PROCEEDINGS

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TABLE OF CONTENTS

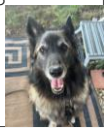
Friday, May 15, 2026

RUSTIC Reboot

REAL WORLD CE FROM WISCONSIN SPECIALISTS

NEUROLOGY WORK UP BEFORE REFERRAL: PRACTICAL SCREENING TESTS

Joy Delamaide, DVM, DACVIM (Neurology)



1

MVS Neurology service

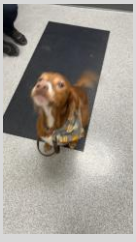
- Neurology consultations available Monday – Friday.
- Please feel welcome to call, and we'll try to get back to you promptly. There are many days we are not too busy
- Online form for vet-to-vet consultation, or referral information – please let us know if this form is working for you. Please make sure to let us know what your clinical question is.

2

Is it neuro or not neuro?

If Neuro: brain, spinal cord, or neuromuscular

If not neuro: orthopedic? Metabolic? Cardiac?



3

METABOLIC

4

Metabolic causes

- Metabolic diseases are my least favorite problems to 'miss'.
  - Hypothyroidism
  - Insulinoma causing hypoglycemia or Diabetes mellitus
  - Hyper or hypocalcemia

Ideally, run a full CBC and chem 26 and Total T4 prior to referral within one month of appt. Disclaimer: this does not apply to emergency cases/patients deteriorating quickly

5

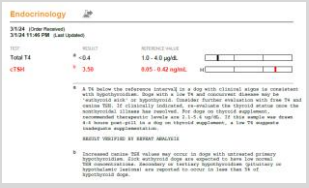
Hypothyroidism: Case 1: old GSP with front leg lameness

- January 2024: 10 y FS German Short-haired Pointer (GSP) presents to Dr. Tuttle (DACVS) with left shoulder pain
- Has been lame for 3 years, but worse recently. Increased activity makes lameness worse, so they're having to limit her.
- Being treated with gabapentin and carprofen
- Blood work 3 months prior to referral WNL
- BCS 6/9
- Left elbow pain, shoulder seemed OK, discussed option of CT. Did left shoulder joint injection (had previous injury in left shoulder). Signs have worsened despite this.
- Neurology appointment 2/29/24: Other history questions: activity level decreased, spends a lot of time sleeping / laying around at home.
- 10/31/2023 - Cholesterol is actually 524 (elevated)
- Exam – disuse muscle atrophy in left front leg, mild hind limb ataxia (not out of the ordinary of what you might expect for a 10 y GSP)
- Recommend an Idexx Health Chek Plus (gets cholesterol, Total T4)
- Already on carprofen / tramadol, added amantadine
- Talked about advanced imaging, prednisone trial, etc.

6

Hypothyroidism: case

Hypercholesterolemia occurs in hypothyroidism due to reduced lipid metabolism.


Endocrinology

3/1/24 (Order Received)
3/1/24 11:46 PM (Last Updated)

TEST	RESULT	REFERENCE VALUE
Total T4	a <0.4	1.0 - 4.0 µg/dL
cTSH	b 3.50	0.05 - 0.42 ng/mL

a A T4 below the reference interval in a dog with clinical signs is consistent with hypothyroidism. Dogs with a low T4 and concurrent disease may be 'euthyroid sick' or hypothyroid. Consider further evaluation with free T4 and canine TSH. If clinically indicated, re-evaluate the thyroid status once the nonthyroidal illness has resolved. For dogs on thyroid supplement, recommended therapeutic levels are 2.1-3.6 ug/dL. If this sample was drawn 4-6 hours post-pill in a dog on thyroid supplement, a low T4 suggests inadequate supplementation.

RESULT VERIFIED BY REPEAT ANALYSIS

b Increased canine TSH values may occur in dogs with untreated primary hypothyroidism. Sick euthyroid dogs are expected to have low normal TSH concentrations. Secondary or tertiary hypothyroidism (pituitary or hypothalamic lesions) are reported to occur in less than 5% of hypothyroid dogs.

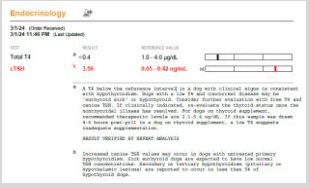
Chemistry

- Cholesterol 551 (131-345 mg/dL)
- Total T4 < 0.4
- cTSH 3.40 (0.05-0.42 ng/mL)

7

Hypothyroidism: case

Hypothyroid patients sometimes come in for a front leg lameness as their main sign.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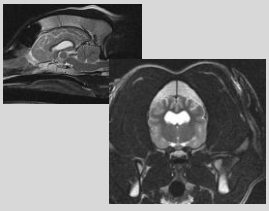
Treatment

- Thyrotabs at appropriate doses, adjust based on follow-up T4s

8

Hypothyroidism: Case 2: young dog with no neurological signs

- 8/2025- skin changes over previous 2 weeks. Not itchy
- Low total T4- 0.9, Free T4 – 0.4, cTSH < 0.030
- Central hypothyroidism: referred for brain MRI
- Normal neuro exam, weight gain, poor haircoat –
  - improved since starting thyrotabs
- Being treated with Thyro-tabs 0.8 mg- 1 tab PO q24h
- Follow-up T4 was 3.4



9

Hypothyroidism: Case 3: dog low T4 and myxedema coma

- 1 y MN Pitbull mix presented with right front leg monoparesis
- Possible hypothyroidism (T4 low, cholesterol high, MSU panel pending)
- Non-pitting edema in all limbs, and especially in right front axillary region
  - (could there have been a mass there?)
- Poor skin condition on ventral abdomen, yeast overgrowth
- Face looked tired/sad (sometimes patients stop smiling)

- Theory was he had true hypothyroidism, but did talk to the family about could he also have another problem such as lymphoma, infection, etc.
- Tried to start PO levothyroxine, but patient deteriorated. Tried IV levothyroxine (helped) but then patient started having seizures, vomiting, not eating, and passed away at home.

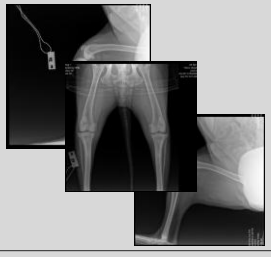
10

Hypoglycemia

- Complex partial seizures that always occur first thing in the morning, or during activity
- Video of the patient's episodes – look dizzy
- Need to measure fasted blood sugar – typically blood sugar is 40-60, but could be a little higher than that and still have insulinoma.
- Submit paired blood sugar with insulin level.
- Recommend consultation with oncology, abdominal imaging
- Managament of seizure-like episodes – could include Keppra or phenobarbital, but medical management mainly relies on
- Small frequent meals – 4-6 small, high protein, high-fat, low simple carbohydrate meals per day.
- Anti-inflammatory prednisone – increase blood glucose levels by stimulating liver sugar production, reduce insulin sensitivity in the tissues.

11

Diesel 8 y MN GSD mix, progressive hind end weakness



- Aggressive, so evaluated on gaba/traz
- Shifting hind limb lameness
- Painful to put weight on either back leg, so he sways side to side
- Stifles bilaterally effusive with pain upon hyperextension
- Too tense for me to check for cranial drawer
- Scheduled for sedated procedure another day: Called owner after stifle radiographs showed bilateral cranial cruciate ligament rupture

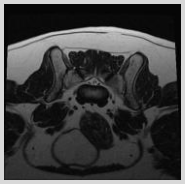
12

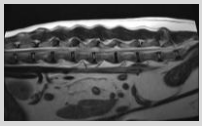
Diesel 8 y MN GSD mix, progressive hind end weakness

- Pre-anesthesia blood work
- Total calcium 12.8 (7.9-12.0) mg/dL
- Submitted PTH panel to MSU

13

Diesel 8 y MN GSD mix: lumbar MRI





14

Diesel 8 y MN GSD mix, progressive hind end weakness

- MSU panel
- Parathyroid hormone 5.40 (1.10-10.60) pmol/L
- Ionized Calcium 1.62 (1.25-1.45) mmol/L

- Came back for sedated neck ultrasound with surgery, bilateral nodules in the region of the parathyroid glands.
- Bilateral parathyroidectomy (6 and 8 mm).
- Recovered well
- Post op treated with TUMS and calcitriol

- When the calcium is high, the PTH should be 0.
- The PTH being in normal range is not normal.

15

Hypercalcemia

- Some cases that are referred that have had recent/previous blood work have limited chemistries that don't include total calcium
- On average, I would say I see 2-3 cases of primary hyperparathyroidism per year.
- I try to always run a full chemistry 26 pre-anesthesia
- Calcium > high end of reference range,
- I run an in-house ionized calcium. If this is also high,
- I'll recommend a Malignancy panel (if applicable), or a parathyroid panel to MSU.

16

Hypercalcemia

- Increased thirst/urination
- Lethargy
- Weakness
- Reduced appetite
- Muscle trembling, facial twitching
- Seizures
- Ectopic mineralization
- Kidney / bladder stones (not usually in the patients I've seen)

17

Infectious disease

- Screening tests we often submit:
- Blastomycosis urine antigen to MiraVista (through Idexx for us) (on urine)
- Neospora IgG by IFA (on serum)
- Toxoplasma IgG & IgM (on serum)
- Cryptococcus antigen by latex agglutination (on serum)
- Less common
- Distemper PCR (on CSF ideally, or conjunctival scrape/urine sediment if active / very strong clinical suspicion)
- SNAP 4DX/ tick borne vector panel (has often already been done)

18

INFECTIOUS DISEASE

19

Blastomycosis causing neurological signs

If it's wearing anything that is hunter orange, it gets a blasto test. If we do nothing else, we recommend a blasto.

	Urine positive	Urine negative
Serum positive	75%	4%
Serum negative	21%	Not determined

- 5 y MN black lab presented for seizures
- Treated with pred and seizure medications
- No tests submitted at consultation, not planning to pursue MRI.
- Presented back to pcDVM 3 weeks later in respiratory distress & TXR showed miliary pneumonia → blastomycosis.
- Patient died.

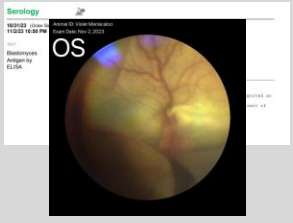
20

Blastomycosis causing neurological signs

- 7 y FS Golden Retriever
- 1mo history of lethargy and coughing
- Left eye – blepharospasm and scleral injection, miosis
- 5 days prior to presentation – generalized bronchiolar pattern
- Sent out blastomycosis antigen
- 3 seizures in 3 days prior to presentation

21

Blastomycosis causing neurological signs

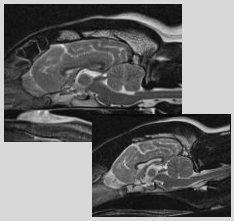


- 7 y FS Golden Retriever
- Right front foot – cystic/ serous discharge from right digit 5
- NE: CP absent right rear, reduced left rear
- Localized left forebrain
- In-house ophth consult:
- OS: blind due to retinal detachment, posterior and anterior uveitis
- OD: mild anterior uveitis

22

Neosporosis causing neurological signs

- 6 y FS Labrador, presenting for 'right hind limb weakness'
- Neurological examination showed cerebellar ataxia with CP deficits on the right side, hind limb worse than right
- Patient insured, and 'here for an MRI'
- Infectious disease testing was submitted after scan
- It could have been submitted prior to or instead of MRI, it could have been submitted by pcDVM at previous presentation.



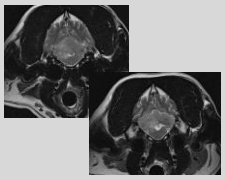
23

Neosporosis causing cerebellar ataxia

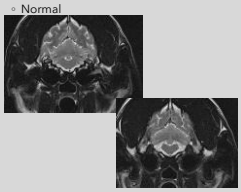
24

MRI of dog with neosporosis

- Abnormal



- Normal



25

Dog with neosporosis

Cytology Source: CSF

Volume 0.8 mL

Appearance COLORLESS/CLEAR

Protein (CSF) a 68.0 0.0 - 35.0 mg/dL

RBC 765 0 - 30 cells/uL

Nucleated Cell Count b 16 0 - 4 cells/uL

Pathologist's Report INTERPRETATION: Lymphocytic pleocytosis

Serology

3/21/26 (Order Received)
3/26/26 5:50 PM (Last Updated)

TEST		RESULT	REFERENCE VALUE
Blastomyces Antigen by ELISA	a	NEGATIVE	ng/mL
Cryptococcus Antigen by Latex Agglutination		NEGATIVE	
Specimen Type:		SERUM	
Toxoplasma IgG Antibody by IFA	b	Negative	
Toxoplasma IgM	c	Negative	
Neospora caninum Antibody by IFA	d	Pos 800	

26

Dog with Neosporosis

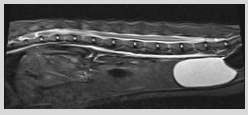
- Prescribed prednisone, clindamycin, and fluconazole. At phone call follow-up increased clindamycin, stopped fluconazole and tapered prednisone
- Almost back to 100% 3 weeks later

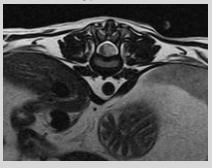
- The following treatment regimens are used to control clinical neosporosis:
- Clindamycin (12.5-25 mg/kg PO or IM every 12 hours for 4 weeks)
- Trimethoprim sulfadiazine (15-20 mg/kg PO every 12 hours for 4 weeks) in combination with pyrimethamine (1 mg/kg PO every 24 hours for 4 weeks)
- Or clindamycin and TMS if needed

27

7 y MN Cat down in hind

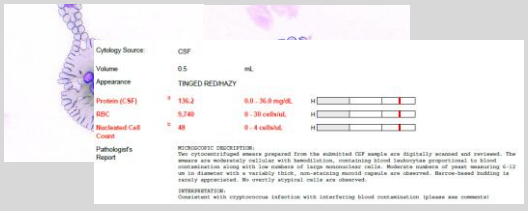
- Presented to MVS Neurology in 2022
- Neuro exam: non-ambulatory paraparesis, moderate hind limb muscle atrophy, localized T3-L3 myelopathy
- advised client that in cats I recommend FeLV, cryptococcus and toxo testing prior to MRI, but drove from Iowa and "here for an MRI"





28

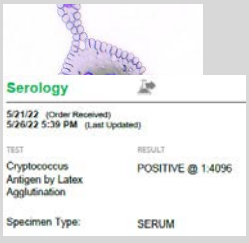
7 y MN Cat Lumbar puncture CSF analysis



Cytology Source:	CSF			
Volume	0.5	mL		
Appearance	TINGED RED/HAZY			
Protein (CSF)	136.2	0.0 - 36.0 mg/dL	H	
RBC	5,740	0 - 30 cells/uL	H	
Nucleated Cell Count	48	0 - 4 cells/uL	H	
Pathologist's Report	MICROSCOPIC DESCRIPTION: Two cytocentrifuged smears prepared from the submitted CSF sample are digitally scanned and reviewed. The smears are moderately cellular with hemodilution, containing blood leukocytes proportional to blood contamination along with low numbers of large mononuclear cells. Moderate numbers of yeast measuring 6-12 um in diameter with a variably thick, non-staining mucoid capsule are observed. Narrow-based budding is rarely appreciated. No overtly atypical cells are observed. INTERPRETATION: Consistent with cryptococcus infection with interfering blood contamination (please see comments)			

29

7 y MN Cat cryptococcosis



Serology

5/21/22 (Order Received)
5/26/22 5:39 PM (Last Updated)

TEST	RESULT
Cryptococcus Antigen by Latex Agglutination	POSITIVE @ 1:4096
Specimen Type:	SERUM

- The following treatment regimens are used to control clinical cryptococcosis:
- Fluconazole 50 mg/cat q12h or 5-15 mg/kg q24h
- Rarely need to add amphotericin B
- anti-inflammatory prednisolone
- This patient improved back to normal, but did have a relapse which was treated with fluconazole again and then posaconazole and he responded well.

30

MYASTHENIA GRAVIS

31

Myasthenia gravis

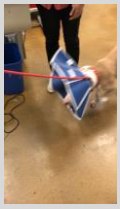
- Usually immune-mediated
- Can be paraneoplastic, so should recommend a work-up
- Always do 3-view thoracic radiographs
  - Megaesophagus
  - Aspiration pneumonia
  - Thymoma
- Submit acetylcholine receptor antibody titer – doesn't usually come back quickly, so just need to be able to share results if you submit this and then refer the case
- Prescribe pyridostigmine at 0.5 mg/kg-1 mg/kg PO q8-12h as starting dose

32

Myasthenia gravis

33

Myasthenia gravis- Tensilon test (historical significance)



34

Myasthenia gravis

- Prescribe pyridostigmine at 0.5 mg/kg-1 mg/kg PO q8-12h as starting dose
- Side effects are similar to clinical signs – muscular weakness, salivation, plus diarrhea/ tearing
- Timing of worsening signs: 1-2 hours after med? From the med
- Later, showing these signs when due for med? Needs more med
- Managing myasthenia gravis is a roller coaster
- Upright feedings
- Minimize things given by mouth
- Gelled water, clump meds with feedings
- Avoid esophagitis meds unless absolutely necessary

35

Seronegative Myasthenia gravis

- Originally reported to only be 2% of myasthenics, a recent paper of a case series of MG cases from 3 referral centers found that 22% of cases were seronegative.
- Esophageal weakness markedly reduces survival time
- Aspiration pneumonia is the most likely cause of death/euthanasia
- If clinical signs/ presentation fit, and patient improves/responds with pyridostigmine, then it is probably myasthenia.

36

3 y Golden

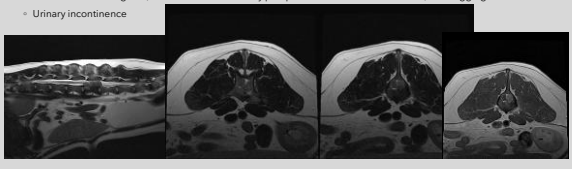
- Progressive hind end weakness over the previous week
- No apparent pain in spine
- Normal thoracic radiographs
- Spinal radiographs – narrowed disc space L5-L6, L6-L7
- Treated with carprofen, doxycycline, gabapentin – no improvement seen

- NE: ambulatory with hind limb weakness, after rest able to walk fairly normally, then develops weakness and stiff/stilted gait.
- CPs were normal, did not react as if painful (maybe skewed by medications)
- Submitted Acetylcholine receptor antibody titer and prescribed pyridostigmine 60 mg: ¼ tab PO q8-12h

37

3 y Golden

- Hind limbs became weaker over the weekend, and she stopped wagging her tail
- Came back in through ER, and was non-ambulatory paraparetic with CP absent in PL x 2, not wagging tail
- Urinary incontinence

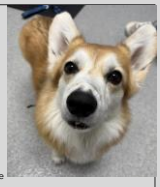


38

SEIZURES

39

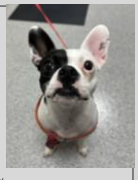
Seizures



- Minimum data base as screening prior to referral is ideal.
  - Fasted Complete CBC / chemistry / T4
  - Urinalysis +/- urine culture → Urinary tract infections will sometimes do funny things
  - low blood sugar, high insulin levels → probable insulinoma
  - Hyper or hypocalcemia
- Still treating with phenobarbital, levetiracetam, potassium bromide, and /or zonisamide

40

A comment on Keppra ER



- We sometimes hear "Keppra Extended Release doesn't work."
- It's a tricky thing to say a seizure medication isn't working because you never know what seizures didn't happen
- seizure medications are dose dependent, some patients have refractory epilepsy…
- Regular formulation levetiracetam (generic Keppra) tablets have to be given 3 times per day
- We see 4-5 cases per year (at least) of dogs that are on regular formulation Keppra twice per day and having seizures, and we either switch them to extended-release tablets or advise clients that it needs to be given three times per day, and seizure free interval improves.
- Communication between prescription pad / staff / pharmacy that we are intending to prescribe extended release is important

41

First-line treatment for status epilepticus (SE)

- SE is prolonged seizure, > 5 min

Primary

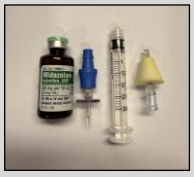
- Out-of-hospital (or in absence of IV catheter access IH): intranasal midazolam
- In-hospital: intravenous benzodiazepine

Secondary

- Rectal diazepam in dogs or cats
- Intramuscular in dogs or cats (if owners are medically trained)

42

Intra-nasal midazolam



43

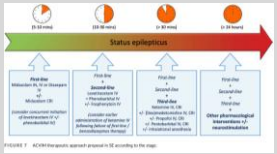
Intra-nasal midazolam

Teleflex Medical LMA MAD Nasal Intranasal Mucosal Atomization Device, 25 Per Box
Brand: Mucosal atomization
4.7 ★★★★☆ (12)
$172.97 ($172.97 / count)

ICU Medical
Inc (B9909) Bravo 24 Multi Dose Vial Access 50/Ca
4.5 ★★★★★ (49)
50+ bought in past month
$87.41 ($1.75/count) Typical: ~~$97.41~~

44

Second-line tx for SE



- Levetiracetam and phenobarbital
- Second line when midazolam hasn't worked
- Also starting the plan for oral management at home
- Giving one or both of these sooner increases probability of terminating seizure emergencies earlier, helps to prevent refractory SE
- Earlier establishment of more effective long-term seizure management
- Treatment with IV levetiracetam should be initiated in dogs and cats, IM or rectal in dogs and cats
  - Treatment with subcutenaous levetiracetam 60 mg/kg over the shoulder blades, kicks in within 15 min and can last 7 hours, n=4
- Treatment with IV phenobarbital in dogs and cats, although loading doses still seem to scare people

45

Cases that refer but then don't work up

- There are a few different reasons that clients would accept referrals, and come for a consultation, but then decide not to do the work-up when they expressed willingness to do so at your office
- Underestimated for the cost of the procedure, or not aware they have to basically prepay for any testing/procedure
- Not realizing the severity of neurological status (paraplegic deep pain negative for long period for example)
- Not understanding the length of nursing care such as urinary bladder expression that may be expected
- Not realizing that problems like IVDD can recur in the future
- The long car ride, and a shift in ranking of priorities

46

Cases that refer but then don't work up

- We are understanding of this situation, and ultimately would rather they decline a work up than later regret having put their pet through a work-up that didn't turn out positively.
- Sometimes anti-inflammatory prednisone and antibiotics can be life saving.
- I have some long-term patients that I manage for "Prednisone responsive neurological problem"

47

3 y FS pitbull mix

- Presented in July 2023 for recurrent episodes of hard to localize pain and lameness for > 18 month prior to presentation
- Exercise induced pain/yelping
- Hesitant to jump/ use stairs
- No improvement with carprofen/gabapentin
- Negative tick PCR
- PE: tarsi possibly slightly effusive, otherwise WNL
- Nervous/skiddish, otherwise normal NE
- DDx: cervical spondylomyelopathy, polyarthritis (immune-mediated vs infectious)
- CBC/chem/T4 – WNL
- Gave estimate for joint taps +/- MRI +/- spinal taps
- Treated with prednisone and doxycycline
- Tapered prednisone by early Feb 2024, and then by end of Feb 2024 she relapsed

48

Questions?

