Powerful Techniques Using Local and Regional Anesthetics

Dr. Ralph C. Harvey
University of Tennessee
College of Veterinary Medicine

AAHA American Animal Hospital Association

AAHA! Denver 2007

Pfizer

Center for the Management of Animal Pain

The University of Tennessee
College of Veterinary Medicine

Powerful Techniques Using Local and Regional Anesthetics

Dr. Ralph C. Harvey
University of Tennessee
College of Veterinary Medicine

AAHA American Animal Hospital Association

AAHA! Denver 2007

Pfizer

Center for the Management of Animal Pain

The University of Tennessee
College of Veterinary Medicine

Historical Perspective

- Cocaine, 1884

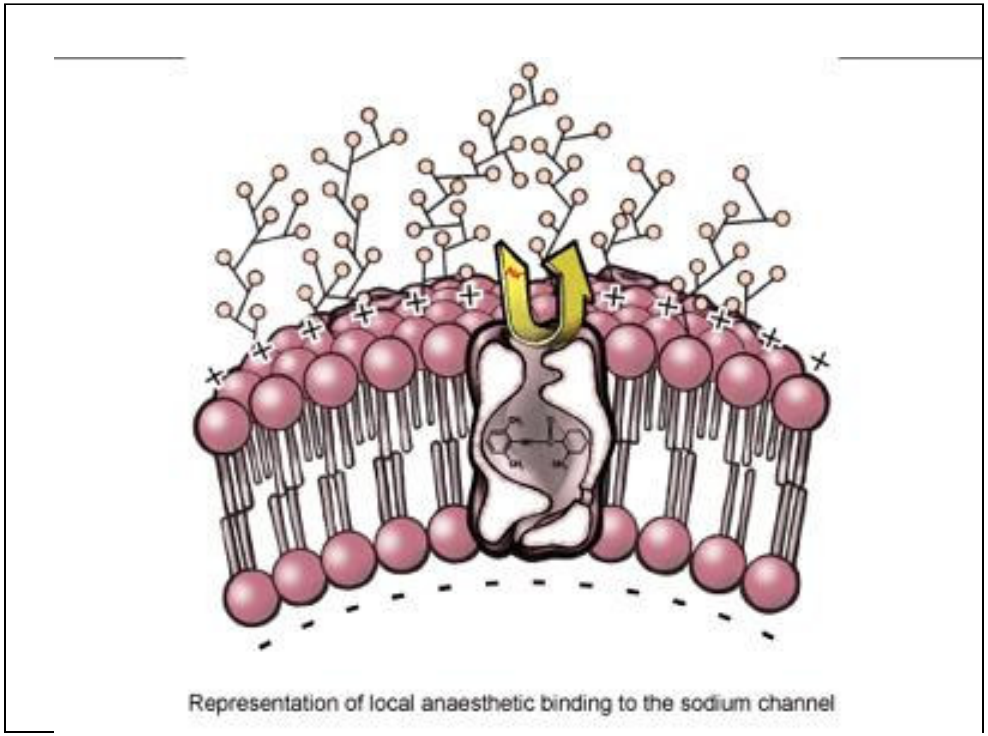
  topical anesthetic-abuse potential
- Peripheral nerve block - Halsted
- Spinal anesthesia - Halsted
- Procaine,1905
- Lidocaine,1943

  standard of comparison

Mechanism of Action

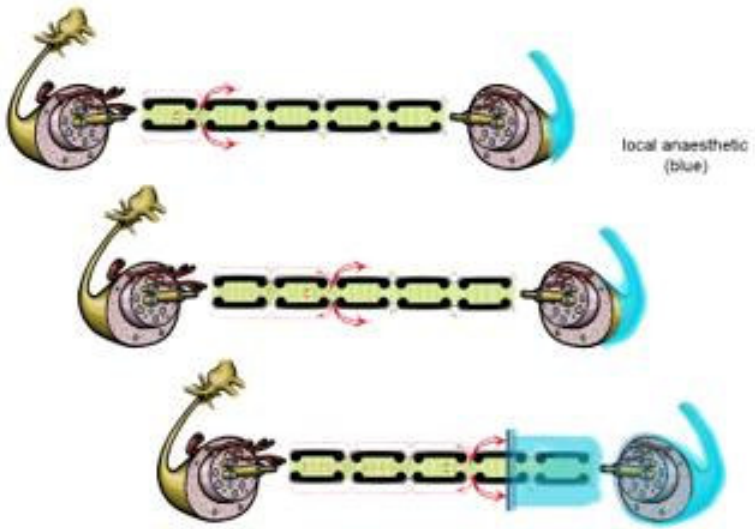
- Conduction blockade - prevents increases in permeability of nerve membranes to sodium ions
- Slows rate of depolarization - threshold potential is not reached, action potential is not propagated.
- No alteration of resting membrane potential or threshold potential

Conduction blockade - prevents increases in permeability of nerve membranes to sodium ions…

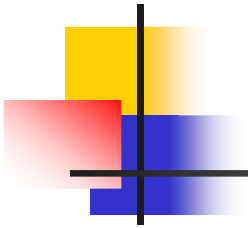


Representation of local anaesthetic binding to the sodium channel

Slows rate of depolarization - threshold potential is not reached, action potential is not propagated.



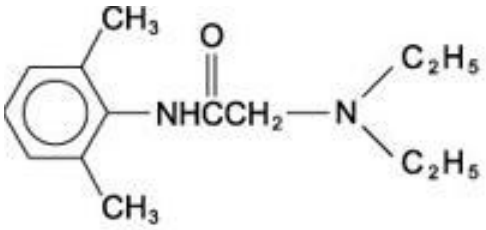
Representation of local anaesthetic blocking the propagation of the action potential



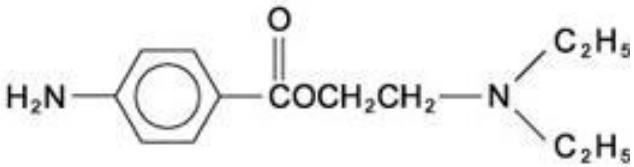
Locally active reversible blockade of conduction of nerve impulses

- Autonomic - autonomic NS blockade
- Somatic sensory - anesthesia
- Somatic motor - paralysis

