Case Report

Ultrasound-guided sciatic and femoral nerve block for perioperative pain management in a Thai crossbreed dog undergoing Tibial Plateau Leveling Osteotomy (TPLO): A case report

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Abstract

This case report presents the use of ultrasound-guided sciatic and femoral nerve blocks as an alternative analgesic technique for perioperative pain control in a Thai crossbreed dog undergoing left tibial plateau leveling osteotomy (TPLO). The orthopedic examination revealed a 4/5 left hindlimb lameness score, with positive results on both the tibial compression test (TCT) and cranial drawer test (CDT). Radiographic evaluation showed the absence of a fat pad sign and osteophyte formation around the left stifle joint. A definitive diagnosis of left cranial cruciate ligament rupture (CCLR) was made. The dog underwent CCLR correction via TPLO, with perioperative pain managed through ultrasound-guided sciatic and femoral nerve blocks at the Kasetsart University Veterinary Teaching Hospital (KUVTH), Bangkok, Thailand. The surgery was completed with favorable outcomes, and the dog was discharged 3 days postoperatively.

Keywords: CCLR, sciatic and femoral nerve blocks, TPLO, ultrasound-guided

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Introduction

Cranial cruciate ligament rupture (CCLR) is a prevalent cause of hindlimb lameness in dogs and often necessitates surgical intervention, with tibial plateau leveling osteotomy (TPLO) being a widely accepted corrective procedure (Kowaleski *et al.*, 2013). In Thailand, TPLO has been routinely performed by skilled orthopedic surgeons for several years. Conventional methods for perioperative pain management in hindlimb surgeries, such as epidural anesthesia and constant rate infusions (CRI) of analgesic drugs, are associated with risks, including hypotension, urinary retention, and prolonged recovery times (Campoy *et al.*, 2015). As an alternative, ultrasound-guided peripheral nerve blocks have emerged as a valuable option for achieving effective perioperative analgesia while potentially reducing these adverse effects.

Effective analgesia for the hindlimb requires blocking two key nerves: the femoral and sciatic nerves. The femoral nerve block provides sensory and motor blockade to the femur, medial stifle joint, intra-articular structures, dorsomedial tarsus, and first digit. The sciatic nerve block, in contrast, targets the lateral stifle joint, remaining digits, and surrounding structures. To enhance the precision and efficacy of these blocks, both peripheral nerve stimulation and ultrasound guidance are employed, either separately or in combination (Campoy *et al.*, 2015).

Studies have supported the accuracy and reliability of ultrasound-guided peripheral nerve blocks. Echeverry *et al.* (2010) investigated the anatomical and ultrasonographic features of the sciatic and femoral nerves in dog cadavers, confirming the feasibility of ultrasound-guided nerve blocks. Further, Campoy *et al.* (2012) demonstrated that combining sciatic and femoral nerve blocks provided effective analgesia for stifle surgery, reducing opioid needs and minimizing side effects often linked to epidurals. A recent study in 2019 compared peripheral nerve blocks with targeted-controlled opioid infusion during TPLO, finding that nerve blocks reduced opioid use and improved postoperative recovery outcomes, especially in dogs over 15 kg (Palomba *et al.*, 2019). Additionally, Marolf *et al.* (2021) reported that dogs receiving ultrasound-guided nerve blocks often did not require supplemental opioids postoperatively.

This case report aims to present the use of ultrasound-guided sciatic and femoral nerve blocks as an effective perioperative pain control technique in a Thai crossbreed dog undergoing TPLO surgery, highlighting it as a preferred analgesic method in Thai veterinary practice.

Case description

Case history and Clinical examination: A 13-year-old intact male Thai crossbreed dog, weighing 21.4 kg, was referred to Kasetsart University Veterinary Teaching Hospital (KUVTH), Bangkok, Thailand, for evaluation of left hindlimb lameness persisting for one week. Upon physical examination, the patient exhibited pain localized to the left stifle joint, a 4/5 lameness score, evidence of muscle atrophy, and a small cutaneous mass near the lateral aspect of the thigh. An orthopedic evaluation by a specialist revealed positive tibial compression test (TCT) and cranial drawer test (CDT) results, leading to a definitive diagnosis of cranial cruciate ligament rupture (CCLR).

