Electrostimulation-guided sciatic and femoral nerve blocks as a multimodal analgesia approach in an alpaca (*Vicugna pacos*) undergoing stifle surgery: a case report

Anne-Sophie Van Wijnsberghe*, Alexandru Tutunaru, Hélène Casalta, Bernard Bouvy, Charlotte Sandersen.

University Veterinary Clinic, Faculty of Veterinary Medicine, Liege University, Belgium.

Quartier Vallée 2, Avenue de Cureghem 3 B67, Sart-Tilman, 4000 Liège.

Submitted February 16, 2021; Accepted March 8, 2021 ; Published June 14, 2021

Abstract

A seven-year-old male pet alpaca (*Vicugna pacos*) weighing 67 kg, with a 2-year history of bilateral patellar luxation, was presented for stifle surgery. Pain management was based on a multimodal analgesia approach with systemic drugs like ketamine, morphine, xylazine, flunixin meglumine and an electrostimulation-guided sciatic and femoral nerve block as a loco-regional anaesthesia technique. This technique was extrapolated from one described for dogs and it was feasible and rapidly performed. The use of the nerve block provided partial analgesia to this alpaca.

Keywords: Alpaca, electrostimulation-guided sciatic and femoral nerve block, lidocaine, stifle surgery.

***Corresponding author**: Dr Anne-Sophie Van Wijnsberghe,

E-mail: anne-sophie.vanwijnsberghe@uliege.be

Introduction

The use of loco-regional anaesthesia techniques has increased in recent years, as part of multimodal pain management in veterinary patients (Cox and Riedesel, 1997; Ramussen et al., 2006). The sciatic-femoral nerve block (SFNB) technique has been described with success in several species: dog (Shilo et al., 2010), guinea pig (Aguiar et al., 2014), rabbit (d'Ovidio et al., 2014), goat (Adami et al., 2011), calf (Viscasillas et al., 2015), and wallaby (Monticelli et al., 2016). Foster et al. (2020) investigated the ultrasound-guided psoas compartment and sciatic nerve blocks in alpacas by extrapolating the technique from dogs. To our knowledge, some specific nerve block techniques are already described (Grubb, 2014), but there are no reports on the use of the electrostimulation-guided technique of the sciatic and femoral nerve block in alpacas. This case report describes the electrostimulation-guided sciatic and femoral nerve block approach in an alpaca undergoing a tibial tuberosity transposition (TTT) surgery.

Literature review

Pain management can be challenging in camelids because they tend to hide signs of discomfort (Livingston, 2010). Pain and its management have not always been contemplated in farm animals (Adams, 2017). The targets for managing pain should be focused on the provision of pre-emptive and multimodal analgesia and the minimization of negative secondary effects by using balanced analgesic protocols (Plummer and Schleining,

2013; Stathopoulou et al., 2019). The use of loco-regional anaesthesia allows for a decrease in the quantity of systemic analgesics needed for pain relief with fewer side effects (Adami et al., 2011). There are only a limited number of techniques described for ruminants (Adami et al., 2011; Shafford et al., 2004) and, to date, there are no reports on the use of the electrostimulation-guided SFNB in alpacas.

Case

A seven-year-old male pet alpaca (Vicugna pacos) weighing 67 kg, with a 2-year history of bilateral patellar luxation, was referred to our institution. In the previous 6 months, the alpaca had been dysorexic and reluctant to stand up and walk. A physical examination revealed bilateral hindlimb lameness. On palpation, both patellae could be easily displaced and luxated, but only the left patella could be repositioned easily and maintained in place. The rest of the physical examination was unremarkable.

Stifle joint radiographs showed a bilateral patellar luxation: right patellar luxation with osteophytes and left patellar luxation with comminuted fracture and femur-patellar arthropathy.

A tibial tuberosity transposition (TTT) was proposed to the owners who signed a written consent authorizing surgery.

The alpaca was sedated intramuscularly (IM) with 0.4 mg kg^{-1} of xylazine (Proxylaz® 2%, Prodivet, Belgium) and 3 mg kg^{-1} of ketamine (Ketamidor® 100mg/ml, Richter Pharma, Germany) in the neck region. While the animal was in sternal recumbency, the moderate sedation after ten minutes allowed for the placement of a 16-gauge jugular cannula (Intraflon2, Vygon, Belgium). One hour after the premedication, anaesthesia was induced with 3 mg kg^{-1} ketamine combined with 0.1 mg kg^{-1} midazolam (Midazolam 5 mg/ml, Mylan, Belgium) intravenously (IV) via the cannula. With the animal in sternal recumbency and the neck in an extended position, the larynx was visualized with the use of a 30 cm long Miller blade laryngoscope. Lidocaine 10% (Xylocaine spray® 10%, Aspen, France) was applied topically on the laryngeal cartilages and orotracheal intubation was performed using a 9-mm inner diameter cuffed endotracheal tube. After the tube was secured in place and the cuff was inflated, the alpaca was positioned in right lateral recumbency and connected to a circle rebreathing system (Tafonius, Vetronic services, UK). The neck was positioned slightly elevated to avoid regurgitation and the head was angled down to facilitate drainage of saliva.

