WHAT MOVES YOU?

Anesthesia & Pain Management in Small Ruminants

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Conflict of Interest Disclosure:

I have no relevant financial interest, arrangement or affiliation with any company or organization.
Sheep & Goats

- Local & Regional Anesthesia
- Sedation
- General Anesthesia
- Analgesics
  - NSAIDs
  - Opioids
  - Other
Local & Regional Anesthesia

• Advantages of local or regional
  – avoids recumbency
  – relatively few post op complication
  – easy to learn & perform
  – minimal assistance required
  – inexpensive
  – can achieve surgical analgesia
Local & Regional Anesthesia

• Epidural
  – Lumbosacral
  – Caudal
• Cornual Nerve
• Inverted L block
• Distal Paravertebral *
• Regional Bier Blocks *
Lidocaine

• More Sensitive!
  – Toxic dose = 10-12 mg/kg

• Maximum **TOTAL** (blocks + epidural) **safe** dose (~1 ml / 4.5 kg (10#) bw)

  5-6 mg/kg

• Buffer with Sodium Bicarb
  – 1:10 dilution
Lidocaine Overdose

• Signs include:
  – depression
  – behavior changes
  – ataxia
  – muscle tremors
  – opisthotonus
  – blindness
  – apnea
  – hypotensive shock
  – seizures

• Treatment:
  – Diazepam
  – 0.1–0.5 mg/kg IV
Other local agents

• **Bupivacaine** – 0.25% to 0.5% solutions
  – Dose = 1 - 2 mg/kg
  – Slower onset (5-10 minutes)
  – Up to 3 x duration vs. lidocaine (2-4 hours)
  – No meat or milk withdrawals established.

• 2% mepivacaine

• 2% procaine
Epidurals
CAUDAL EPIDURAL
Caudal Epidural

- Workhorse for all obstetrical interventions
- Desensitizes: perineum, vulva, vagina, rectum
  - Castrations, prolapses, dystocia, C sections, vasectomies
- Analgesia without ataxia (usually)
- Can be difficult if very short tail dock (sheep)
Caudal Epidural

Workhorse of small ruminant ob work!

Location: 5th sacral - 1st coccygeal or 1st–2nd coccygeal interspace

Grasp high & pump tail
Shave a small area (2" square) and surgically prep the site.
Caudal epidural

- Needle angle = 90° angle to slope of tail head
- Slowly advance
  - Feel/see “POP”
  - Animal reaction
- Lack of resistance to injection
  → correct placement
- Hanging drop often doesn’t work
- CSF: reduce dose by 1/2
Caudal Epidural – Lidocaine/Xylazine

- Combined xylazine + lidocaine epidural:
  - Xylazine @ 0.07 mg/kg
  - Lidocaine @ 0.5 mg/kg

- Standard ewe (80 kg or 175 #):
  - 2 ml 2% lidocaine + 0.25 ml 20 mg/ml xylazine in 3 ml syringe

- Onset 5-10 minutes, duration 24-36 hours

- Do NOT combine with other systemic alpha 2s (xylazine, detomidine)
Xylazine + Lidocaine

- Some hind limb ataxia in 41% sheep
  - 24 hours
  - May lay down

- Eliminated forceful abdominal straining
  - 24 hours (92%)

- Minimal to no sedation or other systemic effects of xylazine observed
  - NO excessive salivation or rumen distention, cardiac effects
Lidocaine only

- No bicarbonate, no epinephrine
- 0.5 mg/kg
  - 45 kg: 1.0 ml of 2%
- Onset 1-5 min, duration 1 hour
High Volume Lidocaine Epidural

- Anesthesia to thoracolumbar junction
- Caudal epidural space
- 1 ml/10 kg BW 2% Lidocaine
  - 200# ewe = 8 ml 2% lidocaine
  - substantial portion of total safe dose of lidocaine
LUMBOSACRAL EPIDURAL
Lumbosacral Epidural

- Useful in ultra-short tailed sheep
- Analgesia from paralumbar space back
  - Onset- 5 min
  - Lasts 3-4 hours
  - Pelvic limb ataxia

- Lidocaine
  - 0.4 mg/kg
  - not xylazine combo
Lumbosacral Epidural

• 0.3 to 0.5 ml of 2% lidocaine per 10 kg BW Lidocaine

• Insert needle (18-20 g x 1.5 or 2 in) at ~90°
  – Advance slowly: See or feel “pop”