Radiographic imaging was performed to further assess the extent of the injury. The vertebral heart scale (VHS) was measured at 9.0, and the vertebral left atrial scale (VLAS) at 1.5, both within normal limits. Thoracic radiographs showed clear lungs, while abdominal radiographs incidentally detected cystic and urethral calculi. A radiographic examination of the hindlimb revealed shows reduced density of the infrapatellar fat pad and osteophyte formation at the dorsal aspect of the patella and the tibial ligament insertion point (Figure 1).

Preoperative Anesthesia Protocol: Premedication was achieved with intravenous (IV) midazolam at a dose of 0.18 mg/kg. Anesthetic induction followed with propofol was administered IV to effect at 4 mg/kg, followed by endotracheal intubation with an 8.0 Fr endotracheal tube. After the induction process, A full-mu agonist opioid, morphine, was administered intramuscularly (IM) at 0.5 mg/kg for preoperative analgesia, and general anesthesia was maintained using sevoflurane at an end-tidal concentration of 2.1–2.5% in 100% oxygen, delivered via a rebreathing circuit. Prophylactic antibiotics consist of cefazolin at 20 mg/kg IV every 90 minutes. IV fluid therapy was initiated with Acetate Ringer solution at a rate of 5 ml/kg/hr via a 23-gauge catheter placed in the cephalic vein.

Sciatic and Femoral Nerve Block Procedure: A portable ultrasound device (MyLab™ Alpha SL 2325, Esaote) with an 18-6 MHz linear probe was used to perform ultrasound-guided sciatic and femoral nerve blocks, providing visualization of the target nerves, needle, surrounding soft tissues, and vascular structures. Following aseptic preparation of the injection sites, a 22-gauge, 3.5-inch spinal needle (BD Spinal Needle, Spain) was used to administer 0.5% bupivacaine (Marcaine®) at a total volume of 4 ml (2 ml per nerve, approximately 1 mg/kg). The successful nerve block was verified by observing the "donut sign", indicating that the hypoechoic nerves were encircled by the anechoic bupivacaine solution.

For the sciatic nerve block, the dog was positioned in lateral recumbency, and the ultrasound probe was placed over the mid-thigh muscle, distal to the greater trochanter of the femur, with the transducer directed cranially. The needle was inserted in a caudal-to-cranial direction, targeting the sciatic nerve situated between the quadriceps muscle group, with the biceps femoris muscle laterally and the semitendinosus, semimembranosus, and adductor muscles medially. Visualization showed the sciatic nerve as a hyperechoic nodular structure, which divides into the common peroneal and tibial nerves when traced distally (Figures 2, 3, and 4).

The femoral nerve block was performed with the dog in dorsal recumbency, placing the hindlimb in a relaxed, natural position. The femoral nerve is situated within the femoral triangle in the inguinal area, adjacent to the femoral artery and vein, with the sartorius muscle cranially, iliopsoas muscle dorsally, and pectineus muscle caudally. Ultrasound guidance allowed clear visualization of these structures, with the femoral nerve appearing as a hyperechoic nodular structure beneath the fascia iliaca. Needle insertion proceeded at a 20-30° angle relative to the skin, advancing from the cranial aspect of the sartorius muscle toward the iliopsoas (Figures 5, 6, and 7).

Intraoperative and Postoperative Management: Surgery commenced 20 minutes post-nerve block administration and lasted approximately 76 minutes. The dog remained hemodynamically stable throughout, with recorded vital parameters including a heart rate of 110-120 bpm, respiratory rate of 10-16 breaths per minute, systolic blood pressure of 85-95 mmHg, mean blood pressure of 60-65 mmHg, and diastolic blood pressure of 45-55 mmHg (Figure 8). End-tidal sevoflurane concentrations ranged from 2.1-2.5%, and no additional analgesics were required during the procedure. At the conclusion of surgery, an incisional line block with 0.5% bupivacaine (4 ml, approximately 1 mg/kg) was administered along both sides of the surgical site. Additionally, carprofen at 2.2 mg/kg subcutaneously (Rimadyl®, Zoetis, Thailand) was given for postoperative pain (Table 1).

