A survey-based study into the use of peripheral nerve blocks for pelvic limb surgery among veterinary professionals with an interest in anaesthesia

Thomson, R[a]., Trimble, T[b]., Pawson, P[c]., Bell, A.M.[c]

Author Details:

Robyn Thomson, BVMS, MSc [a]
Toby Trimble, European Diplomat in Veterinary Anaesthesia and Analgesia[b]
Patricia Pawson, European Diplomat in Veterinary Anaesthesia and Analgesia[c]
Andrew Bell, European Diplomat in Veterinary Anaesthesia and Analgesia[c]

[a]The Ralph, Fourth Avenue, Globe Business Park, Marlow, SL7 1YG, UK
[b]Wear Referrals, Bradbury, Stockton-on-Tees TS21 2E, UK

[c]University of Glasgow School of Veterinary Medicine, Glasgow G61 1QH, UK.

Corresponding author
Robyn Thomson
E-mail: robyn.thomson@theralph.vet
Phone: 01628 308330

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The authors declare no conflict of interest

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Abstract (Word count 196)

Peripheral nerve blocks are commonly recommended as perioperative analgesia for orthopaedic procedures. We aimed to determine the prevalence of use of techniques and drugs amongst veterinary professionals with an interest in anaesthesia. Veterinary professionals were contacted via an email (ACVA-list) and newsletter (Association of Veterinary Anaesthetists) containing a link to an online survey. Surveys completed in full were used for analysis. Analysis found that peripheral nerve blocks (PNBs) and epidural analgesia techniques were the preferred techniques of 46% and 38% of individuals, respectively. Of those using PNBs, nerve stimulator techniques were most common, used by 72% of individuals. Bupivacaine was used by 71% of individuals. Adjuvants were used by 37% of respondents; most commonly an alpha-2 agonist. Severe adverse effects were reported by 11 respondents, while 49% of individuals had not witnessed any adverse effects. More experienced veterinary anaesthetists (> 100 blocks performed) were more likely to have seen adverse effects. In conclusion, peripheral nerve blocks are utilised by anaesthetists for pelvic limb orthopaedic surgery, with nerve stimulation being the most commonly used PNB technique. Bupivacaine was the most commonly used local anaesthetic however diversity in both the techniques and drugs used was evident amongst respondents.

Keywords analgesia, canine, local anaesthetic, pelvic limb, peripheral nerve blocks

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Introduction

The use of peripheral nerve blocks (PNBs) is well established in human medicine as an effective technique to provide both intraoperative and postoperative analgesia [1]. The use of local anaesthetic techniques as part of a balanced anaesthetic protocol has been shown to reduce acute pain, chronic pain after some procedures and postoperative nausea and vomiting [2]. When used appropriately, peripheral nerve blocks also reduce opioid consumption in the postoperative period [2]. In small animal veterinary patients an increasing number of publications describe novel local anaesthetic techniques and their efficacy, and these can be used to provide pelvic limb analgesia in the perioperative period. Anecdotally, peripheral nerve blocks would appear to be commonly used in referral practice, and less so in general practice, however the extent of this use is currently unknown.

Surgery of the pelvic limb is commonly carried out in both referral practice and first opinion practice. Analgesia can be provided for pelvic limb surgery through femoral and sciatic nerve blocks. Several techniques can be used to target the nerves in question [3], which include blind techniques, electrical nerve stimulation [4], and ultrasound guidance [5]. As a result, many different approaches to the femoral and sciatic nerves have been described [4-8]. It is currently unknown which techniques and approaches are most popular in clinical veterinary practice.

The primary aim of this study was to determine the prevalence of PNB use among veterinary professionals with an interest in anaesthesia and determine which techniques

are commonly used for pelvic limb surgery; the underlying hypothesis being that PNBs will be popular but there will be no consensus in terms of the techniques performed, as the literature has not yet demonstrated superiority of one technique over another. The secondary aim was to determine the drugs of choice and the nature of adverse effects experienced.

Methods and Materials

This study was approved by the Research Ethics Committee at the University of XXXX and consent was obtained from individuals participating in the survey. Participation in the survey was voluntary and no data was collected to identify participants. The study was initially trialled within the anaesthesia department at the University of XXX to ensure usability and technical functionality by staff who were not involved with the design of the study.

