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Case Report

Erector Spinae Plane Catheter for Postoperative Analgesia after a Rib Resection Surgery in a Dog

Iago Asorey* and Maja Drozdzynska

Dick White Referrals, Six Mile Bottom, Cambridgeshire, CB80UH, UK

***Corresponding author**

Iago Asorey, Dick White Referrals, Six Mile Bottom, Cambridgeshire, CB8 0UH, UK. Tel: +44-01638572012; Fax: +44-01638 572013; Email: iago.asorey@dwr.co.uk

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Abstract

The ultrasound-guided erector spinae plane block (UG-ESP) is a novel locoregional anaesthesia technique that belongs to interfacial plane blocks. In humans, it has been used for effective thoracic analgesia that reduces the risk of complications and offers the possibility of a catheter placement for long-term post-operative pain management. A 15-months-old Sprocker Spaniel underwent surgery of the left caudo-ventral thoracic wall including a partial rib resection due to a recurrent abscess. Multimodal analgesia consisted of intravenous methadone and dexmedetomidine given as premedication followed by UG-ESP block with levobupivacaine. Before anaesthetic recovery, an UG-ESP catheter was placed at the level of the left 10th thoracic vertebra. Postoperative analgesia was provided by intermittent local anaesthetic administration via ESP catheter and systemic non-steroidal anti-inflammatory drugs. This analgesic approach prevented the use of systemic opioids during the hospitalization period. This report presents the first successful application of an ESP catheter for post-thoracotomy opioid-free pain management in a dog.

ABBREVIATIONS

UG-ESP: Ultrasound-Guided Erector Spinae Plane Block; **LA:** Local Anaesthetic; **HR:** Heart Rate; **ASA:** American Society of Anaesthetists Physical Status.

INTRODUCTION

The compartmental or interfascial plane blocks are the analgesic techniques that can be used to manage acute perioperative as well as chronic pain conditions. In the recent years, the new interfascial plane blocks have been described and quickly introduced to the clinical practice. Due to the anatomical features of the fascias like superficial location, poor vascularization and good sonographic echogenicity, these techniques are considered easy to learn and easy to perform. They are associated with low risk of complications and very importantly, give the possibility of intrafascial catheter placement for longer-term postoperative analgesia or for the treatment of chronic pain conditions. In compartmental blocks, no individual nerves but fascial planes with their neural structures are the anatomical targets [1]. Among them, the UG-ESP block was originally described in people for the treatment of chronic thoracic neuropathic pain [2]. Since its original description, UG-ESP has offered a wide range of clinical applications not only restricted to the thoracic area but also to the abdomen and posterior limbs [3]. This locoregional technique consists of the injection of local anaesthetic (LA) solution into the thoracolumbar fascia that is located at the level of the transverse processes of the thoracolumbar vertebras, just below the erector spinae muscle group. Multi-segmental distribution of LA within this fascial plane, consistently blocks the dorsal branches of the spinal nerves (lateral and medial) [4]. In the veterinary literature, thoracic UG-ESP block has been investigated in two recent canine cadaveric studies that only found the staining of the dorsal rami of the spinal nerves [5,6]. These findings are supported by a porcine research [7]. To the best of authors knowledge, UG-ESP has not been clinically described for thoracic pain treatment in dogs. Thus, we report its first clinical application for intraoperative analgesia followed by postoperative intermittent ESP block provided by a catheter in a dog that underwent partial rib resection due to a recurrent caudal thoracic wall abscess formation.

CASE PRESENTATION

A fifteen-months-old female spayed Sprocker Spaniel was presented to the clinic with three months history of a recurrent abscess formation at the level of the left caudal thoracic wall. After two previous surgical interventions, a Computed Tomography scan was performed to assess the extension of the recurrent lesion. The study revealed the left ventro-caudal thoracic flank abscess, 10^{th} left costo-cartilaginous junction sequestrum and regional lymphadenomegaly. No intrathoracic abnormalities were detected. Histopathology revealed a pyogranulomatous inflammatory process with maturing granulation tissue. Bacteriological culture was consistent with Actinomyces. Due to recurrence of paracostal swelling in the same area of the left lateral thoracic wall, the patient was scheduled for revision surgical abscess resection and partial resection of the left 10^{th} rib. The dog was fasted for twelve hours before surgery. Access to water was not restricted. The preanaesthetic physical examination revealed a bright, alert and responsive patient with a bodyweight of 13.6 kg, body condition score 5/9, heart rate (HR) 104 beats per minute, respiratory rate 24 breaths per minute, good pulse quality, capillary refill time less than two seconds, pink mucous membranes and normothermia. No abnormalities were detected in relation to the hydration status or the cardiopulmonary system. Haematology and biochemistry results were within normal limits. The dog was classified according to the American Society of Anaesthetists (ASA) physical status as two (II).

