Iceberg Diseases

• AKA Thin ewe / thin goat / fading goat / chronic wasting syndrome...
• Clinical disease is only a fraction of sub-clinical infection present in the herd / flock
• Adults
  • Usually 3 to 5 years
  • Affects few animals at a time
  • Many individuals over time
  • Thinner than cohorts
  • Thinner than expected
  • Fail to respond to good nutrition
  • If group is thin? Nutritional issue

Common

• Competition
• Dental disease
• Retroviral diseases
  • Ovine progressive pneumonia (sheep)
  • Caprine arthritis encephalitis (goats)
• Paratuberculosis (John’s disease)
• Caseous lymphadenitis
• Enzootic nasal adenocarcinoma

Uncommon

• Gastrointestinal parasitism (adults)
• Ovine pulmonary adenomatosis / adenocarcinoma (Jaagsiekte)
• Abomasal emptying defect of sheep
• Lymphosarcoma
• Intestinal adenocarcinoma

• Reportable
  • Scrapie
    • Covered under neurological disease
Competition

- Inadequate feeder space
  - Pregnancy status
  - Ad-lib versus limit fed
- Mixing
  - Size
  - Age (young and mature)
  - Pregnancy status
- Horned versus no horns
- Species
  - Sheep versus goats aggressive behaviour
- Breed
  - E.g. Nubian goats versus Alpines

Dental Disease

- “Broken mouth”
  - Presenting complaint & history
    - Adult usually 4 years or older
    - Sporadic, low incidence
  - Epidemiology
    - Some farms worse than others
    - Risk factors not well understood

Dental Disease – Clinical Presentation

- Normally OK until 7 or 8 years of age
- Primary gingivitis
- Tooth loss and abnormal wear
- Secondary osteomyelitis
- Thin, ≤ BCS 2
- Appetite but slow eating
- Decreased cud chewing
- Swellings on jaw

Dental Disease – Clinical Exam

- Pull down lower lip
- Loss of incisors – broken mouth
- Clinical significance?
Palpate dental arcade for uneven wear

Osteomyelitis associated with dental disease

Dental disease – Postmortem Findings
- Tooth loss and uneven wear
- Osteomyelitis
- Long stems in rumen (poor mastication)
- Soft tissue infection

Dental Disease
- Treatment
  - Usually none
  - Pets: rasp premolars and molars
  - Recognize and cull
- Control
  - Grazing poor quality soil
  - Thistles and awns in hay
Ovine Progressive Pneumonia

- AKA maedi visna – same disease
- Presenting complaint and history
  - Adult sheep
  - Respiratory disease
  - Exercise intolerance
  - Hard udders at lambing with little milk
  - Often unrecognized or blamed on something else

Small Ruminant Lentiviruses

- Family – retroviridae
- Genus – lentivirus
- Small Ruminant Lentivirus (SRLV)
  - Group A = sheep
    - Group A2 = North American sheep
  - Group B = goats (caprine arthritis encephalitis)
    - Group B1 = goats world-wide including North America
  - B1 can infect sheep and A2 can infect goats

Santry LA et al. Genetic characterization of small ruminant lentiviruses circulating in naturally infected sheep and goats in Ontario, Canada

Variability of the strains of MVV found in seven Ontario sheep flocks in comparison with reference isolates
OPP / MV - Epidemiology

- Widespread throughout the world except Australia and New Zealand
- Within flock seroprevalence
  - 20 to 40% up to 90-100%
- Seroprevalence increases with age

- Effect on productivity
  - Reduced reproductive performance
  - Early culling of adults
  - Reduced lamb growth & survival / decreased milk production

OPP / MV - Pathogenesis

- Chronic active inflammatory process
  - Virus inside macrophages (monocytes recruited from bone marrow)
  - Recruited to tissues and stimulates lymphocytic immune response
  - Unable to kill virus however
- Lymphocytic infiltration and proliferation
  - Continuous recruitment, inflammation and scarring
  - Target tissues:
    - Mammary gland; Lungs; CNS; Joints

OPP / MV - Transmission

- Aerosol – respiratory secretions *****
- Colostrum ****
- Milk **
  - In utero transmission **
  - Blood contaminated instruments / needles +/-
  - Semen – white blood cells +/-
  - Can be infected multiple times

OPP / MV - Pneumonia

- Non-febrile, bright and alert
- Productive cough
- Exercise intolerance
- No response to treatment
- Progressive & 100% fatal
Maedi Visna video

