Received: 29 October 2022 | Revised: 15 May 2023 | Accepted: 23 May 2023

DOI: 10.1002/vrc2.653

VetRecord CaseReports

CASE REPORT

Food/farmed animals

Ultrasound-guided saphenous and sciatic nerve block with ropivacaine in an adult goat undergoing trochlear sulcoplasty for lateral patellar luxation

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Abstract

A 75 kg, 4-year-old, male, neutered, Saanen-cross, pet-owned, adult goat presented for left trochlear sulcoplasty for treatment of lateral patellar luxation. Premedication consisted of intravenous butorphanol (0.2 mg/kg), and midazolam (0.5 mg/kg, intravenous), followed by ketamine (2 mg/kg, intravenous) and propofol (2 mg/kg, intravenous) for induction of anaesthesia. Anaesthesia was maintained using isoflurane in oxygen (100%) and mechanical ventilation was started. An ultrasound-guided saphenous and sciatic nerve block with 0.1 mL/kg of ropivacaine 0.75% and 0.25%, respectively, was performed. Anaesthesia was uneventful, except for a transient period of hypotension and a nociceptive reaction during skin suture. Recovery was uneventful. No motor block was observed using this combination of ropivacaine concentrations. Buprenorphine (0.01 mg/kg, intravenous) was initiated (twice daily first day; once daily second and third day) 6.5 hours after the nerve block due to discomfort. Meloxicam (0.5 mg/kg, intravenous) was administered once daily for 5 days, after which the patient was fully ambulatory.

BACKGROUND

Patellar luxation is a rare condition in small ruminants that requires surgical treatment.[1] Adequate perioperative analgesia is essential to improve patient welfare and outcome.[2] Local anaesthetic techniques, as an integral part of a multimodal analgesic approach, have gained increased interest in veterinary medicine over the last years in both small and large animal species.[3–6]

Saphenous and sciatic blocks are widely used in humans and various animal species, aiming to provide perioperative analgesia in patients undergoing orthopaedic surgeries in their pelvic limbs.[7–9] This technique consists of injecting local anaesthetic drugs surrounding the saphenous and sciatic nerves. The saphenous nerve runs together with the femoral nerve within the proximal portion of the femoral triangle, which is located at the medial aspect of the thigh.[7] After emerging from this area, the femoral nerve ends into the vastus medialis and rectus femoris muscles on the third proximal area of the limb. The saphenous nerve continues distally in close contact with the cranial aspect of the femoral artery. It then subdivides to the cutaneous branches, innervating the medial and distal portion of the thigh and the cutaneous and articular branches of the medial, anteromedial and posteromedial areas of the stifle.[3,10] The sciatic nerve runs between the ischiatic tuberosity and the greater femoral trochanter in the lateral aspect of the pelvic limb and innervates the caudolateral aspect of the stifle and the areas below it.[11] Both the saphenous and sciatic nerves are involved in the sensory innervation of the pelvic limb. While the femoral and sciatic nerves also provide motor innervation, the saphenous nerve is only a sensory nerve for the extremity.[3] Thus, there is a reduction in the motor blockade when the saphenous nerve is combined with the sciatic nerve block compared to the femoral and sciatic nerve block. To avoid the femoral nerve, the blockade of the saphenous nerve is done distally to the connection between the proximal and medial third of the tight.[10] By reducing the concentration of the local anaesthetic drug on the sciatic nerve, the motor blockade can also be reduced.[3,12–15]

In ruminants, there are several legal restrictions that result in a decreased availability of analgesic drugs (Directive 37/2010). This situation reduces the options available for pain management during surgical procedures, making nociceptive control a challenge for the anaesthetist. Combined femoral and sciatic block using nerve stimulation showed to improve perioperative analgesia in goats undergoing pelvic limb surgeries and the combination of saphenous, and sciatic nerve blocks with an ultrasound-guided approach was useful as a part of a multimodal pain management in a juvenile goat experiencing a similar procedure.[8,16] However, to the authors' knowledge, an ultrasound-guided saphenous and sciatic nerve block has not been described in adult goats undergoing trochlear sulcoplasty.

The aim of this case report is to describe the perioperative pain management in a goat undergoing trochlear sulcoplasty for lateral patellar luxation with an ultrasound-guided saphenous and sciatic block.

