NEUROLOGICAL DISEASES WE COMMONLY SEE IN SMALL RUMINANTS

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Sheep or Goats with Neurological Signs

• Common
  • Polioencephalomalacia
  • Listeriosis
• Uncommon but Reportable
  • Rabies
  • Scrapie

Sheep or Goats with Neurological Signs

• Uncommon but important at flock level
  • Tetanus
  • Copper deficiency
  • Many toxicoses (lead, organophosphate / organochlorine etc)
  • Parelaphostrongylus (deer meningeal worm)
  • Sarcocystosis
• Many common diseases also have neurological signs
  • E.g. enterotoxaemia, pregnancy toxaemia, MV / CAE
  • Brain and spinal abscesses can be sporadic, secondary to tail-docking or septicaemia or due to CLA

Polioencephalomalacia

• Presenting complaint
  • Usually a single case gets “called in”
  • Acting bizarre, blind
• Etiology
  • Thiamine deficiency (vitamin B1)
• Epidemiology
  • Dietary problem
  • High level of carbohydrate (grain) in diet, molasses
    • Change in microflora in rumen to bacteria which produce thiaminase
    • Some toxic plants (bracken fern, horsetail)
  • High levels of sulfur in water / diet
**PEM – Clinical Findings**

- Separates from group
- Stiff, stilted gait
- Opisthotonus
- Cortical blindness
  - Still has a normal pupillary light response
  - Oculomotor nerve intact
- Eventually cannot stand
- Down, spastic, convulsions
- Die in 1 to 2 days if not treated

**Polioencephalomalacia**

Phil Scott, Royal Dick Veterinary School, U of Edinburgh

**PEM – Necropsy**

- Cerebral / cerebellar edema
- Necrosis of grey matter – yellow pigmentation
- Fluorescence with UV light
**PEM - Treatment**

- Thiamine (vitamin B1)
- 10 to 20 mg/kg bw IM or SC TID for 3 days
  - Injectable products vary in concentration (75 mg/mL to 500 mg/mL)
- If treat early – response seen within a few hours
- If no response in 24 hrs, likely will not
- Flock level for at risk animals
  - 50 to 60 mg/head/day in feed
- If PEM due to high sulfur
  - Will not respond
- Regardless of hypotheses, treat SR neuro cases with thiamine.

**Listeriosis**

- Presenting complaint
  - Individual animal with cranial nerve deficit
- **Etiology**
  - Infection due to *Listeria monocytogenes*
- **Epidemiology**
  - Silage / haylage feeding
    - pH > 5.0
    - Contaminated with dirt / manure
  - Forages fed on ground
  - Bacteria found in environment, rodents, manure
  - 2 % common
  - Outbreak of 10% or higher may occur

**Listeriosis - Pathogenesis**

- Organism ingested and enters into blood stream or trigeminal nerve through superficial abrasions in oral cavity
- Incubation 10 to 21 days
- Microabscesses in brainstem

**Listeriosis – Clinical Findings**

- Febrile (> 40.0 C)
- Unilateral signs referable to cranial nerves
  - Circling, head tilt (vestibulo-cochlear n)
  - Forward propulsion
  - Trigeminal & facial n paralysis
  - Often very severe
  - High case fatality rate
- Sheep and goats more susceptible than cattle
- Neonates – uncommonly septicaemia
- Pregnant ewes and does – abortion & metritis
**Listeriosis**

- **Treatment**
  - Oxytetracycline, penicillin, trimethoprim-sulfa
  - Single injection of dexamethasone (1.1 mg/kg)
  - Extended nursing care
  - High case fatality rate

- **Control**
  - If outbreak (several cases over time)
  - Metaphylactic treatment with long acting oxytetracycline
  - Remove source but incubation at least 10 days
  - Silage & forage feeding management
  - Public health issue