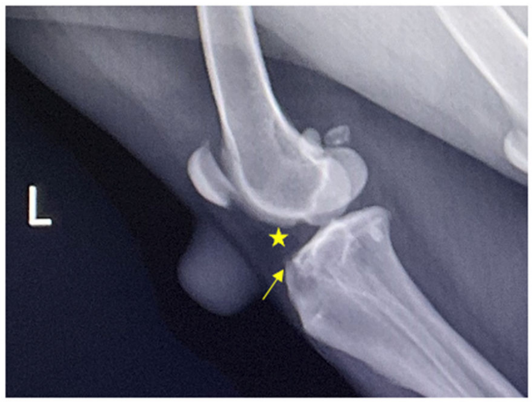

Figure 1 The radiographic image of the patient's left stifle joint and adjacent soft tissue mass shows the reduced density of the infrapatellar fat pad (asterisk) and osteophyte formation (arrow) at the dorsal aspect of the patella and the tibial ligament insertion point.

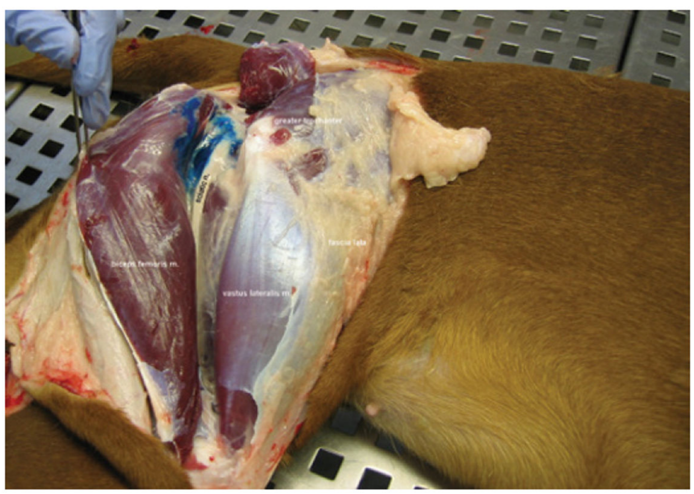

Figure 2 The picture shows the anatomy of the lateral thigh muscle, bicep femoris was distracted caudally gluteal muscles were transected, and the surrounding structure of the right sciatic nerve in canine cadaver. Source: Veterinary Anesthesia and Analgesia 6th (2024).

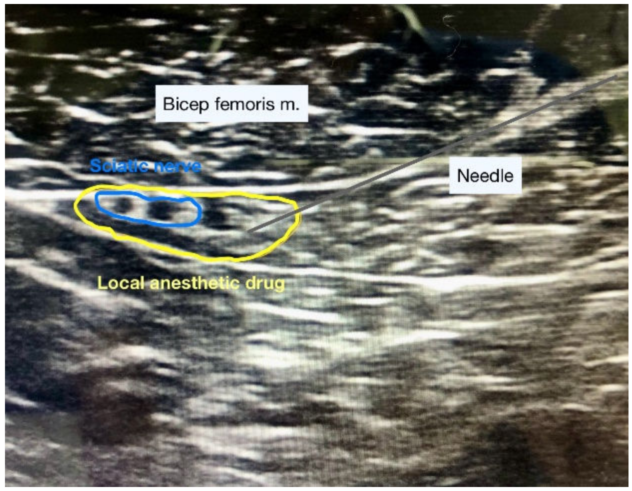

Figure 3A The ultrasonographic image showed the area of the left sciatic nerve (blue area) under the biceps femoris muscle fascia was surrounded by an anechoic local anesthetic drug (yellow area) created a "Donut sign" and showed the hyperechoic needle (Gray line) insert caudocranial direction from the right side of the image.

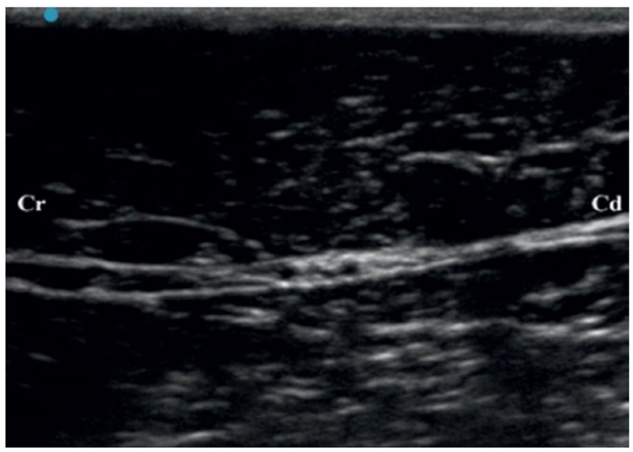

Figure 3B The reference ultrasonographic image of a cross-sectional view of the sciatic nerve underneath the bicep femoris muscle. The blue dot indicates the cranial side. Source: Veterinary Anesthesia and Analgesia 6th (2024).

