LOCAL AND REGIONAL ANAESTHESIA

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In animals several minor and major surgical procedures can be performed under local and regional anaesthesia, depending on the species, breed, temperament of the animal, health status of the animal and magnitude of the procedures.

Local anaesthetics

Local anaesthetics are a group of chemically related compounds that reversibly bind sodium channels and block impulse conduction in nerve fibers. This interruption of conduction of pain stimulus or nociception uniquely and most effectively prevents or reduces pain or nociceptive input during and after surgery.

The use of a local anaesthetic is essential if surgery is to be performed in a conscious patient and the pain associated with trauma and inflammation is to be relieved. The use of a local anaesthetic technique before surgery may also benefit patients by avoiding general anesthesia or reducing the amount of required general anaesthetic s. Sustained analgesia into the recovery period is a great benefit to patients when a local anaesthetic with a longer anaesthetic effect is used. Knowledge of the clinical pharmacology of individual local anaesthetic s enables the achievement of effective and safe neural blockade.

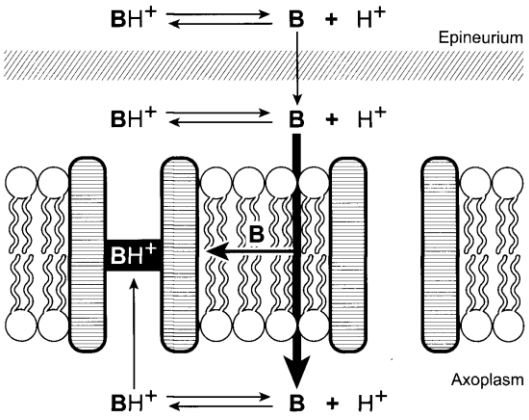
Mechanism of action

The precise mode of action of the local anaesthetic agents is not known. Several theories have been propounded namely,

(a) The Surface charge theory: the lipophilic ends of the benzene of the local anaesthetic agent binds with the hydrophilic ends of membrane to increase the transmembrane potential,

(b) The membrane expansion theory: the axonal membrane is expanded by benzocaine which compresses the ion channels,

(c) The specific receptor theory: biotoxins bind to receptors at the external surface at or near the sodium channels producing a conduction block, and



(d) Combination of (b) and (c) i.e., membrane expansion and specific receptor theory: the local anaesthetic agents (both types) first pass through the cell membrane as the uncharged base to reach an intra-cellular site where it gets protonated (conjugated with H^+). This cation binds to the receptor and *'plugs'* the channel.

Perhaps best accepted is the idea that local anaesthesia results when local anesthetics bind to sodium-selective ionic channels in nerves, inhibiting the sodium permeability that underlies action potential and depolarization of the cell membrane. Electrical transmission through a myelinated axon stops when enough concentration of the anaesthetic is applied to bathe at least three consecutive nodes of Ranvier.

Grouping of local anaesthetic agents:

Based on the chemical link between the aromatic ring and the hydrocarbon chain, the local anaesthetic agents may be grouped as amino-esters (ester linked local anaesthetics) and amino-amides (amide linked local anaesthetics).

(a) Ester-linked local anaesthetics-

- Most esters are readily hydrolysed by plasma cholinesterase
- Have short half-lives when stored in solution without preservatives. e.g., cocaine, benzocaine, procaine, chloroprocaine, and tetracaine.

(b) Amide-linked local anaesthetics-

- Very stable, cannot be hydrolysed by cholinesterase,
- Rely on enzymatic degradation in the liver. e.g., lidocaine, prilocaine, dibucaine, etidocaine, mepivacaine, bupivacaine, levobupivacaine, ropivacaine, and articaine.

Potency:

- Seems to be associated with the size of the molecule and its lipid solubility.
- The smaller the molecule and larger the lipophilic property, the more is the potency of the local anaesthetic.

1. Cocaine:
   - It is an extract from the leaves of *Erythroxylon coca.*
   - *Ester* linked local anaesthetic.
   - It is an irritant and toxic in small doses (toxic manifestations include clonic convulsions, loss of consciousness and paralysis of medullary centres.
   - The maximum dose is 780 mg in horses, 120mg in large dogs, 45 mg in small dogs and 15 mg in cats.
   - Cocaine was used as a doping agent in horses.
   - The lethal dose is 15 mg/kg.
   - Cocaine is withdrawn from the injectable forms due to its toxicity.
   - Only topical preparations are available for eye (4% solution) and nasal and laryngeal areas (10 to 20% solutions).
2. Procaine hydrochloride:
   - It is a short acting *ester* linked local anaesthetic.
   - It is detoxified in the blood and liver rapidly.
   - The margin of safety is high in terms of convulsive dose (35 mg/kg in cats).
   - In clinical practice it is administered intravenously to relieve pain in fire injured patients.

- It is also used as adjunct to thiopentone sodium to maintain anaesthesia.
- Procaine is combined with adrenaline 1 in 100000 to potentiate its anaesthetic action.

