Locoregional anaesthesia in cats and dogs – successful pain relief

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BVSc(Hons), MANZCVS(VA+CC), MRCVS discusses the importance of targeted loss of sensation and pain both during and after surgery in companion animal patients, and looks at drugs commonly used

LOCOREGIONAL anaesthesia is a valuable tool in the analgesia armament. Topical anaesthesia (gel, ointment, spray or patch); regional anaesthesia (incisional infiltration, ring block, intravenous regional anaesthesia [IVRA] and so on); peripheral nerve blocks; and neuraxial anaesthesia (extradural or intrathecal) can provide excellent intraoperative and postoperative analgesia.

Ongoing postoperative analgesia can also be provided through an indwelling catheter – either parallel to the wound (wound diffusion catheter) or inserted in the extradural space. One veterinary study (Troncy et al, 2002) found the cost of extradural analgesia was almost 40 per cent cheaper than systemically delivered analgesia over the same time period in dogs.

By minimising nociceptive signalling, the amount of systemic anaesthetic and analgesic drug required during and after surgery is reduced, thereby reducing the unwanted side effects of these drugs (for example, hypotension, hypoventilation, bradycardia, tremors and sedation) and smoothing the plane of anaesthesia.

In humans, the use of locoregional anaesthesia reduces the time to discharge from hospital compared with those patients administered systemic analgesia alone. Certain techniques can also be used to reduce unwanted or potentially dangerous side effects of surgery. For example, a retrobulbar block reduces the risk of an oculocardiac reflex during enucleation of the globe, while neuraxial anaesthesia is the only technique available to block the stress response to surgery.

Locoregional anaesthesia may be performed using anatomical landmarks for needle positioning, or guided using ultrasound or electro-stimulation needles. While ultrasound or electro-stimulation needles may be used to improve the accuracy of peripheral nerve blocks, a thorough understanding of the anatomy of the area to be blocked is still required for their safe execution.

A summary of available locoregional techniques can be found in Table 1.

Four drug classes are commonly used for locoregional anaesthesia: local anaesthetics, opioids, alpha-2 adrenoceptor agonists and adrenaline. A summary of the most commonly used drug combinations and doses can be found in Table 2.

Local anaesthetics

Local anaesthetics block sodium channels from within the cell membrane to stop the transmission of action potentials along the nerve at the level of the blockade; for myelinated nerves, three nodes of Ranvier must be blocked to stop action potential transmission.

The most commonly used local anaesthetics for regional anaesthesia are bupivacaine and ropivacaine (both less than 2mg/kg total dose) or lidocaine (less than 4mg/kg total dose), with or without an opioid or alpha-2 agonist. As a general rule, the author uses a volume of 0.1mL/kg to 0.2mL/kg of 0.5 per cent bupivacaine, 0.5 per cent ropivacaine or two per cent lidocaine for most nerve blocks. If using 0.75 per cent ropivacaine, a volume of 0.1mL/ kg to 0.15mL/kg is used.

The total safe dose (1mg/ kg to 2mg/kg bupivacaine or ropivacaine; 2mg/kg to 4mg/ kg lidocaine) should be calculated and, in some instances, a more dilute solution may be required (for example, 0.25 per cent bupivacaine or one per cent lidocaine) to ensure the safe dose is not exceeded, while ensuring an adequate volume of solution is used.

For extradural (also called epidural) anaesthesia, a total drug volume of 0.2mL/ kg is adequate to desensitise the hindquarters and majority of the abdomen. In pregnant animals, the drug volume should be reduced by 25 per cent to 0.15mL/kg.

For intrathecal (also called subarachnoid or “spinal”) anaesthesia, this volume (and, therefore, dose) should be reduced (0.07mL/kg to 0.1mL/kg), with an additional 25 per cent reduction in pregnant animals (0.05mL/kg to 0.075mL/kg).