- Charalambous et al 2023. ACVIM Consensus Statement on the management of status epilepticus and cluster seizures in dogs and cats. JVIM 38 (1): 19-40.
- Dos Santos et al 2025. Case Series of Canine Myasthenia gravis: A Classification Approach with Consideration of Seronegative Dogs. JVIM 39:e70113

49

The MONSTERS Within

CLINICAL MANAGEMENT OF SMALL RUMINANT & CAMELID PARASITISM

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1

Small Ruminant & Camelid Parasite Management

Overview

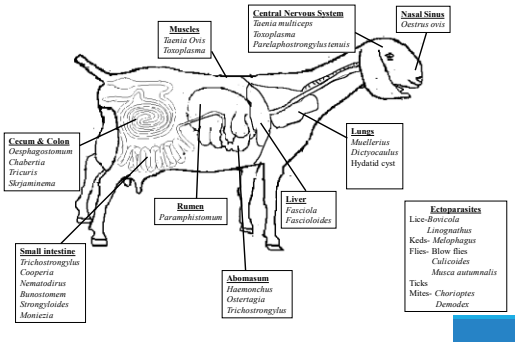
- Clinical importance of common small ruminant & camelid parasites
- Review major small ruminant & camelid parasites
- Evaluation of a parasitized animals
- Treatments and resistance avoidance
- Diagnostics tools available
- Prevention and control strategies
- Case Examples

2

Clinical Signs Associated With Parasitism

- Poor hair coat / peripheral edema
- Ill thrift
- Pneumonia
- Diarrhea
- Weight loss / inappetence
- Deceased production / performance

3



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The "H.O.T." Parasites & More

Abomasal Parasites

- **H** – *Haemonchus*
- **O** – *Ostertagia*
- **T** – *Trichostrongylus*
- These internal gastrointestinal parasites are the most significant parasites of small ruminants & camelids
- ***Eimeria macusaniensis*** = highly pathogenic, large coccidian parasite in camelids

5

Life Cycle of Haemonchus contortus, the barber pole worm

Haemonchus contortus

10

Haemonchus contortus: Barber-pole Worm

- Most important GI parasite of the USA
- **Common Clinical Signs**
  - Anemia (neonates and adults)
  - Hypoproteinemia →Causing clinical signs of bottle jaw and chronic weight loss (adults)
- Peracute to chronic presentations

Haemonchus eggs 80x45um

Necropsy of abomasum with adult worms

11

Haemonchus contortus

12

Why is this parasite such a problem?

- There is an increasingly growing number of resistant intestinal worms of small ruminants and camelids with no currently available affective anthelmintics
- **Resistance:** The ability of a population of organisms to survive a generally efficacious therapeutic regimen
- **Hypobiosis:** Facultative arrested development
- **Refugia**: The population of GI parasites that are not exposed to anthelmintics and as such the anthelmintic remains effective

13

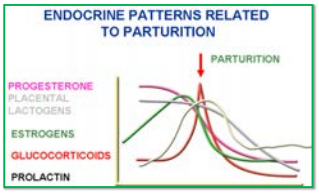
How *Haemonchus* Remains Resilient

Hypobiosis
- Remain in abomasal wall

Activated by hormones
- Estrogen
- Glucocorticoids

Caloric intake changes

Temperature changes
- Overwinter



14

Haemonchus contortus

Reasons for resistance of this parasite
- Resistance genes
- Survival ability
  - Hypobiosis
  - Weather resistance
- Fecundity
  - One worm on one farm can easily lead to millions of eggs being produced over several weeks to months
- Frequent exposure to anthelmintics
  - Misuse of anthelminthics

15

Development of Resistance

Small Ruminant Parasite Treatment Dogma
- Treat **EVERYTHING** on the farm **OFTEN**
  - Accelerated resistance
- This is a major concern as there are no new anthelmintics currently being developed for controlling parasitism
  - Studies on vaccine against *Haemonchus contortus*

16

Other Causes of Resistance

- Using too low of a dose
  - #1 reason for anthelminithic resistance
  - Record weights
    - Scale
    - Measurement
- Increased stocking density
- Often introduced by new livestock to the herd
  - Quarantine protocol for new arrivals
- Changing anthelminithics frequently
  - Leads to increased resistance
- Comingling different age groups
  - Don't forget the bucks / rams
- **Goals:**
  - Minimize anthelminthic drug use
  - Develop "**Refugia**"

17

Refugia

- **Achieving Refugia**
  - Lower but not eliminate the parasite load in adults
  - Reduce contamination of the environment
  - Maintaining a low fecal egg count (FEC) in some of the herd/flock will maintain a parasite population that can become less resistant to anthelminthics

18

4 - Approaches to Parasite Control

"Ostrich"
- Pretend worms don't exist
- Pay the consequences

Cautious
- Deworm frequently
- Whether they need it or not

Crisis
- Wait for signs
- Hope for improvement

Planned
- Design a program
- Monitor with fecal exams

19

Targeted / Strategic De-worming

Targets treatment towards the animals shedding the most parasite eggs

~ 20% of the population

- **High shedders**
  - 20% of the herd sheds/distributes >80% of the parasite burden on the pasture

- **Low shedders**
  - Innate and acquired immunity control the parasite burden
  - Concurrent disease can affect burden
    - Pneumonia
    - Diarrhea
    - Pregnancy Toxemia

20

Environmental Parasite Management

21

How do we know our management and control strategies are working?

22

Diagnostics

Detailed farm history
- Prior anthelmintic use
- Production deficiencies
- Management tactics

Physical Exam

PCV/TS

Fecal Flotations

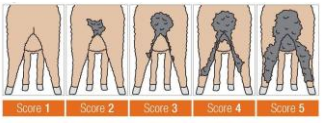
+/- Blood Gas, CBC, Serum Chemistry, Urinalysis

23

Visual Method: DAG Scoring

Scoring amount of scouring / fecal material adhering to wool

Poor method to assess worm burden
- Other issues can cause scours
- Loss of production



24

Visual Method: FAMACHA

Only effective for *Haemonchus*!
- Not to be used by itself!
- Aids in genetic selection for resilience, not resistance
- Score animals from 1-5
  - 1 = Not Anemic
  - 5 = Anemic
- Scores anemia based on mucus membrane color
  - Need to account for:
    - Pigmentation
    - Other diseases
    - Weather
    - Flies

25

Processing FAMACHA Scores

When does one treat an animal when using FAMACHA?
- Treat with scores of 4s and 5s
- Usually, these animals have a PCV of <19%

Treat scores of 3s if:
- > 10% of herd is scored at 4 or 5
- It is a young animal scored as 3
- Pregnant or lactating with a 3 score
- Poor body condition scored as a 3

- With FAMACHA you should always treat an animal with bottle jaw
- Repeat scoring every 2 weeks during the cool, moist seasons of prime survival time for the parasites
- Repeat scoring every 4-6 weeks
- Cull chronic offenders

26

Fecal Exams

Qualitative
- Simple fecal flotation
- Presence does not indicate disease
- Useful if goal is elimination

Quantitative
- McMasters
- Wisconsin/Modified Wisconsin
- Eggs per gram - cutoffs vary

27

F. E. C. R. T. – Evaluating Anthelminthics

Fecal Egg Count Reduction Test ($$)
- Cheaper method to resistance ID
  - On-farm test
  - >95% reduction in eggs per gram
- Forces owner to monitor animals
- Worm species unknown

Day 0
FAMACHA scored
Deworm
McMasters test

Animals remain on same pasture

Day 14
Repeat McMasters test

29

Using Fecal Exam Information

Results reported out as eggs per gram of fecal material

Thresholds are different for each parasite
- *Haemonchus*
  - EPG >2000 EPG bucks and dry does
  - EPG >1000 EPG young and lactating
  - 750 dairy does
- *Ostertagia*
  - EPG >1000 EPG bucks and dry does
  - EPG >500 EPG young and lactating
  - 325 EPG dairy does

Minimum of 6 animals, ideally 10-12 random

EPG, Treat, wait 2 weeks and repeat EPG:
- > 95% reduction → anthelmintic is considered effective
- < 95% reduction → resistance or failure of treatment

Cull out repeat offenders

Animals with low fecal egg counts may not benefit from deworming
- Saves $$$$

30

Treatment Guidelines

Anthelmintic rules
- 80%/20% rule
- Use FAMACHA score
- Correct dosing
- Oral or injectable preferred
- Do not "rotate" dewormers
- Pour – Ons: NOT recommended
  - Goats and sheep are not cows
  - Don't absorb the same, results are unreliable
- Multiple classes may be required
  - Synergy

- Cull if multiple doses are required
  - Natural resilience

31

Treatment

Anthelmintics
- Imidothiazoles
- Benzimidazoles
- Macrocyclic Lactones

Ancillary Treatments
- Increasing dietary protein
- Copper oxide wire particles
- Tobacco
- Nematode trapping fungi
- High tannin containing forages
- Future vaccines???
- Diatomaceous earth – NO!!!!

32

Withdrawals

- Not many approved drugs for small ruminants & camelids
- Almost all extra-label
- Can be lengthy
  - Ivermectin can be over 30 days w/d
- Know where to go for answers
  - FARAD – Food Animal Residue Avoidance Databank
  - http://www.farad.org/
  - Compliance Policy Guide Sec 615.115 Extra label Use of Medicated Feeds for Minor Species

FARAD

Food Animal Residue Avoidance Databank

a component of the Food Animal Residue Avoidance & Depletion Program

33

Treating Severe Parasitism

34

Treatment

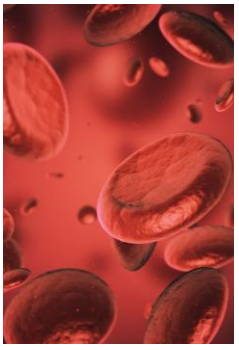
Blood Transfusion ($$$)

- <15% PCV
- Clinically warranted
- Can improve of PCV approx. 10%

Many blood groups in livestock

- Cattle: 70
- Sheep: 8
- Goats: 6
- Camelid: 6

35



When to administer a transfusion?

- **Rate of Blood Loss**
  - 15-20% acute loss
  - <10-15% chronic loss
- **Clinical Signs the Animal is Showing**
  - Tachycardic
  - Tachypneic
  - Edema formation
- **Aggressive Crystalloid Therapy**
  - Severe dehydration and/or azotemic
  - Aggressive fluid therapy needed in high volumes

36

Whole Blood Groups By Species

- **Cattle**
  - A, B, C, F, J, L, M, S, Z, R', T' – with 70 blood group factors
- **Sheep**
  - R-O, A, B, C, D, M, X – with 22 blood group factors
- **Goats**
  - A, B, C, E, F, R – most goats lack the glycolipid factors that cause reactions
- **Camelids**
  - A, B, C, D, E, F

Most transfusions can be given a without a crossmatch due to unlikelihood of transfusion reaction BUT, when possible, perform them especially on repeat transfusions and highly valuable animals!

37

Blood Donor Management

- **Donors = Healthy Adult Animals**
  - Normal PCV and TP
  - Non-gestating & Non-lactating
  - Low GI parasite burden
  - Free of infectious diseases:
    - **Cattle** -
      - BLV, BVD, Brucellosis, Tuberculosis, Johne's (MAP) Disease, Blood parasites
    - **Small Ruminants** -
      - CAE, CL, Brucellosis, Tuberculosis, Coxiella, *Sarcocystis ovicanis*, Blood parasites
    - **Camelids** –
      - BVD, *Mycoplasma haemolamae*

Most blood donors come from the same herd as the recipient – BEWARE!

38

Donations

- **Donation Amount**
  - Donor should weigh more that the recipient!
  - Preferred not to use dam's blood for offspring – dam is immunosuppressed
  - Absolute MAX. donation 20% of total blood volume = 1.5% of body weight
  - Safer to take 10-15% of total blood volume
  - Blood Volume = 8% of total body wgt
  - Donated blood volume can be replaced with crystalloid fluids
  - 2-3 weeks between each donation
  - **Calculations**:
    - (Animal body wgt in kg x 8%) x 10 to 20% = volume to be taken in liters
      - Ex: (100kg x 8%) x 15% = 1.2 L
    - Quick calculation: 10ml/kg (6-15 ml/kg) of blood that can be taken from the donor in ml

39

Whole Blood Transfusion Calculations

- **Recipient Amounts**
  - **Anemia Calculations:**
    - Blood volume to be infused (L) = $\frac{\text{Desired PCV (\%)} - \text{Recipient PCV (\%)} \times \text{Recipient body weight (kg)} \times 0.08}{\text{Donor PCV (\%)}}$
  - **Hypoproteinemia Calculations:**
    - Volume to be infused (L) = $\frac{\text{Desired Alb} - \text{Recipient Alb}}{\text{Donor Alb}}$ X Recipient body weight (kg) x 0.06 L/kg
  - **For Neonates with FTPI**
    - Whole Blood = 40 ml/kg
    - Plasma = 20 ml/kg

40

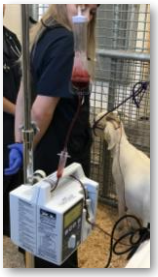
Anticoagulants Available

Acid Citrate Dextrose Anticoagulant
- If blood is to be stored more than a few hours
- 1:7 → ACD : Whole Blood

Sodium Citrate Anticoagulant
- 2.5 – 4% sodium citrate solution
- 1:9 → Sodium Citrate : Whole Blood

Heparin
- CAREFUL! For emergency circumstances – heparinization of patient and cause excessive hemorrhage
- 4.5 – 5 units : 1mL of whole blood

41



Transfusion Logistics

- **Bleeding trocar (high gauged needles/catheter > 10 gauge)**
- **Blood transfusion bags with anticoagulant**
- **Blood filtration set with micro-filter to remove blood clots**
- **Occlude jugular vein**
- **Agitate transfusion bag (rock the bag gently)**
- **Weigh bag to determine volume**
- **Volumetric/Syringe pumps – may cause damage to blood cell ↓ life span**
  - Allow blood flow by gravity for best outcomes

42

Transfusion Logistics

- **Blood Transfusion Rates:**
  - Start with 5 mL/kg/hr for the first 15-20 minutes
  - If tolerated, increase the rate to 10 mL/kg/hr for next 30 minutes
  - Then increase rate to 20 mL/kg/hr
    - Deliver transfusion over the next 4 hours depending on patient weight and volume of transfusion to be infused

Monitor HR, RR, Temp. & M.M. Pallor

Large Animal Transfusion Record

Date: _____ Clinician Contact PH#: _____

Patient's Weight: _____ (lbs / kgs) Administered by: _____

Select type of Transfusion: Whole Blood / RBC's / Plasma / Other: _____

Reason for Transfusion: _____

Date & Time Drawn: _____ Total Amount of Transfusion: _____ mLs

Donor ID/Prod. Serial #: _____ Donor PCV: _____ % Donor TP: _____ g/dL

Patient's Starting PCV: _____ % TP: _____ g/dL Ending PCV: _____ % TP: _____ g/dL

Anti-inflammatory given: _____ Amount: _____ mg Route: SQ / IM / IV

Time Anti-Inflammatory Administered: _____

**** Wait 20 minutes prior to starting transfusion****

TIME	MINUTES	RATE	TEMP	PULSE	RESP	OTHER	INITIALS
	Initial TPR						
	5						
	10						
	15						
	30						
	60						
	90						
	120						
	180						
	240						
	300						

43

Monitor for Transfusion Reactions

Non-Immediate Reactions:

- **Tachypnea (elevated breathing)**
- **Tachycardia (elevated heart rate)**
- **Temperature increase**
- **Urticaria (hives/skin reaction)**
- **Swelling of skin around face and extremities**
- **Piloerection (hair standing on end)**
- **Restlessness**
- **Mentation changes**
- **Vomiting**
- **Hemoglobinuria / Hemoglobinemia**

Immediate Reactions:

- Transient apnea (cessation of breathing)
- Bradycardia and/or arrhythmias (slow heart rate, irregular rhythms)
- Seizures, vocalization, urination, defecation
- Death

44

Recent Transfusion Research

frontiers in Veterinary Science

Front Vet Sci. 2021 Mar 4;8:637988. doi: 10.3389/fvets.2021.637988

Preliminary Investigation of Bovine Whole Blood Xenotransfusion as a Therapeutic Modality for the Treatment of Anemia in Goats

Joe S Smith [1,2,*], Austin K Vial [3], Ryan M Breuer [4], Rebecca A Walton [5], Paul J Plummer [1,6,7], Ronald W Griffith [6], Amanda J Kreuder [1,6,*]

45

Prevention

Management practices

- Routine monitor (FAMACHA)
- Confinement vs pasture
- Nutrition
- Feed bunk location/access
- Fecal management
- Pasture rotation
- Comingle species
- Genetic selection

46

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47

Eye Can't Believe It's Not Better:

Navigating the Nuances of Chronic Ocular Therapy

Jessica McDonald, DVM DACVO

1

Thank you!

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2

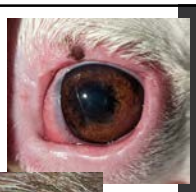
Summary

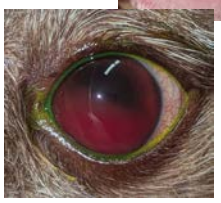
- What?
  - Long term ophthalmic conditions
    - Most immune-mediated
  - Review of inflammatory ocular medications and uses
- Where?
  - Review of common immune mediated ocular conditions
- When?
  - Tips to manage long-term

3

The What?
Long-Term Diseases

- LOTS of them
  - Blepharitis
  - Conjunctivitis
  - Episcleritis
  - Keratitis
  - Keratoconjunctivitis
  - Uveitis (Anterior/Posterior)
    - Cataract
  - Glaucoma
  - Chorioretinitis
  - Optic neuritis





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Etiologies

- Allergic
- Immune-mediated
  - **Most common**
    - **"Idiopathic"**
- Infectious
  - Bacterial
  - Fungal
  - Viral
  - Protozoal
  - Tick-borne
- Neoplastic
  - Primary
  - Metastatic
- Traumatic

5

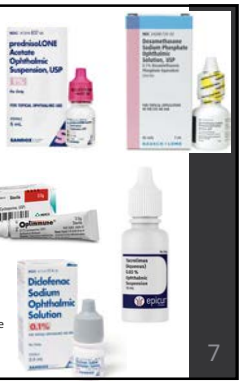
STEROIDS:
STEREOTYPE

STEROIDS:
MEDICAL REALITY

6

Anti-Inflammatory Drugs

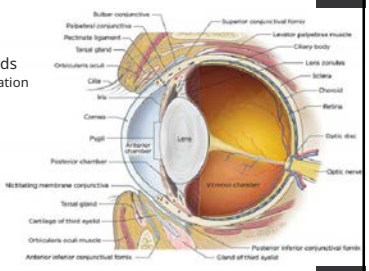
- Topical Steroids
  - Prednisolone acetate 1%
  - Dexamethasone 0.1%
  - NeoPolyDex
  - NeoPolyBac + Hydrocortisone
  - Difluprednate 0.05%
- Topical NSAIDs
  - Flurbiprofen 0.03%
  - Diclofenac 0.1%
  - Ketorolac 0.5%
- T-cell Modulators
  - Cyclosporine 1%, 2%
  - Tacrolimus 0.03%, higher strengths
- Oral Medications
  - Prednisone, cyclosporine, mycophenolate, azathioprine, leflunomide
- Injectable Medications: Triamcinolone



7

The Where?