Figure 4 The approach of left sciatic nerve block in the dog in this case. The ultrasound transducer was placed on the thigh muscle, distal to the greater trochanter of the femur, with the transducer's cursor directed towards the cranial aspect of the thigh muscle. The spinal needle attached with a local anesthetic syringe is inserted in the caudocranial direction through the semimembranosus muscle, medial side of the biceps femoris muscle.

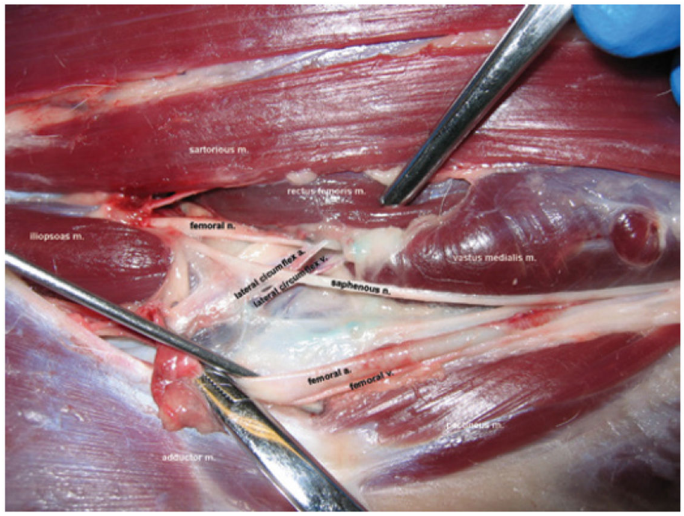

Figure 5 The picture shows the anatomy of the femoral triangle of the left pelvic limb of a dog cadaver. The caudal belly of the sartorius muscle has been distracted to present the femoral nerve. Source: Veterinary Anesthesia and Analgesia 6th (2024).

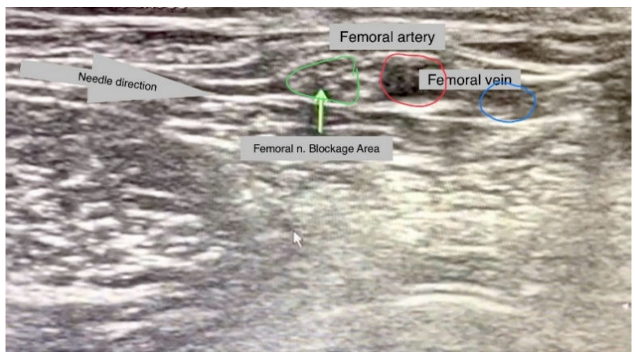

Figure 6A The ultrasonographic image of the left femoral triangle, the area where that femoral nerve should exist (green circle), femoral artery (red circle), and femoral vein (blue circle), which is compressed by ultrasound transducer, respectively. The needle was inserted from the craniocaudal direction on the left side of the image.

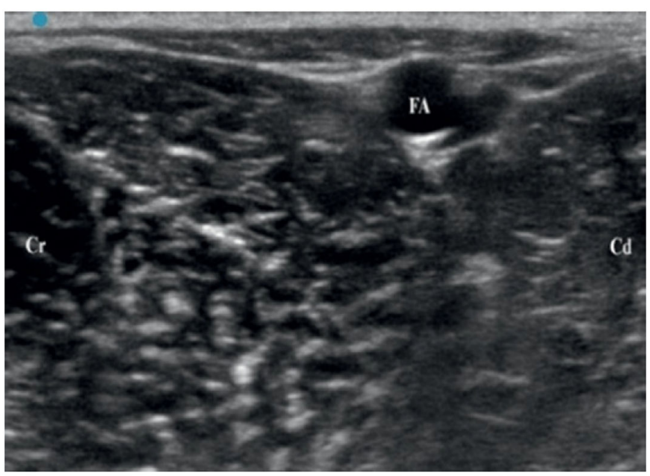

Figure 6B The reference ultrasonographic image of the cross-sectional view of the femoral triangle area. FA, femoral artery; Cr, cranial; Cd, caudal. The blue dot indicates the cranial side. Source: Veterinary Anesthesia and Analgesia 6th (2024).