LEARNING POINTS/TAKE-HOME MESSAGES

- The ultrasound-guided saphenous and sciatic block was useful as part of the multimodal analgesic approach in an adult goat undergoing trochlear sulcoplasty.
- No postoperative motor block was reported after using ropivacaine (0.1 mL/kg) at 0.75% on the saphenous nerve and 0.25% on the sciatic nerve.
- No clinical side effects were found after an ultrasound-guided saphenous and sciatic nerve block.

CASE PRESENTATION

A 4-year-old, male, neutered, Saanen-cross, pet-owned goat presented with a history of acute onset of left hind lameness. Palpation revealed mild-moderate crepitus in the stifle area. Radiographic and orthopaedic examination identified lateral luxation of the left patella. Surgical treatment with trochlear sulcoplasty and soft tissue imbrication under general anaesthesia was planned.

Fasting and water deprivation were applied for 12 hours before general anaesthesia. Pre-anaesthetic clinical examination revealed a heart rate (HR) of 80 beats per minute, a respiratory rate (RR) of 16 respirations per minute (rpm), normal cardiac and pulmonary auscultation, unremarkable lymph nodes on palpation and a rectal temperature of 37.7°C. Bodyweight was 75 kg, and the American Society of Anesthesiologists (ASA) status considered to be a grade II. A peripheral venous blood sample showed a packed cell volume of 30% and total solids of 80 g/dL.

On the day of the procedure, a 14 G (130 mm; Milacath-Extended Use, Mila International) catheter was aseptically placed in the jugular vein. The patient received butorphanol (Dolorex, 10 mg/mL, MSD Animal Health; 0.2 mg/kg intravenously [IV]) and midazolam (Dormazolam, 5 mg/mL, Dechra; 0.5 mg/kg IV) for premedication. After sedation, 5 minutes of preoxygenation flow by at 5 L/min was provided. Anaesthesia was induced with ketamine (Ketamidor, 100 mg/mL, Chanelle Pharma; 2 mg/kg IV). During induction, the sudden onset of cyanosis and lack of muscle relaxation prompted the use of propofol (Propofol-Lipuro Vet, Virbac; 2 mg/kg IV) to facilitate endotracheal intubation. A 10-mm cuffed silicone tube (SurgiVet AIRCARE PVC Endotracheal Tubes, Smith Medical) was used for intubation and was connected to a circle breathing system. Anaesthesia was maintained using isoflurane (IsoFlo, Zoetis; $F_E{}'Iso$ range 1.2%–1.7%) in 100% of oxygen (O_2). Hartman's solution (Vetivex 11, Dechra; 5 mL/kg/h IV) was started and continued throughout. Intermittent positive pressure ventilation (IPPV) was started after induction using a large animal ventilator (Tafonius Junior, Hallowell EMC, Vetronic Services). A tidal volume of 0.7 L, with a peak inspiratory pressure of 17 cmH_2O, was used to maintain physiological levels (35–45 mmHg) of end-tidal pressure of expired carbon dioxide ($P_E{}'CO_2$) during the surgical procedure.

Depth of anaesthesia was monitored by checking palpebral reflexes, eye position, jaw tone and sympathetic reaction to painful stimuli. Anaesthetic agent concentration, $P_E{}'CO_2$, HR, RR, oesophageal temperature, peripheral haemoglobin oxygen saturation (SpO_2), electrocardiogram and oscillometric non-invasive blood pressure were monitored during anaesthesia using a multiparametric monitor (Carescape Monitor B450, GE Healthcare) and were recorded every 5 minutes.