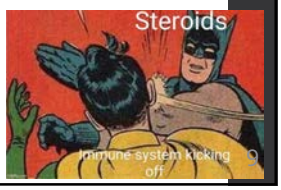
- What area are you treating?
  - Anterior segment --- Topical meds
    - Limited topical medication penetration
  - Back of eye --- Oral meds
    - Vitreal / Retinal inflammation
  - Vascular Structures --- Oral and topical meds
    - Eyelids, uvea
- Combining medications
  - Topical NSAID + Topical Steroid
  - Oral NSAID + Topical Steroid
  - Oral Steroid + Topical NSAID
  - Oral NSAID + Oral Steroid



8

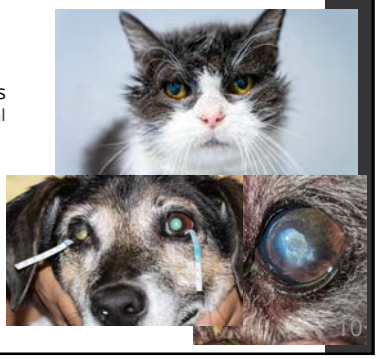
Topical Steroids

- First line therapy for ocular inflammation
- Useful for eyelids, surface, anterior segment
  - Blepharitis / Meibomianitis
  - Keratoconjunctivitis
  - Keratitis
  - Episcleritis
  - Anterior uveitis
  - Glaucoma



Topical Steroids

- Caution with risky corneas
  - Contraindicated with corneal ulcerations
  - Care in older animals
- Not "ideal" for long-term use
  - Steroid keratopathy
  - Corneal degeneration
  - Corneal thinning



10

Topical Steroids

- Risk of antibiotic resistance
  - Neo-poly overuse?
- No neo–poly–**XX** in cats
  - Anaphylaxis, death
  - FHV-1 flare

Bacitracin, neomycin, and polymyxin B (44%)
Oxytetracycline and polymyxin B (21%)

Polymyxin B was present in all cases

In 56% cases, anaphylaxis occurred within 10 min of drug application

Most (82%) cats survived

jfms

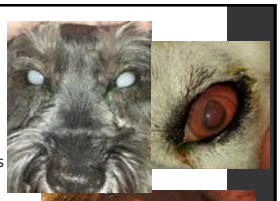
Anaphylactic events observed within 4 h of ocular application of an antibiotic-containing ophthalmic preparation: 61 cats (1993–2010)

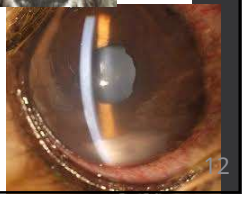
Karen M Hume-Smith DVM[1,a], Allyson D Groth BVSc[1], Mark Rishniw BVSc, Dipl ACVIM[2], Linda A Walter-Grimm DVM[1], Signe J Plunkett DVM[3], David J Maggs BVSc, Dipl ACVO[3,a]

11

Topical NSAIDs

- Not as strong as steroids in acute management as solo therapy
  - Better for maintenance
  - Can be used in combination for severe cases
- Most useful for anterior segment
  - Cataract long-term management
  - Uveitis
- Safe for long term use
  - Get control with topical steroids first
    - Then switch!
  - Elevation in IOP?





12

13

Topical NSAIDs

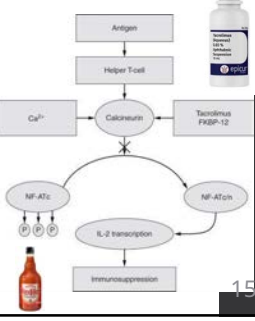
- Contraindications
  - Glaucoma
  - Acute hyphema
    - Continued bleeding?
  - Corneal ulceration
    - Oral meds better
    - Decreased healing, concern for melting
- Caution in cats
  - Can affect GFR
  - Elderly

Systemic absorption and adverse ocular and systemic effects after topical ophthalmic administration of 0.1% diclofenac to healthy cats

Kimberly K. Hsu
Chantale L. Pinard
Ron J. Johnson
Dana G.Allen
Butch K. KuKanich
Stephanie G. Nykamp

14

Calcineurin Inhibitor/T-cell Modulators



- Dry eye / Keratoconjunctivitis
  - Qualitative
  - Quantitative
- Allergic conjunctivitis
- Keratitis
  - Pigmentary Keratitis
  - Eosinophilic Keratitis
  - Chronic superficial / Pannus
- Corneal degeneration / Lipid keratopathy
- Does NOT penetrate into the eye
  - Not effective for uveitis etc!

15

Calcineurin Inhibitors/ T-cell Modulators

- Available formulations – Compounded
  - Oil based (MCT, corn, coconut, others)
  - Aqueous based
- Strengths
  - Optimmune 0.2% (cyclosporine)
  - Cyclosporine 1% , 2%
  - Tacrolimus 0.02%, 0.03%, 0.2%, 0.3%, 0.5%, 1%
- Need 4-6 weeks to fully become effective
- Safe for long term use
  - Safe on corneal ulcers?

16

Key Drug Points

- Target tissue
  - Know where your drug distributes
  - Combine with oral medications often
- Steroids are powerful, not forever (ideally)
  - Combine with NSAID or T-cell modulators
  - Monitor corneal health

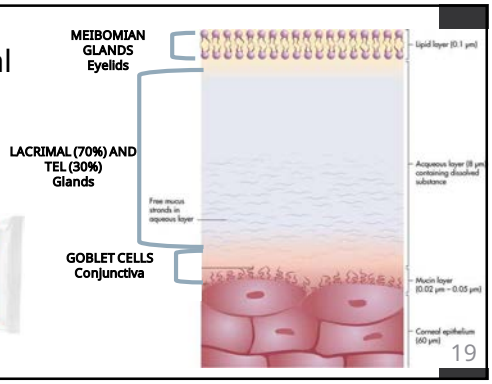
17

Specific Diseases

- Blepharitis
- Conjunctivitis
- Episcleritis
- Keratitis
- Keratoconjunctivitis
- Uveitis (Anterior/Posterior)
  - Cataracts
  - Immune mediated
- Glaucoma
- Chorioretinitis
- Optic neuritis

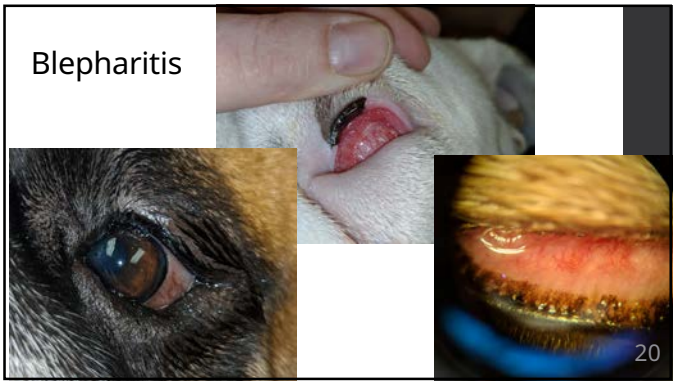
18

Precorneal Tear Film



19

Blepharitis



20

Blepharitis / Blepharoconjunctivitis

- Ultimately a skin condition manifesting around the eyes
- Work on the skin, help the eyes

21

Blepharitis/Blepharoconjunctivitis

- Try to find underlying cause
  - Parasitic (demodex, FAD, flies, ticks)
  - **Allergic**
  - **Immune-mediated**
  - Viral
  - Ocular diseases (KCS, conjunctivitis, keratitis)
  - Bacterial
  - Fungal

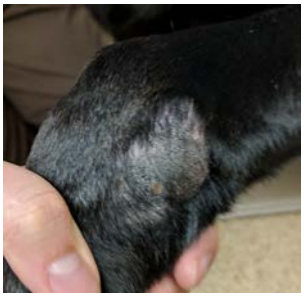
22

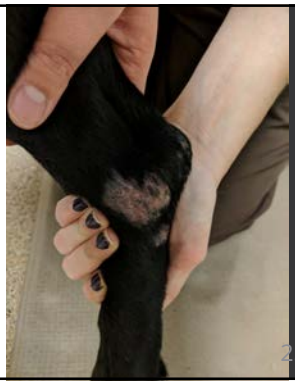
Blepharitis / Blepharoconjunctivitis

- Usually combination of oral and topical anti-inflammatories
  - Oral prednisone on taper (0.5 to 1 mg/kg/day split PO q12hr)
  - Transition to secondary immunosuppressive if concerned about immune mediated/ long term control
    - Cyclosporine, mycophenolate, azathioprine
  - Ophthalmic ointments (NPD ointment) preferred if possible given qualitative tear film deficiencies
- T cell modulators
  - Optimmune, tacrolimus, cyclosporine q12-24 hours
- Tear Stabilizers
  - Lubricating gel, ointment
  - Re-wetting solutions ineffective due to lack of contact time, need to administer frequently

23

24

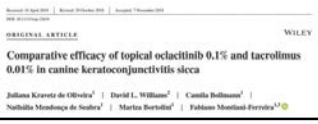




25

A word on JAX inhibitors/ IL-31 Biologics

- Not the best for primary ocular allergic disease
  - Still need to manage ocular signs with topical medications
- Same treatment as blepharitis



ORIGINAL ARTICLE

WILEY

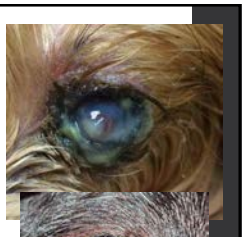
Comparative efficacy of topical oclacitinib 0.1% and tacrolimus 0.01% in canine keratoconjunctivitis sicca

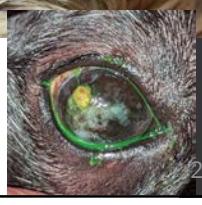
Juliana Kravetz de Oliveira[1] | David L. Williams[2] | Camila Bollmann[1] | Nathália Mendonça de Seabra[1] | Marina Bortolini[1] | Fabiano Montiani-Ferreira[1,2]

26

Keratoconjunctivitis Sicca

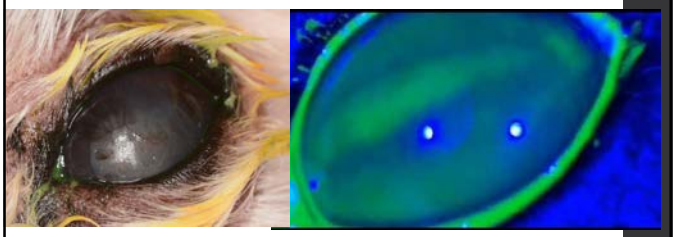
- 15 mm/min = normal production
- 11–14 mm/min = early or subclinical KCS
- 6–10 mm/min = moderate or mild KCS
- <5 mm/min = severe KCS
- Quantitative vs Qualitative
- Pro-tip!
  - Start medications early if able
    - An ounce of prevention can go a long way





27

TFBUT



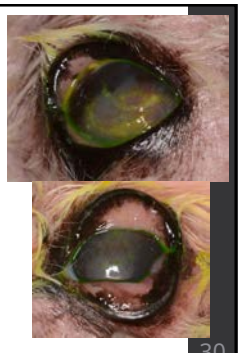
28

Keratoconjunctivitis Sicca

- Optimmune 0.2% ointment (cyclosporine) q8-12hr
  - Wimpy, mild KCS cases only
  - Helpful if need lubricating ointment or qualitative disease
- Compounded medications q8-12hr
  - Tacrolimus 0.03% ophthalmic solution
    - Can go to higher strengths if needed
      - 0.1%, 0.3%, 0.5%, 1% (Stokes/Epicur)
    - Better for corneal pigment (IMO)
  - Cyclosporine 1%, 2% ophthalmic solution
  - Oils better for dry eye? More irritating?
  - Some non-responders to CSA will respond to tacro or vice versa

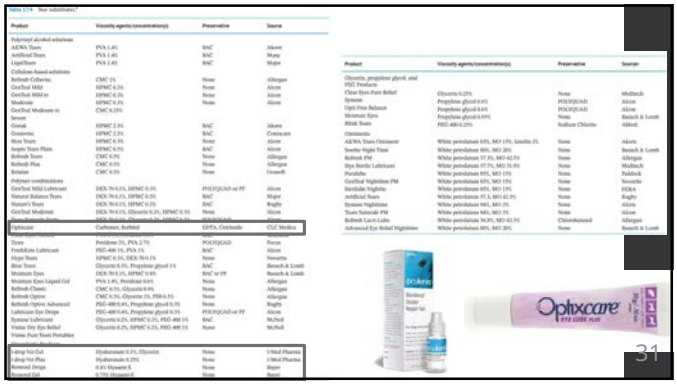
29

Keratoconjunctivitis Sicca



- Start immunomodulator for 4-6 weeks, use lubricant/ tear substitutes in meantime as needed
  - Recheck tear production
  - If controlled, continue for life, recheck q6-12 months
  - If uncontrolled, consider increase in dose or stronger percentage
  - Reassess again in 4-6 weeks
- Cautions corticosteroid if needed, ideally once tear production is better controlled
  - More risk of corneal ulceration if uncontrolled
  - NPD ointment q12-24 hours
  - Topical NSAIDs
    - Careful with ketorolac

30

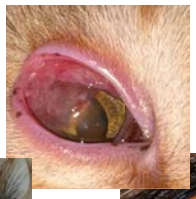


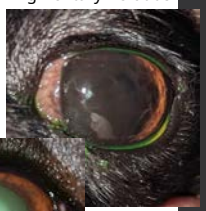
31

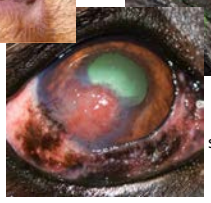
Keratitis

Pigmentary Keratitis

Eosinophilic Keratitis







Pannus/ Chronic superficial keratitis

Nodular Granulomatous Episcleritis

the.eye.vet

32

Management Options of Keratitis

- Topical Immunomodulatory
  - Optimmune 0.2% ointment (cyclosporine) q12hr
  - Compounded medications q12 hours
    - Tacrolimus 0.03% ophthalmic solution
      - Higher strengths usually NOT needed
    - Cyclosporine 1%, 2%

Goal
Least effective dose to keep signs controlled (life)

- Topical Steroid
  - q12-24hr--alcohol and sodium phosphate formulations
    - Dexamethasone 0.1%
    - Neo-poly-dex
      - Avoid in cats!
    - Megesterol acetate 0.5% (compounded)---Eosinophilic Keratitis
    - Prednisolone Acetate 1% is fine too, I typically reserve for uveitis

33

Management Options of Keratitis

Subcutaneous administration of triamcinolone as part of the management of feline eosinophilic keratoconjunctivitis

Danica R Lucyshyn, Kathryn L Good, Kelly E Knickelbein, Maggie W Chang, Ann R Strom, Steven R Hollingsworth, Sara M Thomasy, Brian C Leonard, Lionel Sebbag, K Tonio Wiggans and David J Maggs

Ankara Univ Vet Fak Derg, 68, 61-68, 2021
DOI: 10.33988/auvfd.724846

Long-term prospective assessment of subconjunctival triamcinolone acetonide in addition to topical therapy in the management of chronic superficial keratitis

Florin BETEG, Cristina Alexa LELESCU, Andrada Elena URDĂ-CÎMPEAN, Marian Aurel TAULESCU, Cosmin MUREŞAN

34

Uveitis

****WARNING BUSY SLIDE AHEAD****

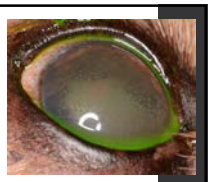
35

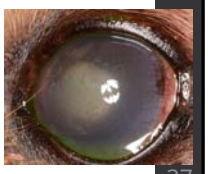
Uveitis

- Dog
  - **Immune-Mediated/Idiopathic: The most common cause**
    - Diagnosed by ruling out infections and neoplasia
  - Infectious Diseases: Bacterial (Leptospirosis), **tick-borne** (Ehrlichia, Lyme Disease, Rocky Mountain Spotted Fever), and fungal (**Blastomycosis**, Histoplasmosis)
  - Neoplasia: Lymphoma, melanoma, and ocular tumors
  - Trauma: Penetrating eye injuries, blunt force trauma (e.g., dogfights, car accidents).
  - Lens-Induced: Damaged or leaking cataracts causing inflammation (lens induced uveitis)
  - Systemic Disease: High blood pressure or metabolic diseases
  - Breed-Specific/Systemic Conditions: Golden Retriever Pigmentary Uveitis/GRPU, uveodermatologic syndrome (common in Akitas, Huskies)
- Cat
  - Feline Infectious Peritonitis (FIP)
  - Feline Leukemia Virus (FeLV)
  - Feline Immunodeficiency Virus (FIV)
  - Toxoplasmosis (Toxoplasma gondii)
  - Bartonella henselae
  - Systemic fungal infections (e.g., Cryptococcus, Blastomycosis)
  - Trauma: Penetrating injuries, corneal ulcers, or blunt trauma.
  - Neoplasia (Cancer): Primary intraocular tumors or metastatic tumors, most notably lymphoma
  - **Immune-Mediated: Chronic idiopathic lymphocytic/plasmacytic cases**
  - Systemic Diseases: High blood pressure (hypertension) or high blood lipids (hyperlipidemia)
  - **Idiopathic: No specific cause can be identified in 40–70% of cases.**

36

Uveitis





- Immediate: Aggressive topical therapy (q6-8hr) initially, to control inflammation and prevent glaucoma or adhesions (posterior synechiae)
  - Prednisolone acetate 1% (better corneal penetration)
  - Dexamethasone 0.1%, Neo-poly-dexamethasone
  - Check fluorescein stain and IOP
- Atropine 1%: Dilate the pupil, prevent further scarring, and relieve ciliary muscle spasm?
  - If IOP <20mmHg due to concerns of glaucoma from closure of the drainage angle
  - Avoid if pupil is "stuck" due to posterior syenchia

37

Uveitis - Initial Management

- Systemic Medication: Oral NSAIDs (e.g., carprofen, meloxicam) or systemic anti-inflammatory steroids (**preferred if severe**) are often necessary initially
  - Caution in infectious cases (anti-inflammatory doses only)
- Addressing Underlying Causes:
  - Diagnostic workup (CBC, chemistry, serology, abdominal ultrasound) is essential to identify infections (tick borne, lepto, fungal) leaving immune-mediated causes
  - **Must start treatment while waiting for results!**
  - Uveitis profile PCR...Cheap but minimally helpful

38

Uveitis-Long Term Management

- Lifelong anti-inflammatories due to risk of relapse
  - Reduce to "lowest-effective dose"
  - Consider transition to topical NSAID lifelong if able to control
    - If relapse, may require topical steroid ongoing
    - Monitor for steroid keratopathy!

39

Steroid keratopathy

Steroid keratopathy

Corneal Degeneration

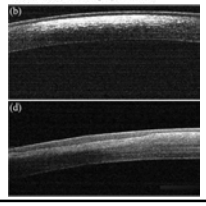
40

Open Veterinary Journal, (2023), Vol. 13(9): 1167–1174
ISSN: 2226-4485 (Print)
ISSN: 2218-6050 (Online)
Original Research
DOI: 10.5455/OVJ.2023.v13.i9.13
Submitted: 02/05/2023 Accepted: 25/08/2023 Published: 30/09/2023

Topical 1% cyclosporine eyedrops for the treatment of crystalline corneal dystrophy in dogs

Manuela Crasta[a], Kevin Arteaga[a,c], Teresa Peña[a,b] and Marta Leiva[a,b]

[a]AniCura Visiovet, Eye Clinic, San Giovanni in Persiceto, Bologna, Italy
[b]Departament de Medicina i Cirurgia Animals, Facultat de Veterinària, Universitat Autònoma de Barcelona, Bellaterra, Spain
[c]Servei d'Oftalmologia, Fundació Hospital Clínic Veterinari, Universitat Autònoma de Barcelona, Bellaterra, Spain
*Both authors contributed equally to this work.



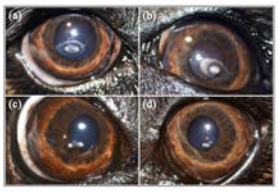
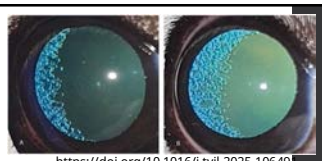


Fig. 1. Cavalier King Charles Spaniel with (a) CCD OD and (b) OS classified as grade 2 at first presentation, and subsequently classified as grade 1 after 12 months of topical 1% CsA treatment (c) OD and (d) OS.

41

Cataract

- Ketorolac 0.5%, Diclofenac 0.1% or Flurbiprofen 0.03%
  - Once a day if still can see the fundus
  - Twice a day if cannot see fundus
  - Lifelong
- Nearly ALL diabetics have evidence of cataract at time of diagnosis
  - Start when able minimally q24hr
  - Monitor for dry eye
- If left untreated, will develop secondary glaucoma in lifetime



https://doi.org/10.1016/j.tvjl.2025.106491

42

Glaucoma

Anti-inflammatories are key in control of glaucoma
- Primary
- Secondary

animals

Review

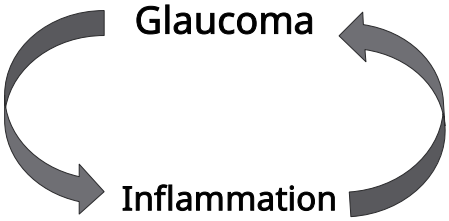
Role of Inflammation in Canine Primary Glaucoma

Lionel Sebbag *[1] and Oren Pe'er [2]

*Among others, **inflammation further impacts IOP by reducing aqueous humor outflow at the level of the iridocorneal angle and accelerates vision loss** by promoting neuronal degeneration. As such, the **vicious cycle of ocular inflammation and IOP elevation might warrant the use of anti-inflammatory medications as a core component of the treatment regime** for dogs with primary glaucoma, either **therapeutically (i.e., actively glaucomatous eye) or prophylactically in the yet unaffected contralateral eye**.*

43

"Death Cycle"

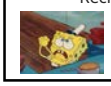


44

Glaucoma

Acute Glaucoma with Visual Eye
- IOP is controlled
  - Dorzolamide +/- Timolol q8-12hr
  - Latanoprost q8-12hr
  - Anti-inflammatory q12-48hr
    - Prednisolone Acetate %, Dexamethasone SP 0.1%
  - Oral anti-inflammatory
  - Analgesic
- Recheck 24-48 hours

Chronic Glaucoma with Blind Eye
- Not emergent!
  - Dorzolamide +/- Timolol q8-12hr
  - +/- Latanoprost q8-12hr
  - Anti-inflammatory q12-48hr
    - Prednisolone Acetate 1%, Dexamethasone SP 0.1%
  - +/- Oral anti-inflammatory
  - +/- Analgesic
- Recheck 1-2 weeks



Make sure owners give drops on day of recheck!!