3. Lidocaine hydrochloride (Lignocaine, Xylocaine):
   - It is a fast-acting *amide* linked local anaesthetic, detoxified in the liver.
   - The convulsive dose is 15 mg/kg in cats.
   - Goats are extremely sensitive to lignocaine. The total dose should never be exceeded 10 mg/kg in any route. The toxic manifestations in goats are excitation, tonic clonic convulsions, opisthotonus, respiratory depression, cardiac arrest and death.
   - Lignocaine is combined with general anaesthetics, which do not possess convulsive properties as an adjunct (See injectable anaesthetics).
   - It is often combined with thiopentone due to its dysrhythmic property and protective action on myocardium.
   - In clinical practice adrenaline free lignocaine is administered intravenously at the rate of 0.25 mg/kg in cats and 2 mg/kg in dogs to control cardiac arrhythmia due to myocardial ischemia.
   - The local anaesthetic preparations marketed in combination with adrenaline 1 in 200000. It is also available as 2% jelly and 2.5% and 5% viscous ointments. The duration of action is two hours.
4. Bupivacaine hydrochloride
   - Bupivacaine is a fast and long-acting *amide* derivative.
   - Its margin of safety is less.
   - The convulsive dose in cats is 3.4 to 5 mg/kg.
   - Intravenous administration induces myocardial depression.
   - Bupivacaine associated ventricular dysrhythmia are due to prolonged inhibition of sedum conductance in the cardiac muscles.
   - It is not combined with general anaesthetics.
   - High molecular weight substance like dextran is added to prolong the duration of action in obstetrical anaesthesia.

Potentiation of local anaesthetics

- *Epinephrine/Adrenaline* - 1 in 1000000 or 1 in 200000 is added to increase the intensity and duration of action.
- *Hyaluronidase* - It increases the diffusion of local anaesthetics and favours quick onset of action. It is added at the rate of 150 TRU (Turbidity reducing unit) Addition of hyaluronidase will reduce the duration of action.
- *Dextran* - High molecular weight substance is added to reduce the rate of absorption and increase the duration of action.

*Surface analgesia***:** Surface anaesthesia includes topical analgesia of skin, eye and mucous membrane of nose, mouth, penis, vulva, urethra and rectum and intra – synovial analgesia.

*Topical analgesia***:**

- Ice, ethyl chloride spray, ether spray and carbonic acid snow are used to achieve superficial analgesia of the skin.

- Absorbent cotton or gauze soaked in 4% procaine or 2% lignocaine is often used on superficial aberrations of the skin and eczematous lesions to alleviate pain.
- Lignocaine 4% and proxymetacaine 5% (Ophthaine) are used as topical anaesthetics for eye.
- Analgesia of mucous membrane is induced for examination, catheterization or intubation.
- The commercial preparation containing lignocaine with carboxymethyl cellulose is applied on mucous membrane.
- This preparation is also used to lubricate catheters and endotracheal tubes. Lignocaine 4% is sprayed on nasal or oral mucous membrane to achieve analgesia.
- In horses 60 ml of lignocaine 1% can be administered intra rectally to reduce the discomfort during examination.

Intra-synovial analgesia:

- Intra-synovial analgesia is induced to relieve pain arising from the joint and tendon sheath.
- Often it is used in the diagnosis of lameness in horses.
- Strict aseptic precautions muse be adopted prior to injection.
- Inadvertent introduction of infection will be disastrous.
- If the needle is placed into the synovial cavity one can notice synovial fluid at the hub of the needle.
- Some quantity of synovial fluid is aspirated before injection into a distended synovial cavity.
- The intra-synovial injection techniques in horses are

Distal interphalangeal (coffin) joint

- Site - in the midline approximately one centimeter proximal to the coronary band with the needle angled slightly steeply than at right angles to the skin.
- Needle and volume 19 G x1", 5 - 8 ml.

Proximal interphalangeal (pastern) joint

- Site - Pastern joint is situated approximately 1 cm below an imaginary line through the attachment of the collateral ligaments to the first phalanx.
- The joint is entered near the midpoint on the dorsal midline approximately 3 cm proximal to the coronary band with the needle pointing obliquely downwards and inwards.
- Needle and volume 20 Gx 1", 5 - 8 ml

Metacarpophalangeal (fetlock) joint

- Site - The fetlock joint is entered in the triangular space formed by the third metacarpal bone, the proximal sesamoid bone and the suspensory ligament. Can be performed with the limb weight bearing.
- Needle and volume 20 G x 1", 10 ml

Digital flexor tendon sheath

- Site - Usually performed only in the presence of synovial distension. The site of injection is the most prominent distended part of the sheath on the lateral aspect of the digital flex or tendons just proximal to the fetlock.
- Needle and volume 20G x 1", 10ml

Carpal joints

- Site - The two carpal joints into which inje3ction can be performed. (mid carpal joint and antebranchio-carpal joint). The mid carpal joint opens with the proximal (antebrachio-carpal joint) between the third and and fourth carpal bones hence does not require separate injection. The joints can be entered on the dorsal aspect of the flexed limb just lateral to the extensor carpi radialis tendon.
- Needle and volume 20G x 1", 10 ml.

Elbow joint

- Site - The elbow joint can be entered either in front or behind its lateral ligament. To enter in front of the ligament the needle is inserted just under the margin of the lateral condyle of the humerus.
- Needle and volume 19G x 2", 15 ml.

Shoulder joint

- Site - The shoulder joint is entered horizontally between the anterior and posterior part of lateral tuberosity of the humerus.
- Needle and volume 19G x 3.5", 20 ml

Tarsometatarsal joint

- Site - Over the head of the fourth metatarsal bone and fourth tarsal bone
- Needle and volume 20G x 1", 5 ml

Stifle joint

- Site -This joint has three synovial sacs, one in the femoro-patellar articulation and two, one medial and one lateral in the femoro-tibial artibulation.
- Femoro-patellar sac can be entered on either side of the middle patellar ligament.
- Medial sac of the femoro-tibial articulation can be entered between the patellar ligament and the medial femoro-tibial ligament.
- Lateral sac of the femoro-tibial articulation can be entered behind the lateral patellar ligament. Another route is between the lateral femoro-tibial ligament and the common tendon of the long digital extensor and the peroneus tertius.
- 18G x 2" needle, 20 ml in each sac.