Figure 7 The approach of left femoral nerve block in the dog. The ultrasound transducer was placed on the femoral triangle, with the transducer's cursor directed in the craniocaudal direction. The needle advancement was performed from the cranial aspect of the sartorius muscle toward the iliopsoas.

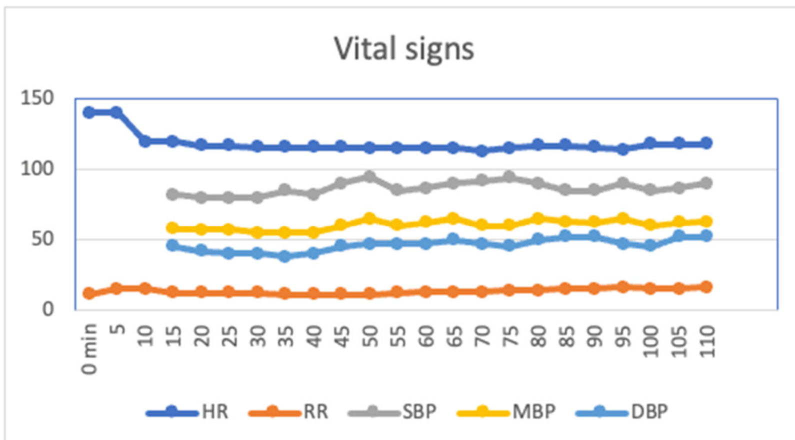

Figure 8 The vital signs from the start of anesthesia until the operation is finished.

Table 1 The analgesic protocol.

Analgesic plan	Drug, Dosage, and Volume	Route	Onset	Timing
Preoperative	Morphine 0.5 mg/kg, 1 ml	Intramuscular	15 mins	1 hour before 1st incision
	Bupivacaine 0.5 mg/kg, 2 ml	Sciatic n. block	20 mins	30 mins before 1st incision
	Bupivacaine 0.5 mg/kg, 2 ml	Femoral n. block		
Postoperative	Bupivacaine 1 mg/kg, 4 ml	Incision line block	20 mins	10 mins after skin closure
	Carprofen 2.2 mg/kg, 0.88 ml	Subcutaneous	30 mins	20 mins after skin closure

Table 2 Timeline, Vital signs and end-tidal % of Sevoflurane concentration.

	HR	RR	SBP	MBP	DBP	End-tidal % Sevoflurane
Start anesthesia 0 min	140	11	-	-	-	-
10	120	15	-	-	-	-
20	117	12	80	57	42	-
30	116	12	80	55	40	2.5
40	116	11	82	55	40	2.5
50	115	11	95	65	47	2.3
60	115	13	87	62	47	2.1
70	113	13	92	60	47	2.1
80	117	14	90	65	50	2.3
90	116	15	85	62	52	2.4
100	118	15	85	60	45	2.4
End surgery 110 mins	118	16	90	63	52	2.4

Result and Discussion

Throughout the perioperative period, cardiovascular parameters, including systolic, mean, and diastolic blood pressures (SBP, MBP, and DBP), remained stable with minimal fluctuations, thus indicating an effective nerve block and reduced nociceptive responses. This stability in blood pressure, a critical and objective marker, highlights the dog's consistent physiological response to surgical stimuli under adequate anesthesia (Basson *et al.*, 2024).

Sympathetic indicators typically associated with nociception, including increases in heart rate (HR), respiratory rate (RR), and involuntary patient movement, were notably absent, further supporting the analgesic efficacy of the block. Additionally, the sevoflurane required for anesthesia maintenance during operation was less than 1.3-1.5 minimum alveolar concentration (MAC) of End-tidal sevoflurane (2.99-3.45%), markedly below the established 1 MAC (2.3%) for canines (Steffey *et al.* 2015). This reduction in anesthetic requirement may highlight an enhanced analgesic effect, contributing to overall anesthetic stability (Table 1). Postoperative pain assessment using the Colorado State University Canine Acute Pain Scale consistently yielded a score of 0/4 at 0, 30, and 60 minutes after extubation, indicating excellent pain control.