- [Maedi Visna - Respiratory Form - YouTube](#)

OPP / MV - Lymphocytic Mastitis

- 30 to 50% affected on histology
- “hard bag”
- Udder uniformly firm to touch
- Milk normal but decreased
- Negative CMT
- Lambs hungry
- Steal milk or starve

OPP / MV – Less Common Disease

- Neurological Form – Visna
  - Hind end ataxia and paresis – paralysis
  - Circling, head tilt
  - Fine tremor of lips
- Arthritis
  - Carpus, stifles, hocks

Expression of Disease

- Level of inflammation varies between animals
- Rapid progressors
- Long-term non-progressors
- Develop disease within 6 months to 8 years post-infection
- Some lambs can “clear” infection or becomes occult
- Factors affecting level of inflammation
  - TMEM154 gene
  - Breed
  - Proportion of flock that is infected (opportunity for repeated infection)
  - Virus subgroup
  - Age of animal when initially infected
Genetic Susceptibility

- Research at the USDA Meat Animal Research Centre
- TMEM154 gene affects susceptibility to infection
  - 3 haplotypes
  - Haplotypes 2 & 3 strongly associated with susceptibility (E35)
  - Haplotype 1 (K35) – 2 copies, much less susceptible
- But there is some variation on SRLV subgroup (4) wrt genetics

Immune Response

- Neutralizing antibodies
  - 2 weeks to up to 6 months post-infection
- Not effective at killing virus
  - Antigenic drift
  - Virus quickly “hides” inside the cell
  - May actually enhance virus’s ability to invade cells
- Are a few animals that have no antibody response
  - Provirus positive
  - Antibody response can vary over time
    - Lower in late gestation, early lactation, debilitated animals
    - Associated with pathology

Immune Response - Humoral

- The important genes and their antigens
  - gag gene – some variability between strains
    - Capsid (p25)
    - Nucleocapsid (p14)
    - Matrix protein (p17)
  - env gene – quite variable between strains
    - Glycoprotein (gp 135)
    - Transmembrane glycoprotein (gp 44)
  - pol gene – more stable between strains

Humoral Response

- Time from infection to seroconversion varies depending on which antigen that the ELISA is detecting
  - Capsid antigen (p25)
  - Then the transmembrane protein (gp44) plus others,
  - Finally the surface glycoprotein gp135
# Detecting Infection - Antibodies

- **Whole virus ELISA**
  - Good sensitivity but variable specificity
- **Recombinant antigen and competitive ELISA**
  - Must select the correct antigens
  - Genes that are well-preserved between strains and are antigenic
  - All stages of infection
- **Ontario & Quebec & Minnesota**
- **ELISA** – (MVV/CAEV Elitest, HYPHEN Bio-Med)
  - Very good sensitivity and specificity

# Detecting Virus

- **PCR** to detect DNA (proivirus) or RNA (free virus)
- **EDTA** blood
- **Tissues**
  - Very low levels in circulation so should be quantitative PCR with very low detection limits
- **At this point, Se is about 10% < than ELISA**
  - Can this be improved?
  - Find those animals that don’t sero-convert
  - Cost

# Postmortem

- Lungs are tanned coloured, highly cellular, firm, heavy.
- Worse affected dorsally.
- Histopathology reveals lymphoid follicles

# Eradicating OPP / MV infection

- Detect and remove all infected animals
  - Offspring marketed, or isolated and tested at 6 months of age
  - Serological test with high sensitivity
  - Every 4 to 8 months until 2 negative whole flock tests
  - What age to start screening for antibody production?
- Screen all incoming animals to prevent reintroduction
  - While in isolation
  - Two negative tests 8 to 12 weeks apart – is this enough?
  - Also tested on next flock test
- Monitor flock to assure status is unchanged
  - To verify biosecurity
  - To “catch” late sero-converters or those that don’t sero-convert
### What do we need in a diagnostic test?

