Enter the product index by choosing one of the following items :

NEW...	Newly recognised	Newly recognised products
ABC...	Alphabetical	Alphabetical name product ordered list
	Simple search	Fast query with this preselected criteria
	Multiple search	Build your own query
A..... B.....	Word index	Search from words contained in the SPC corpus
?	Help	

Withdrawal times are specific of drug presentation and a marketing authorisation (proprietary medicinal product). They are calculated for the tissues of the target species and take into consideration the dose, the route of administration and the treatment duration.

Annex I and III: withdrawal time are based on average daily intake of the foodstuff (API) with information issued from the safety and residue files. It usually involves total residue study with radiolabelled drugs.

Annex II: withdrawal time is estimated from the depletion of the most relevant residue component in the tissue with the slowest depletion rate. A linear regression analysis is then applied.

Drugs used for a food producing animal needs to be in the annex I to III. The article 11 from the directive 2004/28/EC (amending Directive 2001/82/EC on the community code relating to veterinary medicinal products) states the procedure to follow if there is no authorised veterinary medicinal product in a member state for a condition affecting a food-producing species (cascade principle). By way of exception, the veterinarian may, under his direct personal responsibility and particularly to avoid causing unacceptable suffering, treat animals the following way:

- Use a medication authorised in the affected species but with a different indication or a medication authorised in a different species,
- In case of no product authorised in the member state, use a human medicinal product authorised in the member state or a product authorised in another member state for use in the same species or in another food-

- producing species for the the condition in question or for another condition,
- c) If there no product as described in b), an extemporaneous preparation can be used.

That regulation applies only if the pharmacologically active substances included in the medicinal products are listed in the annexes I to III and withdrawal time is specified by the veterinarian.

Unless the medicinal product has a withdrawal time for the species concerned, the specified withdrawal time should not be less than 7 days for milk and 28 days for meat. Record of examination of the animals, details of the owners, number of animals treated, diagnosis, prescription, doses, treatment duration and withdrawal periods should kept for 5 years (even if the animals are going to slaughter before that)

Points not addressed by the cascade principle:

Modification of dosage

Change of route of administration

Modification of galenic form

Drug interactions

Disease effects on drug elimination



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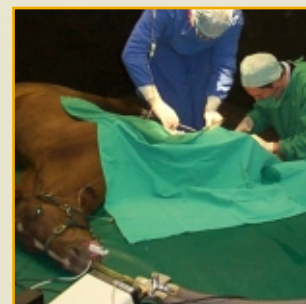
Hyatt Regency , Roissy CDG

NOTES

DOMOSEDAN®



Le sédatif de toutes les situations, l'analgésie en plus !



- Un protocole simple pour une utilisation en toutes circonstances
- Une puissance analgésique reconnue ⁽¹⁾
- La sécurité d'un produit spécifique des chevaux *

(1) JOCHLE W. et al. Acta Vet. Scan. 1986-82 : 69 - 84.
* Chevaux de sport et de course.

DOMOSEDAN® Sédatif et analgésique pour chevaux de sport et de course. **Composition** : Solution injectable : Chlorhydrate de DETOMIDINE 10,0 mg. Parahydroxybenzoate de méthyle 1,0 mg. Chlorure de sodium 5,9 mg. Eau pour préparation injectable q.s.p. 1 mL. **Propriétés** : Découverte par Orion Corporation, la détomidine est un sédatif ayant des propriétés analgésiques ; son utilisation facilite la contention des chevaux et permet de réaliser des examens cliniques, des interventions chirurgicales mineures et d'autres manipulations. Compatible avec des anesthésiques locaux. DOMOSEDAN® a été utilisé chez quelques chevaux en tant que prémédication avec les molécules suivantes : kétamine, thiobarbiturate, et halothane. Lorsqu'il est utilisé comme prémédication : DOMOSEDAN® potentialise les anesthésiques, les doses anesthésiques doivent être diminuées. DOMOSEDAN® peut retarder l'induction de l'anesthésie. **Indication** : Chez les chevaux de sport et de course, l'action sédatrice et analgésique facilite la contention pour réaliser : Examens cliniques : endoscopie, palpation rectale, examen gynécologique, radiographie... Interventions chirurgicales mineures : soins dentaires, sutures cutanées, soins des tendons, excrèse des tumeurs cutanées... Administration de médicaments à la sonde naso-oesophagienne. **Administration et posologie** : Voies I.M. ou I.V. lente. L'apparition de l'effet est plus rapide suite à l'administration intraveineuse. Chevaux de sport et de course : la durée et l'intensité de la sédation et de l'analgésie dépendent de la dose administrée : Sédation légère : 10 µg/kg, soit 0,1 mL/100 kg. Sédation et analgésie : 20 µg/kg, soit 0,2 mL/100 kg. Sédation et analgésie profondes : 40 µg/kg, soit 0,4 mL/100 kg. Début de l'effet en 3-5 minutes. Effet optimal obtenu en 10-15 minutes. **Contre-indications** : Ne pas utiliser le DOMOSEDAN® en association avec les amines sympathomimétiques. Ne pas administrer de sulfamides durant la sédation induite avec le DOMOSEDAN®. **Effets indésirables** : Arythmie cardiaque bénigne réversible. Incoordination des membres et sudation. Léger tremblement musculaire éventuel. **Précautions** : L'administration intraveineuse doit être lente. Tenir hors de portée des enfants. Ne pas utiliser chez les juments durant le dernier mois de gestation. Ne pas administrer aux animaux destinés à la consommation humaine. Même s'ils apparaissent sous sédation profonde, certains chevaux peuvent réagir violemment à un stimulus extérieur. DOMOSEDAN® ne dispense pas des mesures de sécurité habituelles pour protéger le praticien et ses aides. **Catégorie** : À ne délivrer que sur ordonnance. **Conservation** : Conserver dans un endroit frais et sec, à l'abri de la lumière. **Présentations** : Flacon de 5 mL. A.M.M. 680 505.8 du 21/04/88. Flacon de 20 mL. A.M.M. 680 506.4 du 21/04/88. **Exploitant** : Pfizer Santé Animale, 23-25 Avenue du Dr Lannelongue 75668 Paris Cedex - RCS Paris 433 623 550.



Santé Animale
www.pfizer-vet.fr