Anaesthesia was maintained with isoflurane in 100% oxygen. Mechanical ventilation was started using a volume-controlled ventilation mode with a tidal volume of 15 mL kg^{-1} and a respiratory rate (RR) adjusted to maintain normocapnia (35 - 45 mmHg end-tidal carbon dioxide pressure) and a peak inspiratory pressure of up to 11 cmH_2O. The end-tidal isoflurane concentration (EtIso) ranged from 0.7% to 1.6% throughout the procedure. The Tafonius multiparameter module was used to monitor and record the RR, heart rate, electrocardiogram, pulse oximetry, EtIso, end-tidal carbon dioxide pressure, inspired fraction of oxygen, peak inspiratory pressure, and oesophageal temperature every 5 minutes. Non-invasive blood pressure (NIBP) was monitored with the pressure-cuff placed on the left forelimb, using a separate device (Dynamap, Woodley, UK). Lactated Ringer's solution (Vetivex solution, Dechra, Netherlands) was administered at a rate of 5 ml kg^{-1} h^{-1} through the IV cannula.

Thirty minutes after induction, the sciatic and femoral nerves were anaesthetized with a total of 4 mg kg^{-1} lidocaine 2% (Linisol 2% Miniplasco, Braun, Belgium) (2 mg kg^{-1} for each nerve), which corresponded approximately to a volume of 0.1 ml kg^{-1} per nerve. The nerve block needle was guided by a nerve stimulator (TOF-Watch S, Organon Ltd, Ireland) based on a previously described technique for dogs (Campoy and Mahler, 2013). The alpaca was positioned in right lateral

recumbency with the left hindlimb abducted approximately 90 degrees and slightly extended caudally. After aseptic preparation of the inguinal area, a 20-gauge insulated needle of 100 mm length (SonoPlex STIM, Pajunk, Germany) was inserted perpendicularly to the skin cranial to the femoral artery that was palpated concomitantly. The needle was advanced towards the ilio-psoas muscle delivering an initial electrical current of 2 mA with a frequency of 1 Hz. The contraction of the quadriceps muscle and the extension of the stifle (twitches) were used to confirm that the tip of the needle was close to the femoral nerve. At this point, the current was decreased gradually in steps of 0.1 mA to ensure that the needle was not inserted into the nerve fibres. No muscular contraction was established in response to 0.4 mA current). After confirming the absence of blood aspiration, 2 mg kg^{-1} lidocaine 2% (0.1 mL kg^{-1}) was slowly injected with no significant resistance.

The alpaca was maintained in right lateral recumbency for the sciatic nerve block with the left hindlimb in resting position. The greater trochanter and the ischiatic tuberosity area were prepared aseptically. The insulated needle connected to the nerve stimulator was inserted slowly between the cranial and the middle third of a line drawn between these two landmarks. The dorsiflexion of the foot in response to an electrical current of 2 mA was used to confirm that the tip of the needle was close to the sciatic nerve. The current was decreased gradually to 0.4 mA in steps of 0.1 mA while the needle was advanced towards the nerve. The absence of muscle contraction in response to a current under 0.4 mA confirmed that the tip of the needle was not into the nerve fiber. After confirming the absence of blood aspiration, 2 mg kg^{-1} lidocaine (0.1 mL kg^{-1}) was slowly injected without significant resistance. General anaesthesia lasted for 3 hours and 35 minutes and the surgical procedure lasted for 2 hours and 25 minutes.

