RESEARCH PAPER

A comparison of the motor effects and analgesic efficacy following lumbar plexus block combined with sciatic nerve block or epidural in dogs undergoing tibial plateau leveling osteotomy

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Abstract

Objective To compare motor effects and analgesic efficacy following an ultrasound-guided lateral approach to lumbar plexus blockade at L7 and sciatic nerve blockade (LPSNB) against epidural injection in dogs undergoing tibial plateau leveling osteotomy (TPLO).

Study design Prospective, randomized, blinded clinical trial.

Animals A total of 27 healthy adult dogs undergoing unilateral TPLO surgery.

Methods Dogs were allocated to either LPSNB (bupivacaine 2 mg kg^{-1}, 0.75%) or epidural (morphine PF 0.1 mg kg^{-1} and bupivacaine 0.5 mg kg^{-1}, 0.75%). Other aspects of clinical management were identical, including anesthetic drug protocol, area of presurgical clipping and bladder care. Time to perform the block, response to surgical stimuli, pain scores, rescue analgesia, time to stand and walk, motor score and time to first urination were recorded. One evaluator, unaware of treatment status, performed all evaluations. Student's t-test or Mann−Whitney U test was used to compare continuous variables between groups, and Fisher's exact test for categorical variables.

Results Median (range) times to stand and walk were shorter for LPSNB [60 (40−120) minutes and 90 (60−150) minutes, respectively, $p = 0.003$] than for epidural [150 (120−240) minutes and 180 (120−360) minutes, respectively, $p = 0.006$]. Four dogs required rescue intraoperatively (three in epidural group, one in LPSNB group, $p = 0.438$). Pain scores over the 24 hour evaluation period were similar, and not significantly different, for each group. Time to spontaneous urination [LPSNB, 330 (240−360) minutes; epidural, 300 (120−1440) minutes, $p = 1.0$] did not differ between groups.

Conclusions and clinical relevance An ultrasound-guided lateral paravertebral approach to the lumbar plexus within the psoas compartment at L7, combined with sciatic nerve blockade, allows faster return to normal motor function, with similar pain control and impact on urination when compared with epidural in dogs after TPLO surgery.

Keywords analgesia, epidural, lumbar plexus, nerve block, ultrasound-guided.

Introduction

Cruciate ligament disease is a common orthopedic problem in dogs (Hayashi et al. 2004), and tibial plateau leveling osteotomy (TPLO) surgery is frequently performed for treatment of cranial cruciate ligament insufficiency (Kim et al. 2008). TPLO is considered an invasive surgery involving a skin incision, a medial arthrotomy and a tibial osteotomy with subsequent plate fixation, all of which are associated with significant intraoperative nociception and postoperative pain (Slocum & Slocum 1993; Boscan & Wennogle 2016).

Both epidural anesthesia and peripheral nerve block have been shown to provide similar analgesia in dogs following TPLO (Caniglia et al. 2012; Bartel et al. 2016; Ferrero et al. 2021) and nerve block was associated with lower pain scores than epidural at two evaluation points in one study (Kalamaras et al. 2021). Nerve blocks are increasingly used in veterinary practice and one survey of 112 veterinary professionals with an interest in anesthesia reported that 87% (97/112) used nerve block as their familiar or preferred analgesic modality for patients undergoing pelvic limb surgery (Thomson et al. 2021). Human patients have reported higher satisfaction after nerve block than after epidural anesthesia following major knee surgery (Fowler et al. 2008).

Innervation of the canine stifle arises from the lumbar and sacral plexuses, and consists of the posterior articular nerve (a branch of the tibial nerve), the lateral articular nerve (arises from the peroneal nerve) and the medial articular nerve, which originates from the saphenous nerve but also contains branches of the femoral and obturator nerves in up to 50% of dogs (O'Connor & Woodbury 1982). Combined blockade of the lumbar plexus and the sacral plexus, or sciatic nerve, will produce desensitization of the stifle joint, providing reduced nociception and postoperative analgesia following surgery of the stifle (McCally et al. 2015). Many approaches to the lumbar plexus or femoral nerve have been described and categorized (Gurney & Leece 2014; Portela et al. 2013, 2018).

