

Regional Anaesthesia of the Thoracic Limb

Trauma and inflammation cause sensitization of the peripheral nervous system and the subsequent barrage of nociceptive input (usually by surgery) produces sensitization of neurons in the dorsal horn of the spinal cord. Local anaesthetic techniques are the only analgesic techniques that produce a complete blockade of the peripheral nociceptive input and are therefore the most effective way to prevent sensitization of the CNS and development of pathological pain. As veterinary nurse anaesthetists it is important that we have a good comprehension of the analgesic techniques available and how they work.

In human medicine the use of perioperative local & regional anaesthesia greatly reduces major complications as the stress response (which is neuroendocrine) to surgical trauma compromises haemostatic, metabolic and immunological function. This allows for a better recovery. Local blocks work by inhibiting the sodium channels in the neuronal membranes therefore blocking the generation and conduction of nerve impulses.

Mechanism of action

Peripheral nerves are composed of nerve fibres surrounded by a connective tissue (myelinated or unmyelinated) sheath. The local anaesthetic is injected near the peripheral nerves and the drugs must penetrate these connective tissue sheaths before reaching the neuronal membranes. Diffusion of local anaesthetics **AWAY** from the injection site results in uptake to the systemic circulation.

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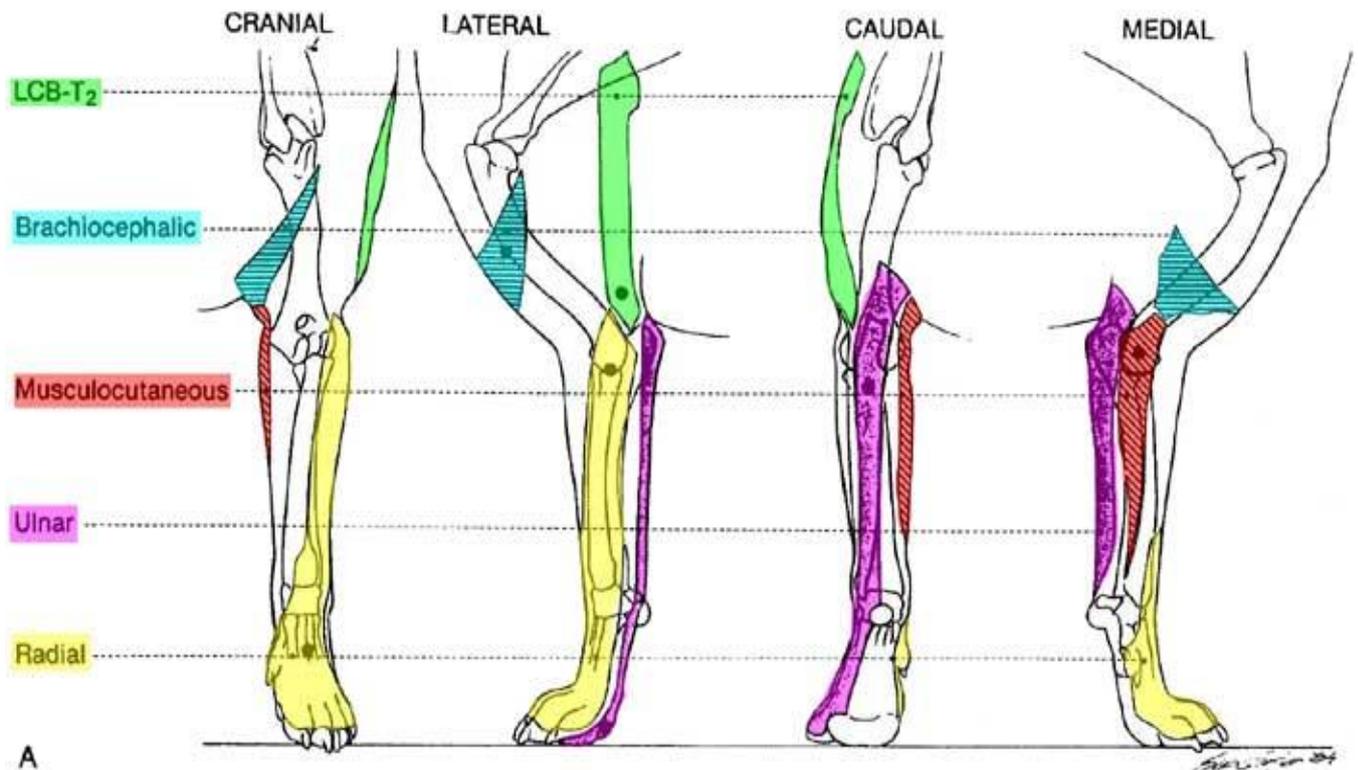
Absorption and metabolism