At the beginning of the anaesthesia, hypotension with a mean arterial pressure (MAP) of 55-60 mmHg was recorded and treated with 10 mL kg^{-1} of Lactated Ringer's solution administered over 15 minutes followed by a continuous rate infusion 5 mL kg^{-1} h^{-1} during the procedure. Surgery started 1 hour and 10 minutes after the beginning of inhalation anaesthesia and 40 minutes after the femoral-sciatic nerve block. Before the surgery started, the alpaca received 4.4 mg kg^{-1} of ceftiofur (Cefokel 50 mg/mL, Kela, Belgium) IM and 1.1 mg kg^{-1} of flunixin meglumine (Emdofluxin 50 mg/mL, Emdoka, Belgium) IV. During the procedure, two boluses of 0.1 mg kg^{-1} of morphine (Morphine, Sterop, Belgium) IV were administered. The first bolus of morphine was administered at the beginning of surgery, driven by a sudden MAP increase of 20 % from the baseline, which was considered to be an indicator of nociception. The second bolus of morphine was administered 1 hour after the first one, driven by a second and sudden relevant increase of HR and MAP compared with the baseline (more than 20%) and the reappearance of the palpebral reflex. Imminent recovery was avoided by the injection of two successive boluses of 0.2 mg kg^{-1} propofol (Diprivan, Aspen, Belgium) IV.

Recovery from the anaesthesia was smooth and uneventful. Extubation was performed 40 minutes after isoflurane was discontinued. At this moment, the rectal temperature was 34.2 °C and a forced warm air device (Bair Hugger 775 model, 3M Health care, Germany) was used until the rectal temperature reached 36.7 °C.

Over the following days, the alpaca stayed in the large animal clinic of our institution, where clinical and behavioural examination (food and water intake, mentation, recumbency time, and, bruxism) was monitored twice a day. Meloxicam (Meloxidyl 20mg/mL, Ceva, Belgium) 0.5 mg kg^{-1} SC was administered every 2 days and morphine 0.1 mg kg^{-1} IM was administered when signs of discomfort were seen. Physiotherapy through the extension-

flexion and leg massage were performed four times daily. Six days post-surgery, the alpaca was comfortable enough to be sent home. One month later, the alpaca was admitted for a global follow-up examination. There was no improvement in locomotor status, and the alpaca was still most of the time in sternal recumbency. Its appetite became capricious and the animal was not comfortable anymore. Due to the guarded prognosis for joint healing and orthopaedic recovery and mainly due to the severe discomfort of the animal, the owner decided to euthanise it.

Discussion

In line with Adami's article about goats, the SFNB was an effective and technically simple method of pain management for the alpaca undergoing stifle surgery. The loco-regional technique extrapolated from dogs was feasible and rapidly performed, just as described for another alpaca and a goat in previous case reports (Adami et al., 2011; Foster et al., 2020). Orthopaedic surgery can produce severe noxious stimulation requiring a multimodal analgesic approach. The stifle surgery is associated with different sources of nociception, including tissue incision, dissection and osteotomy (Campoy and Mahler, 2013). This procedure is also expected to be painful in alpaca. In human patients, common postoperative complications are associated with the pain pathway and can lead to the development of chronic pain (Katz and Seltzer, 2009). The aim of the SFNB used was to improve the perioperative analgesic protocol. Alpacas are relatively stressed in a hospital environment and the SFNB may help to reduce anxiety and to improve recovery by allowing for a rapid return of ambulation compared with the epidural technique (Foster et al., 2020). The decision to use lidocaine, a local anaesthetic agent of short duration of action, was to avoid a prolonged neuron motor blockade, which is an undesirable effect. A rapid recovery from the locomotor block would allow for a prompt assessment of the animal's ability to stand and walk, while avoiding possible distress from the motor paralysis (Adami et al, 2011).

In this case, the chronicity of the lesions, the lethargy and the decrease of food intake suggested that the alpaca was experiencing pain. As this alpaca was a pet animal, the drug choices were made considering the need to minimize pain and to provide a multimodal analgesia.

We assume that the SFNB was not sufficient to completely alleviate the pain. However, we believe that the block had a positive effect in combination with the boluses of morphine. Moreover, premedication and induction drugs were given far in advance of the procedure: 2 hours before surgery for the premedication agents and 1 hour before surgery for the induction agents. According to the literature (Abrahamsen, 2014), the drug choice and dosage was expected to produce sedation and analgesia of less than 1 hour. Therefore, it was considered that the drugs used for premedication and induction were not contributing to analgesia at this point.

Finally, studies describing the detailed innervation of the hindlimb in the alpaca are still lacking. It is possible that differences exist between animal species and within the same species. For instance, the obturator nerve was not blocked in the present alpaca, which could have played a role in nociception since studies in dogs indicate that it plays sensory innervation to the stifle (Foster et al., 2020). Further anatomical studies and the development and validation of pain scales are warranted for the improvement of loco-regional techniques in alpacas (Foster et al., 2020).