At the level of the seventh lumbar vertebra (L7), the femoral nerve is encased within the psoas compartment and the obturator nerve also runs within the iliopsoas muscle nearby (Tayari et al. 2017). Injection of dye in these regions, at the L7 level, stains both the femoral and obturator nerves (Graff et al. 2015). Several different ultrasound-guided approaches to the femoral nerve within the psoas compartment have been described (Echeverry et al. 2012; Mahler 2012; Graff et al. 2015; Tayari et al. 2017).

A lateral, paravertebral approach at the caudal aspect of the psoas compartment, at L7, produced excellent sonographic visibility of the relevant structures and injection of dye accurately stained the femoral and obturator nerves in 35 cadavers (Graff et al. 2015). Local anesthetic injection at this location provided postoperative analgesia in 20 clinical patients (Tayari et al. 2017). Further clinical evaluation of this lateral and caudal approach to the femoral nerve within the psoas compartment is indicated.

This study assessed the clinical application of an ultrasound-guided lateral approach to the lumbar plexus within the psoas compartment at L7. It was hypothesized that peripheral nerve blockade of the lumbar plexus at L7 combined with block of the sciatic nerve (LPSNB) would: 1) allow earlier standing and ambulation; 2) provide similar intraoperative blockade of nociception and postoperative analgesia for the first 24 hours after surgery; and 3) be associated with similar time to first urination when compared with epidural administration of morphine and bupivacaine in dogs undergoing unilateral TPLO.

Materials and methods

Study design

The study was conducted as a randomized, prospective, blinded, single-center clinical trial. The study was approved by the Institutional Animal Care and Use Committee, and the MSU Veterinary Medical Center Clinical Research Committee. CONSORT (Schulz et al. 2010) and ARRIVE (Percie du Sert et al. 2020) guidelines were used in preparation of this manuscript.

Inclusion criteria

A group of 30 adult, clinically normal and healthy dogs (American Society of Anesthesiologists physical classification status of I–II/V), weighing at least 20 kg, which presented to the Veterinary Medical Center, MSU, East Lansing MI, to undergo unilateral TPLO were recruited. Study entry occurred after written informed consent was provided by the owner.

Exclusion criteria

Exclusion criteria comprised skin infections, neurological or neuromuscular disease, owner declining to provide consent, change in surgery plan, technical failure to administer nerve block or epidural, or if hydromorphone [(0.05 mg kg^{-1} intravenously (IV)] was administered during surgery owing to failure of block.

Study protocol

Upon entry into the study, each dog was randomly allocated to either ultrasound-guided blockade of the lumbar plexus and the sciatic nerve (LPSNB) or epidural group based upon a pre-generated table of randomized numbers (block randomization, Microsoft Excel; Microsoft Corporation, WA, USA). All other aspects of the clinical management of the study dogs, including the area of presurgical clipping and skin preparation, asepsis, anesthesia protocol, fluid therapy and bladder care, were identical for every dog. All surgeries were performed by one senior faculty surgeon or a third-year resident. One radiologist (NCN) performed all ultrasound-guided injections, one clinician performed all but one of the epidural injections. One evaluator who was familiar with the use of the pain scales, and unaware of treatment status of the dogs, performed all intraoperative and postoperative evaluations for each dog.