• Injection should be without resistance if properly positioned
Cornual Nerve Block

• Two sites per horn required in goats
  1. Cornual nerve branch of zygomaticotemporal nerve
     • Midway between lateral canthus of eye and lateral horn base
  2. Cornual branch of infratrochlear nerve
     • Midway between medial canthus of eye and medial horn base
Disbudding Kids

- Recommend done before 10 days of age.
  - Horn buds have not attached themselves to frontal bones.
  - Local block +/- sedation (detomidine/ketamine)
    - easy to remember
    - reversible w/ atipamezol at same volume
    - Kids: 4.5 kg = 0.01 cc Dormosedan® + 0.1 cc ketamine IV
      - Dilute alpha-2’s for safety
  - Other sedation: torbugesic/dexmedetomidine, diluted xylazine
• Adult goat:
  – 1-2 mls 2% lidocaine at 2 sites:
    • halfway between lateral canthus of eye & lateral base of horn
    • halfway between medial canthus of eye & medial base of horn

• Use diluted lidocaine for young kids.
  – ¼ cc 2% each site
    • Dilute to 1% to get adequate volume
    • Buffer with Sodium Bicarb

Goat Medicine, Smith
Disbudding Kids

• Recommend done before 10 days of age
  – Horn buds have not attached themselves to frontal bones.
• Local block
  – ¼ cc 2% each site
  – Dilute to 1% & buffer with Sodium Bicarb
• +/- Sedation
  – Dilute alpha-2’s insulin & reverse w/ atipamezol at same volume
  – **Detomidine/ketamine** – IV, same syringe
    • easy to remember
    • Kids: 4.5 kg = 0.01 cc Dormosedan® + 0.1 cc ketamine IV
  – **Torbugesic/dexmedetomidine**
    • Dexmedetomidine @ 0.004-0.005 mg/kg + Torbugesic @ 0.33-0.4 mg/kg
    • 4 kg kid: 0.03 ml dexmedetomidine + 0.12 ml torbugesic
Inverted L block

- Duration: ~ 1.5 hours
- No visceral anesthesia
- May not provide full anesthesia of deep layers & peritoneum
Management procedures
taildock, castration, disbudd

3 points to consider
1. What age?
2. What method?
3. Use of preemptive analgesia? Sedation?

• Preoperatively local anesthetic for castration and tail docking can improve post operative comfort and behavior
  — +/- long acting NSAID

• Needs to be but practical & efficient!
SEDATION
Sedation

- **Butorpanol**
  - 0.05-0.5 mg/kg, IM or IV

- **Diazepam**
  - 0.5 mg/kg IV

- **Ket-Stun Technique** (D. Anderson)
  - Butorphanol 0.02 mg/kg
  - Xylazine 0.04 mg/kg
  - Ketamine 0.1 mg/kg
    - IV, IM or SQ
    - 45-60 min duration of sedation and mild disassociation.
GENERAL ANESTHESIA
Gas Anesthesia

• Induction
  – Propofol 4-8 mg/kg IV
  – Ketamine/Valium
  – Ketamine/alpha-2
  – Telazol
  – Mask (3-4% isoflurane or sevoflurane)

• Intubation

• Maintenance – 1-2% iso or sevo
  – 0.5 to 2 L/min O2 flow rate
Intubation

Need: Speculum, long blade laryngoscope, stylet
• Point nose to ceiling
• Preload tube on stylet
• Pass stylet through oral cavity and arytenoid cartilages
• Feed tube past the arytenoids
  • Withdraw stylet
  • Secure tube-tie
  • Inflate cuff

• Stylet
  • Polyproplene dog catheters
  • Thin aluminum rod
INJECTABLE GENERAL ANESTHESIA
Alpha 2 Agonists

• Xylazine, detomidine, dexmedetomidine
  – All alpha-s’s can produce sedation, bradycardia and respiratory depression
  – Diuretic

• Xylazine much greater risk
  – Two concentrations available
  – Sever cardiac depression $\rightarrow$ Hypoxemia, Death
    • Av block, HR, CO, BP decrease
  – Pulmonary Edema-individual/breed related, highly variable
  – Reduced rumen motility
Xylazine

