Preventive Analgesia for the High Volume Spay Neuter Environment

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A few definitions

• **Pain**
  - An unpleasant sensory and emotional response to actual or potential tissue damage
  - Subjective experience

• **Nociception**
  - Neural encoding of actual or potential tissue damage
  - Does not imply conscious awareness

• **Central sensitization**
  - Amplification of the excitability and efficiency of central nociceptive neural pathways
  - CNS activity-dependent plasticity
A few definitions

- **Multimodal analgesia**
  - The use of different classes of analgesics that interrupt the pain pathway at various locations
  - Allows for lower doses of any one drug

- **Pre-emptive analgesia**
  - Limited to administration of analgesic prior to nociceptive input
Preventive Analgesia

- A comprehensive analgesic strategy designed to minimize the deleterious immediate and long-term effects of nociceptive perioperative input

- Pre-emptive
- Multimodal
- Efficacious
- Of adequate duration
Preventive Analgesia

- Recognizes that afferent nociceptive barrage at time of incision is not the only factor
- Aims to cover pre-, intra-, and post-operative noxious events
- Reducing immediate analgesic needs
- Reducing central sensitization & chronic pain
Pre-emptive Analgesia

Preoperative
- Pre-existing pain
- Stress response
- Noxious preoperative interventions

Intraoperative
- Noxious afferent barrage
- Wind up and central sensitization
- Inflammatory pain

Postoperative
- Inflammatory Pain
- Central Sensitization
- Neuropathic pain

Incision
Pre-emptive Analgesia

Preoperative

Intraoperative

Postoperative

Incision

Opioid
Preventive Analgesia

Preoperative

Intraoperative

Postoperative

Duration of analgesic action covers entire perioperative time period

Incision

Multimodal

Opioids                      NMDA antagonists                   Local anesthetics
Alpha-2 agonists             NSAIDs                           Noradrenergic agents
Preventative Analgesia

- Drug options
  - Opioids
  - Alpha-2 agonists
  - NMDA antagonists
  - Local Anesthetics
  - NSAIDs
  - Oral adjuncts
Pain Pathway

Perception
Pain is recognized by the brain.

Modulation
The impulses are either inhibited or amplified within the dorsal horn of the spinal cord.

Transduction
Noxious pain stimulus (as from a surgical procedure) is converted into nerve impulses.

Transmission
These impulses are transmitted from where the pain originated to the spinal cord.

Local anesthetics
NSAIDs
Opioids
Alpha₂ agonists
NMDA antagonists

www.zoetis.com
Opioids

- Foundational analgesics

- Opioid receptors highly conserved across species
  - Important for maintenance of homeostasis
  - Pharmacogenetic differences exist

- Mu, kappa, delta, ORL-1 receptors
- Endorphins, enkephalins, dynorphin, nociceptin
Opioid Receptors

- Widespread in CNS and periphery
- Hyperpolarize neurons
- Decrease afferent traffic
- Decreasing central transmission
- Increase descending inhibition
- Dampen perception
<table>
<thead>
<tr>
<th>Opioids</th>
<th>Full mu agonists</th>
<th>Mixed agonist-antagonists</th>
<th>Antagonists</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Morphine</td>
<td>Buprenorphine</td>
<td>Naloxone</td>
</tr>
<tr>
<td></td>
<td>Hydromorphone</td>
<td>Butorphanol</td>
<td>Naltrexone</td>
</tr>
<tr>
<td></td>
<td>Oxymorphone</td>
<td>Nalbuphine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meperidine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Methadone</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fentanyl</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remifentanil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Adverse Effects of Opioids

- Cardiovascular
- Respiratory
- Thermoregulation
- Gastrointestinal
- Urinary tract
- Immune system

www.anesthesia-resident.blogspot.com
Hydromorphone
Morphine
Butorphanol
Full mu agonists

- Morphine
  - Inexpensive, can release histamine
  - Likely to cause vomiting

- Hydromorphone
  - Still rather inexpensive
  - A little less vomiting, minimal histamine release

- Methadone
  - Expensive
  - Still less vomiting, SNRI & NMDA antagonist
Full mu agonists

- Fentanyl and its congeners
  - Short-acting
  - IM administration lasts ~ 30 min
  - Infusion must be set up for ongoing analgesia
  - Relatively expensive
  - Good choice for hemodynamically unstable patients
  - Not likely to be used in HVSN clinics
Mixed agonist/antagonists