Anesthetic management

Food was withheld overnight from all dogs before surgery. Water was available until the time at which preanesthetic medications were administered. All dogs were premedicated with intramuscular (IM) acepromazine (0.02 mg kg^{-1}; Boehringer Ingelheim, CT, USA) and hydromorphone (Dilaudid, 0.1 mg kg^{-1}; Purdue Pharma LP, CT, USA) administered 20 minutes before IV catheter placement. Anesthesia was induced with propofol (Diprivan; Fresenius Kabi USA, IL, USA) administered IV until the jaw was relaxed and orotracheal intubation could be performed. Anesthesia was maintained with isoflurane in oxygen. IV fluid therapy was initiated and continued until recovery at 5 mL kg^{-1} hour^{-1} (lactated Ringer's solution; Baxter Healthcare Corp., IL, USA). During anesthesia, heart rate (HR), respiratory rate (f_R), systolic, mean and diastolic blood pressure, end-tidal carbon dioxide partial pressure (Pe'CO$_2$) and peripheral oxygen saturation (SpO$_2$)

were continuously monitored and recorded every 5 minutes by an evaluator unaware of the treatment allocation, until the end of anesthesia. At the end of surgery, all dogs were administered carprofen subcutaneously (4 mg kg^{-1}, Rimadyl injectable, 50 mg mL^{-1}; Zoetis, MI, USA).

Each dog had its urinary bladder manually emptied before surgery and again before removal of the endotracheal tube. Following surgery, all dogs were monitored in the anesthesia recovery area, and returned to their ward when normothermic and judged fully recovered from anesthesia by the attending clinician. All dogs were hospitalized overnight for observation, with pain management provided as needed.

Monitoring

Time of assessments

Time at which premedication, anesthetic induction and the respective epidural or LPSNB injection occurred were recorded, as well as the elapsed time from first needle puncture of the skin until completion of the injection and needle withdrawal for each block. The interval from completion of the epidural or nerve block to beginning of surgery, and the duration of anesthesia and surgery were also recorded.

Assessment of pain and motor function occurred at baseline before premedication (T−60), and post-extubation (T0), 30 minutes after extubation (T30), and then hourly for 6 hours (T60, T120, T180, T240, T300, T360). Final assessment was performed the following morning before discharge from the hospital (T24H, approximately 24 hours after extubation). The time from extubation until dogs were able to stand and walk

was recorded, as was the time of first spontaneous urination which was referenced to T0 (Fig. 1).

Response to surgical stimuli

Patient responses to four specific events were observed and recorded, these events being towel clamping, skin incision, joint incision and the start of skin suture. The HR and f_R were recorded before and after each of these stimuli. Any response to surgical stimulus that caused an increase in HR or f_R of $> 20\%$ (compared with the value before surgical stimulus), or any spontaneous movement in response to the surgical stimulus, would trigger the administration of propofol (1 mg kg^{-1} IV, Diprivan; Fresenius Kabi USA) and this was recorded. If the increase in HR or f_R of $> 20\%$ recurred with a subsequent surgical stimulus, a second dose of propofol was administered, and with a third response of the same magnitude hydromorphone (0.05 mg kg^{-1} IV) was administered.

Assessment of pain

Assessment of pain was performed using the Glasgow Composite Measure Pain Scale−Short Form (GCMPS-SF) (Reid et al. 2007; Testa et al. 2021) for a 24 hour period, from T0 to T24H.