Moderately lipid soluble drugs (e.g. lidocaine) do not bind extensively to tissue proteins and are rapidly absorbed. Highly lipid soluble drugs (ropivacaine) are absorbed much more slowly as they bind extensively to the tissue proteins. Most local anaesthetics cause vasodilation. This accelerates systemic absorption. Vasoconstrictors (e.g. adrenaline) can be added to prolong the duration of action with short acting drugs like lidocaine (lignol). Vasoconstrictors are not commonly added as there is a potential for localized ischaemia and there are long acting local anaesthetics available with an inherently slow systemic absorption rate.

There are 6 different types of block which can be done to block various parts of the thoracic limb.

They are;

- Auxillary (traditional) brachial plexus
- Cervical paravertebral brachial plexus
- RUMM-radial, ulna, medial & musculotaneous nerves
- Wrist block
- Biers block
- Digital block
- A clear understanding of clinical pharmacology and anatomy is required to use these techniques.



(LCB-T2 – intercostal brachial nerves)

This image shows the nerve groups in the forelimb and their position.

The paravertebral brachial plexus blocks the nerve roots C₆, C₇, C₈, T₁ and T₂

There are 3 techniques;

- The **blind technique** follows the transverse process of vertebrae C5-C6, C6-C7 and C7-Head of the first rib.
- The **neurostimulation technique** uses the same landmarks but finds the nerves with electrolocation by use of a nerve stimulator.
- Finally **ultrasound** can be used to guide the anaesthetist. For this the needle enters craneal to the first rib.

The paravertebral cervical block is suitable for patients having surgery on any part of the thoracic limb such as forelimb amputation, humeral fracture repair or elbow

surgery. However there are many potential complications which can occur if the local anaesthetic is administered incorrectly. These can include;

- Pneumothorax
- Intravascular injection leading to uptake in the systemic circulation and the possibility of toxicity.
- Nerve damage
- Phrenic nerve block resulting in the patient being unable to use one side it's thorax and therefore lung for ventilation.
- Injection into the epidural space

Some undesirable but manageable side effects of this block include Horner's syndrome and residual block where its effects are longer acting than desired.

Horner's syndrome

This is when there is interference with the sympathetic nerve supply to the head, resulting in a combination of signs. The clinical features include;

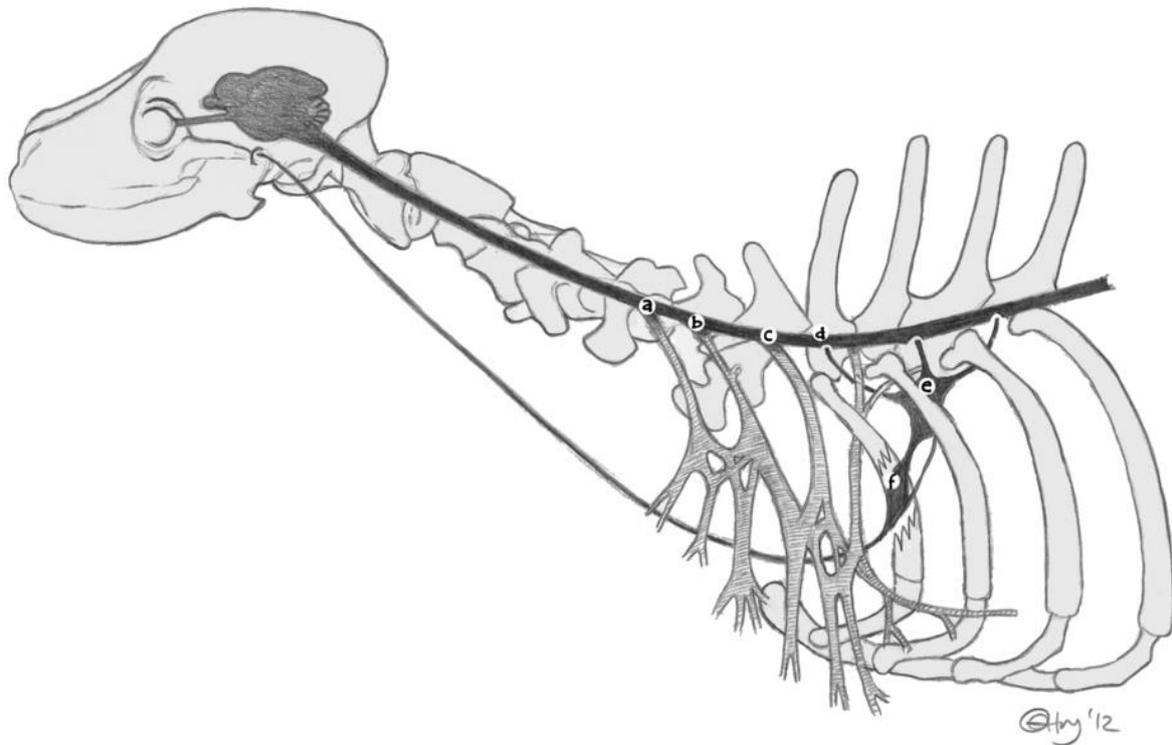
- **Miosis**
Constriction of the affected pupil
- **Protrusion of the nictitating membrane (third eyelid).**
This is due to lack of tone in the smooth muscle retracting the third eyelid, as this is under sympathetic innervation, and also secondary to enophthalmos.
- **Upper eyelid ptosis (incomplete elevation or drooping).**
This is caused by reduced muscle tone. The palpebral fissure may appear narrowed and laxity of the lower eyelid can be observed.
- **Enophthalmos**
This is displacement of the eyeball resulting from a loss of sympathetic innervation which leads to a lack of tone in the orbital smooth muscle. This allows the eyeball to sink back into the orbit.
- **Reduction in intraocular pressure.**
- **Loss of cutaneous vascular tone on the affected side.**
This can result in an increased cutaneous temperature in the affected side. This is often seen as the pinna on the affected side being warmer than the normal side.