45

Long Term Management-Glaucoma

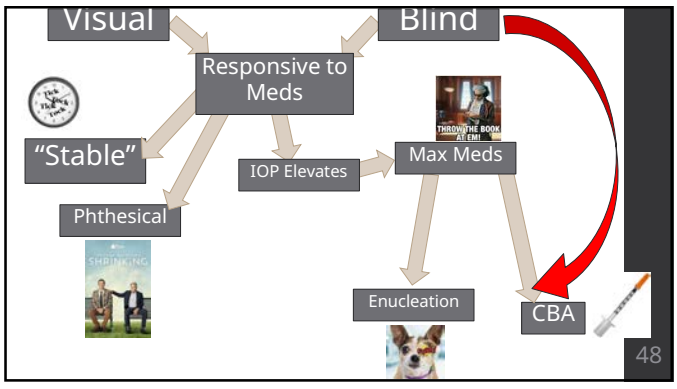
- IOP rechecks
  - Monthly for 3 months, then q3-4 months for monitoring
  - Goal <20mmHg
- Primary glaucoma is a BILATERAL disease
- Prophylaxis in contralateral eye (good eye)

46

Long Term Management-Primary Glaucoma

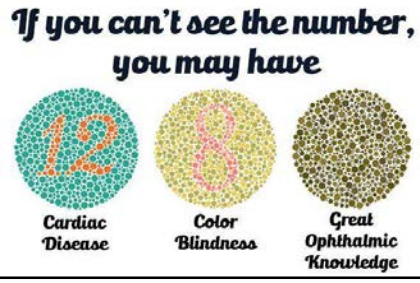
- Asymmetrical presentation
  - Avg 8 months until contralateral eye is affected WITHOUT medications
  - 32-36 months until contralateral eye is affected WITH prophylaxis
  - Extra 12 months with anti-inflammatory added? Dees et al.
- Prophylactic therapy recommendations
  - Dorzolamide 2% q12h
    - Timolol 0.5%, latanoprost 0.005% q12hr
  - Steroid q24-48 hours
    - Monitor for steroid keratopathy

47



48

Questions?



49

The Stone Dilemma: Managing Obstructive Urolithiasis in Small Ruminants

Sabrina Brounts, DVM, MS, PhD, DACVS, DACVSMR
Clinical Professor at University of Wisconsin–Madison

Introduction

Obstructive urolithiasis remains one of the most common and frustrating emergencies encountered in small ruminant practice. The condition is especially prevalent in pet goats, show animals, and feedlot lambs, where dietary management and prolonged lifespan increase the likelihood of stone formation. In production animals, obstructive urolithiasis often results in significant economic loss because cases are frequently identified late in the disease process.

The condition carries both emotional and financial implications for owners. Early recognition, rapid stabilization, and timely surgical decision-making are essential to improve survival and long-term outcomes.

Male small ruminants are predisposed to urinary obstruction because of their long, narrow urethra. Common sites of obstruction include:

- Urethral process (vermiform appendage)
- Distal sigmoid flexure
- Ischial arch

Obstruction in females is uncommon because of the shorter and wider female urethra.

Pathophysiology and Risk Factors

Urolith formation is multifactorial and influenced by diet, urine composition, water intake, and management practices.

Major risk factors include:

- High grain or high phosphorus diets
- Improper calcium-to-phosphorus ratio
- Low water intake
- Infrequent urination
- Alkaline urine pH
- Early castration
- Genetic predisposition

The ideal dietary calcium-to-phosphorus ratio is approximately 2:1. Diets approaching a 1:1 ratio markedly increase the risk of phosphatic stone formation.

Common Urolith Types

Struvite (Magnesium Ammonium Phosphate)

Struvite stones are commonly encountered in feedlot lambs, show goats, and pet animals receiving grain-heavy diets. These stones form in alkaline urine and may respond to urine acidification therapy.

Calcium Carbonate
Calcium carbonate stones are frequently associated with pasture grazing and legume-heavy diets such as alfalfa hay. These stones are hard, smooth, and generally do not dissolve with urinary acidifiers.
Silica and Calcium Oxalate
Silica stones occur more commonly in geographic regions with silicate-rich soils and grasses. Calcium oxalate stones may be associated with oxalate-rich plants or excessive calcium intake.
Understanding the likely stone type helps guide prevention strategies and treatment expectations.

Clinical Presentation and Diagnosis
Clinical signs vary depending on whether the obstruction is partial or complete and whether bladder or urethral rupture has occurred.
Early behavioral signs include straining, "dry" straining (full obstruction), dribbling (partial obstruction), flagging the tail, and "sawhorse" stances due to colic. Owners often misinterpret these signs as constipation.

Physical Exam Findings
- **Early:** Elevated heart rate, pulsing urethra during perineal palpation, and a distended "water balloon" bladder on abdominal palpation.
- **Late:** Arrhythmias, lethargy, a "sloshy" abdomen indicating a ruptured bladder (uroperitoneum), or prepuce swelling indicating a ruptured urethra.

Diagnostic Approach
Laboratory Evaluation
Important laboratory abnormalities include:
- Azotemia (elevated BUN and creatinine)
- Hyperkalemia
- Hemoconcentration from dehydration

Serum potassium concentrations below 5.2 mEq/L are associated with improved survival.
Ultrasonography
Ultrasound is one of the most useful diagnostic tools in field and hospital settings.
Ultrasonographic findings may include:
- Enlarged urinary bladder
- Hyperechoic sediment within the bladder
- Hydronephrosis
- Free abdominal fluid consistent with uroperitoneum

A severely enlarged bladder indicates prolonged obstruction and increased risk of rupture.
Radiography
Survey radiographs may identify radiopaque uroliths such as calcium carbonate and calcium oxalate stones. Radiographs also assist in locating stones and assessing the extent of disease.

Abdominocentesis
Abdominocentesis is useful when bladder rupture is suspected. Fluid creatinine concentration higher than serum creatinine supports a diagnosis of uroperitoneum.

Stabilization and Emergency Triage
Initial stabilization focuses on correcting life-threatening metabolic abnormalities and decompressing the urinary system.

Sedation and Analgesia
Alpha-2 agonists such as xylazine should generally be avoided because they may increase urine production.

Common sedation protocols include:

- Midazolam with butorphanol
- Midazolam with morphine
- Butorphanol, midazolam, and ketamine combinations

Epidural anesthesia using lidocaine, bupivacaine, or preservative-free morphine can provide excellent analgesia for procedures involving the pelvis and urethra.

Fluid Therapy and Hyperkalemia Management
Intravenous fluid therapy using 0.9% saline is preferred because lactated Ringer's solution contains potassium.

Treatment of hyperkalemia may include:

- Calcium gluconate for myocardial protection
- Dextrose administration to promote intracellular potassium shift

Emergency Decompression
Urethral Process Amputation

Excision of the urethral process is a rapid and minimally invasive first step. In some animals, urine flow resumes immediately following removal of distal urethral obstruction.

Percutaneous Cystocentesis

Ultrasound-guided cystocentesis can temporarily decompress the bladder for up to 24 hours. However, repeated drainage may increase the risk of urine leakage or bladder tearing.

Bonanno Catheter Placement

Temporary placement of a Bonanno catheter allows continuous bladder decompression for 12–48 hours while the patient is stabilized prior to surgery.

Medical and Surgical Management
Medical Management
Medical management alone has variable success rates and high recurrence rates.

Components of medical therapy include:

- Urinary decompression
- Intravenous fluids
- Pain management
- Anti-inflammatory medications
- Antibiotic therapy
- Urinary acidification

Walpole’s solution may be used to dissolve struvite stones by acidifying urine within the bladder. This approach is generally reserved for cases where surgery is not financially feasible. Even when medical management is initially successful, recurrence and re-obstruction are common.

Surgical Management

Most obstructed animals ultimately require surgical intervention.

Perineal Urethrostomy

Perineal urethrostomy creates a permanent urethral opening and is typically reserved for pet or meat animals that will not be used for breeding.

Advantages include:

- Rapid relief of obstruction
- Lower cost
- Standing procedure with local anesthesia

Disadvantages include:

- Hemorrhage
- Urine scalding
- Stricture formation
- Risk of recurrent obstruction proximal to the stoma

Long-term survival is variable.

Tube Cystostomy

Tube cystostomy is considered the preferred treatment for valuable breeding or pet animals.

The procedure involves:

- Placement of a Foley catheter into the bladder
- Temporary urine diversion
- Normograde flushing of urethral calculi
- Allowing urethral inflammation to resolve while urine bypasses the urethra

Advantages include preservation of normal anatomy and breeding ability, with reported success rates of approximately 75–80%.

Disadvantages include:

- Higher cost
- Requirement for anesthesia and hospitalization
- Catheter complications
- Potential failure to restore urethral patency

Minimally invasive and percutaneous tube cystostomy techniques may reduce cost and surgical morbidity in selected cases.

Prevention

Successful long-term outcomes depend heavily on prevention strategies.

Prevention Strategies

Dietary management remains the cornerstone of prevention.

Recommendations include:

- Eliminate or minimize grain feeding

- Feed primarily grass hay
- Avoid excessive alfalfa or clover hay
- Maintain a calcium-to-phosphorus ratio of 2:1
- Encourage water consumption through clean, accessible water sources
- Delay castration until at least 6 months of age when possible

Urinary acidification with ammonium chloride may help maintain urine pH below 6.5. Periodic monitoring of urine pH is recommended.

Summary and Key Take-Home Messages

- Obstructive urolithiasis remains a major emergency in small ruminant practice.
- Early recognition and stabilization are essential for survival.
- Hyperkalemia is the most life-threatening metabolic abnormality.
- Tube cystostomy currently offers the best long-term success for valuable animals.
- Medical management alone carries a high recurrence rate.
- Long-term prevention depends primarily on nutrition, hydration, and proper management.
- Owner education is critical to reducing recurrence and improving outcomes.

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Where has all the protein gone? - PLEs and PLNs

A Practical Guide for the General Practitioner

Presented by: Alicia Bangert, DVM, DACVIM
WVRC- Waukesha

Based on current literature through 2025 | CE Lecture

Learning Objectives

1. Recognize the clinical and clinicopathologic features of PLE and PLN
2. Build a systematic diagnostic approach to the hypoalbuminemic dog
3. Differentiate PLE, PLN, and concurrent disease
4. Apply evidence-based treatment and monitoring strategies
5. Know when to refer and what to expect from a specialist

POLL QUESTION

In the last year, how often have you worked up a dog with unexplained hypoalbuminemia?

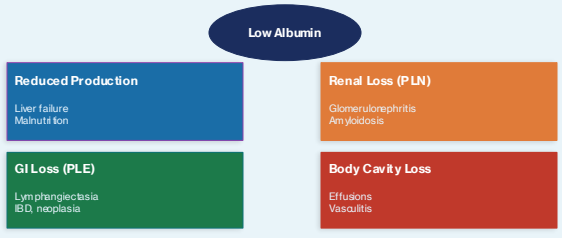
- A – Never / very rarely
- B – 1–3 times
- C – 4–10 times
- D – Feels like every week!

SECTION 1

Pathophysiology & Mechanisms

Understanding how protein is lost — and why it matters

The Hypoalbuminemic Dog: A Systematic Framework



Key: Rule out all causes concurrently — they frequently co-exist!

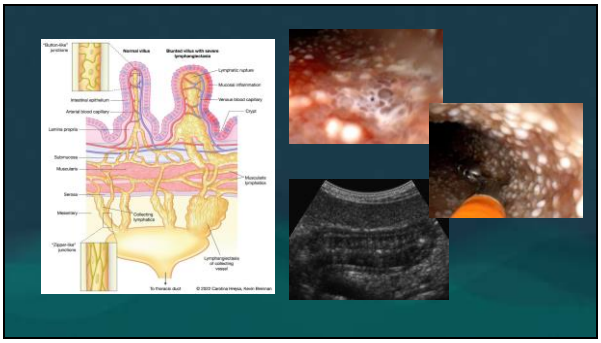
PLE: What Is It & Why Does It Happen?

Protein-Losing Enteropathy — excessive GI protein loss leading to hypoalbuminemia

PLE is a syndrome, not a diagnosis.

Primary Lymphangiectasia	Chronic Inflammatory Enteropathy	Other Causes
• Congenital/acquired lymphatic dilation • Yorkshire Terriers, Maltese predisposed • Protein leaks into dilated lacteals • Low-fat diet is cornerstone of treatment	• Lymphoplasmacytic or eosinophilic enteritis • Most common cause of PLE • Mucosal barrier breakdown → protein loss • Soft Coated Wheaten Terriers, Rottweilers	• Intestinal lymphoma (alimentary) • Infectious (histoplasmosis, pythiosis) • Intestinal intussusception • Severe parvoviral enteritis • Hemorrhagic gastroenteritis (acute PLE)

Craven & Washabau, J Vet Intern Med 2019; Allenspach & Lennerält-Servantez, Vet Clin North Am 2021



PLN: What You Need to Know

DEFINITION

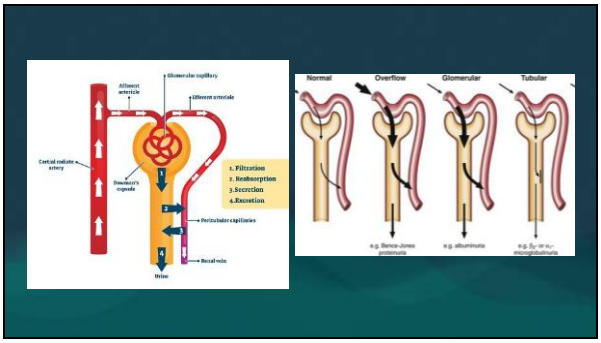
Loss of albumin through damaged glomeruli. Unlike PLE, the globulin fraction is often preserved — UPC ratio is the key diagnostic tool.

HALLMARKS

- ✓ UPC > 2.0 (with non-azotemic hypoalbuminemia)
- ✓ Selective proteinuria (albumin >> globulins)
- ✓ Hypertension common (>40% of cases)
- ✓ Thromboembolic risk HIGH
- ✓ Concurrent renal azotemia may develop

TOP CAUSES

- **Immune-Mediated GN**
  Idiopathic or infection-associated
- **Amyloidosis**
  Beagles, Shar-Pei, Abyssinian cats
- **Infectious / Inflammatory**
  Lyme, Ehrlichia, Leishmania, SLE, etc.
- **Hereditary Nephropathy**
  Wheaten Terriers, Bernese, Cocker
- **Hypertensive Nephropathy**
  2° to other systemic disease



Breed Predispositions: Know Your Patient

PLE + PLN	PLE (Lymphangiectasia)	PLE	PLE (IBD)
Soft Coated Wheaten Terrier	**Yorkshire Terrier**	**Norwegian Lundehund**	**Rottweiler**
Concurrent PLE + PLN Familial glomerulopathy Guarded prognosis	Primary lymphangiectasia Ascites common Low-fat diet critical	Intestinal protein-losing gastroenteropathy Unique breed disease	Lymphoplasmacytic enteritis Responds to immunosuppression Monitor for lymphoma

PLN (Amyloidosis)	PLN (Familial)	PLE (High Mortality)	PLE (Lymphangiectasia)
Shar Pei	**English Cocker**	**Pug**	**Maltese**
Familial amyloidosis Massive proteinuria Poor long-term prognosis	Hereditary nephropathy Progressive CKD Early detection key	4.93× higher in-hospital death vs other breeds (Hawes & Kathrani 2024)	Similar to Yorkies Low-fat diet Fat-soluble vitamin supplementation

Hawes & Kathrani, J Vet Intern Med 2024; Craven & Washabau, J Vet Intern Med 2019

What is your process for collecting urine for UPCs?

- Home or clinic
- Batched samples
- Cystocentesis

SECTION 2

Diagnosis & Diagnostic Workup

A systematic approach — from database to definitive diagnosis

Recognizing PLE vs PLN: Clinical Signs & Lab Findings

Feature	PLE	PLN
Albumin	↓↓ (often <1.5 g/dL)	↓ (variable)
Globulins	↓ (panhypoproteinemia)	Often normal/↑
UPC ratio	Normal (<0.5)	**> 20 (glomerular)**
Cobalamin	↓ (very common)	Usually normal
Cholesterol	↓ (hypocholesterolemia)	↑ (hypercholesterolemia)
Lymphocytes	↓ (lymphopenia)	Usually normal
Calcium (ionized)	↓ (hypocalcemia)	Usually normal
BUN/Creatinine	Usually normal	↑ (azotemia common)
GI signs	Diarrhea, vomiting, weight loss	Often absent initially

Craven & Washabau, J Vet Intern Med 2019; Allenspach & Inneraske-Servantez, Vet Clin North Am 2021

Diagnostic Workup: Step-by-Step

1 Tier 1 – Confirm & Characterize (Every Dog)

CBC, chemistry panel, UA with sediment, +/- culture, UPC ratio, Total protein + albumin + globulins, Blood pressure measurement

2 Tier 2 – Rule Out Liver & External Loss

Bile acids (pre/post), Chest + abdominal radiographs, Abdominal ultrasound, Fluid analysis if effusion present

3 Tier 3 – GI-Specific (if PLE suspected)

Serum cobalamin, folate, TLI, PLI
Alpha-1 proteinase inhibitor
GI ultrasound with wall layering
Endoscopy ± full-thickness biopsy
(Cytology, culture, PCR if indicated)

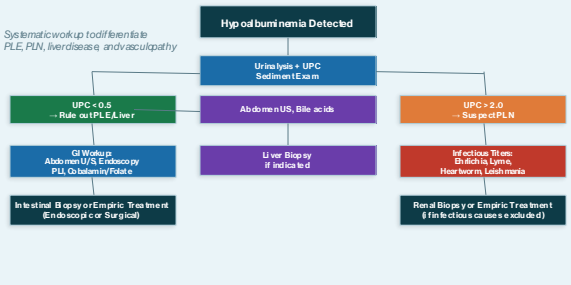
4 Tier 4 – Renal-Specific (if PLN suspected)

Infectious disease panel
(Ehrlichia, Brucella, Leishmania, etc.)
Urine protein electrophoresis
Renal biopsy (with IRIS-IVASA guidelines)

UPC > 0.5 in a hypoalbuminemic dog warrants full PLN investigation regardless of GI signs.

Diagnostic Algorithm: Hypoalbuminemic Dog

Systematic workup to differentiate PLE, PLN, liver disease, and vasculopathy



SECTION 3

Treatment & Management

Evidence-based therapy: diet, immunosuppression, supportive care, and anticoagulation

PLE: Treatment Principles

Dietary Management

- Ultra-low fat diet (< 10% fat on DM basis) — cornerstone of lymphangiectasia treatment
- Hydrolyzed or novel protein for IBD-associated PLE
- Assess response over 4–6 weeks before escalating

Immunosuppression (IBD/CE)

- Prednisone/Prednisolone: 1–2 mg/kg/day to start
  - Dexamethasone SQ
- Budesonide- not early in disease
- Azathioprine, cyclosporine, chlorambucil - steroid-sparing

Vitamin/Mineral Supplementation

- Cobalamin deficiency extremely common in PLE
  - Cyanocobalamin SQ or PO
  - Recheck before tapering/discontinuing
- Folate/folic acid if needed
- Keep an eye on calcium/vitamin D

Supportive / Emergency

- PPIs and other GI support
- Colloid or fresh frozen plasma if critically hypoalbuminemic (<1.5 g/dL); albumin ideal but challenges
- Thromboprophylaxis — **clopidogrel** ± low-dose aspirin
- Manage effusions if compromising respiration/mobility

PLN: Treatment Principles

⭐ **Follow IRIS Canine GN Study Group guidelines — treatment is staged by UPC, histopathology, and clinical signs**

Renin-Angiotensin Blockade

- Enalapril or benazepril 0.5 mg/kg q12–24h
- Telmisartan (ARB): 1.0 mg/kg q24h
- Goal: UPC < 0.5 or 50% reduction
- Monitor K+, BUN/Cr every 2–4 weeks initially until stable

Antithrombotic Therapy

- Clopidogrel 1–3 mg/kg/day — preferred
- Low-dose aspirin (0.5 mg/kg) as alternative
- CRITICAL: PLN has highest TE risk of any protein-losing condition

Treat the Underlying Cause

- Infectious: antimicrobials (doxycycline, etc.)
- Immune-mediated GN: mycophenolate, chlorambucil
- Amyloidosis: DMSO, colchicine — limited efficacy

Blood Pressure Control

- Target BP < 140 mmHg
- Amlodipine 0.1–0.3 mg/kg if ACEI/ARB inadequate
- Recheck BP within 1–2 weeks of any change

How do you measure blood pressures?

- Doppler/Oscillometric
- Exam room/treatment
- Number of readings
- Home monitor

🔬 New Data: Do Glucocorticoids Worsen Proteinuria in PLE Dogs?

Recent Study (2025, PMC)

"Glucocorticoids do not cause a clinically relevant elevation in the urine protein-to-creatinine ratio in dogs with inflammatory protein-losing enteropathy"

Dogs with IPLE received prednisone 1 mg/kg BID + clopidogrel + hypoallergenic diet. UPC increased from 0.10 to 0.30 over 2–3 months — remaining below the pathological threshold (< 0.5). Clinical significance: prednisone appears safe to use in IPLE dogs without pre-existing glomerular disease.