Dose rate is small, dilute preparations and measure accurately

**Xylazine dilution 1 mg/ml**

0.5 ml (20 mg/ml) xylazine + 9.5 ml sterile water/saline
= 1 mg/ml

Kids - 0.1 mg (Nigerian Dwarf) – 0.25 mg / Kid IM
(Mary Smith, AASRP Listserve)
Ketamine / Detomidine Dosing

- Ketamine (100 mg/ml) & Detomidine (Dormosedan®, Zoetis) (10 mg/ml)
- WATCH UNITS
- Healthy, young, uncompromised patient
  - Up to ~150 #:
    - ketamine 1 cc/ 100# (45 kg) BW + 0.1 cc Dormosedan®/100# (45 kg) BW
    - Additional amounts for animals > 150 are added at half that up to 2.0 / 0.2 cc max.
- Geriatric, compromised- reduce by 15-20%
Ketamine / Detomidine Dosing-healthy

Body weight in lbs

Ketamine dose in mls

Detomidine dose in mls

0.1 cc ketamine

0.01 cc Detomidine

0 50 100 150 200 250 300

0 0.05 0.1 0.15 0.2

10#
Measuring micro-doses

- Use a low dead space, U100 insulin syringe for alpha-2 dosing to increase accuracy.
  - 1 unit = 0.01 ml

Low Dead Space = 0.002 ml

U100 insulin syringes
100 units = 1 cc
1 cc, 0.5, 0.3 cc sizes

10 u = 0.1 cc = 100# dose
1 u = 0.01 cc = 10 # dose
Dead Space Comparison

0.084 ml of dead space

= 84 #'s worth of detomidine

Zule, W., "Modeling the effect of high dead-space syringes on the human immunodeficiency virus (HIV) epidemic among injecting drug users", 2010.
Ketamine / Detomidine Dosing - geriatric

Geriatric 125# = 1.0 cc ketamine + 0.1 cc detomidine

Body weight in lbs

Ketamine dose in mls

Detomodine dose in mls

20% reduction
Ketamine / Detomidine continued

• 15-25 minutes solid anesthesia

• Additional sedation/duration:
  – add diazepam (0.05-0.1 mg/kg)
  – ¼ - ½ of initial dose ketamine

• Reversible with Atipazemol (Antisedan®, Zoetis)
  – same volume as Dormosedan®.
Torbugesic/Dexmedetomidine

• Torbugesic (10mg/ml) & dexmedetomidine (Dexdomitor®, Zoetis) (0.5 mg/ml)
• kids (AASRP Listserve)
  – Dexmedetomidine @ 0.004-0.005 mg/kg
  – Torbugesic @ 0.33-0.4 mg/kg
  – IV, same syringe
  – Reverse with atipamezol (diluted)
  – 15-20 minutes anesthesia
  – 4 kg kid: 0.03 ml dexmedetomidine + 0.12 ml torbugesic
    • Up and walking in 10-15 min
Telazol® (Zoetis)

• Tiletamine/zolazepam 1:1 = 100 mg/ml
  – Need immobile longer than 15-25 minutes
    • 45-90 minutes
  – No one to give additional IV doses

• 3-5 mg/kg IV
  – Additional 0.5-1.0 mg/kg – prolong duration
Other options...

- Ketamine/diazepam
- Ketamine/xylazine
- Single agents – any of previously mentioned drugs
Analgesia

• Changing standard of care and animal welfare considerations

• Benefit vs. risk analysis

• Pain → stress → delayed healing & complications

• Prevent complications with appropriate drug and dose choice in suitable patient
NSAID

- Anti-inflammatory, Analgesic, Antipyretic
- Block inflammatory pathways
- Non-sedating
- Longer duration
- Variety of administration routes- IV, IM, SQ, PO
  - Readily absorbed through GI tract
- Ensure adequate hydration status
NSAIDS- Flunixin meglumine

- Flunixin meglumine (50 mg/ml)
  - Non selective PG inhibitor
  - Acute inflammation/tissue damage- esp. viscera (i.e. surgery)
  - Labeled IV @1.1 - 2.2 mg/kg q 12-24 hours
    - 45 kg: =1.0 ml
    - IM & SQ= tissue damage and prolonged withdrawals
    - SQ @ 2.2 mg/kg sheep withdrawal from FARAD= 60 days
    - FDA warns that use other than IV is in violation of AMDUCA
  - Oral @ 2.2 mg/kg
NSAIDS - Meloxicam