Causes

Horners syndrome may result from a lesion(s) affecting the sympathetic nerve supply to head at varying levels or from avulsion of the brachial plexus nerve roots. This is because the T₁ nerve root of the T₁-T₃ sympathetic outflow is affected by injury to the

brachial plexus. These avulsions can be caused when carrying out local anaesthesia techniques on the brachial plexus nerves.



This image shows the nerve roots of C6, C7, C8 & T1 along with the sympathetic outflow to the head and eye to demonstrate how close together the nerves are and how easy it can be to affect the nerves other than those desired.

The auxiliary or traditional brachial plexus technique blocks the radial, ulna, median and musculocutaneous nerves.

Two techniques can be used, either blind or using neurostimulation. With the blind technique the anaesthetist inserts the needle medial to the shoulder joint, staying on the medial side of the scapula but ensuring they are on the outside of the thoracic cavity. Then they advance the needle parallel to the vertebral column, aiming for the costocondral junction of the first rib. Next a small amount of the total volume is injected and the remainder is injected as the needle is withdrawn.

This type of block is suitable for surgeries BELOW the elbow only, such as radial fracture, carpal arthrodesis or digit amputation.

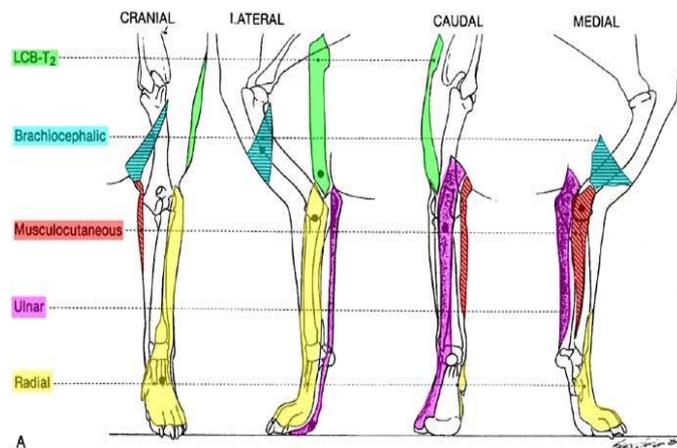
This block has similar potential complications to the paravertebral brachial plexus block but not as many and the chance of them occurring is slightly smaller. With the auxiliary brachial plexus block there is no danger of entering the epidural space.

