Medical and Surgical Approaches to Common Small Ruminant Conditions

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Lumbosacral Epidural Anesthesia

- Lumbosacral Epidural
  - Must be performed aseptically
  - Good for perineum, caudal abdomen, intestinal disease, rear limb disease, umbilicus
  - Tuck the back legs forward, opening up LS space
  - Cattle:
    - Lidocaine: high-volume caudal epidural
    - Morphine 0.1 mg/kg up to 0.5-1 mg/kg q 12 hours
    - Dilute in 10-20 mL saline
    - 18-20ga x 4-5” spinal needle
  - Sheep and goats: 1 mL/15# 2% lidocaine
    - Can be done with 20ga x 1” needle
  - Spinal fluid? Halve the dose

C-Section in Small Ruminants

Suture Suggestions

- Uterus
  - Small ruminant
    - 0-1 catgut, PG-910 (Vicryl®), Polyglecaprone 25 (Monocryl®), p-dioxanone (PDS®II)
- Body wall
  - Small ruminant
    - 1 catgut, PG-910 (Vicryl®),Polyglecaprone 25 (Monocryl®), p-dioxanone (PDS®II)
- Skin
  - Small ruminant
    - 1 nonabsorbable pseudomonofilament (Braunamid®)

Preoperative Drugs

- Antimicrobial
    - Ceftiofur
        - *ELDU* by indication, must use on-label dose, route, duration
- Anti-inflammatory
    - Flunixin 1.1-2.2 mg/kg IV
    - Meloxicam 1 mg/kg PO, then 0.5 mg/kg EOD
        - Follow up
- Analgesic
    - Morphine 0.1mg/kg SC or IV
    - Butorphanol 0.05-0.1 mg/kg SC

Preparation of Skin

- Bath
    - Dish soap, hose, brush
- Rough prep
    - Exam gloves, chlorhexidine
- Sterile prep
    - Sterile gloves, sterile 4x4, chlorhexidine

Uterus

- Utrecht Suture Pattern

Body Wall Layers

- Flank
    - Transversus and peritoneum
    - Internal and external
        - Intermittent tacking to T&P layer
    - Skin
    - Ford Interlocking
    -

Aftercare

- Uterine involution
    - Oxytocin

    - Prostaglandin
- Good footing
- Hobbles
    - 15-20” (38-50cm) between bowline knots
- Analgesia
- Hydration - for *all* of you 😅
- Mothering up

Tube Cystostomy

Pre-Operative

- Sedation and anesthesia
    - 0.1 mg/kg butorphanol or morphine
    - 0.2 mg/kg midazolam
    - 2-4 mg/kg ketamine
    - + gas maintenance
- Lumbosacral epidural

Tube Cystotomy

- Procedure
    - Parapreputial cystotomy
    - Decompress urinary bladder and suction and flush stones out
    - Normograde and/or retrograde 3.5-5fr polypropylene urinary catheter to attempt to clear urethra
    - Create a parapreputial stab incision on opposite side
    - Insert 12-24 fr Foley catheter through stab incision and into bladder and inflate with saline
    - Place pursestring in urinary bladder
    - Pull urinary bladder to body wall with Foley catheter and Chinese finger trap into place, along with other stay sutures
    - Attach extension set and Heimlich valve to Foley
    - Close body wall as routine
    - Urine is diverted via catheter
    - Clamp tube daily starting day 4-5 to test for urethral patency
    - Repeat…
    - Usually takes 7-10 days for normal urination; some > a month

    - When urinating a stream via the urethra for >24 hours, deflate the cuff, pull the tube and institute prevention

- Prognosis
    - 11-11.5 days mean urination
    - 76-90% short-term success
    - 86% long-term success [Rakestraw et al 1995, Ewoldt et al 2006]

    - Goats
        - 54.9% post op complications (reobstruction) at median of 171 days (1d - 6y)
        - 48.4% non survivors at follow up [Mag et al 2020]

Peri- & Postoperative Management

- IV fluids
- Ceftiofur sodium labelled for respiratory disease
- Morphine 0.1 mg/kg SC q 4-6h
- Acepromazine 0.05 mg/kg SC q 4h
- Midazolam 0.2 mg/kg SC q 4h
- Flunixin meglumine 1 mg/kg IV (once hydrated)
- 200 mg/kg ammonium chloride PO BID
    - Monitor pH

Cerebrospinal Fluid Collection

- AO tap
    - Best for intracranial disease
    - Requires anesthesia
- LS tap
    - Better for spinal disease
    - Can be performed awake