A survey was designed using an online survey website (Google Forms, California, USA). Individuals within the veterinary profession with an interest in anaesthesia were contacted through the American College of Veterinary Anaesthesiology (ACVA) email list and the Association of Veterinary Anaesthetists (AVA) newsletter, both of which can be subscribed to by specialists, trainees in anaesthesia, general practitioners and nurses/technicians and industry professionals with an interest in anaesthesia. The survey was accessed via a link in an email that invited all veterinary surgeons, nurses and technicians participate.

Responses were collected over a period of 3 weeks in May 2017. Questions were not randomised but streamlined based on individual responses (i.e. adaptive questioning), as shown in Figure 1. Participants were able to review and change their responses as necessary. All questions were mandatory and required an answer to move through the survey. The full survey is available in the supplementary materials.

The survey was voluntary, open, and non-incentivised. No more than 4 items were displayed per page and the total number of pages depended on the answers given (see Fig. 1 & Supplementary material). Many aspects of the survey design align with Checklist for Reporting Results of Internet E-Surveys [9].

Demographics

All participants were asked to complete the demographics section. This section included, age, gender, profession, year of graduation, level of training, specialism if applicable and country of work.

Local Anaesthetic techniques

Participants were presented with a case scenario; a healthy adult canine undergoing general anaesthesia for a tibial osteotomy, such as a tibial plateau levelling osteotomy. All questions following this pertained to this scenario.

Initially, participants were asked if in this scenario, they would use any local anaesthetic (LA) techniques (peripheral nerve blocks, epidural analgesia, intraarticular analgesia) and which was their preferred method, if any. Those using PNBs, epidural analgesia or intraarticular local anaesthetics as their preferred technique were then presented with a

series of questions as demonstrated in Figure 1. Those who indicated they had experience with PNBs as either their preferred method or as a secondary method were asked further questions relating to nerves blocked, technique of choice, and approach used. Photographs of the different PNBs were provided should the participant be unaware of the name of the particular block they were performing (see supplementary material Figures 1-4). A free text field where respondents could describe nerve block techniques was also available.

Drug Choice

All participants with experience of PNBs were taken onto this section regardless of techniques used. The participants were asked initially which local anaesthetic they would use most commonly, and if an adjuvant was used.

Adverse Effects

All participants using PNBs were asked '*Have you ever experienced, or witnessed, any of these adverse effects following these blocks?*'. A list of possible adverse effects was given, with a free text box to input additional answers if required. In order to determine the level of experience of the survey respondents they were also asked approximately how many blocks they had performed at this stage.

Data analysis

Descriptive analysis was carried out using Microsoft Excel (Microsoft, WA, USA). A comparison of experience data with complications experience was made using a chi-squared test (Graphpad Software, California, USA). A p value of < 0.05 was deemed

significant. For analysis of adverse effects, they were split into severe and moderate/mild side effects. Severe adverse effects comprised cardiac arrest, neuropraxia for greater than 7 days and systemic toxicity. Moderate/mild adverse effects comprised localised infection at site of injection, haematoma formation, and neuropraxia for greater than 24 hours and less than 7 days.

Results

Of the 114 respondents, 112 individuals completed the survey in full. Within the respondents, 68% (*n* = 76) were anaesthesia specialists (holding European or American college of veterinary anaesthesia and analgesia [ECVAA or ACVAA] diplomas), 21% (*n* = 24) were residents undertaking anaesthesia residencies, 8% (n = 9) were veterinary nurses/technicians, and 3% (*n* = 3) were general practitioners, one of whom was a certificate holder, a United Kingdom (UK) Royal College of Veterinary Surgery postgraduate qualification indicating advanced practitioner status. Participants were from the USA (38%), the UK (25%), Canada (7%) and Australia (5%), with the remaining 25% working in other countries worldwide. The mean number of years graduated was 16 years, ranging from 3-62 years. Of the 112 participants, 36% (*n* = 41) were male, 61% (*n* = 68) were female, and 3% (*n* = 3) indicated they preferred not to say.