Motor function

Motor function was evaluated following each pain assessment. The dogs were offered water and food separately, and were encouraged to walk using standardized verbal commands. A sling was then passed under the dog's abdomen for support and the animal's ability to ambulate was assessed. A previously
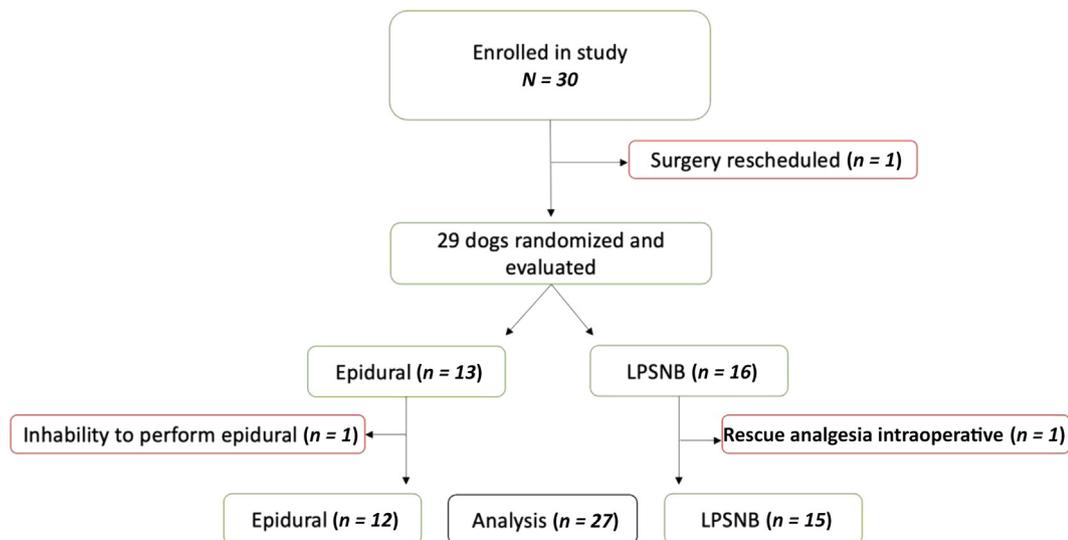
Figure 1 CONSORT flow diagram of dogs randomized into the study, and the reasons for removal from the study. Dogs underwent unilateral tibial plateau leveling osteotomy surgery and were randomly allocated to either epidural injection or lumbar plexus and sciatic nerve blockade (LPSNB).

published five-point scale was used to grade pelvic limb motor function (Abelson et al. 2011). This scale ranged from a score of 1 to 5, with a score of 1 being no motor weakness and 5 representing paralysis.

Rescue analgesia

If any dog was judged as painful in the recovery period by the trained evaluator (GCMPS-SF $\geq 6/24$ or $\geq 5/20$), or if deemed necessary by the attending anesthesiologist, hydromorphone (0.05 mg kg^{-1} IV or IM, Dilaudid; Purdue Pharma LP) was administered.

Injection techniques

All the clipped skin, including the site of epidural and ultrasound-guided injections, was aseptically prepared using chlorhexidine gluconate 2% scrub (Chlohexiderm plus; IVX, Mo, USA).

Approach to lumbar plexus

The lateral paravertebral approach at L7 evaluated in this study has been previously described and illustrated by Graff et al. (2015). Briefly, the ultrasound transducer was placed parallel and lateral to the spine and cranial to the wing of the ilium at the level of the vertebral bodies. Following identification of the wing of the ileum, and the body of L7, then the L6−7 intervertebral disc, the ultrasound beam was fanned more dorsally until a large nerve root was seen exiting the L6−7 intervertebral foramen. The probe was manipulated to place this nerve in long axis and a 22 gauge, 80 mm needle with extension attached (Uniplex Nanoline; Pajunk Medical Systems LP, GA, USA) was advanced in plane from the cranial aspect of the transducer. The injection of bupivacaine (1.3 mg kg^{-1}; 7.5 mg mL^{-1}, Marcaine; Hospira Inc., IL, USA) was performed and directly observed, using aspiration to avoid inadvertent intravascular injection, and ensuring the injection was low pressure and minimal resistance encountered (Campoy et al 2012).

Approach to sciatic nerve

The ultrasound probe was oriented perpendicular to the long axis of the pelvic limb just distal to a line between the greater trochanter and the ischiatic tuberosity (Campoy et al. 2010). Once the sciatic nerve was identified, using the same needle as for lumbar plexus block, bupivacaine (0.7 mg kg^{-1}; 7.5 mg mL^{-1}) was injected adjacent to the nerve, using aspiration to avoid inadvertent intravascular injection, and ensuring there was minimal resistance to injection (Campoy et al. 2012).