Conclusion

The multimodal approach with the use of lidocaine SFNB provided at least partial analgesia to this alpaca undergoing stifle surgery. This approach is feasible and may provide some control of nociception in this species. The anatomical landmarks used in the dog example could be easily identified in the

alpaca. The information described in this case report could be used in future studies on the SFNB in the alpaca.

References

Abrahamsen, E. J., 2014. Chemical restraint of Camelids. Llama and alpacas' care. Ed. Elsevier Saunders, Philadelphia, USA, 6, 587-592 pp.

Adams, J., 2017. Assessment and management of pain in small ruminants. Ed. Elsevier, Philadelphia, USA, 22, 324-328 pp.

Adami, C., Bergadano, A., Bruckmaier, R. M., Stoffel, M. H., Doherr, M. G., Spadavecchia, C. 2011. Sciatic-femoral nerve block with bupivacaine in goats undergoing elective stifle arthrotomy. *The Vet. J.*, 188: 53-57.

Aguiar, J., Mogridge, G., Hall, J. 2014. Femoral fracture repair and sciatic and femoral nerve blocks in a guinea pig. *J. Small Anim. Pract.*, 55: 635–639

Campoy, L., Mahler, S., 2013. The pelvic limb. Small animal regional anesthesia and analgesia. Ed. Wiley-Blackwell, Oxford, UK, 199-226pp.

Cox, K. R., Riedesel, D. 1997. Evaluation of femoral nerve blockade for postoperative analgesia in dogs undergoing stifle arthrotomy. *Vet. Comp. Orthop. Traumatol.*, 10(01): 37-44.

d'Ovidio, D., Rota, S., Noviello, E., Briganti, A., Adami, C. 2014. Nerve stimulator-guided sciatic- femoral block in pet rabbits (*Oryctolagus cuniculus*) undergoing hind limb surgery: a case series. *J. Exot. Pet Med.*, 23: 91–95.

Foster, A., McSloy, A., Monticelli, P. 2020. Ultrasound-guided psoas compartment and sciatic nerve blocks for pain management of hind limb procedures in the alpaca (Vicugna pacos). *Open Vet. J.*, 10: 120-127.

Grubb, T. 2014. Local and regional analgesic techniques in camelids. Llama and alpacas' care. Ed. Science Direct. Ed. Saunders, Philadelphia, USA, 6: 600-606.

Katz, J., Seltzer, Z. 2009. Transition from acute to chronic postsurgical pain: risk factors and protective factors. Expert. Rev. Neurother., 9, 723–44

Livingston, A. 2010. Pain and analgesia in domestic animals. Comparative and veterinary pharmacology. Ed. Springer-Verlag Berlin, Germany, 159-89 pp.

Monticelli, P., Campoy, L., Adami, C. 2016. Ultrasound-guided femoral and sciatic nerve blocks for repair of tibia and fibula fractures in a Bennett's wallaby (*Macropus rufogriseus*). Case Rep. *Anesthesiol.*, 16: 1–4.

Plummer, P. J., Schleining, J. A. 2013. Assessment and management of pain in small ruminants and camelids. *Vet. Clin. North Am. Food Anim. Pract.*, 29: 185-208.

Ramussen, L. M., Lipowitz, A. J., Graham, L. F. 2006. Development and verification of saphenous, tibial and common peroneal nerve block techniques for analgesia below the thigh in the nonchondrodystrophoid dog. *Vet. Anaesth. Analg.*, 33: 36-48.

Shafford, H. L., Hellyer, P.W., Turner, A. S. 2004. Intra-articular lidocaine plus bupivacaine in sheep, undergoing stifle arthrotomy. *Vet. Anaesth. Analg.*, 31: 20-26.

Shilo, Y., Pascoe, P. J., Cissell, D., Johnson, E. G., Kass, P. H.,Wisner, E. R. 2010. Ultrasound-guided nerve blocks of the pelvic limb in dogs. *Vet. Anaesth. Analg.*, 37: 460–470.

Stathopoulou, T., Seymour, C., McSloy, A., Adams, J., Viscasillas, J. 2019. Pain management of a mandibular fracture in an alpaca (Vicugna pacos) via epidural catheter placement in the mandibular foramen. *Vet. Rec.* Case Rep.,7: 1-5.

Viscasillas, J., Drozdzynska, M. J., McSloy, A. 2015. Ultrasound-guided sciatic and femoral nerve blocks for metatarsal fracture stabilisation in a two- day-old neonatal calf. *Vet. Rec.*, 3: 1–4.