- Anti-inflammatory, analgesic and antipyretic
- Injectable - 5 mg/ml, 20 mg/ml (CA)
- Oral
  - 7.5 mg & 15 mg tablets
  - 0.5 & 1.5 mg/ml liquid (K9), 15 mg/ml (LA- CA)
- Longer duration of action= SID to EOD dosing
- 2 mg/kg PO loading dose, then 0.5 -1 mg/kg PO q 24-48 hrs
- 0.5 mg/kg IM or SC once( CA cattle dose)
NSAIDs- Meloxicam

• Advantages
  – Semi-Selective COX 2 inhibitor
  – Inexpensive tablets
    • US$0.11 / dose @ 45 kg BW
  – Well tolerated longterm with minimal side effects
  – Easily administered
    • Eat in handful grain or peanuts
  – Clinically: arthritis, long term, post surgical, illness

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Opioids

- Potent visceral analgesia
- Controlled substances
- Some sedation, limited excitation in ruminants
- Shorter duration of action than NSAIDS
- In combo with low dose alpha 2= synergistic effects
Butorphanol

• Sedative, analgesia
  – 3-5 times more potent than morphine

• 10 mg/ml

• Dose: 0.05-0.5 (up to 1.0) mg/kg IM or IV up to q 4 hrs
  – Usually 0.1-0.2 mg/kg = 45 kg = 0.5-1 ml

• Excellent in combinations

• Fewer GI & respiratory side effects than other opioids
Opioids - others

- **Buprenorphine** (Buprenex®)
  - 0.004mg/kg IM every 12 hours (goats)

- **Fentanyl Patch**
  - 0.2 mg/kg, q 2-3 days

- **Morphine**
  - **Epidural** – 0.1 mg/kg (15mg/ml morphine) plus 2 cc Lidocaine

- **Naloxone** reverses morphine/ butorphanol/buprenorphine
  - 0.01-0.02mg/kg IV or IM, redose q 2 -1 hour if necessary.
Ketamine

- Potent analgesia at sub-anesthetic doses
  - 0.25-0.5 mg/kg IM q 6-8 hours
- Better somatic pain
- No respiratory depression
- Stimulated cardiovascular system

Gabapenten- with NSAID – 900 mg/day sid
My preference

• Ketamine/Dormosedan
  – Pre-med with butorphanol
  – “bump” with valium first, then ½ dose ketamine.

• Telazol®-  If no one to give additional IV drugs and need longer than 10-15 minutes

• I Never use xylazine except in epidurals
## Cost comparison

<table>
<thead>
<tr>
<th>Drug Combo</th>
<th>Cost per 45 kg</th>
<th>Cost per 4.5 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine/ Dormosedan</td>
<td>$ 1.16</td>
<td>$ 0.12</td>
</tr>
<tr>
<td>Telazol</td>
<td>$ 23.13</td>
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</tr>
<tr>
<td>Torbugesic/ Dexdomitor</td>
<td>$ 12.26</td>
<td>$ 1.23</td>
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<tr>
<td>Ketamine / Diazepam</td>
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<tr>
<td>Ketamine / Xylazine</td>
<td>$ 1.45</td>
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<td>Ket Stun</td>
<td>$ 3.48</td>
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<tr>
<td>Lidocaine/ Xylazine Epidural</td>
<td>$ 0.31</td>
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<tr>
<td>Lidocaine block (max)</td>
<td>$ 0.23</td>
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<tr>
<td>Butorphanol</td>
<td>$ 5.73</td>
<td></td>
</tr>
</tbody>
</table>

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Questions?
Contact Info

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References

- AASRP Listserve
- Pugh, D.G., Sheep & Goat Medicine, 2002, W.B. Saunders.
American Association of Small Ruminant Practitioners
Removed slides
Paravertebral

- Insert needle parallel to transverse process of L1, L2 and L4.
• Insert needle parallel to transverse process of L1, L2 and L4
• Inject ~ 5 cc 2% lidocaine
  – fanning pattern above and below processes
  – 15 ccs total
• Onset = 5 minutes
• Duration = 2 hrs
Bier Blocks

• Regional / limb analgesia for up to 90 minutes.
• Dose = 1 mg/ kg lidocaine  
  – diluted to a total volume of 1 mL/4.5 kg with sterile saline
• Injected through a butterfly catheter below a tourniquet placed on limb.