Preferred Method of Locoregional Anaesthesia

Within this study group, 99% would use LA techniques as part of their anaesthetic protocol for the case described in the survey. The flow chart (Fig. 1) shows the division of respondents after the first question. A small number of individuals used intraarticular

(*n* = 1) or epidural analgesic techniques as their sole choice of locoregional anaesthesia (*n* = 13). These results are not discussed due to the small sample size. In total, 97 (87%) participants used PNB as either their preferred method or as a non-preferred but familiar method of providing analgesia during the previously mentioned scenario.

Peripheral nerve blocks

Of the 97 participants using PNB, 92% (*n* = 89) blocked the femoral and sciatic nerves in combination, 4 % (*n* = 4) blocked the femoral nerve alone and 4 % (*n* = 4) blocked other nerves (obturator, lumbar plexus, undefined).

Femoral nerve

Of the 97 individuals using PNBs, 93 people performed this nerve block as part of their anaesthetic management of a tibial osteotomy, with 5 % (*n* = 5) using a blind technique, 72% (*n* = 67) using nerve stimulation, 8% (*n* = 7) using ultrasound alone, and 15 % (*n* = 14) using ultrasound with nerve stimulation. The details of the approaches used can be found in Table 1.

Sciatic Nerve

Of the 97 individuals using PNBs, 89 people performed this nerve block in combination with the femoral nerve, with 72% (*n* = 64) using nerve stimulation, 15% (*n* = 13) using ultrasound in combination with nerve stimulation, 10 % (*n* = 9) using ultrasound alone and 3 % (*n* = 3) using a blind technique. Details of the approaches being used can be found in Table 2.

Local anaesthetic choice & adjuvants

Most respondents (71%, *n* = 69) used bupivacaine as their choice of local anaesthesia (table 3). Of the 97 individuals using peripheral nerve blocks, 36% (*n* = 35) used an adjuvant. Of those using an adjuvant, 91% (*n* = 32) described use of an α_2-adrenoceptor-agonist in the free text field, of which dexmedetomidine was the most commonly used. A range of other drugs were used in lower percentages (Table 4).

Adverse Effects and Experience

Of the respondents, 10% had performed less than 10 blocks, 29% had performed between 10 and 50 blocks, 16% had performed 50-100 blocks, 24% had performed 100-500 blocks and 21% had performed over 500 blocks. Using this data, and taking the mid-point for each range, it was estimated that this group of respondents had an accumulated experience of over 15,000 peripheral nerve block procedures.

Of the 97 participants that answered this question, 49% indicated they had seen no adverse effects. Severe adverse effects [*e.g.* systemic toxicity (8%), neuropraxia for greater than seven days (2%) and cardiac arrest (1%)] had been witnessed by 11% of the respondents. The remaining results are listed in Table 5. Severe adverse effects were more likely to be seen by more experienced participants, [those having performed more than 100 blocks ($p = < 0.001$]. Those who were less experienced (having performed fewer than 50 blocks) were less likely to have experienced any adverse effects at all ($p < 0.001$).

Discussion

Overall, our findings show that local anaesthetic techniques and particularly peripheral nerve blocks are being utilized extensively by this study population. Based on the number of blocks performed, experience had a significant effect on the adverse effects experienced.

The popularity of PNBs demonstrated here may relate to recent studies demonstrating analgesic equivalence to epidural techniques [17,18] and decreased postoperative opioid consumption in dogs [19]. The perception that complications are reduced with PNBs when compared with epidural analgesia may also have influenced the popularity. Epidural analgesia may result in urinary retention, hypotension and severe neurological complications [20]. In dogs, it has been demonstrated that urinary retention is reduced with PNB compared to epidural techniques [17] however, PNBs still carry a risk of hypotension, and neurological complications [21]. In a systematic review by Fowler et al. [20] it was concluded that, in humans, analgesia provided by epidural analgesia and PNBs for stifle surgery was comparable. However, animals administered a PNB had a better side-effect profile, with less urinary retention and hypotension than those receiving epidural analgesia [17]. This may make PNB more appropriate for use in general practice compared to epidural analgesia.

Of those indicating they would use a PNB, nerve stimulation was the most popular technique. A review of the human literature demonstrated that ultrasound guided peripheral nerve blocks reduced supplemental analgesia requirements more than block performed using nerve stimulation [22]. This has not yet been demonstrated in

veterinary medicine. As such, individuals are likely to continue with techniques they are familiar with, hence nerve stimulation being more popular within the study population. Several different approaches to the femoral and sciatic nerve blocks were used by survey respondents. At present, there is no literature directly comparing the efficacy and complications associated with each approach. In this study, the most commonly used approaches were those described by either Campoy et al. [14] or Mahler & Adogwa [6]. This is perhaps due to these being described earliest in the literature or the difficullty being perceived as easier than other alternatives.