If neuraxially administered, local anaesthetic spreads rostral to the first lumbar vertebrae, the sympathetic ganglion chain is anaesthetised. The loss of sympathetic tone to the hindquarters, and abdominal viscera if there is very rostral spread, results in vasodilation with subsequent hypotension and hypothermia.

The onset time for bupivacaine and ropivacaine is up to 30 minutes and the duration of action four to six hours, peripherally and neuraxially. The duration of motor blockade following extradural and subarachnoid injection is shorter after ropivacaine than bupivacaine.The combination of morphine (0.1mg/kg) and 0.5 per cent bupivacaine administered extradurally provides analgesia for up to 24 hours, while the addition of adrenaline to either ropivacaine or bupivacaine did not affect the duration of analgesia. Lidocaine has an onset time of up to 15 minutes and duration of action of one to two hours, peripherally and neuraxially.

Using a combination of lidocaine and bupivacaine shortens the onset time for regional anaesthesia, but may result in a shorter duration of anaesthesia. The duration of anaesthesia following intrathecal administration of local anaesthetic is markedly reduced (30 minutes to one hour) compared to extradural administration, as it is cleared more rapidly by the cerebrospinal fluid.

Opioids

Opioids have a modulating effect on pain signalling and are most useful for neuraxial analgesia, but can also be added to blocks within inflamed tissues – particularly intra-articularly or through wound diffusion catheters.

Morphine is the most commonly used opioid, although fentanyl, methadone, buprenorphine, tramadol and butorphanol have also been reported. Only preservative-free opioid preparations should be used neuraxially or intra-articularly. The onset time for morphine is up to 30 minutes when administered extradurally, with a duration of 10 to 24 hours. Methadone is more lipophilic than morphine and has a shorter onset time (10 to 20 minutes) and duration of action (two to six hours) accordingly.

The efficacy of opioid regional analgesia is improved if administration occurs prior to the pain stimulus. A dose rate of 0.1mg/kg to 0.2mg/kg of morphine or methadone is recommended for neuraxial analgesia. This dose rate is unlikely to result in systemic side effects (respiratory or cardiovascular depression, sedation, dysphoria, reduced gastrointestinal motility, facial rubbing/pruritus, vomiting and urinary retention) when administered extradurally.

The reported incidence of severe complications following extradural analgesia is 0.75 per cent. The risk of systemic side effects is increased following intrathecal opioid administration. If side effects are severe, a low dose of naloxone (5?g/kg to 10?g/kg IV, may be repeated after six hours) can be administered intravenously and will usually reverse the adverse effect with little effect on analgesia.

Alpha-2 adrenoceptor agonists

Alpha-2 adrenoceptor agonists have a modulating effect on pain signalling, and some alpha-2 agonists exhibit local anaesthetic-like properties too, due to their effect on imidazoline receptors. Alpha-2 agonists can be used to prolong the duration of analgesia of extradural morphine.

Medetomidine (15?g/kg) provided up to eight hours of analgesia in dogs following a single dose extradural injection, but also caused significant bradycardia, transient hypotension, respiratory depression and sinus arrhythmia/seconddegree atrioventricular heart block (Vesal et al, 1996).

For dexmedetomidine the onset time was 15 minutes after extradural and intrathecal administration. The duration of analgesia was 90 minutes after intrathecal administration and four hours after extradural administration (Sabbe et al, 1994).

Extradural administration resulted in a reduced respiratory rate, but end-tidal carbon dioxide concentrations were unchanged. Bradycardia and transient hypertension developed following extradural administration, but was less pronounced than following intravenous administration. There was minimal sedation following extradural or intrathecal administration. There was also a slight reduction in core body temperature following extradural administration. The use of alpha-2 agonists neuraxially is limited at present as there are currently no preservative-free, commercially available alpha-2 agonist preparations available in the UK.