The patient was positioned in right lateral recumbency, with the neck elevated and the head sloped down to facilitate drainage of saliva. The surgical area was clipped and aseptically prepared. The ultrasound transducer (5.0–10.0 MHz, 38-mm linear probe) was covered with a latex sterile glove (Biogel tech, Mölnlycke). A left saphenous and sciatic nerve block with 0.1 mL/kg of ropivacaine hydrochloride (HCl) (Naropin 7.5 mg/mL, Aspen pharma) 0.75% and 0.1 mL/kg of ropivacaine HCl 0.25% (1:2 dilution of ropivacaine HCl 0.75% and sodium chloride [sodium chloride 0.9%, Hameln Pharmaceuticals]), respectively, were performed using a portable ultrasound device (DP-50Vet, Mindray). For the saphenous nerve block, the limb was abducted dorsocaudally by another operator. The transducer was placed transversal to the long axis of the limb at the medial aspect of the thigh, where the femoral pulse was previously palpated (Figure 1).[16] The femoral artery was centred in the image, and the saphenous nerve was identified as a hyperechoic ovoid structure cranial to the femoral artery and medial to the sartorius muscle (Figure 1). A 20 G, 150 mm echogenic insulated needle (Ultraplex 360 needle, BBraun Medical) was introduced in-plane using a craniocaudal approach until the tip was close to the nerve of interest (Figure 1). For the sciatic nerve block, the ultrasound probe was placed on the lateral aspect of the left thigh. The transducer was situated perpendicular to the long axis of the extremity under the ischiatic tuberosity and the femoral greater trochanter (Figure 2). The probe was moved distally following the sciatic nerve until an ovoid hyperechoic structure with a double-rounded hypoechoic area was located medial to the biceps femoris and the adductor muscle and cranial to the semitendinosus muscle (Figure 2).[16] The needle was inserted in-plane using a caudocranial approach until the tip reached the target area (Figure 2). Extravascular administration was confirmed after negative aspiration before injecting ropivacaine in both areas.

OUTCOME AND FOLLOW-UP

Baseline cardiovascular values were recorded before the beginning of the surgery. The patient presented a mean (±

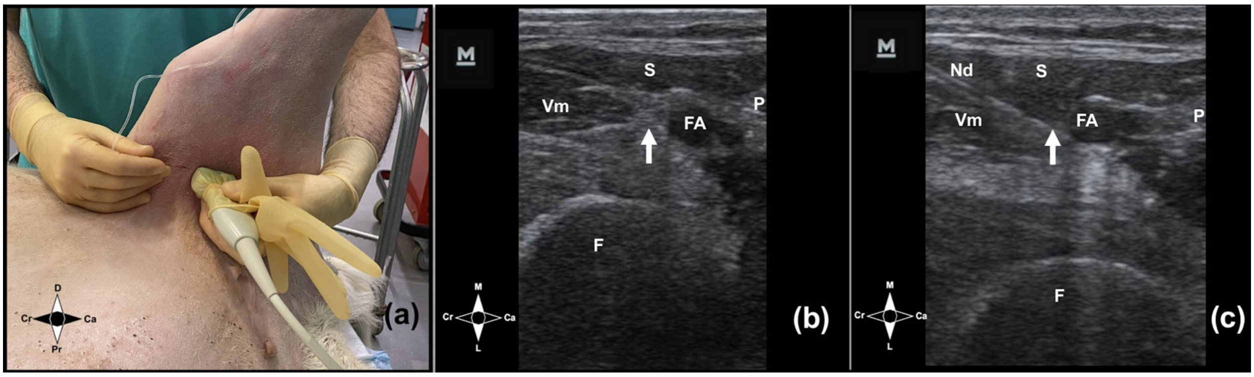

FIGURE 1 Images of ultrasound-guided saphenous nerve block with the patient in right lateral recumbency and the left hindlimb abducted dorsocaudally. (a) Orientation of the probe transversally to the long axis of the medial aspect of the left thigh and injection using a craniocaudal approach. (b) Ultrasonographic visualisation of the saphenous nerve (white arrow). (c) Ultrasonographic visualisation of the saphenous nerve (white arrow) and the needle before injecting the local anaesthetic drug. Cd, caudal; Cr, cranial; D, distal; F, femur; FA, femoral artery; L, lateral; M, medial; M, ultrasound probe marker; Nd, echogenic needle; P, pectineus muscle; Pr, proximal; S, sartorius muscle; VM, vastus medialis muscle.