When using neurostimulation to guide the administration of this local block the landmarks and approach are the same as the traditional blind method. The nerve

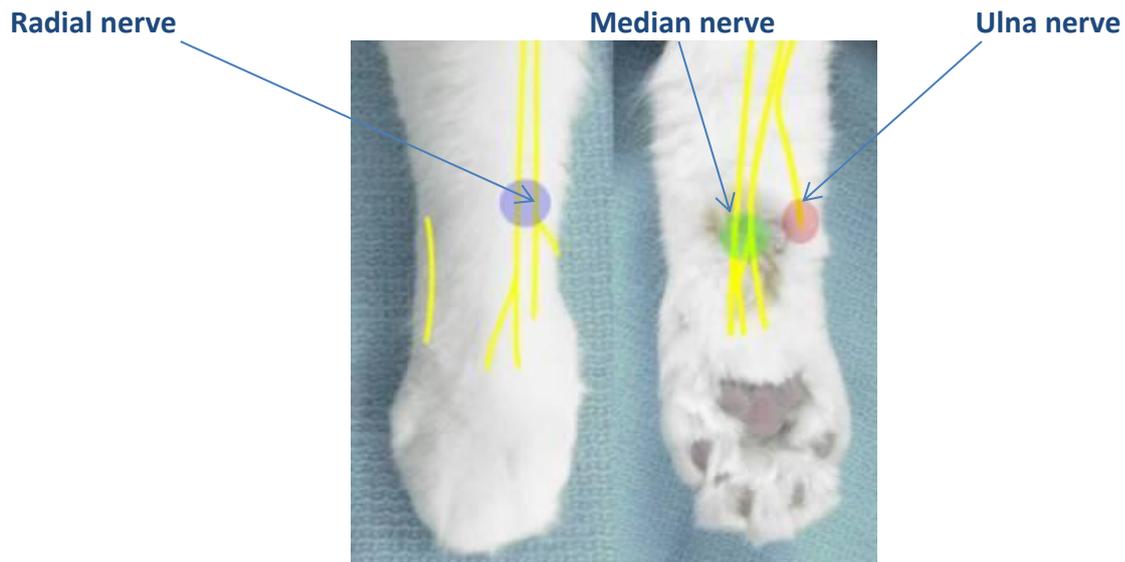
stimulator allows the anaesthetist to find the brachial plexus nerve branch accurately. The anaesthetist knows they are in the correct place as there is contraction of the biceps brachii and flexion of the elbow at a stimulation of 0.3mA. When the local anaesthetic is injected this response will fade and disappear.

The RUMM block blocks the radial, ulna, median and musculocutaneous nerves individually rather than collectively as occurs with the brachial plexus block. This technique should be done using neurostimulation.

The radial nerve, which can be seen in these pictures, lies lateral and distal to the humerus. Extension of the paw is required to perform a block on the radial nerve. The median, musculocutaneous and ulna nerves lie to the mid medial area of the humerus. Flexion of the paw is required to correctly achieve a block on the ulna and median nerves. Flexion of the elbow is needed in order to accomplish a block on the musculocutaneous nerves. The positioning of these nerve groups can be seen on this image.



The wrist block provides analgesia for the radial, median & ulna nerves, which is ideal for procedures affecting only the paw. The anaesthetist aims to inject perineurally which from a practical skill perspective is similar to subcutaneously, at 3 sites. Injecting at 3 sites enables the 3 different nerves to be blocked individually. These are shown on the image here. About 0.1mls/kg can be injected at this site but it depends upon the patient's size and condition.



The Beir's block provides intravenous regional anaesthesia. First an intravenous catheter must be placed as distally as possible. Then the foot should be bandaged distal to proximal, then tourniqueted. The tourniquet must be placed proximal to the surgical area and it must be tight enough to overcome arterial blood pressure. Then the local anaesthetic can be injected. Only lidocaine should be used as other local anaesthetics are cardiotoxic.

Leave tourniquet on for 20mins minimum as less than that will release the local anaesthetic too suddenly into the systemic circulation. When it is released it should be released slowly for the same reason. The tourniquet should not be left on for more than 90minutes otherwise necrosis will occur. This block provides analgesic affects for 15-30mins after the tourniquet has been removed.



Finally the digital block provides analgesia for the nerves in the phalanges. These nerve run medially and laterally to the bone. The anethetist should insert the needle dorsally into the digit and advance it to the medial side of the bone. Then half of the volume is injected and the needle can be withdrawn. The anaesthetist repeats the same procedure on the lateral side of the bone. This is suitable for procedures such as digit amputation,

abscesses and problems with the nail. This procedure has few potential complications and is very effective, not particularly difficult to carry out.