Clinical Takeaways:

For PLE Dogs

- Prednisone remains appropriate first-line therapy for IPLE
- Mild UPC increase expected but not clinically relevant
- Still check baseline UPC before starting steroids
- Monitor UPC at 4–6 week rechecks

For Concurrent PLE + PLN

- Exercise greater caution — underlying glomerular disease present
- Prednisone may worsen UPC if glomerular component significant
- Budesonide may be preferable (lower systemic bioavailability)
- Consult internal medicine specialist

For PLN-Primary Dogs

- AVOID prednisone as immunosuppressant
- Steroids not recommended by IRIS for glomerular disease
- Use mycophenolate or chlorambucil instead
- ACEi + clopidogrel = IRIS standard therapy backbone

Glucocorticoids do not cause clinically relevant UPC elevation in dogs with IPLE. J Vet Intern Med/ PMC 2025

Dietary Management: The Foundation of PLE & PLN Therapy

PLE / Lymphangiectasia: Low-Fat Diet

- Fat intake < 10% dry matter basis
- Reduces lymphatic pressure & protein leakage
- Hydrolyzed protein or novel protein source
- Medium-chain triglycerides (MCTs) can supplement calories
- 58-dog nutrition service study: dietary modification central to management (Margrey et al., JVIM 2025)

PLE / IBD: Elimination / Hydrolyzed Diet

- Food-responsive enteropathy in ~50% of CIE dogs
- Strictly novel protein x 4–6 weeks before declaring failure
- Hydrolyzed diets equally effective — consistent formulation key
- Consider intestinal microbiome support (cobalamin supplementation)

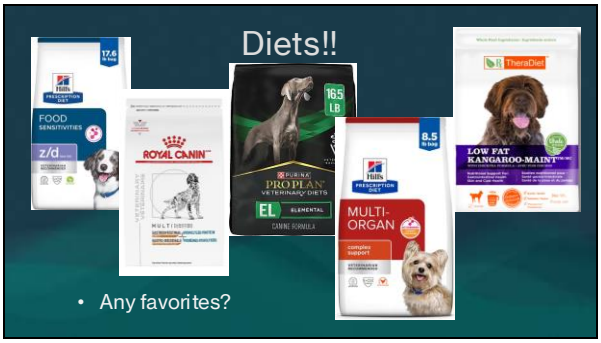
PLN: Moderate Protein Restriction

- Avoid excessive restriction — risk of muscle wasting
- IRIS recommends: avoid high protein diets in proteinuric dogs
- Target high-quality, bioavailable protein sources
- Salt restriction if hypertension or edema present
- Omega-3 fatty acids (EPA/DHA): anti-proteinuric effect

Concurrent PLE + PLN: The Balancing Act

- Low fat (for PLE) + moderate protein (for PLN) simultaneously
- Custom prescription diet consultation recommended
- Feeding tube may be needed in critical hypoalbuminemia
- Reassess caloric intake — these dogs are catabolic

Margreyet al., JVIM 2025; IRIS Treatment Recommendations 2023; Purina Institute PLN Nutrition Review



Thromboembolism: A Serious & Underrecognized Complication

Both PLE and PLN predispose to hypercoagulability — this can be fatal

~27%
Prevalence of TE in IPLE dogs (Oishi et al., JVIM 2025)

~25%
Prevalence of TE in PLN dogs (IRIS consensus)

Key Mechanism
Loss of antithrombin III (same MW as albumin) → hypercoagulable state. Heparin INEFFECTIVE (requires AT-III). Clopidogrel preferred.

Agent	Use	Dose	Notes
Clopidogrel	PLE + PLN (1st line)	2–4 mg/kg q24h PO	IRIS first-line for PLN; PLE also benefits
Aspirin (low-dose)	Alternative antiplatelet	0.5–1 mg/kg q24h PO	GI side effects; use if clopidogrel unavailable
Rivaroxaban	Confirmed thrombosis	0.5–1 mg/kg q24h PO	Direct Xa inhibitor; case reports in PLE + portal vein thrombus
Heparin	AVOID in AT-III deficiency	–	Requires AT-III to work – lost along with albumin

Oishi et al., JVIM 2025; IRIS Treatment Recommendations 2023; Yamamoto et al., case report 2020

Monitoring & Prognosis

PLE – Monitoring

2–4 Weeks	Albumin, total protein, bodyweight, BCS
4–8 Weeks	Cobalamin recheck, steroid taper assessment
3–6 Months	Full chemistry, imaging if incomplete response
Ongoing	Diet compliance, QOL scoring
Prognosis	Guarded to fair; lymphangiectasia can be managed long-term with diet; IBD/neoplasia prognosis varies

PLN – Monitoring

1–2 Weeks	BP recheck after any BP med change
2–4 Weeks	BUN, Cr, K+, UPC after starting ACEi/ARB, BP
3 Months	Full IRIS staging; UPC goal < 0.5–1.0, BP
6 Months	Renal biopsy response assessment (if Rx for GN)
Prognosis	Guarded; median survival 12–24 months in GN. Hypertension control is a KEY modifiable factor

SECTION 4

Prognosis & When to Refer

Understanding outcomes, prognostic factors, and appropriate referral triggers

Prognostic Factors in Canine PLN

Outcome depends on underlying etiology, severity of proteinuria, and presence of CKD

Favorable Prognostic Indicators

- Infectious etiology identified and treated (best prognosis)
- UPC <3.5 at diagnosis
- Early response to ACEi/ARB (UPC reduction ≥ 50% at 4 weeks)
- No azotemia at presentation
- Absence of hypertension at diagnosis
- Membranous nephropathy (better prognosis than MPGN)

Negative Prognostic Indicators

- UPC >8 or nephrotic syndrome (edema + hypoalbuminemia + hypercholesterolemia)
- Azotemia at presentation (IRIS CKD stage 3–4)
- Amyloidosis (no effective treatment; progressive)
- Thromboembolism (~25% prevalence; 50% mortality once TE occurs)
- Systolic hypertension > 180 mmHg unresponsive to treatment
- Concurrent PLN + PLE (more complex management, worse outcomes)

IRIS Treatment Recommendations 2023; IRIS GN Study Group 2013; Díaz-Soler et al., Vet Sci 2025

When to Refer: A Practical Decision Guide

Refer Now / Urgently

- ✓ Albumin < 1.5 g/dL with clinical signs of collapse, respiratory distress, or TE
- ✓ Suspected or confirmed thromboembolism (PE, portal vein, splenic vein)
- ✓ Renal biopsy being considered (PLN with UPC > 2.0 and infectious causes excluded)
- ✓ Lack of response to 6–8 weeks of appropriate therapy
- ✓ Pug with PLE — high in-hospital mortality risk, aspiration pneumonia risk
- ✓ Concurrent PLE + PLN (complex nutritional and pharmacologic balancing act)
- ✓ Suspected intestinal lymphoma (alimentary — requires oncology)

Can Manage in GP

- ✓ Mild-moderate PLE with albumin > 2.0 g/dL and food-responsive diseases suspected
- ✓ Monitoring of known PLE/PLN on established therapy
- ✓ Infectious PLN identified and under treatment (e.g., ehrlichiosis)
- ✓ Dietary management and client education
- ✓ Routine cobalamin supplementation and electrolyte correction
- ✓ Blood pressure monitoring in PLN patients on IRIS standard therapy

Top 10 Take-Home Points

1. Always check UPC in every hypoalbuminemic dog — even without GI signs.
2. Panhypoproteinemia (albumin + globulins low) points to PLE; preserved globulins point to PLN.
3. PLE and PLN co-exist — especially in Wheaten Terriers, Bernese, and Basenjis.
4. Hypercholesterolemia + low B12 in a hypoalbuminemic dog = lymphangiectasia until proven otherwise.
5. Intestinal ultrasound is high-yield and non-invasive — use it early.
6. Blood pressure measurement is mandatory in every protein-losing dog.
7. Both PLE and PLN cause AT-III loss and hypercoagulability — use dopidogrel (not heparin) for thromboprophylaxis.
8. Diet is the cornerstone: ultra-low fat for lymphangiectasia, hydrolyzed/novel protein for IBD-PLE; moderate protein + omega-3 for PLN.
9. Monitor/supplement cobalamin in all PLE patients — deficiency is the rule, not the exception.
10. Know your referral triggers — early referral leads to better outcomes.

CASE DISCUSSION

Case Presentation

6-year-old neutered male Rottweiler • Weight loss × 3 months, chronic intermittent diarrhea, mild ascites
Albumin: 1.2 g/dL | Globulins: 1.8 g/dL | Cholesterol: 88 mg/dL | Lymphocytes: 500/µL | Cobalamin: LOW
UPC: 0.35 | BUN/Creatinine: NORMAL | Infectious titers: NEGATIVE | U/S: diffuse small intestinal wall changes, ascites

Discussion Questions:

1. What is the most likely diagnosis and what syndrome is this?
2. What additional diagnostic tests would you recommend before initiating treatment?
3. Which diet would you choose, and why?
4. How would you approach anticoagulation in this patient?

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Questions & Discussion

Thank you for your attention

Internal Medicine referrals welcome – for complex cases, renal biopsy, or refractory PLE/PLN

Casts, Splints, and Common Sense: Ruminant Fracture Management in General Practice

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Clinical Professor at University of Wisconsin–Madison

Introduction

Fracture management in ruminants remains a common challenge in food animal practice, particularly as expectations for veterinary care and animal welfare continue to increase. Advances in orthopedic techniques have expanded treatment options for cattle, sheep, and goats; however, successful outcomes in general practice still depend heavily on practical decision-making, early stabilization, realistic prognosis assessment, and cost-conscious treatment planning.

Unlike equine patients, ruminants possess several characteristics that make them favorable orthopedic candidates. They spend more time recumbent, tolerate external coaptation well, and develop rapid callus formation due to their thick periosteum, especially when young. Consequently, many fractures that would be difficult to manage in horses can often be treated successfully in ruminants with relatively simple techniques.

For the general practitioner, the most important question is not simply whether a fracture can be repaired, but whether it should be repaired in the field, referred for advanced care, or managed through salvage or euthanasia. Early assessment and stabilization strongly influence outcome and economic viability.

Initial Assessment and Triage

The first priority is stabilization of the patient rather than fixation of the bone. Practitioners should assess the cardiovascular and pulmonary status of the animal, evaluate hydration, and identify concurrent injuries before focusing exclusively on the fracture.

Clinical signs strongly suggestive of fracture include:

- Acute non-weight-bearing lameness
- Limb instability or abnormal angulation
- Audible or palpable crepitus
- Abnormal mobility
- Severe pain and reluctance to stand

The injury site should be carefully evaluated for:

- Open versus closed fracture
- Degree of soft tissue trauma
- Neurovascular compromise
- Joint involvement
- Contamination and duration of exposure

Open fractures with prolonged contamination, severe neurologic deficits, or highly fractious adult cattle often carry a poor prognosis and may not be suitable candidates for repair.

Radiographs are strongly recommended whenever feasible. Two orthogonal views should be obtained and should include the joints proximal and distal to the fracture. Radiographs aid in determining fracture configuration, physeal involvement, displacement, and suitability for field stabilization versus referral.

Sedation, Analgesia, and Stabilization

Appropriate sedation improves safety during examination, splint application, transportation, and radiography. Pain management is essential and improves patient comfort and handling. Nonsteroidal anti-inflammatory drugs are commonly administered, and antimicrobial therapy is indicated in open fractures or when significant soft tissue injury exists.

Temporary stabilization before transport or definitive treatment is critical. The goals of stabilization include:

- Minimizing additional soft tissue trauma
- Reducing pain and anxiety
- Improving patient mobility and balance
- Protecting vascular and neurologic structures
- Improving prognosis for definitive repair

Closed fractures generally have a much better prognosis than open fractures because preservation of soft tissue integrity is essential for bone healing.

Decision-Making: Repair, Referral, or Salvage

Several factors influence treatment recommendations:

Fracture Factors

• Location of fracture	• Degree of comminution
• Open versus closed injury	• Soft tissue damage
• Articular involvement	• Presence of infection

Animal Factors

• Age and body weight	• Economic value
• Temperament	• Ability to provide aftercare
• Intended use	

Fracture location remains one of the most important determinants of treatment success.

Distal Limb Fractures

Fractures distal to the carpus or tarsus generally carry the best prognosis for treatment using external coaptation. Metacarpal and metatarsal fractures in calves frequently heal successfully with casts or splints.

Articular Fractures

Fractures involving joints may be stabilized successfully but often result in osteoarthritis and persistent lameness. Owners should be counseled regarding long-term expectations.

Proximal Limb Fractures

Fractures involving the radius, ulna, tibia, femur, or humerus are substantially more difficult to manage in the field because immobilization of the joint above the fracture is

difficult or impossible with standard casts alone. Referral for advanced fixation techniques should be considered.

Body Weight Considerations

Body weight significantly influences prognosis:

Weight	Expected Outcome
<150 kg	High success with external coaptation
150–400 kg	Moderate success; may require surgical fixation
>400 kg	Guarded prognosis; salvage often considered

Young calves generally have the best outcomes due to rapid bone healing and lower mechanical loads.

External Coaptation: Splints and Casts

External coaptation remains one of the most practical and economical fracture management techniques available to general practitioners.

Splints

Splints are especially useful for temporary stabilization, transport, or management of distal limb fractures. Proper splint application begins with a well-padded Robert Jones bandage or modified Robert Jones bandage.

Important principles include:

- Immobilize the joint above and below the fracture (“rule of two”)
- Use generous padding to prevent pressure sores
- Leave the toes exposed for monitoring
- Ensure the bandage diameter is approximately three times the diameter of the limb

Common splint materials include PVC, wood, aluminum, and fiberglass cast material. Thomas-Schroeder splints, Walker splints, and modified Spica splints may be useful for selected proximal limb fractures.

Daily monitoring is essential. Practitioners and owners should monitor for swelling, slipping, odor, pressure sores, reluctance to bear weight, or evidence of cast failure.

Casts

Casts are appropriate for:

- Simple transverse fractures
- Short oblique fractures
- Salter-Harris type I and II fractures
- Minimally displaced fractures

Fiberglass casts are generally preferred over plaster of Paris because they are lighter, stronger, more durable, and radiolucent.

Key casting principles include:

- Immobilize the joints above and below the fracture (“rule of two”)
- Include the foot to create a walking cast
- Apply adequate padding over bony prominences
- Maintain the limb in a neutral position with some tension
- Use sufficient fiberglass layers based on patient size

A cast should never terminate near the fracture line or mid-diaphysis, as this increases stress concentration and risk of secondary fracture.

Cast Aftercare

Successful outcomes depend heavily on diligent aftercare. Practitioners should advise owners to monitor:

- Foul odor (“sniff test”)
- Swelling above the cast
- Excessive licking or chewing
- Sudden worsening lameness
- Cracks, soft spots, or discharge

Young animals typically require cast changes every 2–3 weeks, while adults may require changes every 4–6 weeks. Total immobilization time is generally 4–6 weeks in calves and considerably longer in adult cattle.

Common complications include pressure sores, malalignment, joint stiffness, tendon laxity, angular limb deformities, and contralateral limb overload.

Advanced Fixation Techniques

External Skeletal Fixation

External skeletal fixation (ESF) and transfixation pin casts are useful for open fractures, proximal tibial or radial fractures, and fractures associated with significant soft tissue injury. Advantages include preservation of soft tissue access and adjustable stability. However, these techniques generally require anesthesia, specialized equipment, and technical expertise.

Complications include:

- Pin tract infection
- Implant loosening
- Thermal necrosis
- Osteomyelitis
- Implant or bone failure

Internal Fixation

Internal fixation using plates and screws provides the most stable fracture repair and is generally reserved for valuable animals.

Advantages include:

- Excellent fracture alignment
- Earlier return to limb function
- Reduced external coaptation needs
- Faster overall recovery

Limitations include cost, anesthesia risk, specialized equipment, implant failure, and the challenge of supporting large adult ruminants with available implants. In many cases, supplemental external coaptation is still required following internal fixation.

Prognosis and Practical Recommendations

The best prognosis is seen in:

• Young animals	• Lightweight animals
• Closed fractures	• Distal limb fractures
• Simple fracture configurations	

The poorest prognosis is associated with:

• Open fractures	• Heavy adult animals
• Proximal limb fractures	• Severe soft tissue trauma
• Comminuted fractures	• Articular fractures

General practitioners can successfully manage many ruminant fractures with thoughtful case selection, good stabilization techniques, and diligent aftercare. External coaptation remains a highly effective and economical treatment option for many distal limb fractures encountered in food animal practice.

Key Take-Home Messages

- Initial stabilization strongly influences fracture outcome.
- Ruminants are generally favorable orthopedic patients.
- External coaptation remains an effective and economical treatment option.
- Fracture location, body weight, and soft tissue injury are major prognostic indicators.
- Open fractures and proximal limb fractures carry a guarded prognosis.
- Early referral should be considered for complex or proximal fractures in valuable animals.

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Practical Approaches to Common Cancers in Dogs and Cats

Dr. Breann Sommer, DVM, MS, DACVIM (Oncology)

May 15, 2026

Overview

- Tumor grade vs. cancer stage
- Staging imaging options
- How to prepare client for oncology referral
- Common oral chemotherapy options including safety and handling
- Common cancers: lymphoma, mast cell tumor, soft tissue sarcoma, splenic masses, mammary tumors
- Veterinary hospice and palliative care

Tumor Histologic Grade

- **Histologic grade** - microscopic evaluation of defined histopathologic criteria which are predictive of biologic behavior
  - Can be helpful estimate of expected clinical progression or clinical outcome including metastatic potential, disease-free interval, or overall survival
  - No grading scheme accurately predicts behavior in 100% of patients
  - Grading is based exclusively on histomorphologic characteristics of the primary tumor and does not incorporate clinical staging such as presence of metastasis

Tumor Histologic Grade

- Variables that can affect grade:
  - Subjectivity and reproducibility among pathologists
  - Tumor heterogeneity
  - Incisional vs. excisional biopsy sample
  - Necrosis
  - Pre-treatment (eg. steroids, chemotherapy)

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Tumor Histologic Grade

- Canine tumors with grades or histologic features with prognostic significance
  - Mast cell tumor - grade I, II, III vs. 2-tier: high, low
  - Soft tissue sarcoma - grade I, II, III
  - Melanoma - mitotic index, atypical nuclei, Ki67 Index
  - Mammary carcinoma - histologic subtype (mixed tumors, complex carcinoma, tubulopapillary carcinoma); grade I, II, III
  - Pulmonary carcinoma - grade I, II, III

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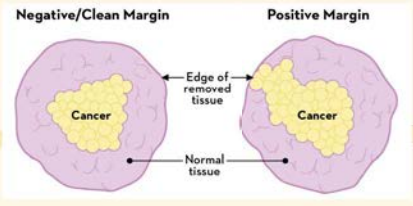
Histologic Tumor Margins

- Histologic margins are a predictive marker of surgical treatment; however, margins status does not predict recurrence with absolute certainty
- Margins status at primary site does not address potential for metastases or likelihood of disease-free state



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Histologic Tumor Margins

- Clinician responsible for communicating surgical goal (incisional vs. excisional) and identifying which tissue edges require microscopic activity to pathologist
  - Annotated sketches
  - Inking
- Pathologist report should be clear and concise including:
  - Description of neoplastic cells closest to surgical edge
  - Objective measurement (mm)
  - Description of tissue constituents (eg. adipose, connective tissue, muscle)
- Vague terminology such as clean, dirty, close, or narrow should be avoided because these are subjective terms with no established criteria

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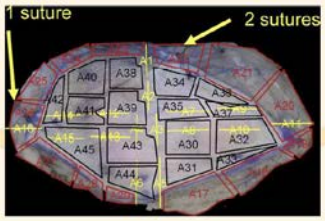
Histologic Tumor Margins

- Margin measurements are influenced by:
  - Post-excisional tissue retraction (shrinkage)
  - Tissue thickness
  - Formalin fixation - shrinkage, tissue distortion
  - Sectioning and mounting of paraffin-embedded tissue onto the slide



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Histologic Tumor Margins

- Histologic margin status is important clinical consideration but incompletely excised malignancies do not always recur
  - Canine low grade soft tissue sarcomas
  - Canine low grade and subcutaneous mast cell tumors
- Some tumors are highly invasive and have recurrence potential that is not necessarily related to complete histologic margins status
  - Feline injection site sarcomas

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Tumor Stage

- **Tumor Stage** - refers to tumor size and/or whether or not it has spread; determined by clinical tests (exam, imaging, lymph node sampling. Typically includes:
  - Tumor size (T)
  - Lymph node involvement (N)
  - Metastasis (M)

TABLE 21.5 World Health Organization Clinical Staging System for Mast Cell Tumors

Stage	Description
0	One tumor incompletely excised from the dermis, identified histologically, without regional lymph node involvement a. Without systemic signs b. With systemic signs
I	One tumor confined to the dermis, without regional lymph node involvement a. Without systemic signs b. With systemic signs
II	One tumor confined to the dermis, with regional lymph node involvement a. Without systemic signs b. With systemic signs
III	Multiple dermal tumors; large, infiltrating tumors with or without regional lymph node involvement a. Without systemic signs b. With systemic signs
IV	Any tumor with distant metastasis, including blood or bone marrow involvement

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Radiography

- Radiographs have historically been the primary modality for assessment of cancer as it's readily available and low cost but is gradually being replaced with other modalities including CT scan
- The most common application is screening for pulmonary metastasis
- Three views (left and right lateral, ventrodorsal) are recommended (12-15% discrepancy compared to two views)

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Ultrasonography

- Becoming more widely available and relatively inexpensive
- The most common application is abdominal ultrasound to identify and localize primary or metastatic lesions
- Sonographic appearance may not be specific to nature of lesion so often needs to be interpreted in context with sampling
- Accuracy is highly dependant on experience of operator, quality of images, equipment, and knowledge/experience of interpreter
- Clinician ultimately responsible for interpreting imaging results

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Computed Tomography

- Becoming more widely available and accessible
- Requires heavy sedation or general anesthesia; increased cost compared to radiography and ultrasonography
- CT is more sensitive (1 mm diameter) than radiographs (7-9 mm diameter) at detection of pulmonary metastasis
- Highly valuable for surgical planning for locally invasive tumors especially in challenging anatomic regions such as oral tumor or anal sac tumors
- Accuracy is highly dependant on experience of operator including positioning, slice thickness, quality of images, and equipment used
- Clinician ultimately responsible for interpreting imaging results

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Lymph Node Assessment

- Depending on the tumor type regional lymph nodes can be assessed via palpation, radiographs, ultrasound, CT along with sampling (aspirate, biopsy)
- Lymphangiography and sentinel lymph node mapping not routinely performed but may be recommended case by case

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Preparing Your Client for Oncology Referral

- **Explain the purpose of referral** - to get oncology expertise and to discuss options
- **What will happen at first visit**
  - Review records, physical examination
  - Discuss options for additional testing (staging)
  - Discuss treatment options
    - Treatment is individualized and options may include chemotherapy, surgery, radiation therapy, or palliative care.
- **Cost and logistics** - cost of consult ($200). Cost estimate will be presented to client at time of consult for any recommended diagnostics and treatment
- **Address emotional and quality of life considerations**
  - Acknowledge that cancer diagnosis is stressful and it's normal to have a lot of questions
  - Discuss quality of life goals
  - Reassure them palliative or comfort care focused options are available
- **Questions and communication**
  - Encourage open discussion
  - Reinforce shared decision-making is crucial to determine best plan for both pet and family

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Cancer Treatment Options

- Surgery
  - General practice setting
  - Board certified surgeon
  - Specialty surgeon - oncologic surgeon, oral surgeon
- Radiation therapy
- Chemotherapy
- Palliative Care

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Chemotherapy

- Prescribing and handling of chemotherapy requires knowledge of handling hazardous drugs to minimize harm to personnel and for the safety of the patient
- The **National Institute for Occupational Safety and Health (NIOSH)** alert on hazardous drugs was first published in 2004 and subsequently updated in 2016 and 2024
- **US Pharmacopeia (USP) 800 Hazardous Drugs** - Handling in Healthcare Settings defines standards for safely handling hazardous drugs to protect healthcare personnel, patients, and the environment

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Chemotherapy

- Depending on what hazardous drugs will be handled will dictate:
  - Proper PPE - gown, mask/respirator, chemotherapy gloves, shoe covers
  - Biosafety cabinet
  - Negative pressure room
  - Closed system transfer device (CSTD)

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Chemotherapy

- Chemotherapy forms:
  - Injectable - IV, SQ
  - Oral
- Oral ≠ safer
- Proper handling is critical
- Environmental half-life varies by drug. Cyclophosphamide is one of the most problematic drugs in environmental and surface contaminant testing given it's long half-life and ability to remain chemically stable despite exposure to UV light, water, and approved multi-step chemotherapy cleaning protocols.