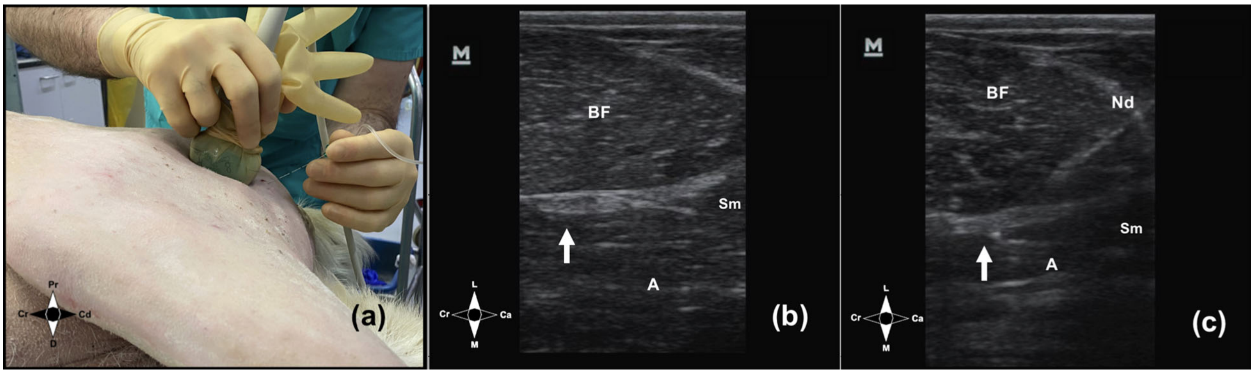

FIGURE 2 Images of the ultrasound-guided sciatic nerve block with the patient in right lateral recumbency. (a) Orientation of the probe transversally to the long axis of the lateral aspect of the left thigh and injection using a caudocranial approach. (b) Ultrasonographic visualisation of the sciatic nerve (white arrow). (c) Ultrasonographic visualisation of the sciatic never (white arrow) and needle approaching the area of injection of the local anaesthetic drug. A, adductor muscle; BF, biceps femoris muscle; Cd, caudal; Cr, cranial; D, distal; L, lateral; M, medial; M, ultrasound probe marker; Nd, echogenic needle; Pr, proximal; Sm, semimembranosus muscle.

SD) HR of 103 (± 7.6) beats per minute, RR of 15 (± 0) rpm and a mean arterial pressure (MAP) of 74 (± 2.2) mmHg. Nociception was defined as an increase of HR and/or MAP of more than 10% from baseline values. The temperature before starting the procedure was 36.4°C.

A craniolateral surgical approach was performed. The trochlear sulcus was deepened via a trochlea wedge sulcoplasty using an X-acto hand saw. Wedge recession was preferred to block to maintain sufficient medial and lateral support to the patellar after recession due to the narrow shape of the caprine trochlea. The redundant lateral joint capsule was excised and closed in an interrupted mattress, and the lateral fascia was imbricated using a modified mayo mattress suture pattern using polydioxanone absorbable sutures (3.5 Ph. PDS II, Ethicon). The patellar was within the groove and stable at the end of the procedure.[17]

The surgery consisted of a trochlear wedge recession in the left distal femur and imbrication of the medial joint capsule via a craniolateral approach in dorsal recumbency (Figure 3).[18–20] The patient remained stable during the anaesthetic period, except for two abnormal events. First, 30 minutes after induction, F_E´Iso inadvertently increased from 1.3% to 1.7% and the patient developed a transient period of hypotension (15 minutes). The MAP decreased from 75 to 50 mmHg, and gradually increased up to 78 mmHg after decreasing de F_E´Iso to 1.3%, starting intravenous fluid therapy and initiating the surgery. The F_E´Iso, HR, MAP and RR remained stable during the procedure (mean [± SD] F_E´Iso 1.34% [± 0.9], HR 96.6 [± 5.9] beats per minute, MAP 77.2 [± 5.7] mmHg and RR 15 [± 0] rpm). The second event occurred at the end of the procedure (125 minutes after the block) when the skin was sutured (MAP increased >10%). The HR increased up to 105 beats per minute, and the MAP increased up to 90 mmHg. The rest of the anaesthetic period was uneventful, with no other nociceptive stimulus noted.

The total surgery time was 100 minutes. The total anaesthesia time was 205 minutes. At the end of the procedure, spontaneous breathing was immediately resumed after discontinuation of IPPV. No regurgitation was noted during the period under general anaesthesia, and temperature decreased to 35.5°C. The patient was moved to the recovery box and positioned in sternal recumbency, with the head elevated 5 minutes after finishing the procedure and oxygen was administered flow by. Fifteen minutes after discontinuing isoflurane, and when the swallowing reflex was present, the goat was extubated and successfully attempted to stand