- When attempting eradication need a test
  - High sensitivity and good specificity
  - Detects infection early
  - Easy to sample animal (serum, milk)
  - Test is reliable, repeatable, low cost
- When determining if the flock is truly negative, need a test
  - High specificity and good sensitivity
  - Could be pooled to keep costs down without sacrificing sensitivity
  - As above

### Testing a proportion of the flock

- Too expensive to test every animal every time
- Detect disease if >= 5% infected
- Random – why?
- Not a direct proportion
  - Testing a set proportion (e.g., 25%) is too low in small flocks and may be too high in large flocks
  - In larger flock, more animals infected @ 5% infected – so need to test a smaller proportion to find 1 infected animal
- Testing pooled samples?
  - Reduce costs of testing
  - May reduce sensitivity
  - Need to increase proportion of animals sampled

### Ontario Maedi Visna Flock Status Program Whole Flock

- **QUALIFYING TEST**
  - Test all sheep > 6 mo
  - Any positive
    - All sheep testing +ve & lambs < 6 mo must be culled
  - Retest in 4-8 mo

- **ENROLLED**
  - Test all sheep > 6 mo
  - All -ve
    - Retest in 6-12 mo

- **“A” STATUS**
  - Test a random proportion of sheep > 12 mo
  - All -ve
    - Annual retest

- **“B” STATUS**
  - Test all sheep > 6 mo
  - Retest in 6-12 mo
  - Any positive
    - All -ve

- **http://www.uoguelph.ca/~pmenzies/mv/Index.htm**

### Ontario MVFS - Monitored

- Test a random sample of all sheep > 12 mo of age.
  - All -ve
  - MV Monitored
  - Low Risk
  - The flock is infected with MV & has no status in the program

- **MV Monitored**
  - Annual retesting required to maintain status
  - Can enter Whole Flock program at Qualifying Test anytime
  - After 3 consecutive annual –ve flock tests & biosecurity as for whole flock
  - Now qualifies to enter Whole Flock program at “B” STATUS – one whole flock test needed
  - Test proportion of sheep to detect disease at a prevalence of 5% or greater with 95% probability
Biosecurity is critical to maintaining “A” status

- Animals are biggest risk!
- Embryos / semen from test negative sheep
- Sheep from “A” status flock
- Sheep back from show & tested negative twice
- Sheep from infected or unknown status flock but tested negative twice
- Single sourced sheep - not tested or isolated
- Sheep from sales barn, feedlot or multiple sources – not tested or isolated

Other biosecurity requirements are standard

- Unique and readable identification
- Ability to isolate animals with non-negative status
- Reduce risk of visitor bringing in infection
- Reduce risk from blood contamination

What about flocks that can’t afford to cull all positives?

- Snatch potential replacement lambs at birth
- Move to separate facility
- Give “safe” colostrum
- Rear on milk replacer
- Keep separate from “positive” flock
- These lambs have a lower risk – but not “no risk”
  - Some in utero transmission
  - Accidental nursing before removed
  - Contact with respiratory droplets from infected ewe
- Test this new flock and remove positive animals
- Cull positive flock ASAP

Is it worthwhile to enroll in an OPP/MV program?

“Well, what if you knew… I’m a follower, too?”
### Years to Break-even – Whole Flock Program

<table>
<thead>
<tr>
<th>Purebred Flock</th>
<th>100 Ewes</th>
<th>Sampling Costs</th>
<th>$4.50</th>
<th>$15.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewe Value</td>
<td>$200</td>
<td></td>
<td>-1.4</td>
<td>-1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+0.8</td>
<td>+1.9</td>
</tr>
<tr>
<td>$600</td>
<td></td>
<td></td>
<td>-2.0</td>
<td>-1.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-1.5</td>
<td>-1.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>500 Ewes</th>
<th>Sampling Costs</th>
<th>$4.50</th>
<th>$15.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewe Value</td>
<td>$200</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1.5</td>
<td>-1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+0.1</td>
<td>+0.9</td>
</tr>
<tr>
<td>$600</td>
<td></td>
<td>-2.0</td>
<td>-1.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1.5</td>
<td>-1.2</td>
</tr>
</tbody>
</table>

# of years before being “A” status to achieve break-even on cost of program


### Benefit-Return for Commercial Flocks
- No return from breeding sales
- Only return is from cost of disease
- At a prevalence of 10%
  - Return after 5.9 yrs of becoming negative (B status)
- Should enroll if > 10% of breeding ewes are seropositive

### Caprine Arthritis Encephalitis
- Presenting complaint and history
  - Goats with enlarged joints and lameness often progressing to recumbency
  - Chronic wasting

- Etiology
  - Caprine arthritis encephalitis virus (CAEV)
  - Possible for cross-infection with sheep to occur
  - Genotypes in-between MVV and CAEV
  - Europe and Quebec
  - Test performance differences