Epidural injection

Epidural injection was performed after aseptic preparation of the skin and using aseptic technique. The dog was positioned

in sternal recumbency and with the pelvic limbs pulled cranially, needle placement and landmarks for the L7−S1 space were all as previously described (Jones 2001). A sterile 22 gauge, 63 mm Quincke needle (BD Spinal Needle; BD Medical, NJ, USA) was advanced through the skin and supraspinous, interspinous and interarcuate ligaments and subsequently into the epidural space. Entering the epidural space was confirmed using either the hanging drop technique and/or loss of resistance to injection. The epidural injection contained a combination of morphine (0.1 mg kg^{-1}, Duramorph 0.1%; Baxter Healthcare Corp.) and bupivacaine (0.5 mg kg^{-1}, 0.75% Marcaine; Hospira Inc.) with a final volume of 0.167 mL kg^{-1}.
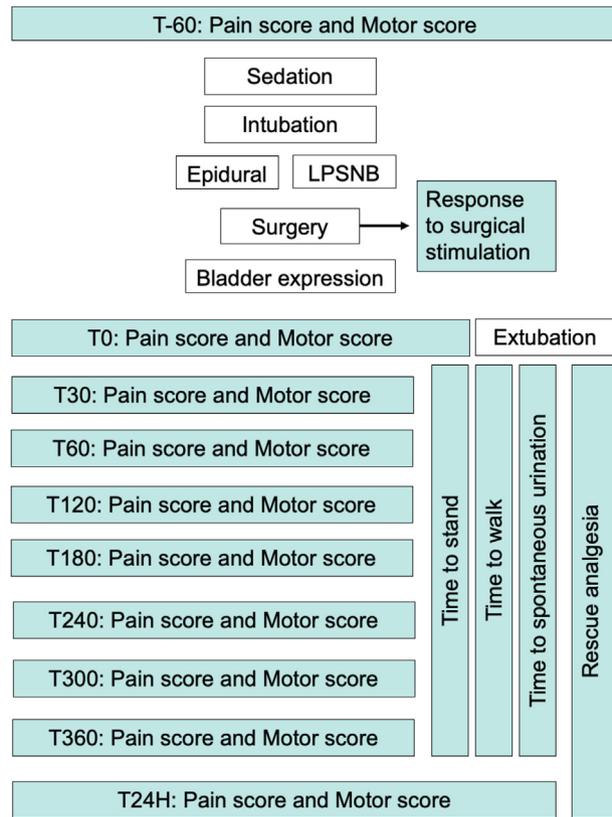
Statistical analysis

Power calculation

A sample size calculation was performed using time to ambulate following a pilot trial at our institution using the same approach for LPSNB blockade: three clinical patients allocated to LPSNB group ambulated within 90 minutes after tracheal extubation, 140 ± 119 minutes earlier than 10 dogs administered an epidural. Setting power at 0.8 and an alpha level of 0.05 resulted in 11 dogs per treatment group (http://clincalc.com/stats/Power.aspx; accessed 28 October 2023).

Continuous variables are presented as mean and standard deviation (SD) when normally distributed or as median and interquartile range when not normally distributed. Each variable was checked for normality using an outcome histogram. Student's *t*-test or Mann−Whitney *U* test (when variable was not normally distributed) were used to compare continuous variables between LPSNB and epidural groups. Fisher's exact test was used for categorical variables. Statistical significance was defined as $p < 0.05$. Statistical analysis was performed using STATA version 14.0 (StataCorp LP Statistical Software, TX, USA).

Results

A total of 30 dogs were recruited into the study (Fig. 2). One dog was excluded from the study because the surgery was rescheduled to after the study period. Therefore, 29 dogs were randomly allocated to either epidural group ($n = 13$) or LPSNB group ($n = 16$). Two dogs were withdrawn from the study, one owing to difficulties with epidural injection and the other, in the LPSNB group, required a dose of propofol at joint incision, and subsequent hydromorphone administration during surgery. The data from 27 dogs (epidural $n = 12$ and LPSNB $n = 15$) were analyzed.