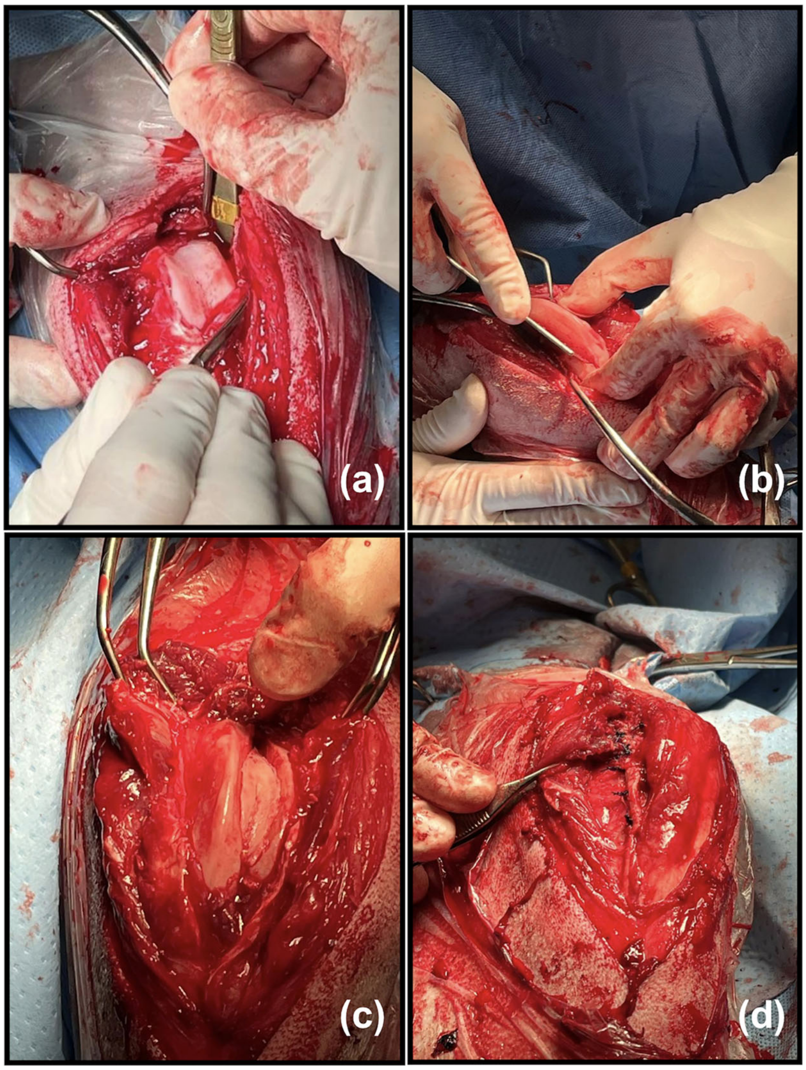

FIGURE 3 Trochlear sulcoplasty surgery images. (a) Note the shallow proximal region of the groove. (b) Deepening the groove further after temporary removal of the wedge. (c) Final image showing the increased depth of the groove with the wedge replaced. (d) Deep imbrication.

25 minutes later. No motor block was noted when the patient recovered, and the clinical exam was unremarkable. Palpation of the surgical area was difficult to evaluate due to the continuous shivering of the patient.

The patient was moved to the stable 1.5 hours after extubation. Three and a half hours after extubation, the goat went into sternal recumbency and discomfort signs such as groaning and shaking were present, with a sheep pain facial expression score (SPFES) of 4/10.[21] Buprenorphine (Bruprecare 0.3 mg/mL, Animalcare; 0.01 mg/kg IV) was administered, and 1 hour later the patient stood up. After this event, the SPFES remained at 0/10 and the patient showed normal behaviour through the rest of the postoperative hospitalisation period. Weight-bearing of the left pelvic limb was observed on the orthopaedic examination the following day.

The postoperative medical management consisted of buprenorphine (0.01 mg/kg IV) administered 6.5 hours after the sciatic and saphenous nerve block twice a day the first day and once a day the following 2 days. Meloxicam (Loxicom, 20 mg/mL, Norbrook Laboratories; 0.5 mg/kg IV) was administered 1 hour after extubation and repeated every 24 hours. Ceftiofur (Excenel 50 mg/mL, Zoetis; 2.2 mg/kg IV) was administered every 12 hours. After 5 days, the patient was fully ambulatory, and all the drugs were discontinued. Although the goat could have been discharged at that time, the animal remained in the hospital for another 30 days at the owner's request.