Adrenaline

Adrenaline (1: 200 000 = 5?g/ mL) can be added to prolong the duration of analgesia as systemic absorption is slowed by vasoconstriction. Adrenaline should be avoided in areas with minimal collateral arterial circulation or where temporary ischaemia would be catastrophic (for example, ring blocks, IVRA and incisional blocks) as prolonged vasoconstriction may be detrimental to the integrity and/or healing of the appendage, area or incision. While the use of solutions containing adrenaline neuraxially has been reported in dogs without adverse sequelae, some anaesthetists are reluctant to instil adrenaline-containing solutions around the spinal cord/cauda equina.

Summary

There is great scope for locoregional anaesthesia in veterinary practice. The techniques improve the quality of anaesthesia and reduce the doses of systemic drugs required both for the maintenance of anaesthesia and for systemic opioids postoperatively, often resulting in reduced hospitalisation time and cost. See the further reading list for detailed information on specific locoregional techniques.

• Please note some drugs mentioned within this article are unlicensed in cats and dogs and are

used under the cascade.

References and further reading

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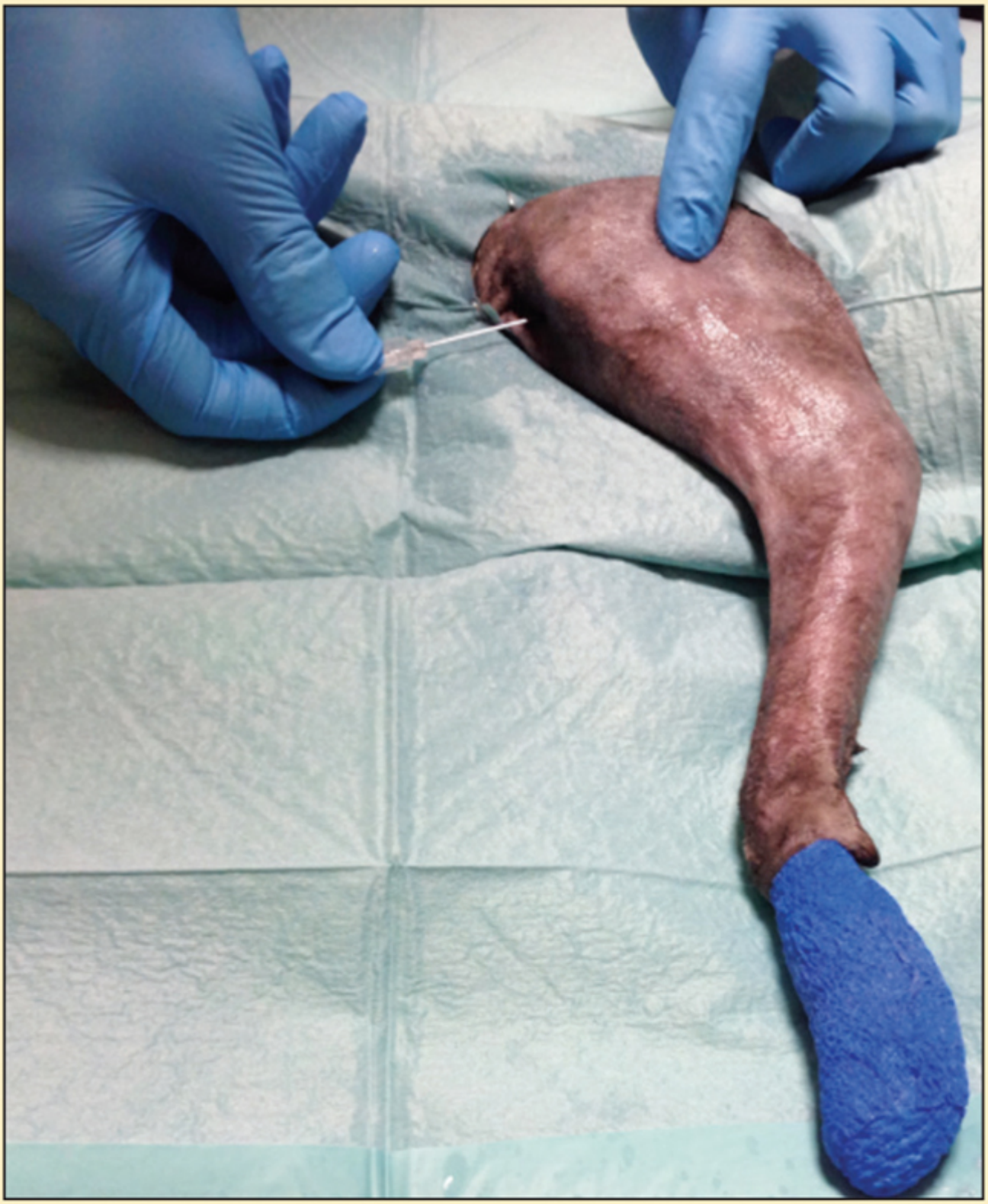
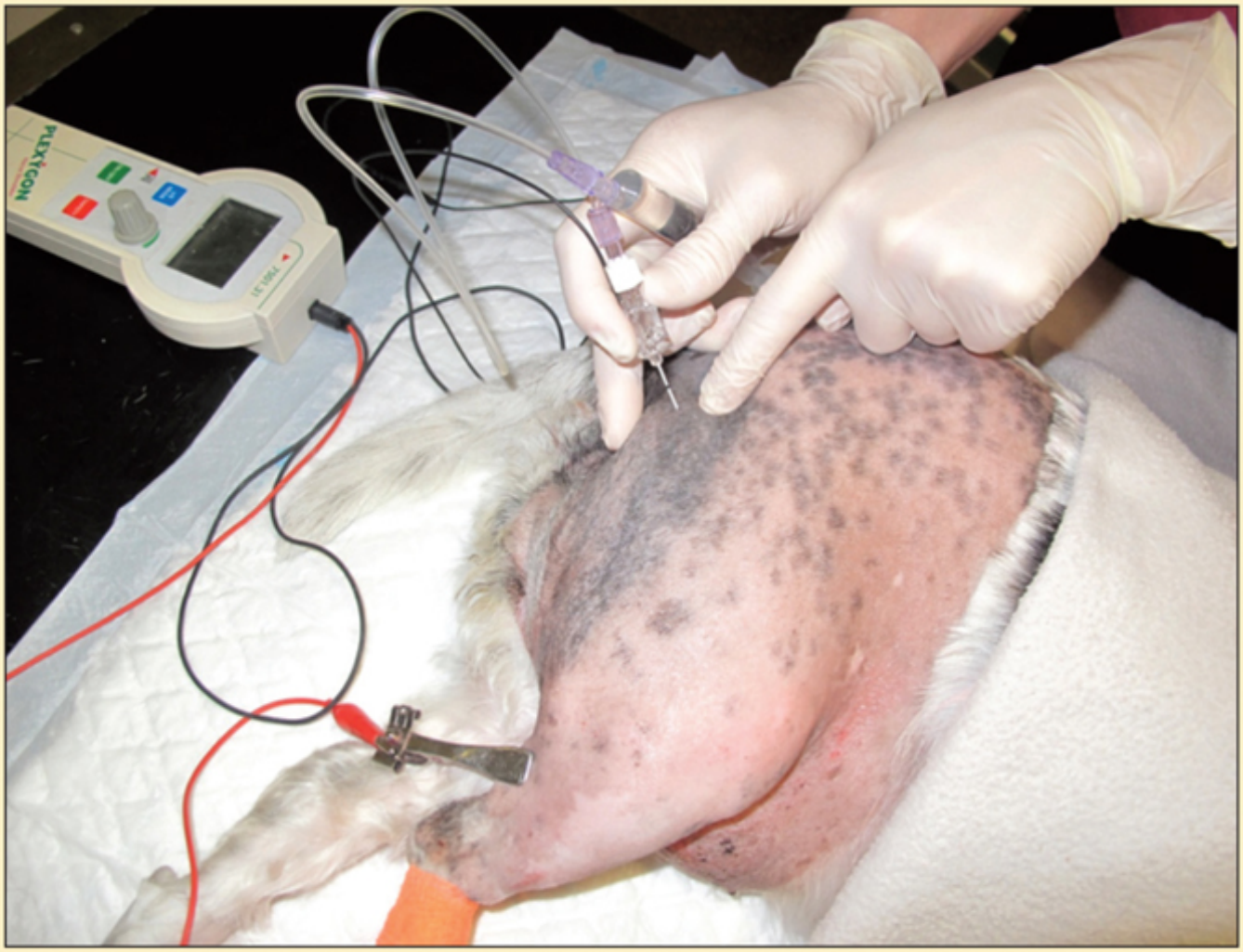
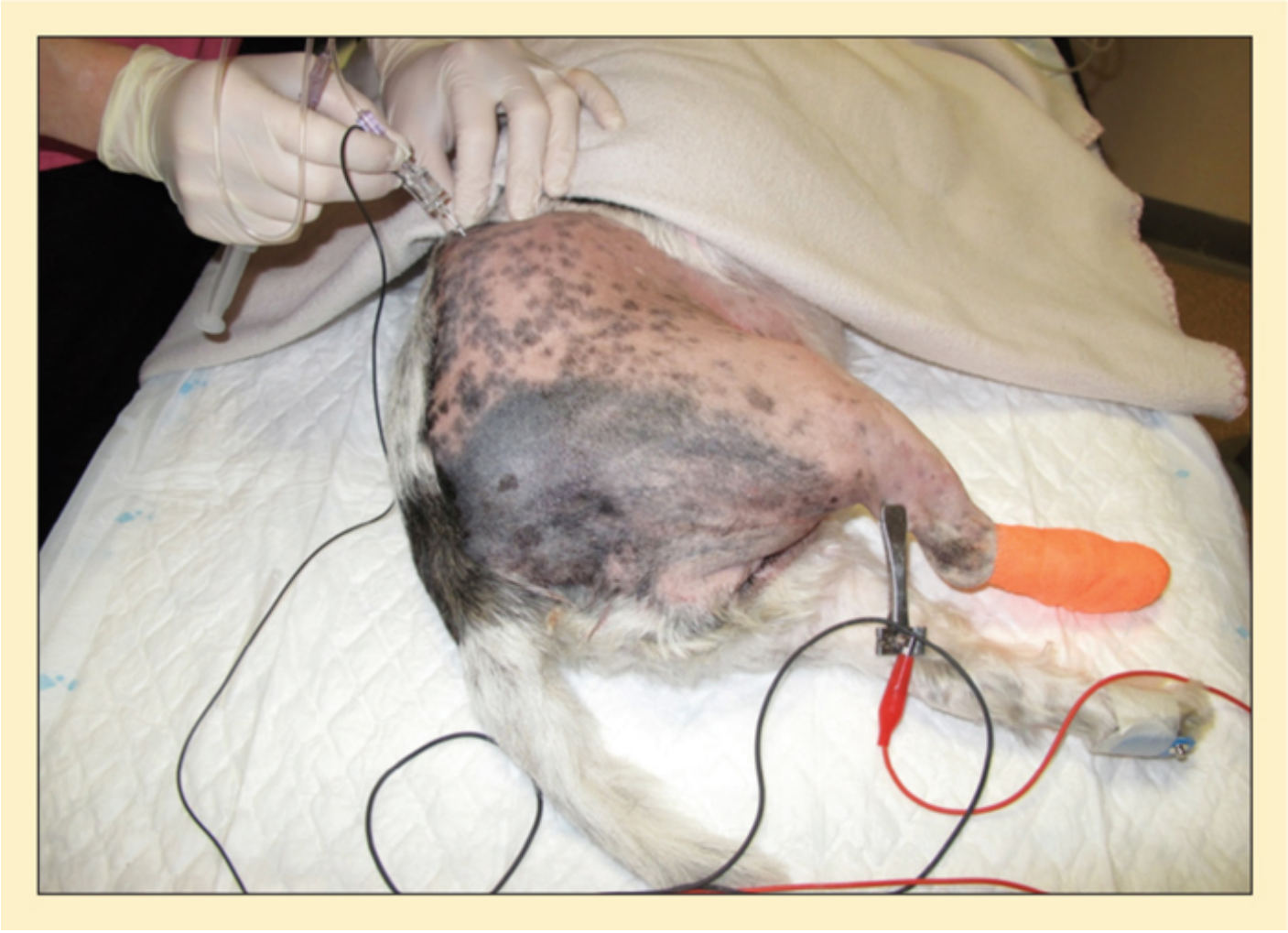