Structure-Activity Relationships



Example of an amide: Lidocaine HCl



Example of an ester: Procaine HCl

Lipophilic Portion (unsaturated aromatic ring)

Hydrocarbon connecting chain (ester-CO or amide-NHC)

Hydrophilic portion (tertiary amine)

Order of sensory function block

- 1. pain
- 2. cold
- 3. warmth
- 4. touch
- 5. deep pressure
- 6. motor

Recovery in reverse order

Toxicity associated with local anesthetics

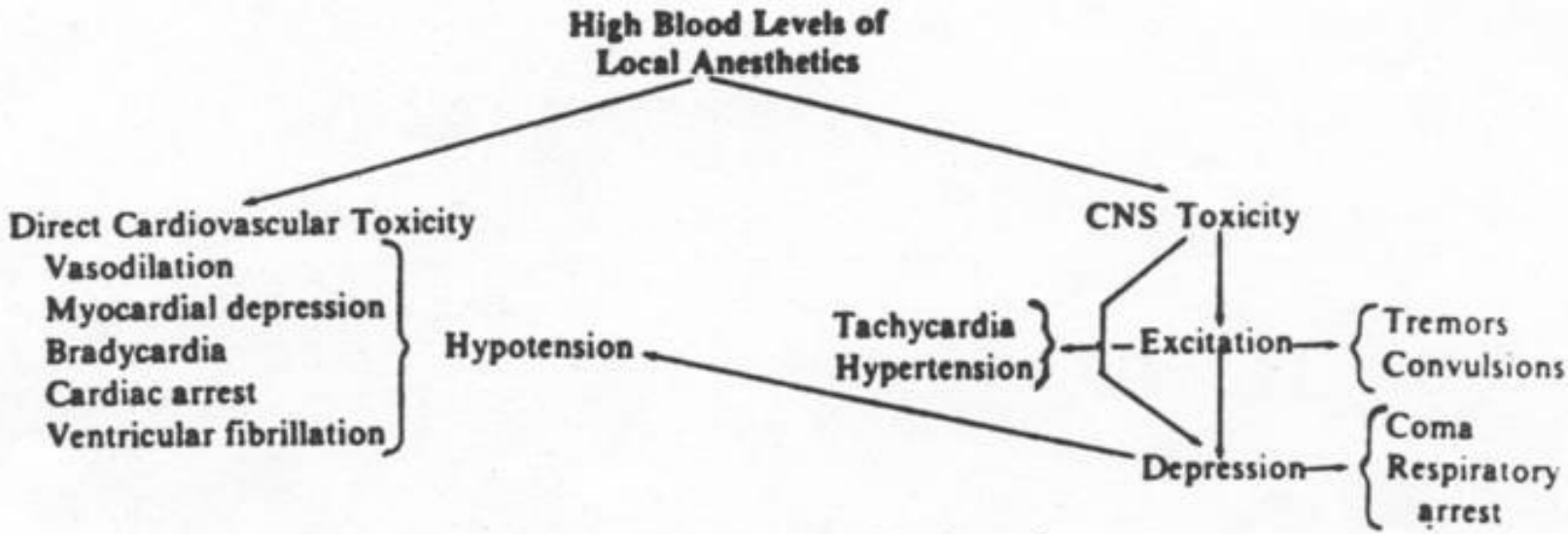


Fig. 10.4-2 *Systemic toxicity of local anesthetics.*

from:
Pharmacology in Medicine: Principles and Practice, Eds. S.N. Pradhan, R.P. Maickel, and S.N. Dutta, 1986

Adverse effects of overdosing local anesthetics:

- Nausea, CNS stimulation, Cardiac depression
- Maximum dose guideline:
  - Total volume 0.2 ml / kg
    - Lidocaine 2%
    - Bupivacaine 0.5%

Toxicity

Table 10.4-5
Adverse Reactions Encountered with the Use of Local Anesthetics

Adverse Effects	Mechanism	Significance (Management)
Tissue sloughing at site of injection	Due to extravasation of concentrated vasoconstrictor	(α-Adrenergic blocker)
Gangrene of digits	Vasospasm of terminal vessels	(α-Adrenergic blocker)
Anxiety, excitation	Dopaminergic stimulation?	Sign of possible systemic toxicity
Tremors, convulsions	Removal of tonic inhibition	Usually not life-threatening (diazepam)
Coma, respiratory depression	Depression of respiratory center	(Artificial respiration; O_2)
Hypertension	Central sympathetic stimulation	(Diazepam, α-Adrenergic blocker)
Hypotension	Sympathetic inhibition; myocardial depression	Systemic absorption
	Direct vasodilator action	(Dopamine)
AV block, cardiac arrest		(Cardiac massage, electrical pacing)
Ventricular fibrillation		(Cardiac massage, electrical defibrillation; do not use antiarrhythmic agents)

Principles of Pain Management

1. Preemptive analgesia
2. Balanced analgesia
3. Dose to effect

1. Preemptive Analgesia

- Dose early
- Dose before "the knife hits the flesh"
- Dose before the patient hurts.
- Dose before the last dose wears off.

2. Balanced Analgesia

- Similar to "balanced anesthesia“
- Combination of complimentary methods or drug classes
- Maximize effectiveness and minimize side effects
- Local anesthetics are the key

3. Dose to Effect

- "Give until it helps!“
- Medicate smartly. Make the most of your analgesic strategy.
- Inadequate analgesia is wasteful and counter productive.

Specific Local Anesthetics

Lidocaine – reference, and most widely used local anesthetic

Procaine - Novocaine

Mepivacaine - Carbocaine

Bupivacaine – delayed onset, long duration

Benzocaine – caution! methemoglobin

Proparacaine – ophthalmic topical

Articaine – Septocaine – dental, etc.