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**Rabies**

- Presenting complaint
  - Sheep / goat behaving bizarrely
- Reportable to
  - Local Public Health Unit if human exposure
  - If domestic animal exposure but no human – follow state rules
- Epidemiology
  - Usually on pasture but sometimes wildlife / cats in barn
  - Skunk, foxes, raccoons, bats
  - Disease ~ 2 weeks later
- Treat all neurological cases as if might be rabies
  - Even if low on your list of hypotheses
  - Wear water-proof gloves

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**Scrapie**

- Presenting complaint
  - Sheep / goats acting bizarrely
- **Wasting**
- **Etiology**
  - Infectious prion but
  - Genetics determine expression of disease
  - Abnormal configuration of a normal protein (PrPsc)
  - Protease resistant
  - Presence of beta sheets
### Scrapie - Epidemiology
- First case in Canada 1938 in Suffolk sheep imported from the UK
- First described in the UK in the 1732
- Reportable in Canada since 1945 but stigma forced disease underground
- In North America
  - Mostly associated with “black-face” sheep
  - Sporadic within an infected flock but level of infection may be high
  - Difficult to diagnose clinically

### Scrapie - Pathogenesis
- PrP<sub>sc</sub> disseminated throughout body
  - Neurological tissue
  - Lymphatic tissue and cells, including peripheral blood
  - Different than BSE!
  - Space-occupying accumulation

### Scrapie - Transmission
- At lambing, PrP<sub>sc</sub> present in large amount in placenta and birth fluids
- If ewe is infected and susceptible genetics
- If lamb born is susceptible as well
  - Contaminates lambing area
- If lambs born are resistant – no shedding
- Lambs infected at birth
  - Common lambing ground
- Adults infected grazing contaminated pastures, feed

### Scrapie - Pathogenesis
- Incubation 2 to 5 years or longer?
  - Infectious load
  - Age at infection
  - Genetic susceptibility in sheep
  - Infected rams are dead-end hosts
Scrapie and Goats

- Are very susceptible to scrapie
- Cases usually seen in goats living with infected sheep
- In 2013, large goat dairy diagnosed with scrapie
  - After two years, CFIA believes they have traced the origin to sheep
- In 2016 a meat goat herd diagnosed with scrapie, no association with sheep or dairy goats
- In 2017, another outbreak in goats in another province

Scrapie – Genetic Resistance - Sheep

<table>
<thead>
<tr>
<th>PrP ARQ*</th>
<th>Red = susceptible</th>
<th>Green = resistant</th>
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<tbody>
<tr>
<td></td>
<td>136</td>
<td>154</td>
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<tr>
<td>PrP VRQ</td>
<td>V</td>
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<td>PrP AHQ</td>
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<td>PrP ARR</td>
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* Most common in nature

Little variation at 136 & 154 in North American sheep breeds

Scrapie – Genetic Susceptibility - Sheep

- VRQ / ARQ ★★★
  - Very very rare but very, very susceptible
- ARQ / ARQ ★★★
  - Very common and very susceptible
- ARQ / ARR ★★★
  - Common and moderately resistant
  - If lots of scrapie in flock, will express disease
- ARR / ARR ★★★
  - Used to be uncommon but genetic breeding programs seeking out these animals

- Ongoing work to determine genetics of goat scrapie
  - Not yet a clear picture and resistant genes appear very rare

Scrapie – Clinical Findings

- 2 to 5 years of age but as young as 6 months
- Are different presentations of scrapie
  - Pruritic
  - Ataxic
  - Paralytic
  - Wasting ***
Scrapie – Clinical Findings

- Early signs
- Nervous
- Separate from flock
- As disease progresses
  - Hypersensitive to noise
  - Dull / somnolent when undisturbed
  - Early only episodic
  - Teeth grinding and lip licking

Scrapie – Clinical Findings

- Increased “grooming”
- Intense bilateral pruritis
- Scratch test

Scrapie

Locomotor incoordination
- High stepping
- Stumbling
- Abnormal head carriage

Scrap - EU TSE Reference Centre

MAY 20 2002
Scrapie – Clinical Findings

- Not all forms present in all outbreaks

- Atypical signs
  - Regurgitation of rumen fluid
  - Rumen impaction
  - Apparent blindness
  - Cardiac arrhythmia