Complications and Limitations of Ultrasound-Guided Sciatic and Femoral Nerve Blocks: The use of ultrasound-guided sciatic and femoral nerve blocks in perioperative analgesia, while effective, is not without its complications. One potential complication arises from the accidental puncture of blood vessels during the procedure, particularly during the femoral nerve block. If a blood vessel is punctured, a hematoma may form at the site, which can prevent further nerve block performance. To minimize the risk of such an event, the anesthetist must ensure that the ultrasound image is clear and that the needle is advanced with caution.

Another significant complication is the potential for local anesthetic systemic toxicity (LAST). If a blood vessel is inadvertently punctured, the anesthetic drug may be injected intravenously rather than perineurally. This can result in systemic toxicity (especially bupivacaine), with symptoms ranging from hypotension and cardiac arrhythmias seizures, coma, and, in extreme cases, death. To mitigate this risk, it is crucial for the anesthetist to routinely perform a negative aspiration test for blood before administering the anesthetic. On the other hand, when the anesthetist administers the local anesthetic appropriately, the plasma concentration of bupivacaine in the systemic circulation of dogs undergoing ultrasound-guided nerve blocks does not reach toxic levels. Additionally, the duration of motor and sensory blockade is sufficient to provide effective analgesia for pelvic limb surgeries (Cathasaigh *et al.*, 2018).

Nerve injury is another concern, particularly in cases of intraneural injection. Ultrasound guidance aims to minimize this risk by allowing real-time visualization of the needle and nerve, but the potential for damage remains if the needle is improperly positioned (Waag *et al.*, 2014). If the anesthetist encounters resistance during injection, it is vital to stop immediately and withdraw the needle to avoid intraneural placement. Intraneural injections can lead to neuropathy in the affected limb, which can have serious long-term consequences for the animal.

Minor complications, such as infection at the injection site, can be minimized through the use of appropriate aseptic techniques during the procedure. Incomplete nerve blocks are another potential issue. If the nerve block is found to be incomplete, the anesthetist can detect this through physiological changes, and alternative analgesic protocols, such as continuous rate infusion (CRI), should be considered to effectively manage the animal's pain.

While the technique offers several benefits, there are also limitations to be considered. First, the technique requires a highly skilled anesthetist with both experience and knowledge to obtain clear and accurate ultrasound images of the nerve and its surrounding structures. Typically, two individuals are needed to perform the procedure effectively: one to operate the ultrasound and the other to facilitate the nerve block. However, in situations where staff availability is limited, individual performance may be preferred to reduce manpower requirements, though this may present some challenges in achieving the same level of precision.

The size of the patient is another important factor to consider. The ultrasound probe used in this technique may not be suitable for smaller animals, such as puppies or kittens, which could present difficulties in obtaining clear images. Furthermore, the anatomical variation in other species, rabbits, undergoing ultrasound-guided block of the sciatic and femoral nerve found that differences in anatomy among species can complicate the identification and blockade of nerves; while the sciatic nerve can be consistently identified and blocked, the femoral nerve's location within the iliopsoas muscle presents challenges due to its variable appearance on ultrasound. (Trujanovic *et al.*, 2023). Additionally, determining an appropriate needle length to avoid damage to surrounding organs can be more challenging in smaller animals.

The technique is also more time-consuming compared to traditional pain control protocols such as epidural nerve blocks or CRI, particularly if the anesthetist lacks experience. This can lead to extended procedure times, which may not always be feasible in a busy clinical setting. However, training with an experimental model is recommended to reduce procedure time and enhance the speed and accuracy of needle manipulation in clinicians without prior experience in ultrasound-guided techniques (da Silva *et al.*, 2017).

Finally, the analgesic effect of ultrasound-guided sciatic and femoral nerve blocks is limited to the area around the distal femur or below the stifle joint. As a result, the technique has restricted applicability to procedures involving these specific regions, limiting its broader use in certain clinical scenarios (Lamont *et al.*, 2024).

In conclusion, ultrasound-guided femoral and sciatic nerve blocks offer a promising alternative for perioperative analgesia in TPLO surgeries. These techniques could potentially be extended to other stifle and limb procedures to enhance pain management. However, complications and limitations, such as the potential for blood vessel puncture, nerve injury, and the need for skilled personnel, should be carefully considered before implementation. Finally, further study should be done regarding the benefits of postoperative outcomes compared to standard methods to encourage improving techniques.