Preanaesthetic medication consisted of 0.18 mg/kg methadone (Comfortan; Dechra, UK) and 1.1 µg/kg dexmedetomidine (Dexdomitor; Orion Pharma, UK) administered intravenously using a previously placed cannula (Introcan 18 G; Braun, Germany) in the left cephalic vein. After 15 minutes the patient was induced with intravenous 3.7 mg/kg propofol (PropoFlo; Zoetis, UK) titrated to effect until adequate anaesthetic depth allowed for tracheal intubation with a 10 mm internal diameter cuffed endotracheal polyvinyl tube. The endotracheal tube was secured and connected via a heat and moisture exchanger (Flexicare Thermoshield; Flexicare Medical Limited, UK) to the rebreathing, circle anaesthetic system. General anaesthesia was maintained with isoflurane (IsoFlo; Zoetis, UK) given in 100% oxygen throughout the surgical procedure. After induction, the patient was positioned in sternal recumbency. The left side of the thorax, up to the spinous processes of thoracic vertebras, was clipped and aseptically prepared. The unilateral UG-ESP block was performed at the level of the left 10th thoracic vertebrae using a linear transducer (5-13 MHz SonoScape™; Shenzhen, China) placed in the parasagittal position and cephalo-caudal orientation, 2-3 cm lateral from the thoracic spinous processes of T9 and T10. With this transducer position, the short axis view of the T9 and T10 transverse processes as well as long axis view of thoracolumbar fascia and epaxial muscle complex were obtained. The pre-flushed tuohy needle (20 G x 2", 50 mm, Perican; Braun, Germany) was advanced using an in-plane technique through the epaxial muscles in a craniocaudal direction until it reached the dorsal surface of the T10 transverse process. At this point, 2 ml of 0.18% levobupivacaine (Chirocaine; AbbVie, UK) solution was injected as a test dose. The hydro-dissection of the thoracolumbar fascia and elevation of the epaxial muscles was a confirmation of an appropriate needle placement. After positive confirmation, the remaining 13 ml of levobupivacaine 0.18% were administered.

During the surgery, the patient was mechanically ventilated in the volume-controlled mode with a minute volume of 1.9 L/minute and positive end expiratory pressure of 4 cmH_2O (Wato EX-65; Midray, China). Depth of anaesthesia was assessed using muscular tone, palpebral reflex, the eye position and jaw tone. The patient was continuously monitored using electrocardiogram, invasive blood pressure, pulse oximetry, oesophageal temperature (Beneview T5; Mindray, China), capnography, spirometry and end-tidal fraction of anaesthetic gases (Wato EX-65; Midray, China). The end-tidal isofluorane concentration varied between 1.2-1.3% during the surgical procedure. The cardiovascular system remained stable (mean arterial pressure > 65 mmHg) and was not compromised by the ESP block. Throughout the procedure that lasted 50 minutes, one moment of nociception, defined as 20% increase in HR and arterial blood pressure, was recorded and treated with 1 µg/kg intravenous bolus of fentanyl (Fentadon; Dechra, the Netherlands). The surgical procedure consisted of complete resection of the abscess and partial resection of the left 10th rib at the level of the costochondral junction. The thoracic wall was reconstructed by placing sutures around the adjacent ribs (9th and 11th ribs). A thoracic drain (12 G, 30 cm, MILA International, Florence, USA) was placed in the left 8th intercostal space.