Peripheral nerve blocks are generally performed with the aim of blocking sensory nerve stimulation which may reduce the need for post-operative opioid use. The use of adjuvants aims to increase the duration of action of the PNB [23]. Studies in humans have shown that the addition of an α-2 adrenoceptor agonist, dexmedetomidine, as an adjuvant can increase the length of sensory blockade [24]. This is also supported in the veterinary literature with the α-2 adrenoceptor agonist medetomidine [25], although published studies do not universally support these findings [26]. This may account for the finding that the majority of respondents did not use adjuvants, alongside possible concerns regarding licensing, especially within the UK, and additional potential side effects of bradycardia and hypotension [27].

The potential for adverse effects from any form of intervention must be considered prior to it being performed. In humans, PNBs may be associated with nerve injury, bleeding, infection and local anaesthetic toxicity [28,29]. A comparatively small, retrospective case series of over 200 dogs who had PNBs reported no long-term complications. In that study, hypotension during general anaesthesia was seen in 7.8% of dogs and bilateral pelvic limb paralysis (following lumbar plexus and sciatic nerve blocks), which

resolved after 6 hours, was observed in 1 dog [21]. Participants in this study were simply asked if they had observed any adverse effects, not the frequency at which they occurred. As such, the overall frequency of complications cannot be determined from the survey results, though our results do suggest that major complications are not common. The human literature also supports this notion, with the incidence of permanent nerve damage being 1.5 – 1.9 cases in 10,000 [28,30]. As complications with PNB seem uncommon, it may be that these techniques are appropriate for use in general practice.

This study did have several limitations. Firstly, we are unable to accurately report a response rate as we cannot verify the number of possible respondents and any overlap between email lists. The survey was aimed at those with an interest in anaesthesia. These individuals would likely be either a diplomate or trainee within either the American or European specialist colleges. In 2017, at the time of the survey the European college of veterinary anaesthesia and analgesia (ECVAA) had 149 practicing diplomates and approximately 65 trainees (ECVAA Secretary, personal communication). The equivalent figures for the American College, excluding any European diplomates also recorded as holding the American qualification, were 231 diplomates and 71 trainees. Within the respondents in this study there were 76 diploma holders and 24 residents, representing 20%, and 18% respectively. Despite a small number of additional responses from technicians and general practitioners, this clearly represents a small percentage of the veterinary anaesthesia community. As this was a self-selecting survey-based study a degree of bias is likely, as individuals with an interest in PNBs would be more likely to complete the survey. Additionally, as the ECVAA and ACVAA do not hold demographic information for their members (*e.g.*

age), it is not possible to determine how representative this sample of respondents is of the target population. We therefore suspect that the prevalence of local anaesthesia and peripheral nerve block use in the wider veterinary anaesthesia community is significantly lower than found here. Despite these limitations, the results presented here represent the views of a group of veterinary professionals, many of whom have significant experience performing PNBs. As such, these results are of value, especially to the wider community who may be considering utilising nerve.

As previously stated, the methodology does not allow extrapolation to rates of adverse effects, simply those who have observed them. Additionally, the adverse effects were recalled by participants retrospectively rather than prospectively evaluated and hence their results may be subject to a degree of recall bias. They are also subjectively interpreted by the clinician, so the adverse effect may have in fact been attributed to a factor unrelated to the PNB. Finally, this study does not give any indication as to how effective these blocks were.

In conclusion, this is the first study demonstrating the prevalence of locoregional anaesthesia use among a cohort of veterinary professionals with an interest in anaesthesia. It demonstrates that PNBs are being used as part of the perioperative management of dogs undergoing osteotomies of the pelvic limbs, with nerve stimulation being the most commonly used PNB technique and a small number of specific approaches were used by the majority of respondents. Bupivacaine was the most commonly used local anaesthetic however diversity in both techniques and drugs used was evident amongst respondents. Further studies are required to determine which techniques and approaches provide the most effective analgesia in the perioperative period, and to investigate the rate of associated complications.

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