DISCUSSION

This case report showed that the use of an ultrasound-guided saphenous and sciatic nerve block with 0.75% and 0.25% of ropivacaine, respectively, was a successful component of a multimodal perioperative analgesic approach in a pet-owned adult goat undergoing trochlear wedge sulcoplasty. This loco-regional anaesthetic technique has been previously published in dogs and in a 6-week-old goat to localise the nerves of interest.[7,16] However, to the authors' knowledge, this is the only clinical report using this approach in an adult goat undergoing trochlear sulcoplasty for lateral patellar luxation with the preservation of motor function of the limb to promote quicker recovery.

Previous studies in goats and dogs undergoing stifle surgeries described loco-regional anaesthesia techniques as part of a multimodal analgesic approach. These studies showed that regional anaesthesia reduced the intraoperative parenteral analgesia requirements including rescue analgesia intra- and postoperatively.[8,22–24] For the present case, the use of locoregional anaesthesia was considered beneficial, especially taking into consideration the legal restrictions in food-producing animals (directive 37/2010) making analgesic management difficult. Hence, the use of a local anaesthetic technique in this case allowed the anaesthesia to proceed without the need for more analgesic drugs to treat intraoperative nociception. However, at the end of the procedure, the patient showed a sympathetic reaction (increase of MAP >10%) 125 minutes after the block when the skin was sutured. The saphenous and sciatic nerves are involved in the sensitivity of the medial and distal portion of the thigh, and lateral, medial, anteromedial, posteromedial and distal areas of the stifle, while the incision was made lateral and proximal to the knee.[3,10] Therefore, the goat could have reacted to the sutures of a non-desensitised area. A transient period of hypotension was also noted before the surgery started. Nevertheless, during this event, the $F_E{}'$Iso accidentally increased substantially. The blood pressure increased back to levels shown before this event after decreasing the $F_E{}'$Iso, starting the surgery and the IV fluid therapy. The aforementioned increase in blood pressure after this period of hypotension is more likely to be associated with the cardiovascular effects of the anaesthetic agent rather than nociception.[25]

The only local anaesthetic drug licensed in this species is procaine, with a duration of action of 30–60 minutes and a low analgesic effect in comparison to similar drugs. Lidocaine can be used under the cascade in goats. However, the duration of action of lidocaine is also short (60–120 minutes).[26] The length of this orthopaedic procedure was expected to outstay the duration of action of procaine or lidocaine. In contrast, ropivacaine, which is not licensed in this species, has a duration of action of 5–8 hours and is eight times more potent than procaine.[26] Different studies in goats showed the efficacy of ropivacaine when local anaesthetic techniques were performed.[16,27] Therefore, it was the best choice for the authors on this pet-owned goat.

Ropivacaine is a sensory selective local anaesthetic drug presenting less motor blockade than other similar drugs.[15] In this case, ropivacaine was injected at two different concentrations, 0.75% for the saphenous block and 0.25% for the sciatic block. Ruminants usually have good recoveries after general anaesthesia, and traumatic events rarely occur.[28] However, uncoordinated attempts to stand due to pain or motor block increase the risk of a potential injury.[28] When higher concentrations of local anaesthetic drugs are used, the risk of motor block increases.[15] A study in children showed decreased and absent motor block 2 and 3 hours after receiving a caudal epidural block with 0.25% ropivacaine.[13] Therefore, this concentration was used to decrease the sciatic nerve's motor block and improve recovery times. And, contrary to other publications using bupivacaine in goats for a sciatic and femoral block, no postoperative motor blockage was found using this combination of ropivacaine concentrations.[8]

Orthopaedic surgeries are generally known as potentially painful procedures. Pure μ-agonist opioids are generally effective analgesic drugs.[2] But, these drugs are not exempt from side effects.[29] Furthermore, their use is limited in farm animals because of legal restrictions (directive 37/2010). Butorphanol is the only opioid licensed in goats. However, it does not provide as much analgesia as pure μ-agonist opioids nor, to the authors' experience, adequate analgesia for orthopaedic surgeries as the sole analgesic drug.[30,31] In this case, butorphanol was only used to decrease the dosage of the induction agent required for intubation in combination with midazolam.[32] To improve the analgesia perioperatively, a saphenous and sciatic block was performed. Butorphanol has shown inadequate analgesia for somatic and postoperative pain in different species.[33,34] Nevertheless, buprenorphine, which is not licensed in farm animals, demonstrated to be safe and to have similar postoperative analgesic effects to transdermal fentanyl in goats undergoing orthopaedic surgeries.[35] Thus, buprenorphine was used in the interest of the animal welfare to improve postsurgical pain management, especially as the goat was a pet-owned animal.