Once the surgery was finished, the patient was positioned in sternal recumbency and the chest was drained until negative intrapleural pressure was achieved. At this point, due to the satisfactory intraoperative analgesic effects of ESP bock, decision was made to place an ESP catheter for postoperative analgesia. An epidural catheter (Perifix One Paed Set 20; Braun, Germany) was used for this purpose. The procedure was repeated in the similar manner as the preoperative block. The tuohy needle (20 G x 2", 50 mm, Perican; Braun, Germany) was advanced under ultrasound guidance up to the dorsal surface of the left 10th transverse process. With this needle location, 8 ml of 0.15% levobupivacaine (Chirocaine; AbbVie, UK) was injected. It produced hydro-dissection of the thoracolumbar fascia and facilitated catheter advancement. The catheter could be visualized by the ultrasound at the dorsal surface of the 10th transverse process (Figure 1). While in position, extra 2 ml of 0.15% levobupivacaine was given to confirm appropriate position of the catheter tip. After reassurance given by further fascial hydro-dissection, the catheter was tunneled twice under the skin for better security. The epidural catheter was connected to a bacterio-viral filter and sutured in place (Figure 2).

The dog had a smooth and uneventful recovery from anaesthesia. The postoperative analgesia plan consisted of 2 mg/kg carprofen (Rimadyl; Zoetis, UK) given orally every 12 hours and 10 ml of 0.15% levobupivacaine (Chirocaine; AbbVie, UK) administered via the ESP catheter every five hours for the

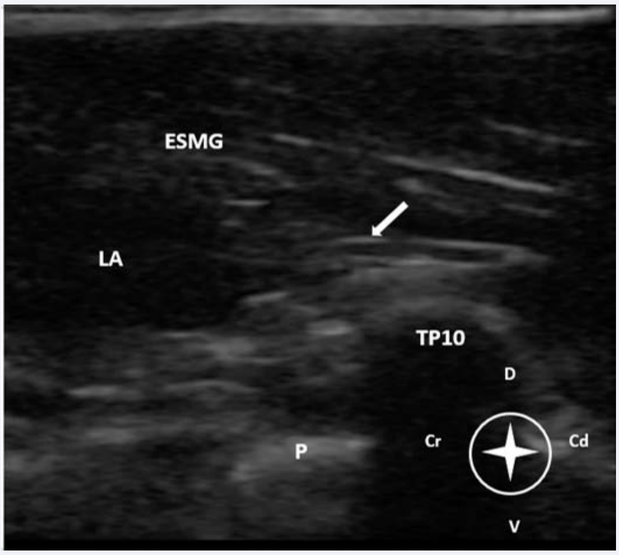

Figure 1 Parasagittal ultrasound image at the level of the left transverse process of the 10th vertebrae (TP10), location where the erector spinae catheter was inserted in this dog after partial rib resection. The image shows the erector spinae muscle group (ESMG), displaced dorsally from the TP10 after local anaesthetic (LA) solution administration through the erector spinae catheter (arrow). Pleura (P), dorsal (D), cranial (Cr), caudal (Cd) and ventral (V).

Figure 2 Image of the postoperative period after partial rib resection in a dog showing the erector spinae catheter insertion site and method used to secure it to de skin. The catheter was temporary uncovered for the purpose of the image.

first 24 hours after surgery. Pain was monitored using the short form of the Glasgow Composite pain scale every two hours for 48 postoperative hours. During this period, the pain score at every time point remained ≤2/24, so rescue analgesia with opioids was not required. In addition, the number of dermatomes blocked by LA given via ESP catheter were assessed by pinching the skin with haemostatic forceps within each intercostal space at the level of middle-thorax. This determined the successful unilateral blockade of the left thoracic wall between the 6^{th} and 12^{th} intercostal spaces. During this period, the patient was closely monitored and no complications related to the locoregional anaesthetic technique were detected. There were no signs of hypoventilation or motor dysfunction of the anterior or posterior limbs. Food intake was 10/10 eight hours post-extubation. The use of ESP catheter between 24-48 hours after the surgery was based on the pain scores with the instruction to administer LA only if pain score at any given time was ≥5/24. It was not needed within this period as pain scores were 2/24. The chest drain and the ESP catheter were removed 24 hours and 48 hours after surgery, respectively. Due to an uneventful postoperative period, the patient was discharged home 48 hours after the surgical procedure.

DISCUSSION

Thoracic wall surgery involves significant nociception, that if not treated adequately may progress to severe and chronic postoperative pain [8]. Shallow and inefficient breathing pattern caused by pain may lead to respiratory complications such as hypercapnea and hypoxaemia [9]. For this reason, early and aggressive pain control with a multimodal approach that involves locoregional anaesthesia is considered crucial for thoracic procedures.