Needle position for axillary brachial plexus anaesthesia in a cat.



Needle position for sciatic nerve anaesthesia using an electrolocation needle in a dog.



Needle position for lumbar plexus anaesthesia using an electrolocation needle in a dog.

	Topical anaesthesia	Peripheral nerve blocks	Neuraxial anaesthesia	Miscellaneous techniques
Head	EMLA cream Lidocaine throat spray	Infraorbital Mandibular Maxillary Mental Supraorbital Diamond	N/A	Wound diffusion catheter
Forelimb	Lidocaine patch EMLA cream	Paravertebral brachial plexus Axillary brachial plexus Radial Ulnar-median and musculocutaneous trunk	N/A	Intravenous regional anaesthesia Wound diffusion catheter
Hindlimb	Lidocaine patch EMLA cream	Lumbar plexus Femoral Sciatic Peroneal	Lumbosacral extradural Lumbar intrathecal	IVRA Wound diffusion catheter
Tail/perineum	EMLA cream	Pudendal	Sacrococcygeal/ "caudal" extradural	N/A
Thorax	Lidocaine patch EMLA cream	Intercostal (three cranial and three caudal to incision/ wound)	Thoracic extradural/ intrathecal Lumbosacral extradural/ intrathecal	Intrapleural Wound diffusion catheter
Abdomen	Lidocaine patch EMLA cream	N/A	Lumbosacral extradural Lumbosacral intrathecal Lumbar intrathecal	Intrapleural (for stellate ganglion blockade) Wound diffusion catheter
Joints	Lidocaine patch	N/A	N/A	Intra-articular local anaesthetic +/– morphine
Miscellaneous	EMLA cream Lidocaine patch	N/A	N/A	Incisional/perilesional infiltration "Splash block" Wound diffusion catheter Ring block Inverted L-block Intratesticular

Table 1. Summary of potential locoregional techniques in companion animals by body region

Drug	Dose	Common stock solution strength	Peripheral block	Neuraxial block
Lidocaine	≤4mg/kg	1% (10mg/mL) 2% (20mg/mL)	0.1mL/kg to 0.2mL/kg	0.2mL/kg total volume
Bupivacaine	<2mg/kg	0.25% (2.5mg/mL) 0.5% (5mg/mL)	0.1mL/kg to 0.2mL/kg	0.2mL/kg total volume
Ropivacaine	<2mg/kg	0.75% (7.5mg/mL)	0.1mL/kg to 0.2mL/kg	0.2mL/kg total volume
Preservative-free morphine	0.1mg/kg to 0.3mg/kg	1% (10mg/mL) 3% (30mg/mL)	0.1mL/kg intra-articular/ intralesional	0.2mL/kg total volume

Table 2. Summary of drugs and common doses recommended for use in companion animal regional anaesthesia