CSF Fluid Collection

- Surgically clip, prep and block with 2% lidocaine
- 20-18ga, 3.5” (9cm) spinal needle inserted into LS space

- First pop through interarcuate ligament
- Continue into subarachnoid space
- Remove stylet and wipe across sterile glove
- Aspirate fluid
- Place into red top tube and purple top tube

CSF Fluid Preservation

- For shipment to reference laboratory
- 0.2mL CSF into plastic vial for protein determination
- Collect blood and let clot 30 minutes, centrifuge
- 0.25mL CSF into purple top + 0.03mL of serum
    - Label as serum-spiked
- Ship overnight on cold packs

CSF Fluid Evaluation

- Reference ranges
    - Protein – <40mg/dL
    - Pandy – negative
    - Glucose – 60-80% of blood
    - Sodium – 134-144mEq/L
    - CK – 2-48 IU/L
    - Xanthochromia – negative
- Visual inspection
    - Foamy?
        - Protein is >200 mg/dL
    - Cloudy?
        - Cell count is >40 cells/uL
- Cannot test protein on handheld refractometer (g/dL)

Transtracheal Wash

- Smaller Calves, Camelids, Sheep and Goats
    - Bacterial or viral testing
    - Prepare midline of middle third of trachea ventrally
    - Local lidocaine
    - Insert 14 ga needle between rings, bevel and tip pointed down
    - Pass 3.5 fr dog polypropylene urinary catheter toward lungs
    - Pull needle
    - Infuse 10-20 mL nonbacteriostatic saline and aspirate
    - Repeat and place samples in RTT

Tracheostomy

Temporary Tracheostomy

- Cuffed or uncuffed tracheostomy tube
- Intranasal or flow-by oxygen
- +/- sedation with opioid or benzodiazepine
- Clip, prep upper 1/3 of neck
- Lidocaine block
- Vertical skin incision
- Dissect to trachea and stabilize
- Horizontal incision between rings, no greater than 1/3 circumference
- They cough and blood goes all over your face
- Grasp tracheal rings, insert tube and secure

Tracheostomy Maintenance

- Can be useful to have 2 tubes
- Clean several times per day
    - Suction
    - Pipe cleaners
    - Cotton tip applicators
- Remove at least once per day

- Soak in warm soapy water

Permanent Tracheostomy

- Intranasal or flow-by oxygen
- +/- sedation with opioid or benzodiazepine
- Clip, prep upper 1/3 of neck
- Lidocaine block
- Vertical skin incision
- Dissect to trachea and stabilize
- Vertical, elliptical incision across ~3-4 rings
- They cough and blood goes all over your face
- Grasp edges and suture to skin

Rumenostomy

Preoperative Drugs

- Antimicrobial
    - Ceftiofur
        - ELDU by indication, must use on-label dose, route, duration
- Anti-inflammatory
    - Flunixin 1.1 - 2.2 mg/kg IV
    - Meloxicam 1 mg/kg PO, then 0.5 mg/kg EOD
        - Follow up
- Analgesic
    - Morphine 0.1 mg/kg SC or IV
    - Butorphanol 0.05 - 0.1 mg/kg SC

Left Flank Anesthesia

• Proximal or distal paravertebral regional anesthesia, reverse 7 or inverted L

Permanent Rumenostomy

- Remove 2.5-3” (6-8 cm) circle of skin (sheep and goats: Nickle)
- Grid or incise muscle layers and open peritoneum
- Grasp dorsal sac of rumen
- Suture at 4 points to skin, without entering lumen (cutting needle)

    - #1 non absorbable monofilament or long-lasting absorbable
- Suture each quadrant in continuous or interrupted pattern
- Incise rumen
- Optional: place syringe case stent
- Allow to stricture closed over weeks to months

Rumenotomy

- Split surgical pack to dirty and clean
- Large flank incision 3-4" (8-10 cm) caudal to last rib (adult)
- Grid or incise muscle layers and open peritoneum
- Optional: explore peritoneal cavity, examining cranioventral abdomen last
- Grasp dorsal sac of rumen
- Suture at 4 points to skin, without entering lumen (cutting needle)
    - #1 non absorbable monofilament or long-lasting absorbable
- Place rumen board -or-
- Suture each quadrant in continuous or interrupted pattern, probe with hemostats to ensure seal; add interrupted sutures
- Incise rumen
- Explore cardia, reticulum, rumen, reticulo-omasal orifice, abomasum transruminally
- Do whatever you are going to do
- Close rumen with Cushing pattern in #1 monofilament absorbable suture
- Lavage and change surgical attire and pack
- Remove board or rumen holding sutures
- Close body wall in standard fashion (#2 suture)

Blood Transfusion

When to transfuse?