- Buprenorphine
  - Partial mu agonist, kappa antagonist
  - Good analgesic for moderate pain
  - Higher doses last longer
  - Not absorbed well SQ in cats
  - Can be given OTM
  - Relatively expensive
    - Could consider Simbadol as cheaper on a per mg basis
Mixed agonist/antagonists

- Butorphanol & Nalbuphine
  - Good sedative
  - Mild analgesic activity
  - Ineffective analgesic for abdominal procedures

- Combine with local anesthetics and NSAIDs for minor procedures
Opioid Antagonists

- Naloxone
  - Antagonistic at all opioid receptors
  - Should have available for anesthesia-related CPR
  - Also, can titrate to reverse unwanted opioid effects
    - Dysphoria
    - Hyperthermia
Alpha$_2$ Agonists

- Presynaptic alpha$_2$ receptors
  - Inhibit norepinephrine release
  - Increase descending inhibition

- Co-localize with opioid receptors on primary afferents and in the dorsal horn

- Profound analgesia
  - Sedative effects outlast analgesic effects
Alpha$_2$ Agonists

- Profound cardiovascular effects
- Profound sedative qualities
- Profound anxiolysis

- Only partially dose-dependent
- Reversible
NMDA Antagonists

- Ketamine/Tiletamine
  - Block glutamate activation of NMDA channels
  - Voltage- and ligand-gated
  - Partial depolarization kicks Mg\(^{2+}\) blockade out
  - Basis for windup and central sensitization
  - Dissociatives binding site in the pore

- Ketamine provides analgesia and anti-hyperalgesia
Local Anesthetics

- Block voltage-gated Na\(^+\) channels
- Weak bases must be in uncharged form to cross the lipid bilayer
- Prevent afferent nociceptive traffic
- Decrease inhalant & opioid requirements
- Reduce the stress response, reduce windup and central sensitization
- Improve GI function, decrease hospital stays, improve patient satisfaction, reduces the incidence of chronic pain
Incorporating Local Anesthetics

- Pre-incisional infiltration
- Wound infiltration
- Body wall splash
- Intratesticular/spermatic cord blocks
- Intraperitoneal blocks
- Soaker catheters
- Epidural
Short-acting Local Anesthetics

- **Lidocaine**
  - Fast onset
  - Duration 45 – 90 minutes
  - Keep total dose under ~5 mg/kg

- **Mepivacaine**
  - Lowest pKa, fast onset
  - Duration 45 – 90 minutes
  - Dosing as for lidocaine
Long-acting Local Anesthetics

- **Bupivacaine**
  - Slightly slower onset
  - Duration up to ~240 minutes
  - Differential blockade can be pronounced
  - CNS and CV toxicity closer than with lidocaine
  - Maximum dose ~2 mg/kg

- **Ropivacaine**
  - S-enantiomer
  - Safer cardiovascular profile
  - Maximum dose 2-3 mg/kg
Local Anesthetic Adjuncts

- Duration of action influenced by:
  - Lipophilicity
  - Vascularity of tissue
  - Protein binding
  - Adjuncts
    - Epinephrine, alpha-2 agonists, buprenorphine
    - Steroids, tramadol, neostigmine

- Mixing short- and long-acting drugs
  - Does not provide onset benefit
  - Shortens duration of action
Intratesticular Blocks

- Aspirate first
- Inject until testicle feels turgid
- Hematoma on testicle may result

- Cats
  - 0.25 mL local anesthetic injected into each testicle

- Dogs
  - Depends on size of dog
  - Usually a maximum of 2 mL/testicle will suffice
Intraperitoneal blocks

- Standard method for laparoscopic procedures
- Diluted and sprayed in the peritoneal cavity
- Assistant drips bupivacaine onto body wall while the abdominal cavity is still open
Wound Soaker Catheters

- A catheter with many holes placed in the lowest layer of wound closure
- Particularly helpful for amputations and large wounds
- Instill bupivacaine 2 mg/kg q 4-6 hours
NSAIDs

- Important part of multimodal analgesia

- Pre op vs post op administration
  - Avoid administering NSAIDs when renal blood flow is prostaglandin dependent:
    - Hypotension
    - Hypovolemia
    - Hyponatremia
    - Pre-existing renal disease
  - If not monitoring blood pressure, consider waiting until recovery

- Cats – patient and dose-selection is key to safety
Preventive Analgesia

Duration of analgesic action covers entire perioperative time period
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