Adding Bicarbonate to Lidocaine

Discomfort during injection is associated with pH, needle size & rate of administration

Neutralizing the pH of the local anesthetic solution somewhat reduces discomfort during injection

Bicarbonate (1 mEq/L) can be added to 2% lidocaine in 1:10 or 2:10 dilution w/o precipitation

But not with bupivacaine…

The addition of bicarb in this proportion to 0.5% bupivacaine yields an impressive white precipitate

Application

Local Injection (Infiltration)

"Splash Block"

Topical (e.g. Laryngeal, Ophthalmic, Intranasal)

Spinal/Epidural Anesthesia/Analgesia

Regional blockade or specific nerve blocks

IVRA – IntraVenousRegionalAnesthesia, "BIER Block"

Antiarrhythmic c.r.i.

Analgesic/Anesthetic adjunct c.r.i.

Local Anesthetics:

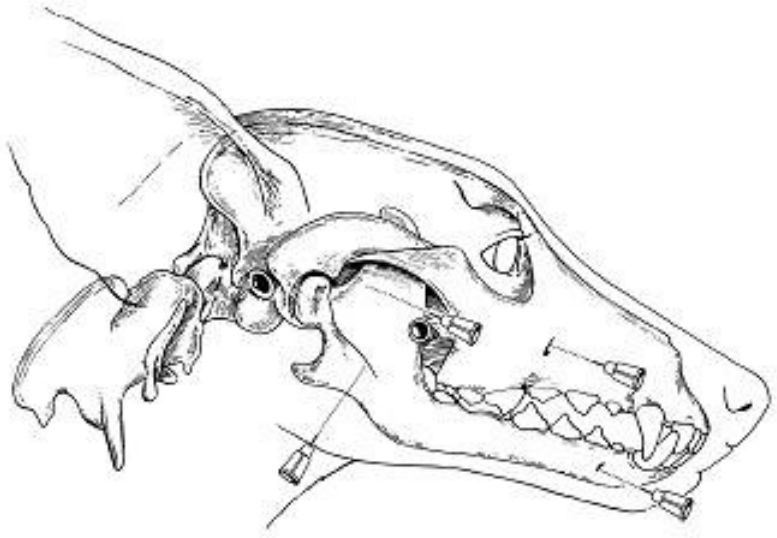
Many excellent uses of bupivacaine:

- Regional
- Specific Nerve Blocks
  (e.g. maxillary n.)
- Infiltration

Maxillary Nerve Block:

- Maxilla, upper teeth, lip, nose
- Insert needle toward the pterygopalatine fossa from ventral margin of zygomatic arch, 0.5 cm lateral to lateral canthus of the eye

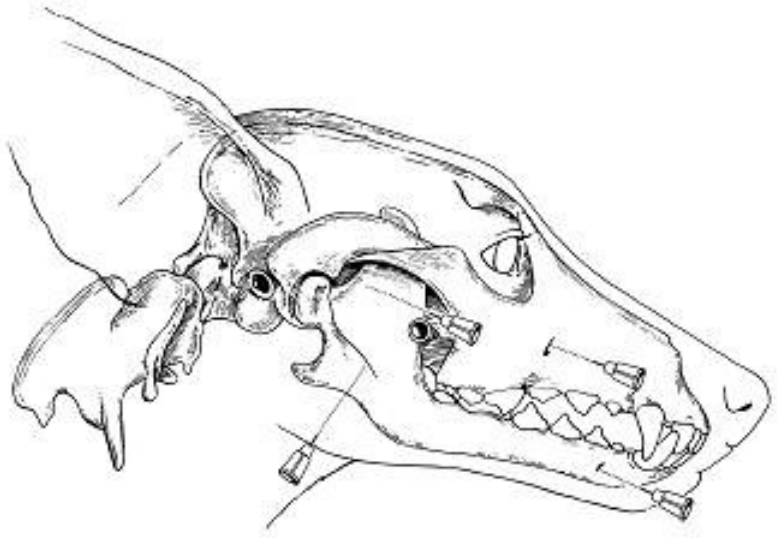
  Aspirate, deposit drug at surface of bone
- Dose: 0.1-1.0 ml bupivacaine or Septocaine (preferred)



Maxillary Nerve Block:

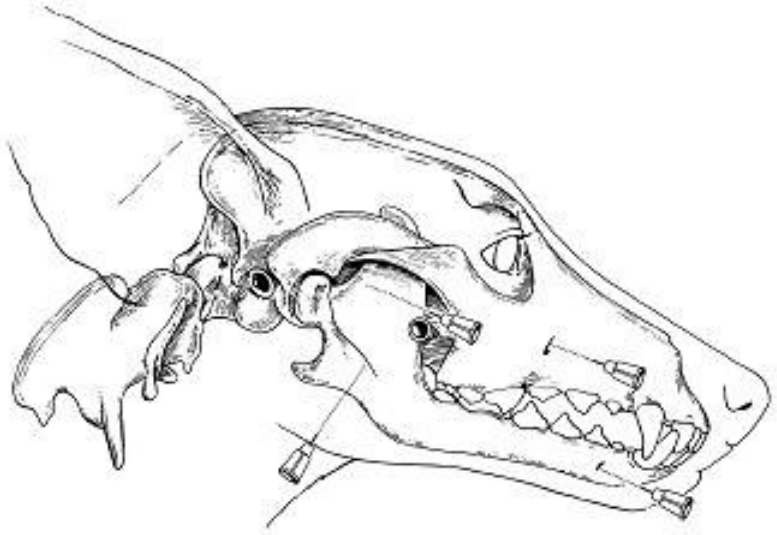
Alternative techniques

- Maxilla, upper teeth, lip, nose
- Insert needle into infra-orbital foramen
- Apply digital pressure over foramen
- Aspirate, deposit drug into foramen with digital pressure
- Drug courses through foramen to bifurcation
- Dose: 0.1-1.0 ml bupivacaine or Septocaine (preferred)