In human medicine, the ESP block has been successfully used for different thoracic surgical interventions and chronic pain conditions [10]. It has been clinically compared with more established locoregional anaesthesia techniques for thoracic procedures such as paravertebral and thoracic epidural block. It has been found to be comparable to the paravertebral block [11] and equivalent or superior to thoracic epidural analgesia [12]. Despite these promising clinical results, the exact mechanism by which ESP block produces thoracic analgesia has not been consistently confirmed among even human cadaveric studies. In order to produce complete analgesia of the thoracic wall, the dorsal rami of the spinal nerves need to be blocked alongside with the ventral rami of the spinal nerves that gives the origin for the intercostal nerves [13]. The possible mechanism by which the ventral spinal nerves could be blocked with the ESP technique is the spread of LA to the paravertebral and/or the epidural space. Human cadaveric studies show very conflicting results in this matter, leaving a significant knowledge gap between clinical effects and full understanding of its mechanism of action [4,14].

In the veterinary clinical setting, the ESP block has been used for hemilaminectomy procedures in dogs [15-17]. Preoperative ESP block was associated with significantly lower use of perioperative analgesic drugs, reduced incidence of intraoperative cardiovascular complications and decreased time to voluntary food intake after surgery [17]. The published veterinary canine cadaveric studies, determined consistent staining of the dorsal rami of the spinal nerves without the involvement of the ventral spinal nerves [5,6]. Neither paravertebral, nor epidural dye spread has been found in these studies, which led to the conclusion that ESP block is suitable for surgical procedures of the dorsum only and the explanation why would it be effective for thoracic analgesia remains unclear. The same conclusion has been reached in the study performed in living pigs with the postmortem examination of the dye spread [7]. The only difference found in this study was the additional staining of the paravertebral lymphnodes, which clinical significance remains unknown [7]. To the best of our knowledge, this case report represents the first clinical description of the intra and postoperative use of ESP block in a dog undergoing thoracic wall surgery. The decision to use it was based on the human literature reporting its successful analgesic effect for rib fractures and thoracic surgeries [18,19]. Intermittent use of LA via ESP catheter in the postoperative period in the conscious dog, allowed us to perform dermatome testing which confirmed unilateral lack of sensation of the chest wall from the 6^{th} to 12^{th} intercostal spaces. It means that intercostal nerves originating from the ventral spinal nerves have been blocked by LA. This again, shows the significant discrepancy between the findings of cadaveric studies and clinical observations. The lack of blockade seen on the contralateral thoracic side makes epidural spread of LA rather unlikely. The possible explanation for thoracic wall analgesia seen in this case might be LA spread to the paravertebral space, as suggested but never confirmed mechanism of action, or the lateral spread of LA to the intercostal muscles where cutaneous branches of the intercostal nerves are located. This mechanism of action has been confirmed in one human cadaveric study [20] and has been suggested as a potential mechanism of analgesic action in a canine cadaveric study [5].

In the present case, the volume used for intermittent LA administration (0.7 ml/kg) is comparable to the volume used by Otero and others [7] in living pigs. The results of this study have suggested that 0.6 ml/kg injected at the level of T6 resulted in a median staining of five dorsal spinal nerves. In our case, dermatome testing performed one hour after LA administration with a volume of 0.7 ml/kg confirmed that seven intercostal spaces (6^{th} and 12^{th}) were covered. The larger area of paraesthesia seen in this case might be due to the species difference, larger volume of LA used or the difference in the distribution of LA between alive and euthanized subjects. In contrast to this study, however, we have seen paraesthesia of the chest wall area that is innervated by the intercostal nerves that originate from the ventral branch of the spinal nerves. Although, it is unknown if in this case LA affected ventral spinal nerves or directly intercostal nerves, it was clinically evident that lateral chest wall between 6th and 12th intercostal spaces was desensitized. The dermatome or sensory testing requires perception and conscious response of an individual to the stimulation provided in the certain body area. It allows to confirm the effectiveness of locoregional technique and spread of the LA. It is routinely performed in human anaesthesia shortly after locoregional block is performed. In human medicine it is possible because many of these blocks are performed under mild sedation and not under general anaesthesia. In veterinary patients, however, dermatome testing is rarely performed. This is why, this case report is quite unique in its nature because the catheter placement allowed us to evaluate the postoperative effectiveness and range of sensory blockade achieved with ESP block in a conscious dog.