### CAE - Epidemiology
- Widespread
- Very common in dairy and meat
- High seroprevalence
- Transmission from high to lower risk
  - Colostrum & milk of infected does (1 mL)****
  - Aerosol, saliva & genital secretions ******
    - More effective in a confined environment
  - Milking equipment (adults)**
  - In utero transmission (3 to 6%)**
  - Blood contaminated instruments, needles +/-
- Pathogenesis same as for OPP / MV
CAE - Clinical

- Arthritis and bursitis
  - Carpus
  - Stifle
  - Scapula
  - Occipital joint

CAE – Clinical Findings

- Arthritis progresses to contracted tendons secondary to recumbency
- All cases progress to this
CAE – Clinical Findings

- **Udder**
  - As for MV
  - Hard at freshening
  - Little milk but normal appearing
  - CMT normal

- **Neurological**
  - Rare
  - Kids 1 to 5 months
  - Posterior paresis
    - Uni or bilateral progresses to tetraparesis
  - Torticollis
  - Progressive Pneumonia
  - Uncommon

CAE - Control

- **Treatment**
  - NSAIDS for lameness but need an endpoint for pets
  - Euthanasia before the animals is “down”

- **Control**
  - Serological testing and removal as for OPP
  - Most MV ELISAs are also accurate for CAE

- But...
  - Delayed seroconversion up to 1 year is reported
  - Research has demonstrated viral shedding in milk is common in seronegative lactating goats (yikes)

- What about the client who is reluctant to cull test positive animals?
- Need to prevent CAEV transmission from positive to negative herd while preserving genetics
- Very resource & labour intensive
- Best to start when herd size is small
Removing Lambs / Kids at Birth

- Intense observation
- Prevent contact with respiratory secretions
  - Don’t allow dam to clean off
- Prevent inadvertent consumption of colostrum
  - Tape teats of dam?
- Prevent fecal contamination
- Breaks are likely to occur
  - Missed births
  - Transplacental infection

Low Risk Replacements

- Raise in separate air space
- At least 2 metres separation if outside
- No shared water, feeders, equipment
- Serological test semi-annually
  - unless one positive then,
  - Repeat test in 12 to 16 weeks
- Cull +ve herd as quickly as possible (< 2 years)

Safe Colostrum

- Each kid needs 5% of bw immediately
  - 50 ml / kg bw (8 lb kid needs ~ 180 mL or 6 ounces)
- And 20% in first 24 h
  - 200 ml / kg bw (8 lb kid need ~ 720 mL or 24 ounces)
- Freeze in 250 ml quantities (~ 1 cup)
- ID with donor I.D. & date
- Double freezer bags or clean plastic bottles
- Thaw slowly in warm water bath

Feeding Low Risk Colostrum

- Goat colostrum from uninfected animals
- Assurance of disease status
- Colostrum bank from known healthy donors
Low Risk Cow Colostrum
- From bovine leucosis virus negative cow.
- MAP test negative cow or Johne’s low risk herd
- Vaccinated against clostridial disease in late gestation
- Older cow but low volume production
- 1st milk taken at calving

Colostrum Replacement Products
- Mix and feed to directions
- Bovine source so may not be as good as sheep / goat in protecting against farm bugs
- Clostridial antibodies?
- Evidence in literature that a significant proportion have total proteins < 52 g/L
- Failure of passive transfer

Heat Treat Colostrum
- 56°C for 60 minutes
- Thermos jar
- Double boiler
- Canner
- Stable water bath with thermostat
- Some home pasteurizers
- Avoid heat damage
- Bring up to 56°C slowly
- Count time from when reaches 56°C
- Verify start and stop temperatures
- Include stirring utensil

Biosecurity Breaks to Consider
- Housing
  - No shared feeders / waterers
  - Handling equipment cleaned between herds
  - Separate 5 meters – direction of air flow?
- Natural breeding
  - Bucks need to be from low-risk herd, even if hand-breeding
- Milking management
  - Milk low-risk herd first
  - No risk of contact travelling to and from the milking parlour
  - If feed grain in the parlour – need to wash out feeders, head gates, after milking positive does
- Continue testing low-risk herd for breaks
Paratuberculosis (Johne’s Disease)

• Presenting complaint and history
  • Annoying level of animals with chronic wasting
  • Often not acted upon until 2 year olds affected
  • Little diarrhea compared to cattle

Paratuberculosis – The Agent

• Etiology
  • *Mycobacterium avium* ssp paratuberculosis (MAP)
  • Type I (sheep or “S” strain)
    • Very slow growing
    • Infects sheep but rarely cattle
  • Type II (cattle or “C” strain)
    • Slow growing
    • Infects cattle, goats and deer but rarely sheep (?)
  • Type I/II (intermediate strain)
    • Slower growing than Type I
    • Infects sheep but also goats