All dogs were adult and medium- to large-sized breeds, with no difference in age [epidural, 7 years (5.2−8.5); LPSNB, 6.2 years (3.5−8.2); $p = 0.623$] or body condition scores between

Figure 2 A flow diagram of the events in dogs during and after unilateral tibial plateau leveling osteotomy surgery and either epidural injection or lumbar plexus and sciatic nerve blockade (LPSNB).

groups [epidural, 6.2 (6−7.5); LPSNB, 6.7 (5−7); $p = 0.503$] (Table 1). Time between premedication and induction [epidural, 38 minutes (30−42); LPSNB, 35 minutes (33−43);

$p = 0.981$)] was not different between groups. Induction of anesthesia was smooth in all cases and propofol dose was similar for both groups [epidural, 3.7 mg kg^{-1} (3.4−4.7); LPSNB, 4.4 mg kg^{-1} (3.0−5.7); $p = 0.963$]. Each LPSNB or epidural injection was completed in under 10 minutes (Table 1).

Total time between LPSNB or epidural and surgery, total surgery time, total anesthesia time and experience level of the surgeons (senior surgeon or surgical resident) performing the procedure did not differ between the two groups (Table 1).

Times to stand and to walk were shorter for LPSNB group than the epidural group ($p = 0.003$ and $p = 0.006$, respectively; Table 2). Baseline evaluations (T−60) of pain and motor scores did not differ between groups (Table 3). Motor function was similar between groups at most evaluation times postoperatively. At T60, motor function was better in the LPSNB group than in the epidural group ($p = 0.014$, Table 3). All dogs displayed normal motor function by the time of discharge from the hospital.

Intraoperatively, four dogs required rescue drug (propofol) when HR increased in excess of the predetermined threshold (>20%). In the epidural group, one dog reacted at skin incision and two reacted at joint incision. In the LPSNB group, one reacted to suturing of the skin. For most dogs, one rescue dose of propofol was enough to complete the surgery without any further response to surgical stimulus observed.

Postoperatively, pain scores did not differ significantly between groups at any time point (Table 3). Postoperatively, hydromorphone administration was similar between groups, with administration times ranging from T30 to T24H in 4/12 dogs in the epidural group, and at T180 and T360 in 1/15 dog in the LPSNB group. Time to first spontaneous urination did not differ between groups (Table 2).

Table 1 Age, body condition score (BCS), elapsed time in minutes between premedication and induction of anesthesia, induction dose of propofol, time from first skin puncture to completion of epidural or lumbar plexus with sciatic nerve block (LPSNB), time between block and start of surgery, and total duration of surgery and anesthesia in 27 dogs undergoing tibial plateau leveling osteotomy. Data are presented as *n* (%) or median (range). LPSNB, lumbar plexus and sciatic nerve block with bupivacaine (1.3 mg kg^{-1}, 0.75% Marcaine; Hospira Inc., IL, USA). Epidural with morphine (0.1 mg kg^{-1}, Duramorph; Baxter Healthcare Corp., IL, USA) and bupivacaine (0.5 mg kg^{-1}, 0.75% Marcaine; Hospira Inc.) with maximum total dose of 0.167 ml kg^{-1}.

	Epidural (*n* = 12)	LPSNB (*n* = 15)	*p*-value
Age (y)	7 (5.2−8.5)	6.2 (3.5−8.2)	0.62
BCS	6.2 (6−7.5)	6.7 (5−7)	0.503
Premedication−induction time (min)	38 (30−42)	35 (33−43)	0.981
Induction (propofol) dose (mg kg^{-1})	3.7 (3.4−4.7)	4.4 (3.0−5.7)	0.963
Time to perform epidural or LPSNB (minutes)	3 (2−5)	6 (5−9.5)	0.003
Time between epidural or LPSNB and surgery (minutes)	48 (42−53)	37 (34−50)	0.103
Surgeon			
Clinician	6 (50)	7 (43.7)	0.521
Third-year resident	6 (50)	9 (56.3)	
Total surgery time (minutes)	48 (39−63)	60 (46−75)	0.113
Total anesthesia time (minutes)	142 (129−166)	162 (144−183)	0.185