In our case, placement of the ESP catheter was done at the end of the surgical procedure in order to not interfere with the surgical site and to avoid possible catheter dislodgement. In the postoperative period, LA was given via catheter in the form of intermittent boluses and not in continuous infusion as it has been reported in human medicine [18,21]. We selected this method due to the lack of pharmacokinetics studies investigating continuous peripheral infusion of levobupivacaine in dogs. In addition, we thought that intermittent ESP catheter use was more appropriate in a veterinary patient that could freely move inside the kennel preventing catheter dislodgement. Furthermore, the technique of LA administration (bolus versus continuous infusion) may affect the LA distribution and the total area covered by the block.

In dogs, the maximum allowed dose of levobupivacaine is 3 mg/kg [22]. In the described case, the total dose of levobupivacaine used was 3 mg/kg (1.9 and 1.1 mg/kg for the first and second injections, respectively). These two doses were given 85 minutes apart, increasing the margin of safety. The lack of levobupivacaine related toxic signs, even when higher doses are clinically used in dogs (4.4 mg/kg), supports the safety margin of the dose used in our case [23]. During the postoperative period, our patient received intermittent boluses of levobupivacaine with a final concentration of 0.15%. The concentration lower than 0.25% aimed to induce sensory but not motor blockade of the target nerve fibers, phenomenon also known as "differential blockade" [24-26]. This allowed us to administer a relatively large volume of LA solution without reaching toxic doses and at a sufficient concentration to produce effective sensory blockade.

Although, the case reports provide the lowest level of clinical evidence, placement of the catheter in this dog allowed to perform sensory testing which confirmed chest wall paraesthesia after ESP block. The lack of sensation in the intercostal spaces, suggests that ESP block could possibly block the ventral branches of the spinal nerves, making this technique potentially suitable for thoracic procedures in dogs. More prospective, blinded, randomized clinical studies with a large sample size are needed to examine and explain the analgesic effects, area of sensory blockade and complication rate of ESP technique in dogs.

REFERENCES

1. Elsharkawy H, Pawa A, Mariano ER. Interfascial plane blocks: back to basics. Reg Anesth Pain Med. 2018; 43: 341-346.
2. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: a novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med. 2016; 41: 621-627.
3. De Cassai A, Bonvicini D, Correale C, Sandei L, Tulgar S, Tonetti T. Erector spinae plane block: a systematic qualitative review. Minerva Anestesiol. 2019; 85: 308-319.
4. Ivanusic J, Konishi Y, Barrington MJ. A cadaveric study investigating the mechanism of action of erector spinae blockade. Reg Anesth Pain Med. 2018; 43: 567-571.
5. Ferreira TH, St James M, Schroeder CA, Hershberger-Braker KL, Teixeira LBC, Schroeder KM. Description of an ultrasound-guided erector spinae plane block and the spread of dye in dog cadavers. Vet AnaesthAnalg. 2019; 46: 516-522.
6. Portela DA, Castro D, Romano M, Gallastegui A, Garcia-Pereira F, Otero PE. Ultrasound-guided erector spinae plane block in canine cadavers: relevant anatomy and injectate distribution. Vet AnaesthAnalg. 2020; 47: 229-237.
7. Otero PE, Fuensalida SE, Russo PC, Verdier N, Blanco C, Portela DA. Mechanism of action of the erector spinae plane block: distribution of dye in a porcine model. Reg Anesth Pain Med. 2020; 45: 198-203.
8. Wildgaard K, Ravn J, Kehlet H. Chronic post-thoracotomy pain: a critical review of pathogenic mechanisms and strategies for prevention. Eur J Cardiothorac Surg. 2009; 36: 170-180.
9. Stobie D, Caywood DD, Rozanski EA, Bing DR, Dhokarikar P, Raffe MR, et al. Evaluation of pulmonary function and analgesia in dogs after intercostal thoracotomy and use of morphine administered intramuscularly or intrapleurally and bupivacaine administered intrapleurally. Am J Vet Res. 1995; 56: 1098-1109.
10. Kot P, Rodriguez P, Granell M, Cano B, Rovira L, Morales J, et al. The erector spinae plane block: a narrative review. Korean J Anesthesiol. 2019; 72: 209-220.
11. Taketa Y, Irisawa Y, Fujitani T. Comparison of ultrasound-guided erector spinae plane block and thoracic paravertebral block for postoperative analgesia after video-assisted thoracic surgery: a randomized controlled non-inferiority clinical trial. Reg Anesth Pain Med. 2020; 45: 10-15.
12. Nagaraja PS, Ragavendran S, Singh NG, Asai O, Bhavya G, Manjunath N, et al. Comparison of continuous thoracic epidural analgesia with bilateral erector spinae plane block for perioperative pain management in cardiac surgery. Ann Card Anaesth. 2018; 21: 323-327.
13. Bailey CS, Kitchell RL, Haghighi SS, Johnson RD. Cutaneous innervation of the thorax and abdomen of the dog. Am J Vet Res. 1984; 45: 1689-1698.
14. Aponte A, Sala-Blanch X, Prats-Galino A, Masdeu J, Moreno LA, Sermeus LA. Anatomical evaluation of the extent of spread in the erector spinae plane block: a cadaveric study. Can J Anaesth J Can Anesth. 2019; 66: 886-893.
15. Herron A, Bianchi C, Viscasillas J, Sanchis S, Foster A, Medina R. The erector spinae plane block for intraoperative analgesia in dogs undergoing hemilaminectomy: a retrospective study. Proceedings of the BSAVA Congress. British Small Animal Veterinary Association: Birmingham, 2019: 504-504.