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Oral Chemotherapy

- **Storage** - hazardous drugs must be identified and handled separately from non-hazardous drugs
- **Handling** - chemotherapy-rated gloves, disposable or non-porous surfaces (stainless steel) preferred, routine surface decontamination
- **Administration** - give directly to pet via treat or pilling; do NOT split/crush/dissolve
- **Excrement handling** - treat urine/feces/vomit as contaminated for 48-72 hours

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Chemotherapy 4-Step Cleaning

1. **Deactivation** - render hazard inert or inactive (eg. bleach or peroxidase)
2. **Decontamination** - removal of hazardous drug residue (eg. alcohol, water, peroxidase, isopropyl alcohol)
3. **Cleaning** - remove organic or inorganic material (eg. germicide)
4. **Disinfection -** destroy microorganisms

Table 5. Cleaning Steps

Cleaning Step	Purpose	Example Agents
Deactivation	Render compound inert or inactive	As listed in the HD labeling or other agents which may incorporate Environmental Protection Agency (EPA)-registered oxidizers (e.g., peroxide formulations, sodium hypochlorite, etc.)
Decontamination	Remove HD residue	Materials that have been validated to be effective for HD decontamination, or through other materials proven to be effective through testing, which may include alcohol, water, peroxide, or sodium hypochlorite
Cleaning	Remove organic and inorganic material	Germicidal detergent
Disinfection (for sterile manipulations)	Destroy microorganisms	EPA-registered disinfectant and/or sterile alcohol as appropriate for use

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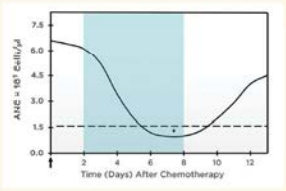
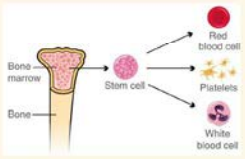
Chemotherapy Adverse Effects

GI toxicity

Myelosuppression - goal to keep neutrophils > 1000 µL





Day 0 Day 3-5 Day 7-10

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Oral Chemotherapy: Chlorambucil

- **Clinical Use:**
  - Chronic lymphocytic leukemia, indolent lymphomas (T zone)
  - Feline small cell gastrointestinal lymphoma
  - Metronomic therapy for a variety of cancers
- **Dosing**
  - 4 mg/m^2 by mouth daily
  - 20 mg/m^2 by mouth every 2 weeks
- **Adverse Effects**
  - Myelosuppression - **thrombocytopenia**
- **Source**
  - Commercial 2 mg tablets, compounded

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Oral Chemotherapy: Cyclophosphamide

- **Clinical Use:**
  - Multi-drug protocols for lymphoma in cats and dogs (Eg. CHOP)
  - Metronomic chemotherapy for a variety of cancers
- **Dosing**
  - 200-250 mg/m^2 PO (bolus)
  - 10-15 mg/m^2 daily (metronomic)
- **Adverse Effects**
  - Myelosuppression - neutropenia
  - Gastrointestinal toxicity - vomiting, diarrhea
  - **Sterile hemorrhagic cystitis** (dogs) → concurrent furosemide 1-2 mg/kg PO
- **Source**
  - Commercial 25 mg and 50 mg capsules

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Oral Chemotherapy: Lomustine (CCNU)

- **Clinical Use:**
  - Multi-drug protocols for lymphoma in cats and dogs (Eg. LAP)
  - Histiocytic sarcoma
  - Mast cell tumors
- **Dosing**
  - 40-60 mg/m^2 PO every 3 weeks
- **Adverse Effects**
  - Myelosuppression - **neutropenia**, thrombocytopenia
    - Cats can have nadir anywhere from 1-4 weeks post treatment)
  - **Hepatotoxicity** → concurrent Denamarin
  - Pulmonary fibrosis (cats) rare
- **Source**
  - Commercial 10 mg and 40 mg capsules; compounded

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Oral Chemotherapy: Palladia®(toceranib phosphate)

- **Clinical Use:**
  - Mast cell tumor
  - Anal sac carcinoma
  - Gastrointestinal stromal cell tumor (GIST)
  - Thyroid carcinoma
- **Dosing**
  - 2.5-2.75 mg/kg by mouth every other day or M-W-F
- **Adverse Effects**
  - **Gastrointestinal toxicity** - diarrhea, vomiting, hyporexia, weight loss, GI bleeding
  - Myelosuppression - neutropenia (uncommon, mild)
  - Protein losing nephropathy (dogs and cats)
  - Hypertension (dogs)
- **Source**
  - Commercial 10 mg, 15, mg, 50 mg tablets; compounded

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Lymphoma

- The most common cancer in dogs and cats!
- Classified according to:
  - Small cell vs. large cell
  - Anatomic location: multicentric, GI, mediastinal, cutaneous
  - Immunophenotype and subtype - B vs. T cell, class II MHC
- Majority of cases diagnosed by cytology
- **Flow cytometry** preferred method to determine subtype and clinical prognosis. Other methods including PARR, Idexx CancerDx do not provide as much information.

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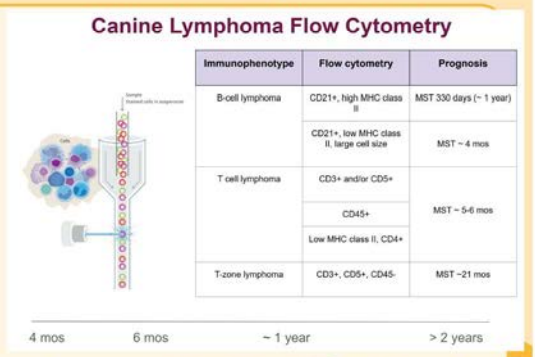
Lymphoma: Flow Cytometry

- Flow cytometry characterizes cell populations in a sample based on size, properties, and proteins expressed on the cell surface
- Must be performed on **live** cells in **fluid suspension** and therefore acquired by lab within 24 hours of shipping to maintain viability



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COLORADO STATE UNIVERSITY | CLINICAL HEMATOPATHOLOGY LABORATORY

Lymphoma: Steroids Before Referral

- Steroids can provide rapid clinical improvement
- The decision to start steroids prior to referral should be weighed carefully
- Sometimes necessary for immediate clinical relief (eg. hypercalcemia, airway obstruction, hyporexia)
- Can induce chemoresistance and result in reduced survival
- May compromise diagnosis and staging results
- Recent study suggests even short-term steroids (<1 wk) prior to chemotherapy had detrimental effects on prognosis (Maga et al VCO 2024)

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Lymphoma: Preparing Your Client for Oncology Referral

- In general, large cell lymphoma in dogs and cats is often an **urgent referral**
- Hypercalcemia or sick lymphoma is often an **emergency referral**
- Small cell GI lymphoma in cats is often a **routine referral**

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Canine Lymphoma Induction Protocols

- **Multidrug CHOP chemotherapy (CHOP-25, CHOP-19, CHOP-15)**
  - Frequency: weekly
  - Route: IV, oral
  - Cost: $8000+
- **Single drug:**
  - **Doxorubicin**
    - Immunophenotype: 100% B cell, 50% T cell
    - Frequency: every 3 weeks x 5 treatments
    - Route: IV
    - Cost: $3000+
  - **CCNU (lomustine) +/- L-asparaginase**
    - Immunophenotype: 83% B cell, 79% T cell
    - Frequency: every 3 weeks x 5 treatments
    - Route: oral
    - Cost: $2700+

Canine Large B cell Lymphoma

Treatment	MST
CHOP	~ 1 year
Doxorubicin	~ 6-9 mos
CCNU	~ 4-6 mos
Steroids	~ 1-2 mos

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Lymphoma Palliative Care

- Prednisone/Prednisolone
  - Dosing: 1-2 mg/kg/day PO; taper to 0.75-1 mg/kg/day long-term
- Median survival time ~ 1-2 months for aggressive large cell lymphomas

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Laverdia®-CA1 (verdinexor tablets)

- Oral targeted therapy
  - SINE - selective inhibitor of nuclear export
- Dosage 1.25-1.5 mg/kg PO twice weekly
- Side effects:
  - **GI - may have severe hyporexia**
- Cost $$ ($200-300+/mos)
- Efficacy
  - Overall response rate ~ 34%
  - Median time to progression ~ 30 days
    - B cell ~ 30%
    - T cell 57-70%
- Additional studies needed

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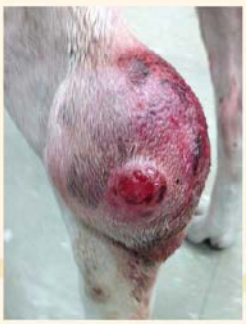
Mast Cell Tumors

- The most common skin tumor!
- Signalment: any age, any breed
- Breeds at risk: Bulldog descent, Labrador retriever, Golden retriever, Pit bull
- Cutaneous vs. subcutaneous
- Extremely varied clinical appearance



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Mast Cell Tumors

- Prognostic factors:
  - Histologic grade
  - Clinical stage - presence of metastasis
  - Location
  - Local tumor signs - ulceration, erythema, hemorrhage
  - Breed
  - Subcutaneous - more favorable; can feel like lipoma!
    - If MI > 4/10 HPF → more aggressive behavior

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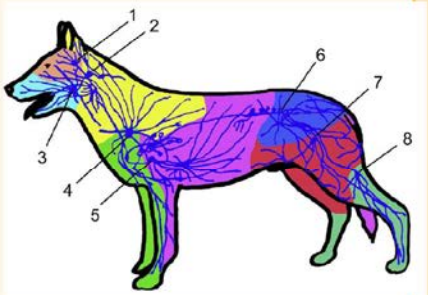
Mast Cell Tumors

- MCT will typically metastasize to regional lymph node first
- Consider FNA if regional lymph node is palpable/accessible
- Effect of LN metastasis is controversial for low/intermediate grade tumors; most can still have good prognosis with extirpation



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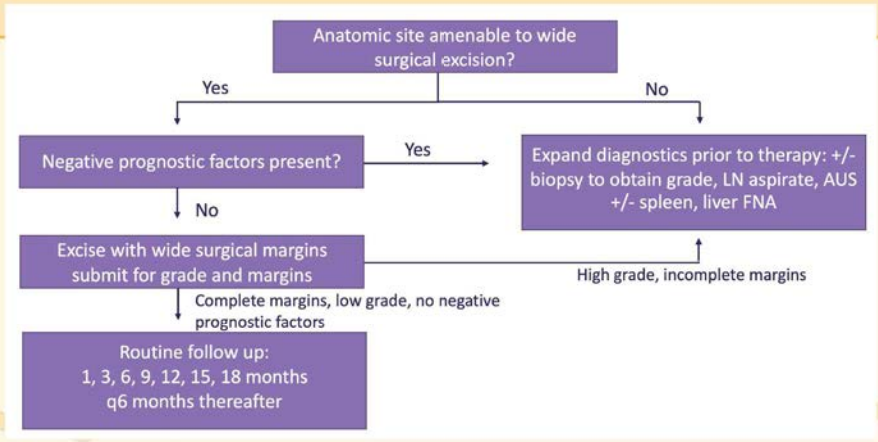
Mast Cell Tumors



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Mast Cell Tumors: Ancillary Therapy

- Antihistamine
  - Diphenhydramine (Benadryl) 2 mg/kg PO q8-12
  - Cetirizine (Zyrtec) 1-4 mg/kg PO q24
- Antacid
  - Omeprazole (Prilosec) 1 mg/kg PO q12

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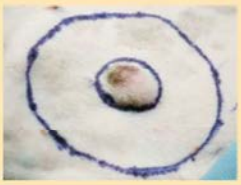
Mast Cell Tumors: Surgery



- Treatment of choice for cutaneous tumors amenable to wide excision
- Historically recommended 3 cm lateral and on uninvolved fascial plane deep
- Low grade MCT < 5 cm in size → 1 cm lateral margins and one fascial plane deep
- Intermediate grade MCT < 5 cm in size → 2 cm lateral margins and one fascial plane deep

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Mast Cell Tumors

- If not amenable to wide surgical excision then consult with an oncologist
  - Marginal excision followed by adjuvant treatment: chemotherapy, electrochemotherapy, radiation therapy, active surveillance
  - Amputation
  - Radiation therapy
  - Chemotherapy
  - Stelfonta®
- <10% low grade MCT will have local recurrence regardless of margins
- Up to 40% high grade MCT will have local recurrence despite complete margins

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Mast Cell Tumors: Chemotherapy

- Recommended for histologic high grade MCT or palliative care for clinically presumed aggressive tumors
  - Vinblastine IV - overall response rate (ORR) 47%
  - Palladia® (toceranib phosphate) PO - ORR ~ 43%
  - Lomustine (CCNU) PO
  - Chlorambucil PO

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Mast Cell Tumors: Palladia® (toceranib phosphate)

- Dosage: 2.5 - 2.75 mg/kg PO every other day or M-W-F - lower than labeled dosage!
- Routine monitoring
  - Two week post-chemotherapy CBC to assess for uncommon neutropenia
  - Every 4-6 weeks
    - Exam - assess tumor response, monitor body weight
    - CBC, chemistry, urinalysis +/- UPC (proteinuria), blood pressure (hypertension)

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Palladia® (toceranib phosphate)

- Managing Toxicity
  - Gastrointestinal
    - Drug holiday
    - Dose/frequency reduction
    - Maropitant, ondansetron
    - Fiber, probiotic, GI diet, metronidazole, tylosin, loperamide
  - Hypertension
    - Amlodipine
  - Proteinuria
    - Benazepril, telmisartan
  - Myelosuppression
    - Drug holiday
    - Dose reduction

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Mast Cell Tumors: Palladia® (toceranib phosphate)

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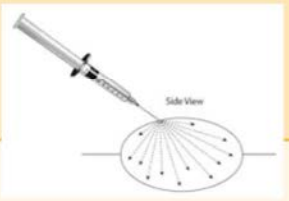
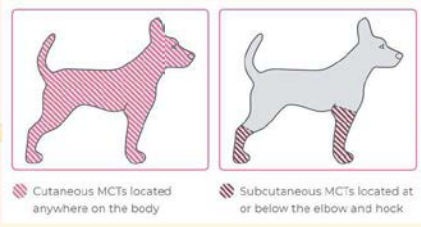
Stelfonta® (Tigilanol tiglate)



- Breaks down tumor cell walls
- Disrupts blood vessel in the tumor
- Destroys tumor forming a "pocket" or wound where the tumor was
- Limitations: non-high grade, non-metastatic, location, and size (<10 cm^3)



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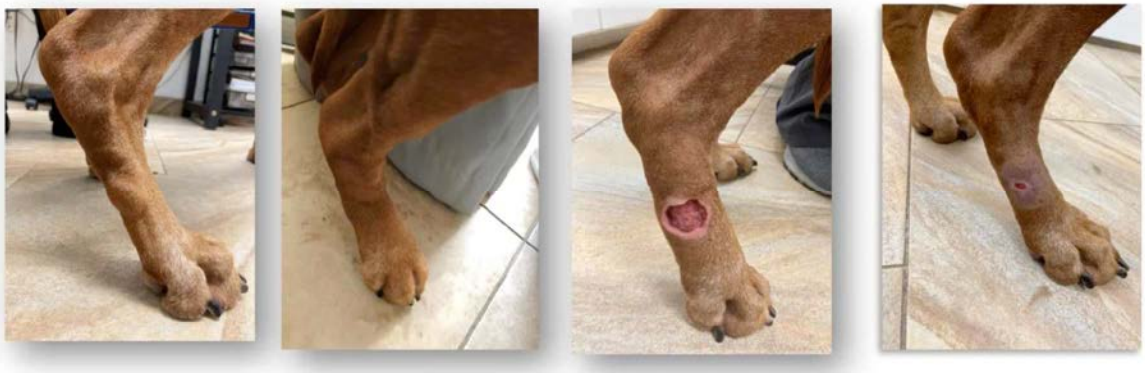
Stelfonta® (Tigilanol tiglate)



Day 0, pre-treatment | Day 2 | Day 7

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Soft Tissue Sarcomas

- Histopathology needed to determine grade
- Recommend wide surgical margins - 2-3 cm lateral and one fascial plane deep
- Metastatic rate
  - Grade I - 0-13%
  - Grade II - 7-27%
  - Grade III - 22-44% → recommend adjuvant chemotherapy (doxorubicin)
- Local recurrence rate after incomplete excision
  - Grade I - 7%
  - Grade II - 34%
  - Grade III - 75%

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Mammary Tumors

- **Canine mammary tumors** - 50% benign + 50% malignant
  - Start with cytology to confirm mammary neoplasia (not expected to distinguish between benign and malignant!)
  - Surgical dose - lumpectomy for histopathology
  - Refer to oncology if incompletely excised, high grade, and/or evidence of intra-vascular invasion/nodal metastasis
- **Feline mammary tumors** - >95% malignant!
  - Start with cytology to confirm mammary neoplasia
  - Staging - chest x-rays, ultrasound mammary chain and abdomen
  - Surgical dose - radical chain mastectomy for histopathology
  - Adjuvant chemotherapy for high grade tumors

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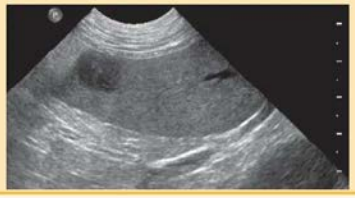
Canine Splenic Masses



- Canine splenic nodule(s) and mass(es) are very common and can represent a wide spectrum of behavior ranging from benign lesions which require no immediate intervention to aggressive cancers associated with short survival times
  - **Incidental, non-ruptured**
    - 60-80% benign (nodular hyperplasia, hematoma, extramedullary hematopoiesis, lymphoid hyperplasia)
    - 20-40% malignant
  - **Ruptured splenic masses**
    - 66% malignant → **hemangiosarcoma**, splenic stromal sarcoma, histiocytic sarcoma, lymphoma, etc.
    - 33% benign

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Veterinary Hospice

- **Veterinary hospice -** philosophy of care that prioritizes comfort, dignity, and quality of life when curative treatment is no longer beneficial or desired
- General practitioners are uniquely positioned to guide families through their pet's life stage transitions; must provide clear information about prognosis, outline all care options, and help families align treatment choices with their values

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Veterinary Hospice

- **Pain -** educate owners on recognizing pain and schedule regular reassessments
- **Dyspnea -** respiratory distress is one of the most concerning hospice symptoms. Focus on comfort with oxygen therapy, opioids to reduce air hunger, and anxiolytics to mitigate panic.
- **Cachexia/anorexia -** appetite stimulants, hand-feeding, highly palatable and calorie dense foods. Feeding should reinforce and not strain the human-animal bond
- **Sarcopenia -** educating owners to recognize, nutritional support, adequate protein and omega-3 fatty acids, encourage gentle exercise and passive range of motion
- **Nausea/vomiting -** antiemetics, prokinetics, and antacids