It must be taken into consideration that midazolam, propofol, buprenorphine and ropivacaine are drugs not compliant with the EU regulation (directive 37/2010). These drugs were used for the sake of the animal welfare with the contingency that the drugs administered do not follow the legislation. However, as the owner agreed the goat will never enter the food chain, the veterinary surgeon deemed it adequate to prescribe the non-licensed drugs. Moreover, the veterinary surgeon followed the patient to ensure it did not enter the food chain. Other alternatives could have been used to comply with these regulations. Xylazine can be used in goats under the cascade. Xylazine and midazolam have shown good sedative effects in goats improving perioperative stress.[36,37] Nevertheless, xylazine showed marked cardiorespiratory depression in goats compared to midazolam and severe respiratory side effects in sheep.[38–40] Consequently, midazolam was chosen instead of xylazine to avoid its side effects, to maintain the cardiovascular and respiratory function as physiological as possible during this procedure and to help with muscle relaxation during intubation. Also, higher doses of ketamine or thiopental instead of propofol could have been used to deepen anaesthesia during induction. Thiopental was not available, and in the face of cyanosis, propofol was chosen, because of a faster induction facilitating endotracheal intubation and therefore avoiding major complications.[41]

Pain assessment in ruminants is a challenge, as they rarely show classical signs of pain.[42] While different pain scores have been developed for sheep, no pain scores have been validated for goats yet.[21,43] However, some publications are evaluating behavioural changes as pain markers.[44,45] The sheep pain facial expression scale is a scale validated in sheep with mastitis and footrot.[21] This system is used to assess facial expression by scoring five facial areas: orbital tightness (0–2), cheek tightness (0–2), ear position (0–2), lip and jaw profile (0–2) and nostril and philtrum position (0–2), considering pain a score superior or equal to 5 out of 10. Due to the lack of validated scales in goats, a combination of behavioural abnormalities (vocalisations, bruxism or teeth grinding) and SPFES was used. Six and a half hours after the ultrasound-guided sciatic and saphenous block, the patient showed signs of discomfort. The SPFES was lower than the limit considered pain. However, the patient showed abnormal behavioural signs that could be associated with pain or discomfort (vocalisation, bruxism and teeth grinding). After buprenorphine, the SPFES decreased, and the behavioural changes improved. Therefore, the authors believe that pain was present 6.5 hours after the block. Probably, there was a lack of analgesia when the pain score was performed as the ropivacaine duration of action is 5–8 hours.[26]

In conclusion, an ultrasound-guided saphenous and sciatic nerve block with ropivacaine HCl can be an integral part of the multimodal analgesia protocol for pet goats undergoing trochlear sulcoplasty or other painful procedures involving the pelvic limb below the distal third of the femur. No side effects or motor block were observed with ropivacaine (0.1 mL/kg) with concentrations of 0.75% and 0.25% in the saphenous and sciatic nerves, respectively. However, more cases would be required to fully confirm efficacy and to identify possible side effects associated with this block in small ruminants.

AUTHOR CONTRIBUTION STATEMENT

Manuel E. Herrera-Linares: anaesthesia, review of the case, acquisition of the data, literature review and writing of the manuscript. Sandra Sanchis-Mora: anaesthesia, review of the manuscript and final corrections. David M. Bolt: surgery, review of the manuscript and final corrections. Richard Meeson: surgery, review of the manuscript and final corrections.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

FUNDING INFORMATION

The authors received no financial support for the research, authorship and/or publication of this article.

ETHICS STATEMENT

No ethical approval was requested.

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How to cite this article: Herrera-Linares ME, Bolt DM, Meeson R, Sanchis-Mora S. Ultrasound-guided saphenous and sciatic nerve block with ropivacaine in an adult goat undergoing trochlear sulcoplasty for lateral patellar luxation. Vet Rec Case Rep. 2023;11:e653. https://doi.org/10.1002/vrc2.653