16. Zannin D, Isaka LJ, Pereira RH, Mencalha R. Opioid-free total intravenous anesthesia with bilateral ultrasound-guided erector spinae plane block for perioperative pain control in a dog undergoing dorsal hemilaminectomy. Vet AnaesthAnalg. 2020; 47: 728-731.

17. Portela DA, Romano M, Zamora GA, Garcia-Pereira F, Pablo LS, Gatson BJ, et al. The effect of erector spinae plane block on perioperative analgesic consumption and complications in dogs undergoing hemilaminectomy surgery: a retrospective cohort study. Vet AnaesthAnalg. 2020; 1467-2987.

18. Hamilton DL, Manickam B. Erector spinae plane block for pain relief in rib fractures. Br J Anaesth. 2017; 118: 474-475.

19. Ince I, Ozmen O, Aksoy M, Zeren S, Ulas AB, Aydin Y. Erector spinae plane block catheter insertion under ultrasound guidance for thoracic surgery: case series of three patients. Eurasian J Med. 2018; 50: 204-206.

20. Adhikary SD, Bernard S, Lopez H, Chin KJ. Erector spinae plane block versus retrolaminar block: a magnetic resonance imaging and anatomical study. Reg Anesth Pain Med. 2018; 43: 756-762.

21. Kaplan I, Jiao Y, AuBuchon JD, Moore, RP. Continuous erector spinae plane catheter for analgesia after infant thoracotomy: a case report. AA Pract. 2018; 11: 250-252.

22. Rioja Garcia, E. Local anesthetics. In: Grimm KA, Lamont LA, Tranquilli WJ, Greene SA, Roberston SA. Veterinary anesthesia and analgesia. Oxford, UK. Willey Blackwell. 2015: 332-354.

23. Korkmaz M, Yilmaz O, Saritas ZK, Demirkan I, Jaroszewski J. Evaluation of intraperitoneal and incisional bupivacaine or levobupivacaine for postoperative analgesia in ovariohysterectomized dogs. Acta Sci Vet. 2019; 47: 1666.

24. Bajwa SJS, Kaur J. Clinical profile of levobupivacaine in regional anesthesia: a systematic review. J Anaesth Clin Pharmacol. 2013; 29: 530-539.

25. Gomez de Segura IA, Menafro A, García-Fernández P, Murillo S, Parodi EM. Analgesic and motor-blocking action of epidurally administered levobupivacaine or bupivacaine in the conscious dog. Vet AnaesthAnalg. 2009; 36: 485-494.

26. Gómez de Segura IA, Vazquez I, De Miguel E. Antinociceptive and motor-blocking action of epidurally administered IQB-9302 and bupivacaine in the dog. Reg Anesth Pain Med. 2000; 25: 522-528.

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