- Hard numbers?
    - Rate of loss
    - 15-20% acute loss, 10-15% chronic loss [Hunt et al 1990]
- Clinical signs?
    - Tachycardia

    - Tachypnea
    - Edema

- Aggressive crystalloid therapy needed
    - Severe dehydration
    - Azotemia

Blood Types

- Blood groups
    - Cattle A, B, C, F, J, L, M, S, Z, R', T' with 70 blood group factors [Stormont 1962, Penedo 2000]
    - Sheep R-O, A, B, C, D, M, X with 22 blood group factors [Rasmusen 1962, Penedo 2000]
    - Goats A, B, C, E, F, R [Penedo 2000]
    - Camelids A, B, C, D, E, F [Penedo 2000]

Donor Management

- Healthy, normal PCV and total protein, free of:
- Bovine
    - BLV, BVD, brucellosis, TB, Johne's, blood parasites
- Small ruminant
    - CAE, brucellosis, TB, Q fever, *Sarcocystis ovicanis*, CL, blood parasites
- Camelid
    - *Mycoplasma haemolamae*

- Donation amount
    - 20% of blood volume = 1.5% of body weight
    - 10 mL/kg (6-15 mL/kg]

Whole Blood Transfusion

- Anemia

Liters = $\frac{\text{PCV (want)} - \text{PCV (have)}}{}$ x BW (kg) x 0.1 L/kg

PCV (donor)

- Hypoproteinemia

$$\text{Liters} = \frac{\text{Alb (want)} - \text{Alb (have)}}{\text{Alb (donor)}} \times \text{BW (kg)} \times 0.06 \text{ L/kg}$$

- For FPT, 40mL/kg whole blood
    - 20mL/kg plasma

Anticoagulant Recipes

- Acid citrate dextrose
    - If blood to be stored more than a few hours
    - 1:4 ACD:whole blood
- Sodium citrate
    - 2.5-4% sodium citrate solution [Soldan 1999]
    - 1:9 sodium citrate:whole blood
- Heparin [Soldan 1999]
    - 4.5-5 units/mL blood
    - Risk of heparinization of recipient

Transfusion Logistics

- Whole blood transfusion rates:
    - 5 mL/kg/hour for first 15 min.
    - Then 10 mL/kg/hour
- Monitor heart rate, respiratory rate, mucous membrane color
- Volumetric and syringe pump use?
    - 4/8 and 1/7 dogs still had transfused cells at 24 hours. [McDevitt et al 2011]

Recovery

- What was the mechanism?
- Ongoing loss
- Increase plane of nutrition

- Iron dextran
    - 0.5-1 mL in small ruminants
- Hb and PCV expected to return to normal by 5 weeks post-bleed
    - Hemorrhage or regenerative anemia

Vasectomy

Selection

- Home raised
    - Friendly demeanor
    - Bottle baby?
- Purchased
    - Treat like a blood donor
    - CL, CAE, Johne's, brucellosis, TB, Q fever, others
    - GI parasites
- Vaccinated

Sedation

- Butorphanol 0.1mg/kg
- Midazolam 0.2mg/kg or Xylazine 0.05-0.1mg/kg
- Ketamine 2-4mg/kg
- Combined IM

Procedure

I typically place the sedated animal in a seated position in a sheep chair or this can be done in lateral recumbency. Clip and surgically prepare the proximal portion of the scrotum on the cranial aspect. After the first scrub, inject 3-5mL of 2% lidocaine into each spermatic cord, leaving a small bleb subcutaneously on the way out with the needle. After the final surgical scrub, make a 1" (2cm) incision over one spermatic cord about halfway between the body wall and the testicle. Dissect down through the parietal tunic and isolate the spermatic cord using a hemostat. Then, make an incision into the visceral tunic and identify the white vas deferens, which is in stark contrast to the dark red cremaster muscle. Separate it from the artery and vein.

After extending the tunic incision over the vas, place hemostats across the vas, about 1" (2cm) apart. Using #1 or #2 suture (I use catgut, but Vicryl or PDS would be fine also), ligate proximal and distal to the hemostats so that you can incise along the interior portion of each hemostat, removing at least a 1cm segment of the vas deferens. Place the vas in formalin for histopathology, if desired, to confirm vasectomy. Close the scrotal incision in an intradermal pattern with absorbable suture of your choice.

Repeat on the other side!

Aftercare

- Flunixin or meloxicam
- +/- antimicrobial therapy
- Tetanus prophylaxis
- Away from females for ~3 weeks
- Recommend semen evaluation before turnout