Transmission

Mainly faecal-oral
Adults: Faecal shedding

Milk and colostrum
Manure
In utero

Most susceptible: < 6 months

Paratuberculosis - Epidemiology

• Common in dairy sheep and goats
  • Likely also common in meat sheep and goats
  • Spread and risk factors similar to cattle
  • Environmental contamination high risk factor
    • Fecal-oral
    • Milk and colostrum to youngstock
    • In utero (disseminated infection)
  • Transmission to adults
    • Less disease but may shed
  • Survival of *M. paratuberculosis*
    • Months (years) in the environment

Courtesy C. Bauman
Transmission

- Adults may become infected in face of high environmental challenge
- Factors affecting development of disease
  - Dose of bacteria
  - Age of infection
  - Genetic susceptibility
  - Goats and sheep appear to express disease more rapidly than cattle

How Does MAP Cause Disease?

Peyer’s Patches are patches of white blood cells that protect against invasion by bacteria in the gut

But MAP bacteria can grow & multiply inside the WBC

Build up of inflammatory cells and disruption of ability of intestine to digest food

Distal Small Intestine - Goat

Note thickening and mosaic appearance from massive proliferation of infected macrophages – prevents absorption of nutrients

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SITE</th>
<th>LESION</th>
<th>CELL TYPE</th>
<th># BACTERIA</th>
<th>ELISA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ileocaecal Lymphoid follicles (Peyer’s patches)</td>
<td>Grossly normal Histio: small granulomas</td>
<td>Macrophages</td>
<td>Rare</td>
<td>12%</td>
</tr>
<tr>
<td>2</td>
<td>Peyer’s patches &amp; associated intestinal mucosa</td>
<td>Grossly normal Histio: small granulomas</td>
<td>Macrophages</td>
<td>Variable Granulomas in lamina propria</td>
<td>33.3%</td>
</tr>
<tr>
<td>3a</td>
<td>Diffuse: Peyer’s patches, associated mucosa as well as mucosa distinct from Peyer’s patches</td>
<td>Slight ↑ lymph vessels Small granulomas ileum, mesenteric &amp; ileo-caecal lymph nodes</td>
<td>Macrophages</td>
<td></td>
<td>80%</td>
</tr>
<tr>
<td>3b</td>
<td>Multi-bacillary Thickened wall, dilated lymphatics, enlarged lymph nodes. Mosaic appearance to mucosa</td>
<td>Large # of macrophages with few lymphocytes</td>
<td>Abundant in lesions</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>3c</td>
<td>Occasionally liver</td>
<td>Diffuse granulomatous enteritis. Gross lesions similar to 3b</td>
<td>Large # of lymphocytes</td>
<td>Absent or very low numbers</td>
<td>20%</td>
</tr>
</tbody>
</table>

Perez et al, 1996 & 1997
Signs of Disease

- No signs evident until 12 months of age
  - Depends on exposure factors
  - Goats even earlier?
- Clinical course usually a few weeks
- Onset may be associated with other stress
  - E.g. lambing / kidding
- Weight loss and decreased appetite
  - Faeces normal or pasty – decreased in amount
  - Diarrhoea not common and usually only terminal (20%) 
- Hypoproteinemia
- Anaemia

Examples

3 year old dairy goat from herd with annual incidence of > 10% mortality d.t. Johne’s. Owner didn’t know what the “mystery” disease was.

18 month old ewe from heavily infected flock. Owner did not recognize a problem although AGID seroprevalence was 30%

Johne’s disease iceberg

Incidence of clinical disease in a flock is variable depending on flock size, exposure risks. Owner may not believe level of loss is important until incidence rate is high and disease is highly prevalent.

Diagnosis – Fecal Culture

- MAP is very slow growing!
  - Type II (“C”) 8 to 12 weeks
  - Type I (“S”) 3 to 4 months
  - Type I/III (“I”) up to 6 months
- Liquid versus solid media
- Multi versus paucibacillary forms
- Early versus later stages
- Cultures confirmed with PCR

Courtesy, Dr. Cathy Bauman
Diagnosis – Pooled Fecal Culture

- To increase sensitivity (up to 92%)
- 7 pools per flock to detect prevalence of 10% or higher
- Large flock
  - 1 fecal pellet from 50 sheep per pool
- Smaller flock
  - Fewer sheep per pool as long as 7 pools per flock
  - If prevalence < 10%, need more pools per flock