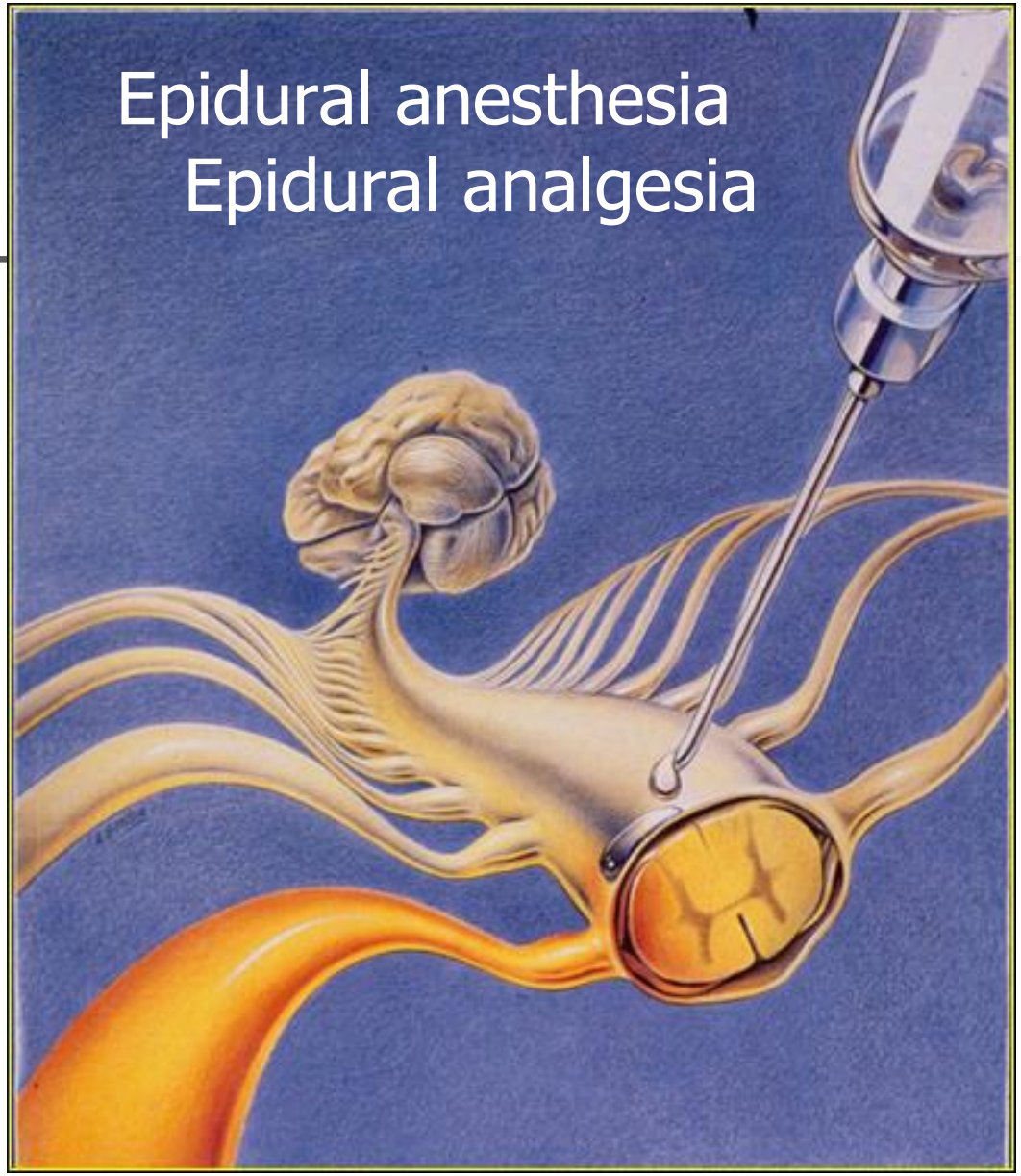


Mandibular Nerve Block:

- (Inferior Alveolar Branch of Mandibular Nerve)
- Mandible, lower teeth, lip
  +/- lingual branch (?)
- Insert needle at lower angle of jaw, rostral to angular process,
  advance dorsally to mid-portion on medial aspect
- Dose: 0.1-1.0 ml bupivacaine or Septocaine (preferred)



Epidural anesthesia
Epidural analgesia



Neuroaxial Analgesia:

- 12-24 hours of substantial analgesia
- Decreased

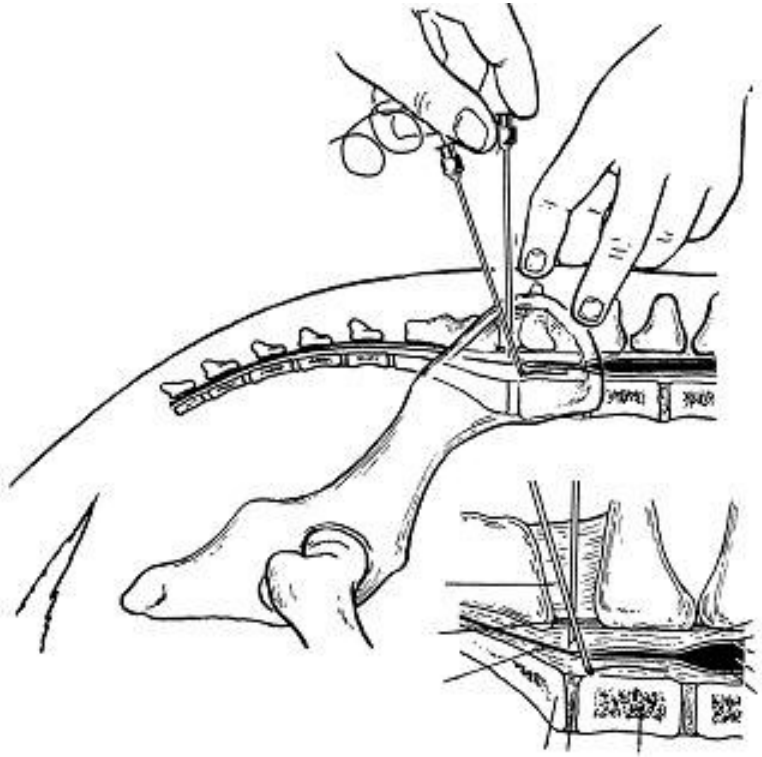
  "Stress response"
- Epidural Morphine

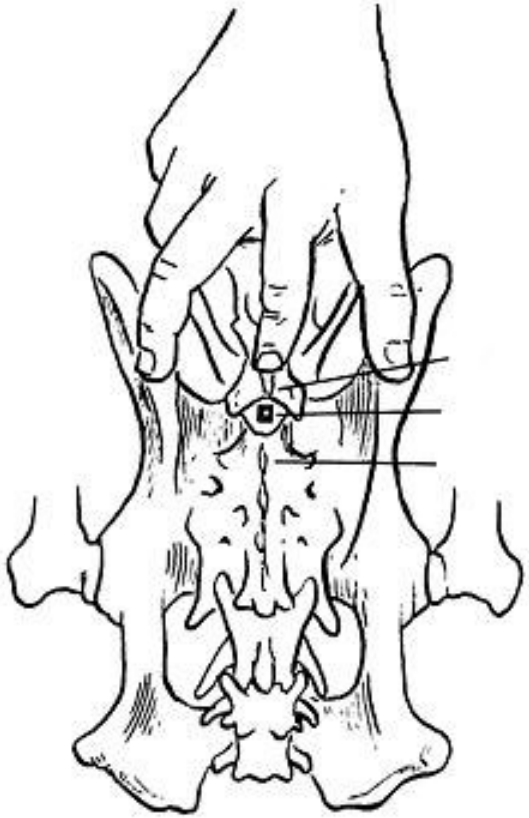
  Duramorph (preservative free)

  (or Morphine USP)
- Bupivacaine or Lidocaine

  (give extra IV fluids to compensate for decreased vascular tone)

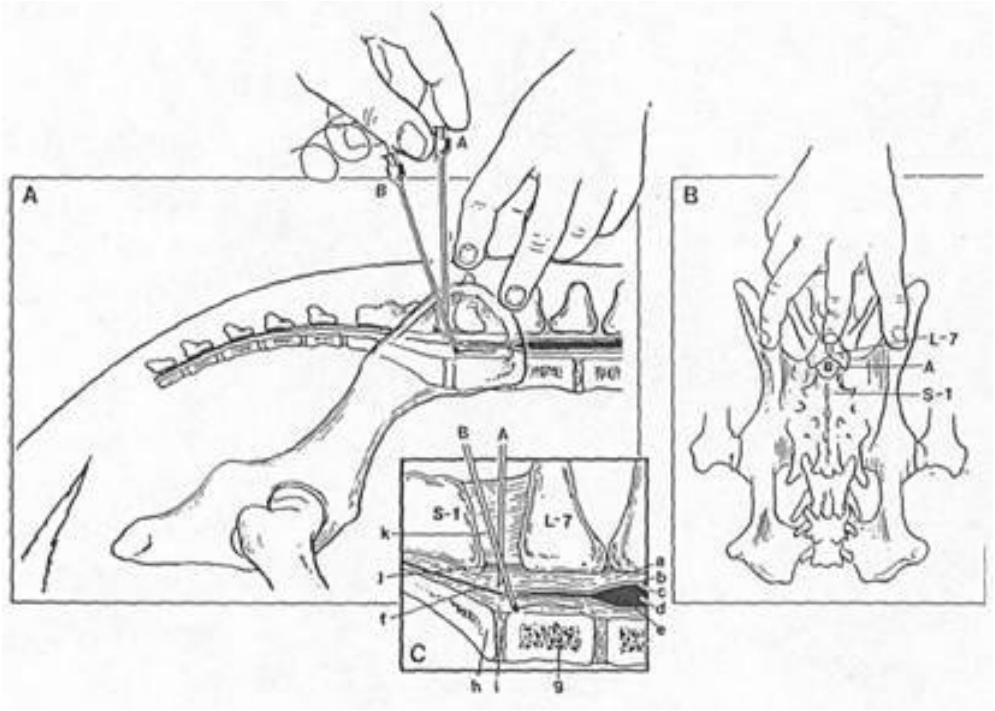
Landmarks: Iliac crests, dorsal midline, and dorsal lumbar vertebral spinous processes





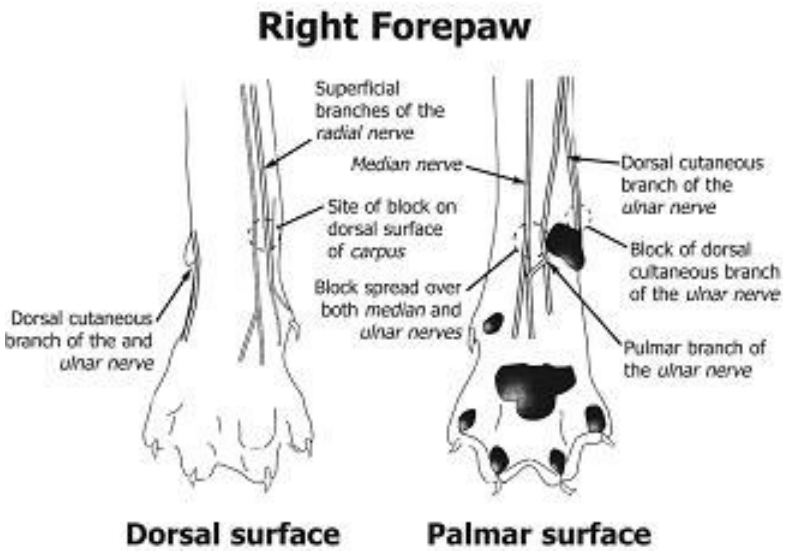
Epidural analgesia / anesthesia

- Powerful and sustained analgesia
- Effective throughout the body
- Technically easy
- Cost effective
- Numerous benefits