Ethical approval: No ethical approval was obtained because this study did not involve laboratory animals and only involved non-invasive procedures.

Conflict of interest: The author (s) declared no potential conflicts of interest with respect to the research, authorship, and/ or publication of this article.

Declaration of Generative AI and AI-assisted technologies in the writing process: During the preparation of this work, the author used ChatGPT to approve the Academic English literature standard. After using this tool, the author reviewed and edited the content as needed and took full responsibility for the publication.

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References

Basson EP, Kadwa AR, Blignaut CJ and Zeiler GE 2024. Physiological variables for the objective detection of nerve block failure in dogs. Veterinary Anaesthesia and Analgesia. 51: 343-353.

Campoy L, Martin-Flores M, Ludders JW, Erb HN and Gleed RD 2012. Comparison of bupivacaine femoral and sciatic nerve block versus bupivacaine and morphine epidural for stifle surgery in dogs. Veterinary Anaesthesia and Analgesia. 39(1): 91–98.

Campoy L, Read M and Peralta S 2015. Canine and Feline local Anesthetic and Analgesic Technique. In: Lumb & Jones' Veterinary Anesthesia and Analgesia 5th ed. John Wiley & Sons, Inc: 844-846

Cathasaigh MO, Read MR, Atilla A, Schiller T and Kwong GPS 2018. Blood concentration of bupivacaine and duration of sensory and motor block following ultrasound-guided femoral and sciatic nerve blocks in dogs. PLOS One. 13(3): e0193400.

Da Silva LCBA, Sellera FP, Gargano RG, Rossetto TC, Gomes GB, Miyahira FT, Futema F and Cortopassi SRG 2017. Preliminary study of a teaching model for ultrasound-guided peripheral nerve blockade and effects on the learning curve in veterinary anesthesia residents. Veterinary anaesthesia and analgesia. 44(3): 684–687.

Echeverry DF, Gil F, Laredo F, Ayala MD, Belda E, Soler M, Agut A 2010. Ultrasound-guided block of the sciatic and femoral nerves in dogs: a descriptive study. Veterinary Anaesthesia and Analgesia. 186: 210–215.

Kalamarasa AB, Aarnesa TK, Moorea S, Jones SC, Pereiraa CR, Peng J and Kieves NR 2021. Effects of perioperative saphenous and sciatic nerve blocks, lumbosacral epidural or morphine lidocaine ketamine infusion on postoperative pain andsedation in dogs undergoing tibial plateau leveling osteotomy. Veterinary Anaesthesia and Analgesia. 48: 415-421.

Kowaleski MP, Boudrieau RJ and Beale BS 2013. Radiographic outcome and complications of tibial plateau leveling osteotomy stabilized with an anatomically contoured locking bone plate. Vet Surg. 42: 847-852.

Lamont L, Grimm K, Robertson S, Love L and Schroeder C 2024. Section 3: Pharmacology, Unit 23: Opioids. In Lumb & Jones' Veterinary Anesthesia and Analgesia 6th ed. John Wiley & Sons: 372.

Marolf V, Spadavecchia C, Müller N, Sandersen C and Rohrbach H 2021. Opioid requirements after locoregional anaesthesia in dogs undergoing tibial plateau levelling osteotomy: a pilot study. Veterinary Anaesthesia and Analgesia. 48(3): 398-406.

Palomba N, Vettorato E, Gennaro CD and Corletto F 2020. Peripheral nerve block versus systemic analgesia for postoperative pain control in tibial plateau leveling osteotomy in dogs. Veterinary Anesthesia and Analgesia. 47(1): 119-128.

Steffey EP, Mama KR and Brosnan RJ 2015. Inhalation Anesthetics. In: Lumb & Jones' Veterinary Anesthesia and Analgesia 5th ed. John Wiley & Sons, Inc: 844-846.

Trujanovic R and Rohrbach H 2023. Ultrasound-Guided Block of the Sciatic and the Femoral Nerves in Rabbits A Descriptive Anatomical Study. Animals. 13(14): 2393.

Waag T, Geffen GJ, Bruhn J, Koscielniak-Nielsen ZJ, Nolte H and Wappler F 2014. Ultrasound-guided block of sciatic and femoral nerves: An anatomical study. Laboratory Animals. 48(1): 56–62.