Table 2 Elapsed time in minutes between extubation and standing, walking and first spontaneous urination in 27 dogs treated with either epidural or lumbar plexus with sciatic nerve block (LPSNB) prior to tibial plateau leveling osteotomy. Data are presented as median (range). LPSNB, lumbar plexus and sciatic nerve block with bupivacaine (1.3 mg kg^{-1}, 0.75% Marcaine; Hospira Inc., IL, USA). Epidural with morphine (0.1 mg kg^{-1}, Duramorph; Baxter Healthcare Corp., IL, USA) and bupivacaine (0.5 mg kg^{-1}, 0.75% Marcaine; Hospira Inc.) with maximum total dose of 0.167 ml kg^{-1}.

	Epidural (*n* = 12)	LPSNB (*n* = 15)	*p*-value
Time to stand	150 (120−240)	60 (40−120)	0.003
Time to walk	180 (120−360)	90 (60−150)	0.006
Time to spontaneous urination	300 (120−1440)	330 (240−360)	1.00

Discussion

The findings of this study support the hypotheses. Time to stand and ambulate were significantly faster following the nerve block than after epidural anesthesia in dogs following TPLO. The decision to focus on time to stand and ambulate and to evaluate return of motor function was made because these outcomes are not commonly investigated together, and are both clinically relevant and objective variables.

Table 3 Glasgow Composite Measure Pain Scale−Short Form pain score and motor scale score before and after tibial plateau leveling osteotomy surgery in 27 dogs treated with either epidural or lumbar plexus with sciatic nerve block (LPSNB). Data are presented as median (range). LPSNB, lumbar plexus and sciatic nerve block with bupivacaine (1.3 mg kg^{-1}, 0.75% Marcaine; Hospira Inc., IL, USA). Epidural with morphine (0.1 mg kg^{-1}, Duramorph; Baxter Healthcare Corp., IL, USA) and bupivacaine (0.5 mg kg^{-1}, 0.75% Marcaine; Hospira Inc.) with maximum total dose of 0.167 ml kg^{-1}.

	Epidural (*n* = 12)	LPSNB (*n* = 15)	*p*-value
Pain scale score			
T−60	1 (1−3.5)	1 (0.5−3)	0.560
T0	1 (1−2.5)	2 (1.5−4.5)	0.122
T30	1 (1−3)	1 (1−4.5)	0.748
T60	1.5 (1−3.2)	3 (2−5)	0.122
T120	3.7 (2.2−5)	3 (2−5)	0.603
T180	2.2 (1−4.2)	3.5 (2−5.5)	0.202
T240	2 (1−8)	3.7 (2−5.5)	0.782
T300	3 (1−5)	2.5 (1−5.5)	0.613
T360	2 (1−3)	2 (1−6)	0.708
T24H	1 (1−2)	1 (1−2)	0.822
Motor score			
T−60	1 (1−1)	1 (1−1)	0.872
T0	5 (5−5)	5 (5−5)	0.872
T30	5 (4.5−5)	5 (4−5)	0.349
T60	5 (4−5)	3 (2−4)	0.014
T120	3 (2−4)	2 (2−3)	0.100
T180	2.5 (2−4)	2 (2−3)	0.234
T240	2 (2−4)	2 (2−2)	0.098
T300	2 (1−4)	2 (2−2)	0.861
T360	2 (1−3)	2 (1−2)	0.648
T24H	1 (1−1)	1 (1−2)	0.369

Significantly shorter times to standing and to ambulation were observed in dogs following LPSNB. This finding differs from the results of previous studies (Campoy et al. 2012; Bartel et al. 2016). Factors that differ and may impact time to ambulation in these studies include differences in total volume of injectate, injection techniques, different bupivacaine concentrations (0.75% *versus* 0.5%), additional dosing of study dogs with hydromorphone (Campoy et al. 2012) and drugs added to bupivacaine (e.g. dexmedetomidine and buprenorphine) (Bartel et al. 2016).