Goat Scrapie Case – Ontario 2013

- Terminally
  - Recumbent, coma
  - Course of disease weeks to months but end comes quickly
Scrapie – Laboratory Diagnosis

• Live Animal Tests
  • Biopsy of lymphoid tissue
    • Treatment with protease & monoclonal antibody for PrP + fluorescence
    • Rectal anal mucosal associated lymphoid tissue biopsy (RAMALT)
• Genome testing
  • Test for susceptibility, not disease
  • 7 mL EDTA blood

Scrapie – RAMALT Biopsy

Scrapie – Postmortem

• Sample obex - Canada
  • Rapid test to screen Animal Health Laboratory
  • Confirmed with histopathology and immunohistochemistry by CFIA
• If you suspect scrapie, you are obligated to report the case
• Surveillance
  • Active - Surveillance from scrapie certified flocks and at the abattoir
  • Passive - Canada - CFIA will pay for tests from sheep and goats with signs suggestive of scrapie
• National ID program
  • Allows trace-back of all positive cases to farm of origin

Scrapie Control - CFIA

• Initial investigation;
• Quarantine;
• Detailed investigation;
• Destruction, disposal and associated compensation;
• Cleaning and disinfection; and
• Surveillance testing for five years
• USDA has information on American Scrapie Eradication program
Scrapie – Canada and USA

- Currently sheep, goats and camelids > 12 months of age cannot enter the USA from Canada
  - Even if just crossing the USA to Mexico
  - Originally because of BSE risk (2003)
- Canadian cattle have been able to come for years now – why not small ruminants!
- We are hopeful the USDA will modify this – waiting for decision
- Canada has a national ID program
  - Mandatory for all sheep leaving the farm of origin since 2003
  - Will be mandatory for goats as of 2018 – voluntary now
- Canada has a voluntary scrapie certification program
  - For many years now
  - We have lots of low risk small ruminants for scrapie

Tetanus

- Presenting complaint
  - Lamb or kid ~ 2 weeks after surgery
    - Tail docking, castration, dehorning
  - Ewe or doe ~ 2 weeks postpartum
- Etiology
  - Clostridium tetani
- Clinical Findings
  - Tetanic spasms without blindness
  - Sensitive to noise, light
  - Mild bloat in adults with rumen motility
  - 3rd eyelid prolapse
  - Case fatality rate close to 100%

Copper Deficiency / Enzootic Ataxia

- Presenting Complaint
  - Lambs or kids develop posterior paresis but bright and alert
- Etiology
  - Insufficient copper in the diet
  - Excess molybdenum in the diet – more common
  - During pregnancy
  - Sometimes due to excess sulfur, iron
- Epidemiology (Ontario)
  - Rare but important to understand clinical presentation
  - Areas with high levels of molybdenum in soil
  - Usually several cases in flock or herd
  - Breed effect (like Cu toxicosis)
Copper Deficiency

- Clinical Findings
  - Congenital
    - Born weak, blind, down, tremours
  - Delayed***
    - Born normal
    - Onset of posterior paresis 4 weeks to 4 months of age
  - Adult
    - Anaemia, lameness, diarrhea, wool break, “spectacles”

- Laboratory Diagnosis
  - Serum copper levels < 0.5 ugm/ml
  - Liver copper levels < 20 ppm DW (< 200 umol/kg DW)
  - If test youngstock, may not reflect levels in the dam during pregnancy

- Necropsy Findings
  - Demyelination of cord
  - DDx
    - CAE, spinal abscess
  - Control
    - Once diagnosis is confirmed
    - Supplement with Cu

Parelaphostrongylosis

- Presenting Complaint
  - Camelids, small ruminants down, ataxic in the fall
  - Sometimes linear pruritis

- Etiology
  - Aberrant migration of deer meningeal worm

- Importance
  - Common in northern USA but usually recognized in Ontario in alpacas and llamas
  - Important DDx for other diseases causing posterior paresis or paralysis

Questions?