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Veterinary Hospice

- **Constipation/diarrhea -** Constipation may be managed with hydration, fiber, stool softeners, or enemas. Diarrhea often improves with bland diet, probiotics, and medications.
- **Hygiene -** bedding changes, absorbent pads, barrier creams, and gentle cleaning
- **Urinary and fecal incontinence -** manage hygiene, diapers, belly bands, adjusting feeding schedules
- **Sleep disturbances -** consistent daily routine, mental enrichment, providing comfortable quiet sleeping areas, night lights, and medications
- **Mobility -** traction tools, slings, harnesses, ramps, non slip flooring, adjustment to food/water dishes and litter boxes

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Palliative Care

- NSAID or steroid?
  - NSAID
    - Pain control
    - Anti-tumor effect if carcinoma (eg. transitional cell carcinoma, anal sac carcinoma, thyroid carcinoma, etc)
    - Adequate appetite
  - Steroid
    - Round cell tumor - lymphoma, MCT, histiocytic sarcoma
    - Hyporexia
    - Swelling, edema, effusion

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Pain Control

- NSAIDs
- Opioids
- Neuropathic pain analgesic
  - Gabapentin 10-20 mg/kg PO q8
  - Pregabalin 2-5 mg/kg PO q8-12
- NMDA/NMDA-receptor antagonist
  - Amantadine 3-5 mg/kg PO q12-24
  - Ketamine 0.5 mg/kg SQ
- Acetaminophen (dogs only) 10-15 mg/kg PO q8
- antiNGF mAb (Solensia™, Librela™)

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Nausea/Vomiting/Anorexia

- **Anti-nausea and anti-emetic**
  - **Maropitant** 2 mg/kg PO q2
  - **Ondansetron** - poor oral bioavailability
    - IV or SQ 0.1-0.2 mg/kg q8-12
    - PO 0.5-1 mg/kg PO q8-12
  - **Metoclopramide** 0.5 mg/kg PO q6-8 hours
- **Appetite stimulant**
  - **Mirtazapine**
    - Dogs 3.75-30 mg/dog
    - Cats 1.88 mg/cat
  - **Capromorelin (Entyce®, Elura®)**
    - Dogs 3 mg/kg PO q24
    - Cats 2 mg/kg PO q24

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Nutrition

- **Hill's Prescription Diet ONC Care**
  - Highly palatable to encourage eating
  - Highly digestible protein
  - Made with ActivBiome+ proprietary blend of prebiotic fibers to support healthy GI
  - Contraindications: renal disease, pancreatitis

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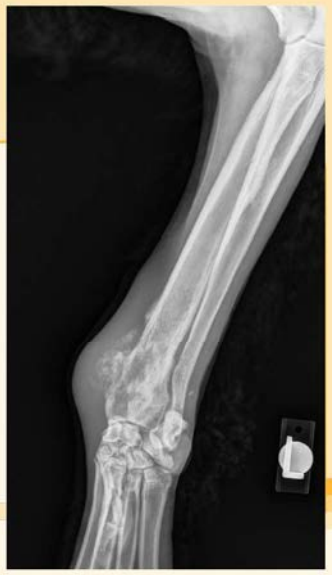
Case Example #1: Arnie

- 7 yo MN Saint Bernard
- Aggressive osteolytic lesion of the left front radius
- **Current medications:** gabapentin 5 mg/kg PO q12
- **Exam -** palpable mass, pain on palpation, moderately lame



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Case Example #1: Arnie

- **Initial Plan:**
  - Zoledronate infusion IV every 3-6 weeks
  - SQ ketamine 0.5 mg/kg once
  - Carprofen 2.2 mg/kg PO q12
  - Gabapentin 10-15 mg/kg PO q8
  - Amantadine 3-5 mg/mg PO q24
- **Education**
  - Signs of pain
  - Risk of pathologic fracture
  - Harness
  - Non-slip flooring
- **Additional options:**
  - SQ ketamine 0.5 mg/kg weekly
  - Acetaminophen 10-15 mg/kg PO q12
  - Oral opioid (tramadol, codeine)

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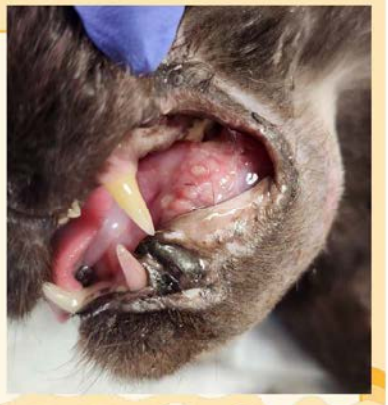
Case Example #2: Mouse

- 7 yo FS DSH
- Extensive mass affecting left caudal mandible
- **Current medications:**
  - Meloxicam 0.05 mg/kg PO q24 (compounded tab)
  - Gabapentin 4 mg/kg PO q8 (compounded liquid)
  - Mirataz® transdermal



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Case Example #2: Mouse

- **Palliative Care Plan:**
  - Cefovecin 8 mg/kg SQ for suspected secondary bacterial infection
  - Zoledronate 0.1 mg/kg IV infusion for bone pain
  - Buprenorphine 0.015 mg/kg oral transmucosal q8
  - Continue gabapentin, increase to 10 mg/kg PO q8
  - Continue meloxicam 0.03-0.05 mg/kg/day
  - ONC Care moistened kibble and canned food

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When the Barnyard Won't Behave: Sedation Tips for Companion Livestock

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1

Introduction

- The Ohio State University: DVM
- University of Wisconsin: DACVAA & PhD

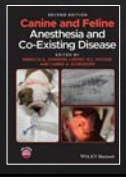
- Clinician Scientist
  - Clinical Anesthesia and Pain Management - SVM
  - Teach
  - Research

2

WVMA WISCONSIN VETERINARY MEDICAL ASSOCIATION

OPK9 MEDICAL TEAM

AALAS



PAVE PROGRAM FOR THE ASSESSMENT OF VETERINARY EDUCATION EQUIVALENCE a service of the AAVSB

3

Tasks …

- Discuss sedation techniques for "weird backyard animals"
  - Poultry, camelids, sheep, goats, pigs …

WVMA
WISCONSIN VETERINARY MEDICAL ASSOCIATION

4

Objectives

- ID common indications for sedation in companion backyard livestock
- Recognize species-specific considerations for sedative choice & risks
- Describe practical sedation strategies for field settings
- Monitor & mitigate complications (stress, hyperthermia, hypoventilation)
- Apply welfare-focused decisions to improve animal, owner & vet team safety

5

3 Takeaway Points

1. Individual analgesic (& anesthetic) protocols
   - Think "outside the box"
   - One protocol may not work for every animal!
   - Improve sedation & animal/personnel safety
2. Know effects on physiology & pathophysiology
   - Cardiopulmonary
3. You CAN monitor & provide support in field!
   - Just take a minute!
   - Appreciate value of an assistant!

6

Common Livestock Species

- Bovine: cattle, oxen, buffalo, zebu, yak
- Swine – Kune Kune
- Small ruminants: sheep & goats
- Equine: horses, donkeys, mules
- Camelids: camels, llamas, alpacas
- Poultry: chickens, turkeys, ducks, geese
- Others: Rabbits, farmed deer, elk, emu

7

Key Points

- Backyard livestock ≠ production animals
- Emotional value to client
- Reduce stress, fear & pain - different expectations …
- Goals:
  - Analgesia (if needed), sedation, muscle relaxation → anesthesia?
    - Enable diagnostic & procedures
  - Safety (animal & humans)
  - Affordable & easy!
  - Take a minute & do not take shortcuts!

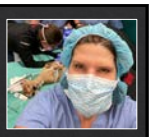
8

The Bottom Line …

- Optimize/maintain O_2 delivery to organs
  - Perfusion & ventilation
  - Minimizing negative side effects of drugs (balanced techniques)
  - Mean Arterial Pressure (MAP) is important!
    - Heart Rate x Stroke Volume = Cardiac Output (HR X SV = CO)
    - Cardiac Output x Systemic Vascular Resistance = MAP (CO X SVR = MAP)
- Risk – client consent!
  - Sedation vs. anesthesia
  - Consider entire procedure
    - Personality, invasiveness, complications, post-procedure recovery/care, duration, etc.

9

Anesthetic Risk?



- Overall morbidity/mortality horses ~ 1.2% (Gozalo-Marcilla 2025)
  - Standing sedation = 0.2%; field procedures = ?
- Overall mortality donkeys ~1.0% (higher in hybrids; Boocock et al 2025)
  - Standing sedation ~ 0.7%
- Overall morbidity/mortality goats ~ 7.3%; elective procedures = 3.4% (Steen et al 2023)
- Compare to small animals (0.1%) & humans (0.001-0.002%)

- ↑ complications/mortality (Laurenza et al 2020): age, ASA score (II-IV), urgent procedures, anesthetic duration > 2 h or <1 h, poor induction, ↓BP, hypothermia
- ↓ complications/mortality: opioid analgesia (butorphanol, buprenorphine), α-2 before recovery, monitoring (IBP, capnography, blood gas, temperature)

10

Common Indications for Sedation (Anesthesia)

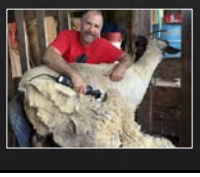
- Hoof & tusk trimming
- Castration
- Laceration/fracture repair
- Abscess drainage
- Imaging (radiographs, ultrasound)
- Painful conditions

11

Pre-Procedure Considerations

- Take time to evaluate procedure & area & patient
  - Is surgical area/instrument table set up?
  - Is recovery area dry with good footing?
  - Is there padding?

VS.



12

Patient Considerations

- Good history & PE!
- Size
  - Large: restraint, ventilation, perfusion, recovery
    - Require good padding (pads, straw, etc.)
    - Safety for personnel!
  - Small: same considerations AND temperature
- Age
  - Bigger ≠ adult!
  - Neonates: glucose, temperature, metabolic capacity
- Temperament
  - Handled? Walk into induction area?
  - Are they a pig???

13

Patient Considerations

- IM or IV
- IV catheter or going off needle?
  - Place without premeds? More predictable IV
  - Quick - butterfly tape and staples
  - Care with xylazine …

14

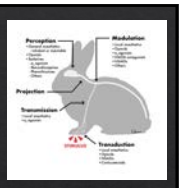
Patient Considerations

- Food withholding
  - Equine ~6-12 h - minimal evidence
  - Ruminant
    - Sheep & goats ~12-18 h
    - Cattle ~18-24+ h
  - Llama/alpaca ~ 12 h
  - Pig ~ 12 h
  - Birds - not routinely held - watch crop!
  - Neonates ~2-4 h Check glucose!
  - Withhold water?

- FED RUMINANTS (cattle) HYPOVENTILATE & BECOME HYPOXEMIC
- FED AND NON-FED RUMINANTS REGURGITATE!!

15

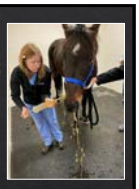
Patient Considerations



- Bloodwork?
  - Necessity based on patient
  - PCV/TP
  - Lactate: anaerobic metabolism
- Physical exam
  - Focus on musculoskeletal system (recovery), heart & lungs!
  - Abnormal PE findings do not improve with anesthesia!
    - Exception: if painful – HR may drop - pain perception reduced
      - However - nociceptive stimulus is still there!
      - Provide multimodal analgesia!

16

Pre-Procedure Considerations



- Common sense…
- Brush off
- Wash mouth out - aspiration
- Do you have control?
  - Good rope/nylon halter & lead rope - not leather
  - Experienced personnel
  - NEVER have control with pigs …
- Ensure everything open & ready!
  - Sometimes don't have time afterwards!

17

Pre-Procedure Agents

- IV more predictable vs. IM – darting, pole syringe (hopefully not)

- Alpha-2 agonists (xylazine, detomidine, dexmedetomidine)
- Benzodiazepines (midazolam)
- Phenothiazines (acepromazine)
- Dissociatives (ketamine, Telazol®)
- Opioids
- Others …

18

Pre-Procedure Agents - Oral Options?

- Gabapentin (Ca^{++} channels → ↓ excitatory NTs)
  - Swine: 15 mg/kg then 8.5 mg/kg PO TID (Hampton et al 2021)
  - Goats: 10-15 mg/kg PO (ataxia; Costa et al 2024; Kleinhenz et al 2024)
  - Camel (1): 5 mg/kg (Wenger & Hatt 2019)
  - Pigeons: 50 mg/kg PO (Burns et al 2026) (10-80 mg/kg – flamingoes, owls, parrots)
- Trazodone (5-HT & NE reuptake inhibitor, blocks H1 & α1 receptors)
  - Goat: 10 mg/kg PO; wildebeest: 12-15 mg/kg (sedation; Pruc'homme et al 2021, 2023)
  - Swine: 60 mg/kg (tranquilization; Hampton et al 2025 abstract)
    - Clonazepam: 0.5 mg/kg PO - pigs could not reach their trough!
  - Alpaca: 12.5 mg/kg (Paranjape et al 2023)
  - Pigeons: 30 mg/kg (Desmarchelier et al 2024)

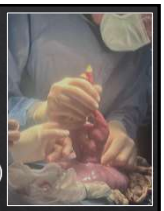
19

Alpha-2 Agonists

- Alpha 2: alpha 1
  - Xylazine (160:1)
  - Detomidine (260:1)
  - Romifidine (340:1)
  - Dexmedetomidine (1620:1)
- Great sedatives (locus coeruleus), good muscle relaxation & mild analgesia (spinal cord)

20

Alpha-2 Agonists

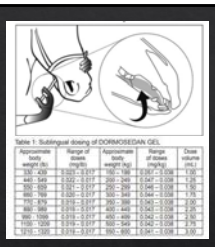


- ↓ HR, CO & vasoconstriction
  - ↓ tissue O_2 delivery (remember … bottom line?)
- Respiratory depression - pulmonary edema (ruminants)
- Ataxia, ↓ to no effect on ICP
- ↓ other drugs/inhalant ~25-34%
- ↓ GI motility
- ↑ uterine tone - constrict uterine vasculature - ↓ oxygen (Seddighi & Doherty 2016)
- ↑ urine output: hyperglycemia & ↓ ADH (vasopressin)
- Improve (slows) horse recovery (Santos et al 2003)
  - Xylazine & romifidine

21

Xylazine (160:1)

- Onset 1-2 min IV, 15-20 min IM
- Duration: sedation ~1 h, analgesia 15-30 min



Detomidine

- More potent (260:1)
- Longer acting: ~1-2 h

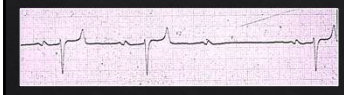
Romifidine

- More potent (340:1)
- Between xylazine & detomidine
- Slightly slower to sedate (~3 min) … lasts slightly longer (~1.5 h)

22

Dexmedetomidine

- Active enantiomer of medetomidine
- Short half-life, rapid redistribution
- Useful to smooth recovery (0.5-1 mcg/kg IV)
- Dose: 1-3+ mcg/kg; 1 mcg/kg/h IV CRI
- Very potent (1620:1)



23

Alpha-2 Agonists

- Equipotent IV doses (Yamashita et al 2000; Papich 2021)
  - 0.5-1 mg/kg xylazine
  - 40-80 mcg/kg romifidine (0.04-0.08 mg/kg)
  - 20-40 mcg/kg detomidine (0.02-0.04 mg/kg)
  - 5-8 (7.5) mcg/kg medetomidine
  - ~3-4 mcg/kg dexmedetomidine

α2-Agonist Dosages for Small-Scale & Hobby Pigs

DRUG	DOSE RANGE	ROUTE	ONSET & DURATION
XYLAZINE	1–4 mg/kg	IM or IV	Onset: 5–10 min Duration: 30–60 min
DETOMIDINE	0.04–0.1 mg/kg	IM or IV	Onset: 3–7 min Duration: 60–120 min
DEXMEDETOMIDINE	10–40 µg/kg (0.01–0.04 mg/kg)	IM or IV	Onset: 3–5 min Duration: 60–90 min

α2-Agonist Dosages for Small-Scale & Companion Camelids

DRUG	DOSE RANGE	ROUTE	ONSET & DURATION
XYLAZINE	0.08–0.6 mg/kg	IM or IV	Onset: 5–15 min Duration: 20–45 min
DETOMIDINE	0.005–0.02 mg/kg	IM or IV	Onset: 3–7 min Duration: 45–90 min
DEXMEDETOMIDINE	2–8 µg/kg (0.002–0.008 mg/kg)	IM or IV	Onset: 3–5 min Duration: 45–75 min

Table 2
Doses of commonly used alpha-2 adrenoceptor agonists in ruminants

Drug	Route of Administration	Adult Cattle	Calf	Sheep	Goat
Xylazine (mg/kg)	IV	0.05–0.1	0.05–0.1	0.05–0.1	0.02–0.05
	IM	0.1–0.3	0.1–0.3	0.1–0.2	0.05–0.1
Dexmedetomidine (µg/kg)	IV	1–5	5–10	5–10	5–10
	IM	5–20	10–30	10–30	10–30
Detomidine (µg/kg)	IV	3–10	3–30	3–20	5–20
	IM	10–20	30–40	20–30	20–30
Romifidine (µg/kg)	IV	3–20	3–50	3–40	3–40
	IM	20–40	50–100	40–80	40–80

Seddighi & Doherty 2016

24

Benzodiazepines - Midazolam

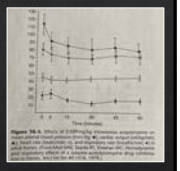
- Most species - TAKES WHAT YOU SEE AND MAKES IT WORSE!!
- Minimal cardiovascular & respiratory effects
- MUCH better in combo (opioid, alpha-2 agonist)
- Used with ketamine for muscle relaxation
  - Propofol (0.5-1 mg/kg IV) also used with ketamine
    - Propofol sandwich (P – K – P)
  - "New" Triple Drips? Another lecture …

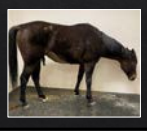
- "GO TO" sedative in birds!!
- Useful in swine (intranasal), lambs, kids, crias, (foals, calves)
  - Can add butorphanol or low dose ketamine for better sedation

25

Phenothiazines - Acepromazine

- Dopamine-2 & alpha-1 receptor antagonist
- Enhances other sedatives
- Mild sedation alone but long-acting - takes edge off!
  - Many pigs need edge taken off!
- Hypotension but HR, RR, CO minimally affected
- (Paraphimosis in stallions)
- Used all the time … sedation & recovery
  - Xylazine (short) + ace (long)





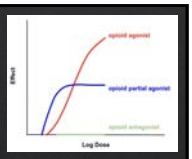
26

If You Don't Like What You See … Reverse!

- Yohimbine (40:1; α2:α1)
  - Compounded (Nexgen Pharmaceuticals, Weatherford, TX; tolazoline too)
- Atipamezole (8526:1; α2:α1)
  - Dose varies: 0.03-0.1 mg/kg IM
  - Xylazine = "dirty"; acts on other receptors (yohimbine/tolazoline ok)
  - Do not administer IV or under GA - unless emergency
    - Quick reversal of ALL receptors
    - Profound vasodilation & hypotension (Zatroch et al 2019)
- Flumazenil (midazolam reversal)
  - Dose: 0.02 mg/kg IV
- Naloxone (opioid reversal - next slides)
  - Dose: 0.02-0.04 mg/kg IM, IN slowly

27

Analgesics … Opioids



- Synergistic with sedatives
  - Smooth & reduce doses
  - Extend duration
  - Analgesia
- Minimal CV effects (↓HR) BUT respiratory depression!
- Equids: sedate with alpha-2s to ↓behavioral effects (hypermotility, dysphoria)
  - Butorphanol (0.01-0.05 mg/kg most species, 1-2 mg/kg birds): kappa opioid *agonist*/mu opioid *antagonist*
    - Mild analgesic, 1 h duration

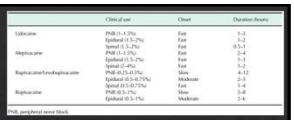
28

Need Greater Analgesia …

- Morphine (0.05-0.1 mg/kg IM, IV SLOWLY): mu opioid agonist
  - Better analgesic, MAY slow GI (but so does PAIN!)
  - ~4-6 h duration
  - Histamine release
  - Don't forget other routes…epidural (12+ h)
- Hydromorphone (0.04 mg/kg IM, IV): mu opioid agonist
  - Better analgesia - less expensive - no histamine release
  - ~ 4-6 h duration
  - ↑HR & SAP, ↓borborygmi & did not change fecal output (Martins et al 2020)
  - Methadone (mu agonist, NMDA antagonist; 0.1-0.2 mg/kg IV) - ↑$

29

Analgesics

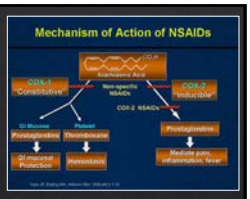


- Local Anesthetics
  - Bupivacaine/ropivacaine (≤ 2 mg/kg)
  - Mepivacaine (≤ 5 mg/kg)
  - Lidocaine (≤ 6 mg/kg)
  - Anywhere there is/are nerves!!
  - Lidocaine IV (50 mcg/kg/min IV)
    - Anti-inflammatory/endotoxin, analgesia, ↓MAC, prokinetic (Nannaroneet al 2015)
  - Nocita® - liposomal encapsulated bupivacaine
    - < 0.4 mL/kg
    - Up to 3 d analgesia

30

Analgesics

- NSAIDs
  - Commonly used
  - Great for inflammatory pain BUT…
  - GI issues, renal effects, etc …
  - COX-2 selective drugs better for GI only



NSAID Dosing for Small-Scale & Backyard Sheep & Goats

DRUG	DOSE RANGE	ROUTE
MELOXICAM	1–2 mg/kg	SC, or PO
PHENYLBUTAZONE	5 mg/kg	PO
FLUNIXIN	1.1–2.2 mg/kg	IV or IM

NSAID Dosing for Small-Scale & Backyard Pigs

DRUG	DOSE RANGE	ROUTE
MELOXICAM	0.4 mg/kg	SC, or PO
PHENYLBUTAZONE	5–8 mg/kg	PO
FLUNIXIN	2.2 mg/kg	IV or IM

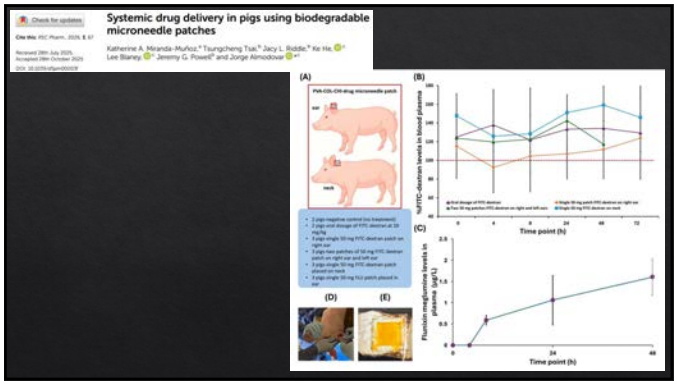
NSAID Dosing for Small-Scale & Companion Camelids

DRUG	DOSE RANGE	ROUTE
MELOXICAM	0.5–1 mg/kg	PO
PHENYLBUTAZONE	2.2–4.4 mg/kg	PO or IV
FLUNIXIN	1.1 mg/kg	IV

CLINICAL TIPS:

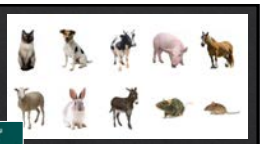
- Routine bloodwork (BUN, creatinine) useful
- Ensure adequate hydration before & after NSAID administration
- Gastroprotectants mitigate ulcer risk
- Use the lowest effective dose **if needed for multiple days**

31



32

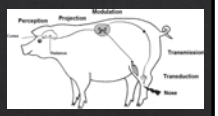
Validated Pain Scoring Systems



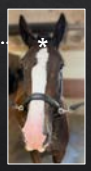
33

Don't Forget ...