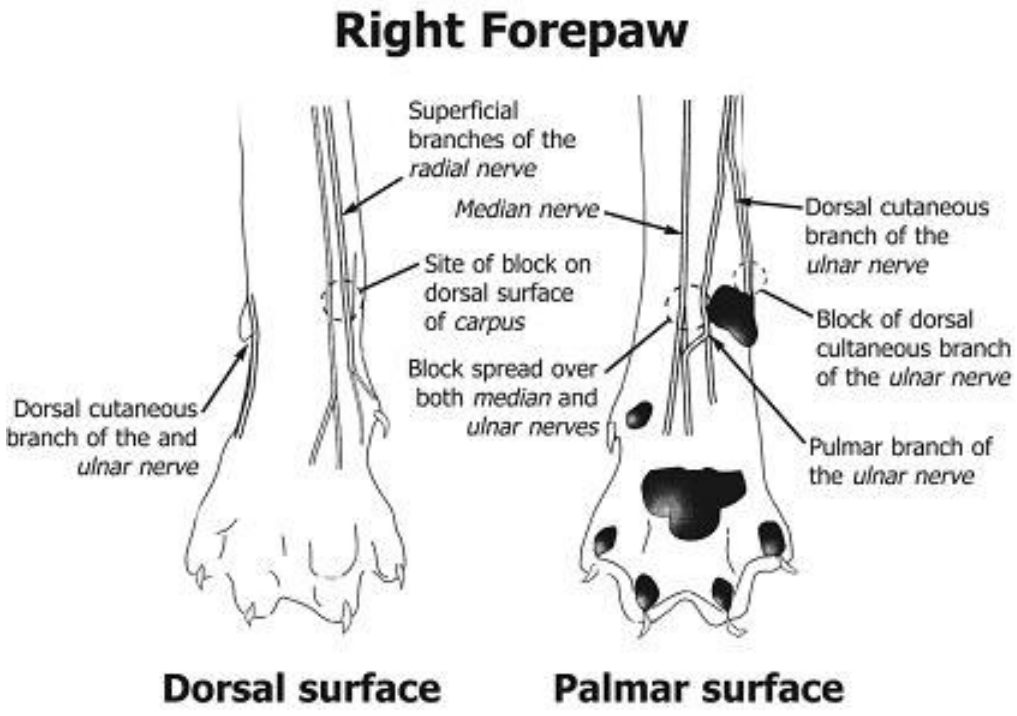


Distal Limb Blocks (declaw analgesia)

- Superficial Radial Nerve
  dorsomedial carpus
- Ulnar N. (branches)
  lateral carpus
- Median N. Ulnar N. (branch)
  palmar carpus adjacent to the accessory carpal pad



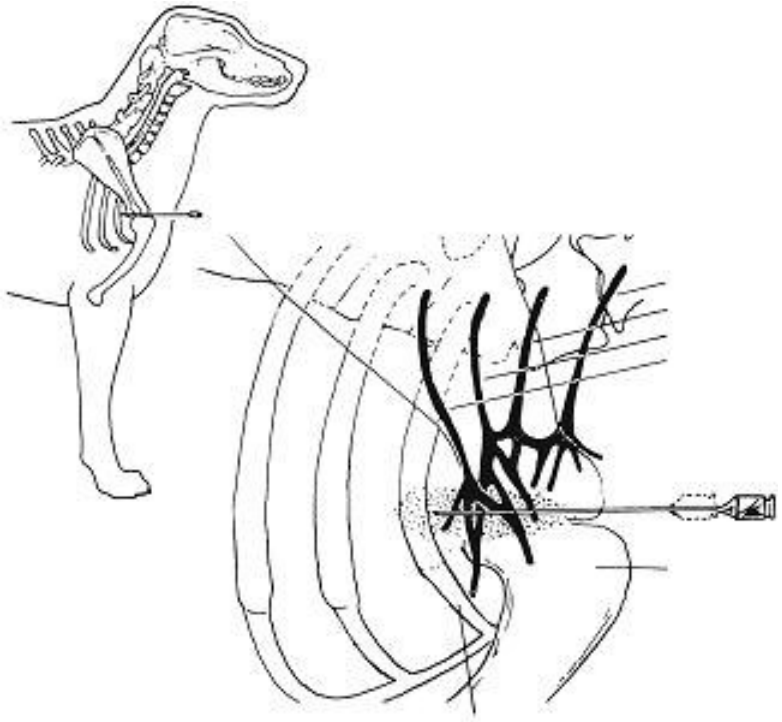
0.1-0.3 ml Bupivacaine (0.5%) at each site



Brachial Plexus Nerve Block:

- Keys to success: distribute drug, aspirate to avoid IV injection and toxicity, minimize volume at each injection site to avoid nerve damage
- 0.2 ml/kg max. dose

  0.5% Bupivacaine

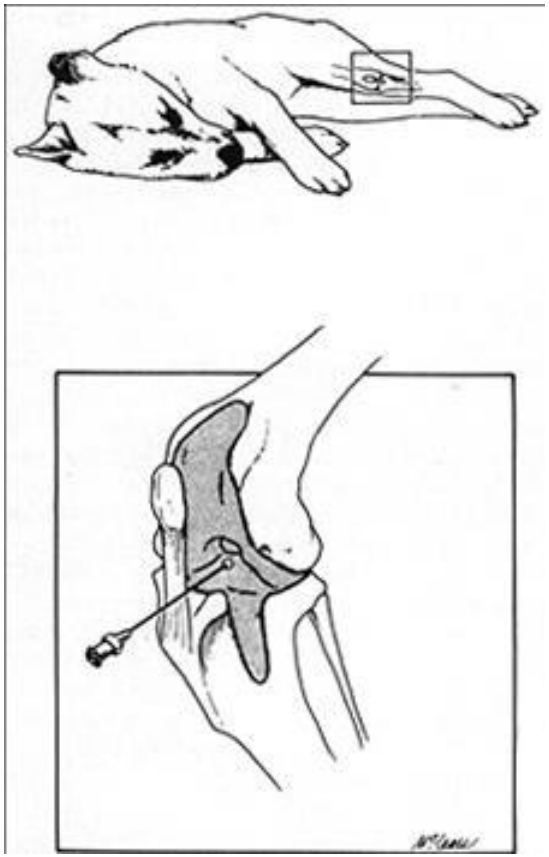


Intra-Articular Stifle Block:

- Distention of the joint with long-lasting local anesthetic
- Bupivacaine 0.5%

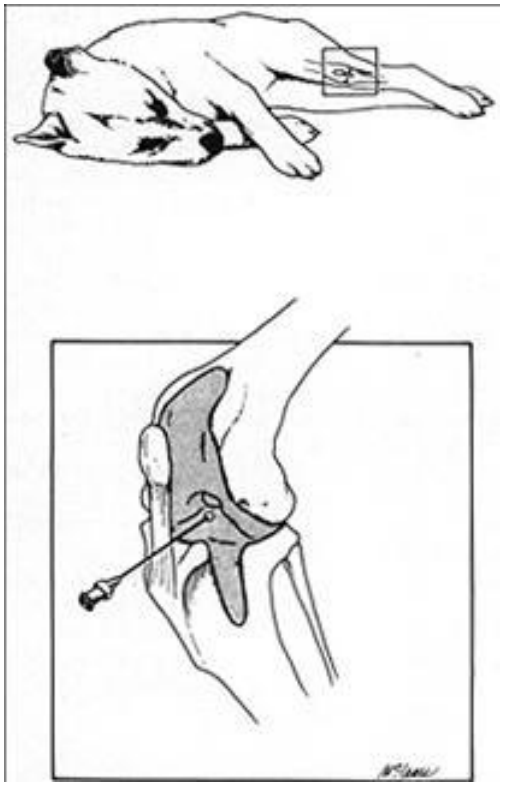
  3-6+ hours duration

  dose 0.2 ml/kg (0.1 ml/lb)
- Injection pre-op and post-op for best effect



Intra-Articular Stifle Block:

- 1" 22g needle
- flex the stifle and apply digital pressure to the medial side of the straight patellar ligament
- Insert the needle on opposite side of straight patellar ligament midway between the patella and the tibial tuberosity, direct it obliquely and distally toward the intercondylar space



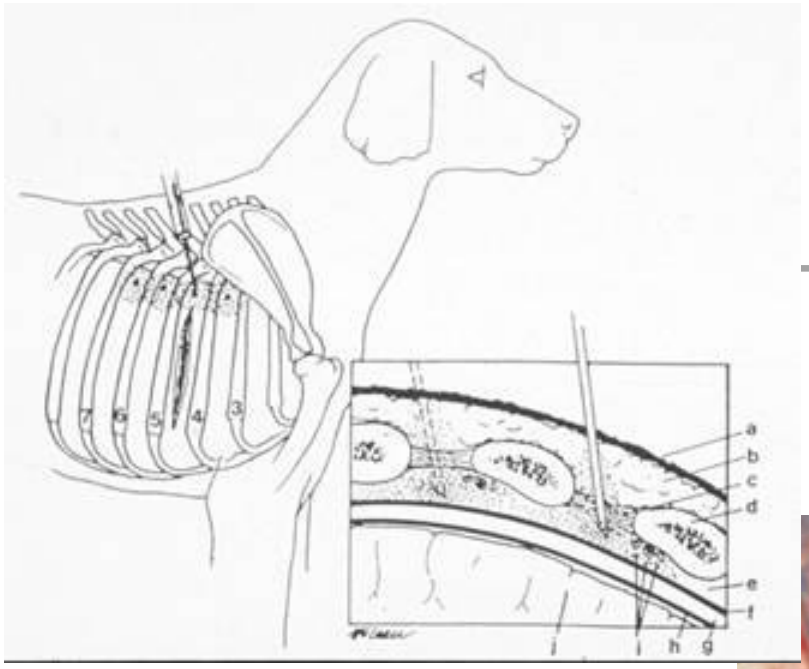
Intra-Articular Stifle Block:

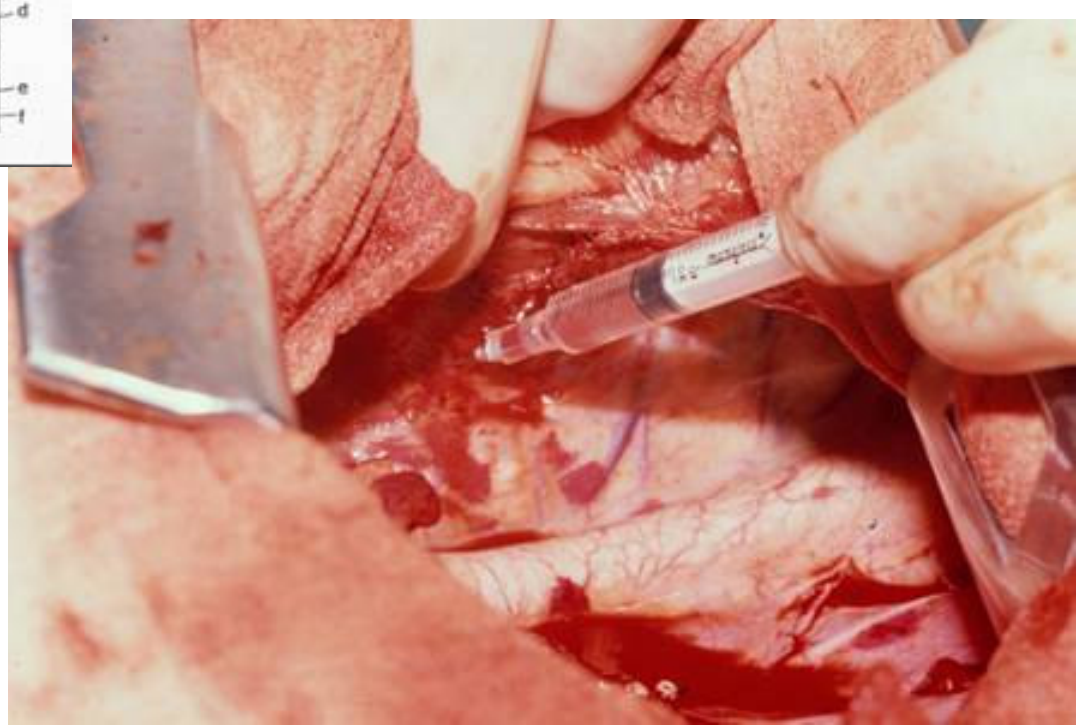
- Pre-op & Post-op
- Bupivacaine 0.5%
  0.2 ml/kg
- Bupivacaine + Morphine