The finding that LPSNB and epidural anesthesia were associated with similar postoperative analgesia is consistent with earlier reports (Caniglia et al. 2012; Bartel et al. 2016; Arnholz et al. 2017; Tayari et al. 2017; Ferrero et al. 2021). Pain assessment may not have been sensitive enough to detect differences between treatments. A widely published and well-validated but subjective pain scoring system was used and only a single evaluator scored pain. The GCMPS-SF is well validated, but it does not discriminate between dogs displaying pain, anxiety or dysphoria (McKune et al. 2014). When dogs in the present study appeared anxious with a high score on the pain scale, the attending anesthesiologist ultimately made the decision whether or not to administer rescue analgesia.

The LPSNB technique was evaluated in a relatively small number of patients and further clinical assessment would be useful. Another limitation of the study is that despite attempts to conceal the treatment allocation, the dogs allocated to epidural group had the unoperated pelvic limb paralyzed for some time in recovery, whereas dogs allocated to LPSNB group did not, thus introducing the potential for bias, which is also described by Palomba et al. (2020).

At present, an objective means to establish the success or failure of a peripheral nerve block is lacking (Kuls et al. 2017). Patients reacting to surgical stimuli or manifesting pain after a regional nerve block suggest an incomplete or failed block. Potential causes of a failed block include an insufficient concentration or volume of local anesthetic, an inaccurate injection or the possibility of additional unblocked sensory nerves (Campoy et al. 2008; Portela et al. 2013; Vettorato et al. 2013; Tayari et al. 2017). The lateral paravertebral approach to the lumbar

plexus within the psoas compartment at L7 offers the advantage of blocking both femoral and obturator nerves, which is advantageous for a proportion of dogs where the obturator nerve provides innervation to the stifle joint. One study reported that adding a separate block of the obturator nerve in addition to femoral and sciatic nerve blocks produced no impact on measured variables in dogs during and after TPLO, suggesting no relevance of the obturator nerve to sensory innervation of the canine stifle joint (Papadopoulos et al. 2022). Further evaluation of the impact of obturator nerve blockade is indicated.

The duration of sensory blockade in dogs following femoral nerve block with bupivacaine has been shown to range from 10 to 18 hours, and from 4 to 12 hours for the sciatic nerve (O'Cathasaigh et al. 2018). Dogs administered morphine and bupivacaine epidural have been shown to require additional analgesia from 4 to 24 hours postepidural (Campoy et al. 2012). This means that irrespective of the regional technique, some postoperative pain may occur as early as 4 hours after an epidural or sciatic block has been performed. This provides a likely explanation for hydromorphone use after surgery in some of the study dogs in both treatment groups.

Epidural injection of morphine has been associated with urinary retention in 3.5–61.5% of dogs (Herperger 1998; Troncy et al. 2002; Campoy et al. 2012; Ferrero et al. 2021). The results of the current study show a similar time to spontaneous urination following either epidural anesthesia or nerve block, consistent with results from several other studies (Bartel et al. 2016; Arnholz et al. 2017). The standard urinary bladder care applied ensures that patients begin recovery with an empty bladder and this may be the strongest reason for similarities between groups for this outcome.

In conclusion, an ultrasound-guided lateral paravertebral approach to the lumbar plexus within the psoas compartment at L7, combined with sciatic nerve blockade, allows faster return to normal motor function, with similar pain control and similar impact on urination when compared with epidural injection in dogs undergoing TPLO surgery.

Authors' contributions

SMG and DVW: study design, data collection, data analysis, manuscript preparation and editing. LMD: data collection, manuscript review. NCN: data collection, data analysis, manuscript review.

Conflict of interest statement

Authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaa.2023.10.034.