- Alternative therapies
  - Acupuncture
  - Physical therapy
  - Others ... laser, cold, ultrasonic, etc..
  - GV20
  - GV24: Da Feng Men
- ↓ pain before it starts by ↓ inflammation - surgical trauma, surgical time, etc...



Kschonek et al 2025



34

Mesotherapy

AJVR AVMA

A multiple-session mesotherapy protocol for the management of hip osteoarthritis in police working dogs

"Mesotherapy (also known as local intradermal therapy) is a minimally invasive technique that applies pharmaceuticals or other substances in small quantities through multipunctures of the dermis. This process creates microdeposits from where the drug(s) is slowly released to the underlying tissues"

- lidocaine, mepivacaine, serapin, vitamin D, corticosteroids, piroxicam, thiocholchicoside -

www.centrallakesequine.co.nz/new-blog-1/2022/3/14/mesotherapy
https://www.rvc.ac.uk/Media/Default/Equine/Documents

35

Need More Sedation? Recumbency? General Anesthesia

- Ketamine
  - NMDA receptor antagonist/opioid agonist
  - Stun (low dose) → unconsciousness (high dose), superficial analgesia, ↓ wind up
  - Reflexes intact (laryngeal, corneal, tear production)
  - High dose: ↑IOP, ICP, myocardial O_2 consumption (care with heart dz & α-2 agonist)
  - Muscle rigidity - add midazolam, propofol as co-agents
- Propofol IV
- Others ... Telazol® (1-6 mg/kg) IV or IM in dart/pole syringe +/- alpha-2 agonist
- With adequate dosing, intubation quickly follows ...

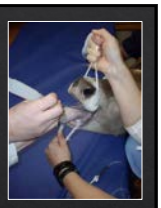
36

Tracheal Intubation

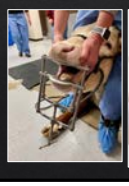
- Largest tube is best
  - Protect airway, reduce obstruction
- In smaller species, have stylets, mouth gags, laryngoscope
- Cuff pressure - tracheal necrosis - only inflate to 20 cm H_2O (Ferreira et al 2021)
- 24-30 mm - horses/adult cattle, 8-10 mm - sheep & goats, smaller in pigs...

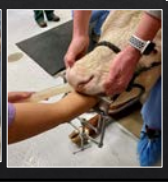
37

Tracheal Intubation



- Take a minute to do it!
- Horses: very straight - blind
- Ruminants: manual or over stylet

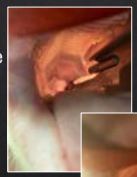


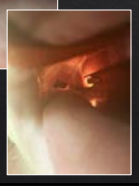


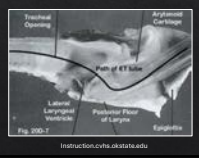
38

Tracheal Intubation: Pigs

- Mouths do not open
- Redundant soft tissue
- Bend in trachea
- Dorsal diverticulum
- Lateral ventricles







39

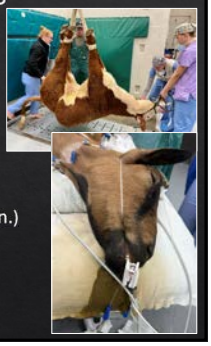
Heavy Sedation/Injectable Anesthetic Considerations

- < 1 h due to hypoxemia/hypoventilation
- Provide oxygen: nasal insufflation, mask, down ET tube

40

Heavy Sedation/Injectable Anesthetic Considerations

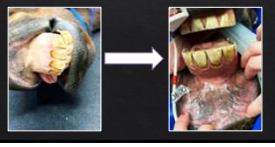
- IV catheters - IV fluids
- Positioning – take a minute! Do not take shortcuts!
  - Even positioning
  - >15-30 min need padding
  - Protect eyes
  - Lateral
    - Front leg pulled forward (protect triceps/radial n.)
    - Legs parallel
  - Dorsal - do NOT overextend neck!
    - Tip nose down - regurgitaton
  - Do not hyperextend legs

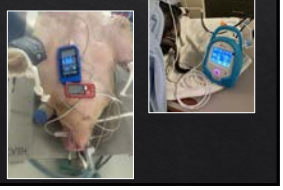


41

Monitoring

- Short procedures
  - Hands/eyes: pulses, respiratory rate & depth, neck tone
  - Vetcorder: ECG, pulse oximetry, temperature
- Long procedures
  - ALL the things … NIBP/IBP, capnometry





42

If Anesthetized or Recumbent … Recovery

- Needs to be a balance between quick & strong recovery!
- Sedate – provide analgesia as above
- Reverse
- Watch temperature
- Pad well
- Do NOT sit on neck
- Care with halter buckle

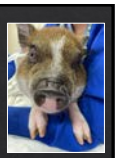
43

Recovery Complications

- Cardiac arrest
- Fractures
- Airway obstruction (usually upper airway, pulmonary edema)
- Myopathies (hypotension & prolonged procedures)
- Neuropathies/myelomalacia
- Cuts/scrapes
- Broken teeth
- Human injuries
- ↑ with duration/complexity, surgical time, dorsal recumbency, age

44

Case #1 Kune Kune "Spa Day"



- Pre-anesthetic considerations
  - Type/age of pig (Kune Kune = brachycephalic)
  - Training SOOOO important!
  - Off food: too long (↓pH), too short (bloat) – vomiting!
    - Gastric emptying long/variable (~10-200 h; Henze et al 2021; Bures et al 2023)
  - Oral sedatives
    - Gabapentin (15 mg/kg PO evening before & 8.5 mg/kg after PO)
      - Getting into the pig is the trick! Handle/feed the pigs!

45

Case #1 Kune Kune "Spa Day"

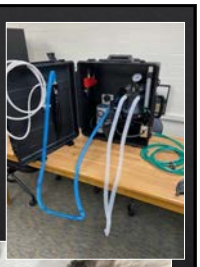
- Pre-medication
  - Midazolam (0.5 mg/kg)
  - Ketamine (10-15 mg/kg)
  - Dexmedetomidine (10-20 mcg/kg) IM (or xylazine 1-2 mg/kg)
  - What is missing?
  - MANY other choices
    - *Question:*
      - How many would choose TKX (Telazol – ketamine – xylazine) or TX?

Fleischmann et al 2023

46

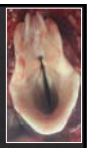
Case #1 Kune Kune "Spa Day"

- IV catheter in auricular vein - crystalloids (5 mL/kg/h)
- Maropitant (1 mg/kg IV, IM; 2 mg/kg PO; Smith et al 2023)
- Pre-oxygenate - IV propofol if needed
- Maintenance: intubate + isoflurane
  - Use a mask??

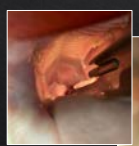


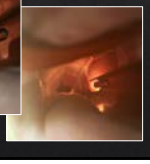
47

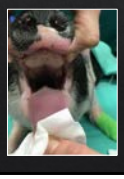
Case #1 Kune Kune "Spa Day"



- Intubation
  - Small opening, excess pharyngeal/laryngeal tissue, laryngospasm
  - ALWAYS use lidocaine splash - why??
- Fleshy tongue, sharp teeth, elongated soft palate, narrow, angled trachea, dorsal pharyngeal diverticulum, lateral ventricles, tracheal bronchus



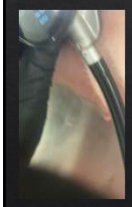


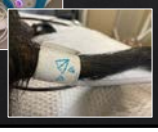
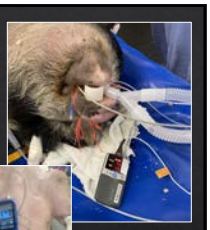
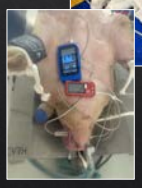


48

Case #1 Kune Kune "Spa Day"

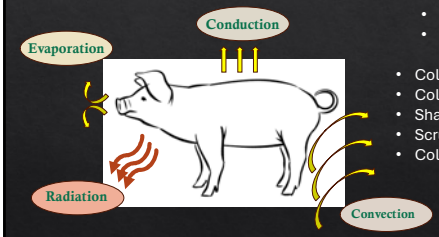
- ALL THE THINGS!
- ECG, BP, SPO_2, capnography, temperature, etc.



49

Thermoregulation Mechanisms of Heat Loss

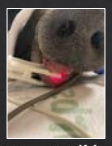


WHY SO COLD?

- Anesthetic drugs
  - Redistribute blood flow
  - Alter autonomic tone
  - Lose thermoregulatory behavior
- Cold fluids & gases
- Cold ambient temperature
- Shaving
- Scrubbing
- Cold surfaces

50

Case #1 Kune Kune "Spa Day"

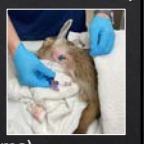


- Quick procedure - needs quick recovery!!
- Alternative:
  - Midazolam (0.2 mg/kg) + detomidine (0.05-0.1 mg/kg) + butorphanol (0.2 mg/kg) IM
  - Could use other alpha-2 agonists/opioids IM such as...
  - BAM (butorphanol, azaperone, medetomidine [AALAS; Bernardini & Williams, 2023])
- Reverse midazolam: flumazenil (0.02-0.04 mg/kg IV/IM) & detomidine (dexmed/xylazine): atipamezole (0.05-0.2 mg/kg IM)

51

Case #2: Goat (Sheep) Dehorn (or Something Else … Cast Application, Obstetrical …)

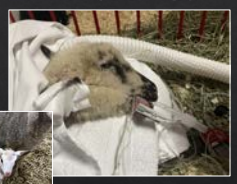
- Hold off feed?
- IM vs. IV
- Midazolam (0.2 mg/kg IV) + butorphanol (0.1-0.2 mg/kg IV)
- Need more??
  - Add 0.5-1+ mg/kg ketamine IV, IM = "ketamine stun"
  - Add xylazine (0.05 mg/kg IV) carefully (CV ↓, pulmonary edema)
  - Add propofol IV
  - Ready to intubate!!!



52

Case #2: Goat (Sheep)

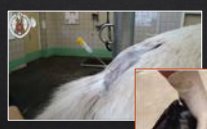
- Tip nose down
- Monitor
  - Temperature
- Local block!

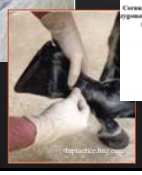


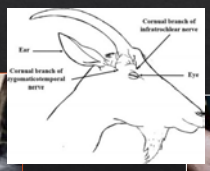
53

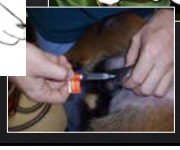
Local Techniques

- Common because of cost & issues with putting large animals under general anesthesia!
- And they work!!





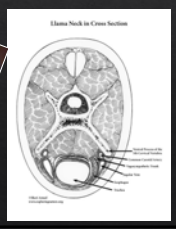




54

What if it was an Alpaca/Llama?

- VERY similar but pseudo-ruminant (3 chambered stomach)
- Alpha-2 sensitivity: pigs < small ruminants < alpacas/llamas < horses
- IV Access is more difficult



(A) Ramus of the mandible. (B) Jugular vein. (C) Omohyoid muscle. (D) Trachea. (E) Carotid artery

55

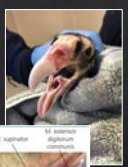
Camelids: Merck Manual

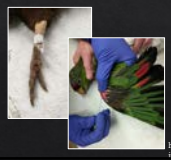
Diazepam	Sedation	0.05–0.2 mg/kg, IV	Flumazenil 0.1–0.2 mg/kg, IV	
Butorphanol	Sedation	0.05–0.1 mg/kg, IM or IV	Naloxone 0.03 mg/kg, IM	Butorphanol can be added to xylazine or other α2-adrenergic agonists for increased sedation and analgesia.
Xylazine	Recumbent sedation	Llamas: 0.25–0.35 mg/kg, IV Alpacas: 0.35–0.45 mg/kg, IV	Atipamezole at 0.1 times the dose of xylazine in milligrams, IM	
	Standing sedation	Llamas: 0.08–0.15 mg/kg, IV; or 0.15–0.2 mg/kg, IM or SC Alpacas: 0.15–0.2 mg/kg, IV; or 0.2–0.3 mg/kg, IM or SC	Reverse with atipamezole at 0.1 times the dose of xylazine in milligrams, IM	
Triple drip (5% guaifenesin [1 L], ketamine [1,000 mg/L], xylazine [50–100 mg/L])	Procedures < 60 min that require recumbency and excellent muscle relaxation	Induction: 1 mL/kg, IV Maintenance: 2 mL/kg/h, IV, CRI		
Ketamine stun	Short, minor procedures, such as castrations, that require recumbency	Ketamine (0.22–0.55 mg/kg) + xylazine (0.22–0.55 mg/kg) + butorphanol (0.08–0.11 mg/kg), all combined in one syringe, IV		This combination can also be given IM. Sedation will be slow onset and will not always cause recumbency.

56

Case #3 Chicken - Draw Blood, Laceration Repair, etc...

- Some clients do spend money on them ...
- High distribution of kappa opioid receptors in forebrain
  - Analgesia?
- Significant hypoventilation - easily intubated
- Midazolam (1-2 mg/kg) + butorphanol (1-2 mg/kg) IM
- IV or IO catheter





https://www.ukvetcompanionanimal.com/content/clinical/a-guide-to-placing-an-intraosseous-catheter-in-the-avian-distal-ulna

57

Case #3 Chicken - Draw Blood, Laceration Repair, etc...

- Monitors do work...
- Ventilate? Do you always need 100% O_2?
  - Room air with Ambu bag

58

HORSE Standing CRIs

(Sedative and Analgesic Infusions in Horses, T. Grubb 2023)

Drug(s)	Doses	Comments
Butorphanol	Load: 0.01-0.02 mg/kg IV CRI: 0.02 mg/kg/hr IV	TIP: add 10 mg (1 mL) butorphanol to 1-L saline; administer at 1 L/hr per 450 kg. May need α-2 agonist for sedation (Sellon et al 2004)
Morphine or methadone	Load: 0.05-0.1 mg/kg IV SLOW CRI: 0.1 mg/kg/hr IV	SLOW administration of morphine due to histamine release
Xylazine	Load: 0.5-1 mg/kg IV CRI: 0.6-1.5 mg/kg/hr IV	TIP: add 1000 mg (10 mL) xylazine to 1 L saline; administer at 1 mL/kg/hr. Can add butorphanol or morphine (see above) (Muller et al 2012)
Dexmedetomidine	Load: 1-3.5 mcg/kg IV CRI: 0.5-3 mcg/kg/hr IV	TIP: add 1000 mcg (2 mL) dexmedetomidine to 8 mL saline (final concentration = 100 mcg/mL. Administer at 1 mcg/kg/hr. Example: A 500 kg horse gets 5 mL/hr.
Detomidine Used alone, dose is higher vs. used in combo "Sliding" dosing = quick onset without continued deep sedation	Load: 6-10 mcg/kg IV "Sliding" CRI: 0.5-0.7 mcg/kg/min for 15 min, then 0.3 mcg/kg/min for 15 min, then 0.15 mcg/kg/min; turn off 5-15 min prior to procedure end 0.5 mcg/kg/min=30 mcg/kg/hr	TIP: remove 5 mL from a 500-mL bag and add 50 mg (5 mL) detomidine (final concentration = 100 mg/mL detomidine) and 60 drops/mL set. Following loading dose, start the drip at 0.005 drops/kg/sec (~2 drops/sec/450 kg) for 15 mins; then 0.003 drops/kg/sec (~1 drop/sec/450 kg) for 15 mins; and then 0.0015 drops/kg/sec (~1 drop every other sec/450 kg) until 5-15 mins prior to procedure end. The drip rate should be adjusted to obtain the desired level of sedation. For smaller horses, 2.5 mL of detomidine can be used.
Detomidine + butorphanol	Load: 6-10 mg/kg detomidine + 0.02 mg/kg butorphanol IV CRI: 5-30 mcg/kg/hr detomidine + 5-30 mcg/kg/hr butorphanol	CRI rate is together usually same as the rate for either drug alone; some use only ½ of the butorphanol CRI rate
Detomidine + morphine	Load: 8 mcg/kg detomidine, WAIT 10 MIN then 0.05 mg/kg morphine CRI: 5-30 mcg/kg/hr detomidine + 30 mcg/kg/hr morphine	Morphine = profound analgesia. Possible pacing after CRI discontinued (administer additional α-2 agonist)
Ketamine	Load: 0.1-0.2 mg/kg IV CRI: 2-10 mcg/kg/min (0.12-0.6 mg/kg/hr) IV	TIP: add 120-600 mg (1.2-6 mL) to 1 L saline (final concentration = 0.12-0.6 mg/mL), administer at 1 mL/kg/hr for 0.12-0.6 mg/kg/hr. 0.4-0.8 mg/kg/hr (6-13 mcg/kg/min) used in conscious or anaesthetized horses (Fielding et al 2006)
Lidocaine	Load: 1-1.5 mg/kg IV SLOW CRI: 40-50 mcg/kg/min IV	TIP: Add 150 mL of 2% lidocaine to 1 L saline and administer at 1 mL/kg/hr (50 mcg/kg/min). Be careful – toxicity is common in overdose!

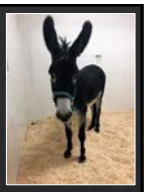
Watch your UNITS!

Double and triple check your math!!

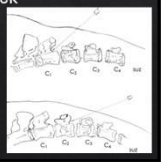
59

Donkeys/Mules vs. Horses

Matthews & van Loon 2019



- Thick skin - cutaneous colli muscle covers jugular v.
- Dose to effect: may need up to 25% higher, especially *mules*
  - Use oral detomidine at label doses
- Metabolize drugs quickly
  - More frequent bolus administration (Ketamine-Xylazine)
  - Donkeys more sensitive to guaifenesin - still metabolize quick
- Local techniques similar
  - Epidural Co2-Co3 better



60

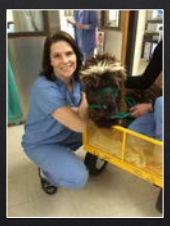
Table 1
Suggested drug doses for sedation, induction, maintenance, and analgesia of donkeys and mules

	Dose (mg/kg)	Route	Expected Duration
Sedation			
Xylazine	1.0 (0.4–1.5)	IV, IM	15–20 min
Romifidine	0.08 (0.05–0.1)	IV, IM	30–60 min
Detomidine	0.01 (0.005–0.02)	IV, IM, sublingual	20–40 min, longer for sublingual
Dexmedetomidine	0.005	IV, IM	20–30 min
Acepromazine	0.03 (0.02–0.05)	IV, IM, sublingual	30 min–2 h
Induction			
Ketamine	2.2–2.5	IV	10–15 min
Diazepam/ midazolam	0.05 (0.02–0.1)	IV	10–15 min with ketamine
Propofol	2.0	IV	10–15 min
Propofol	0.5	IV	10–15 min used with ketamine
Alfaxalone	2.0	IV	10–15 min
Thiopental	6–8	IV	20 min
Telazol	1.0	IV	20–30 min
Maintenance			
Triple drip	Guaifenesin 50 mg/mL, ketamine 2 mg/mL, Xylazine 0.5 mg/mL	IV	Up to 60–90 min
Analgesics			
Butorphanol	0.03 (0.02–0.05)	IV, IM	30–60 min
Buprenorphine	0.006	IV, IM, sublingual	6 h
Morphine	0.1	IV, IM	2–3 h

Data from Matthews N, Taylor T, Hartsfield S. Anaesthesia of donkeys and mules. Equine Vet Educ 2005;7:102-107.

61

Thank you!
Questions?



62