Operative Injection of Nerve Sheaths

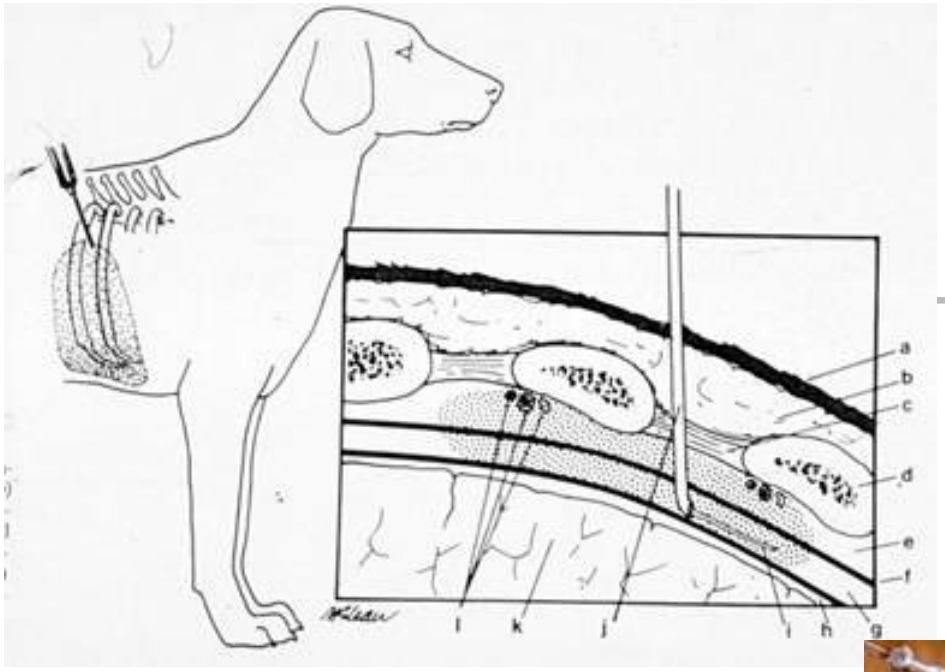
- Great value of local anesthetics in surgical oncology
- Injection of nerve sheath prior to transection
- lidocaine + bupivacaine
  Rapid onset + long duration

Intercostal Nerve Blocks





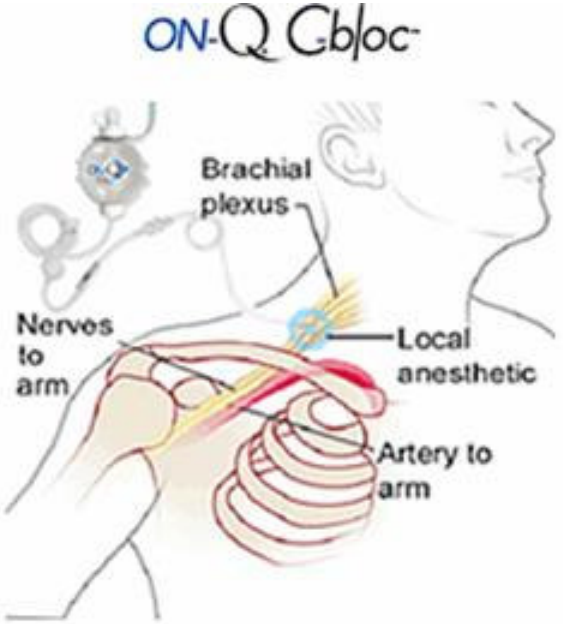
Intrapleural Blocks



Continuous ambulatory infusion of local anesthetics

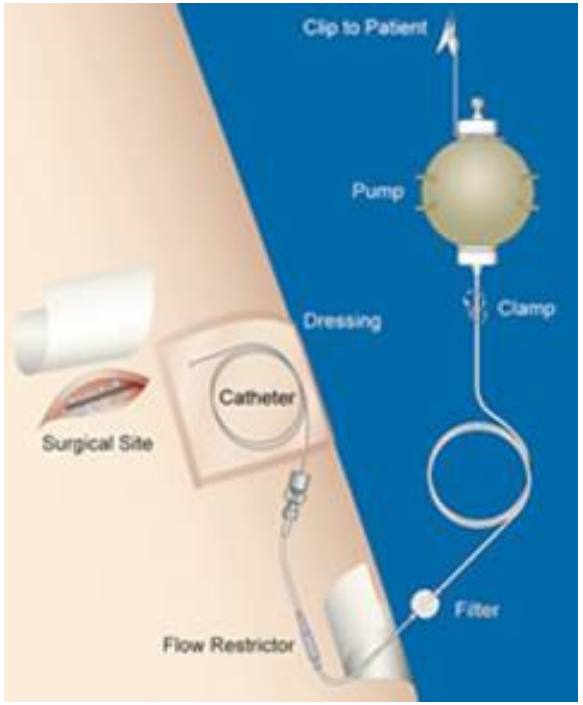
"Pain Buster"

pumpwww.iflo.com



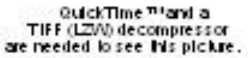
"Pain Buster"
pumpwww.iflo.com

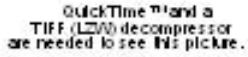
Provides continuous infusion of a local anesthetic directly into the surgical site. Effective, non-narcotic post-operative pain relief for up to five days.



Available in 2.5 inch and 5 inch (6.5 cm and 12.5 cm) infusion lengths, the Soaker Catheter is ideal for post-operative pain relief in large incisions

EMLA Cream


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

IV Lidocaine CRI (constant rate infusion)

- Prokinetic action
- Analgesic contribution and reduction in anesthetic requirements
- Reduced inhalant anesthetic requirement improves blood pressures
- Possible anti-inflammatory contribution
- Very cost-effective analgesic contribution to opioid analgesics

IV Lidocaine CRI (constant rate infusion)

- Loading dose 1-2 mg/kg by slow IV injection over three minutes.
- Constant Rate Infusion at 50-100 micrograms/kg/minute (0.05-0.1 mg/kg/min) syringe pump or controlled drip
- Easy set-up method: 68 cc of 2% lidocaine added to liter bag of IV fluid, administered at 1cc/pound/hour will provide 50 micrograms/kg/min.
- Reduce or discontinue if clinical signs of intolerance or overdose occur: nausea, CNS stimulation (twitching or seizures)

Analgesic CRI (constant rate infusion)

Other CRI options for analgesia:

- Low-dose ketamine
- Fentanyl
- Morphine
- Combinations of analgesics


PAIN

Case Studies

- Fan-belt Trauma

Case Studies

- Total Ear Canal Ablation

Case Studies

- Thoracotomy

Clinical Use of Local and Regional Anesthetics