Diagnosis – PCR of Feces

- Sensitivity appears better than serology
- Primers (genes targeted) determine specificity
- IS900 detects low levels of bacteria [many copies of gene] but cross-reacts with other mycobacteria?
- HspX only one copy of gene but appears very specific
- As with fecal culture, sensitivity depends on
  - Stage of disease
  - Multi versus paucibacillary form

Diagnosis – Total Protein

- Hypoproteinemia with clinical signs of wasting is a good “sheep-side” diagnostic test
  - 51.4 versus 70.4 g/litre
- Low albumin with normal or slightly elevated gammaglobulin
  - 14.1 versus 32.7 g/litre
- Not confirmatory
- R/O GI parasitism

Bauman et al Test parameter estimates

<table>
<thead>
<tr>
<th>Test</th>
<th>Goat Sensitivity (95% CI)</th>
<th>Goat Specificity (95% CI)</th>
<th>Sheep Sensitivity (95% CI)</th>
<th>Sheep Specificity (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faecal culture</td>
<td>81.1% (65.8-93.0)</td>
<td>98.1% (95.6-99.3)</td>
<td>49.5% (27.4-72.5)</td>
<td>97.4% (96.1-98.5)</td>
</tr>
<tr>
<td>Faecal PCR</td>
<td>35.0% (24.2-45.1)</td>
<td>89.4% (86.4-92.2)</td>
<td>42.4% (21.5-65.5)</td>
<td>89.1% (86.0-91.7)</td>
</tr>
<tr>
<td>Serum Prionics</td>
<td>31.4% (22.2-42.6)</td>
<td>96.1% (93.8-97.9)</td>
<td>28.0% (12.6-48.5)</td>
<td>95.7% (93.4-97.5)</td>
</tr>
<tr>
<td>Serum IDEXX</td>
<td>7.8% (3.8-13.7)</td>
<td>98.9% (97.9-99.6)</td>
<td>34.9% (18.5-54.6)</td>
<td>95.6% (93.2-97.4)</td>
</tr>
<tr>
<td>AGID</td>
<td>22.2% (14.5-31.4)</td>
<td>96.3% (94.2-98.0)</td>
<td>14.4% (6.5-25.9)</td>
<td>98.4% (97.1-99.3)</td>
</tr>
<tr>
<td>Milk Prionics</td>
<td>22.4% (13.3-31.7)</td>
<td>97.9% (96.3-99.9)</td>
<td>30.5% (18.0-45.4)</td>
<td>97.8% (96.0-99.0)</td>
</tr>
<tr>
<td>Milk IDEXX</td>
<td>11.7% (6.9-18.4)</td>
<td>98.5% (97.2-99.4)</td>
<td>39.0% (25.1-54.6)</td>
<td>97.2% (95.4-98.6)</td>
</tr>
</tbody>
</table>
Paratuberculosis - Postmortem

- Best diagnostic test for flock status
- More subtle than cattle
- Gross Findings
  - Thickening of distal ileum
  - Dilated lymphatics on small intestine
  - Enlarged ileo-caecal and mesenteric lymph nodes
- Are different types depending on inflammatory response and prevalence of bacteria in lesions

Control of Paratuberculosis

- Similar to CAE control / eradication
  - Neonate
  - Milking
  - Separate facilities
- Plus reduce exposure to adult manure
  - Exposure of newborns
  - Pasture and drylot exposure
  - Issue with hay?
- Individual animal testing will miss lots of positives
- Vaccination should be investigated
  - Replacement lambs and kids at weaning
  - Once in their lives

Caseous Lymphadenitis

- CL; CLA; Cheesy Gland
- Presenting complaint and history
  - Abscesses on head, neck or other parts
  - Several animals in group affected
  - Some chronic wasting
- Etiology
  - Corynebacterium pseudotuberculosis
  - Thick lipid cell wall
  - Intracellular bacteria
  - Phospholipase D exotoxin (PLD)
CLA - Epidemiology

- Very widespread throughout the world
- Sheep, goats, new world camelids, cattle
- Carcass condemnation and trim in adult sheep and goats

Transmission
- Direct contact
- Coughing
- Fomites (shearing equipment, feeders)
- Contaminated feed, bedding, water
- Bacteria can survive days (e.g. water) to months (feed, soil) in environment

CLA - Pathogenesis

- Bacteria enter through
  - Cuts and nicks (external, oral, shearing)
  - Intact skin
- To regional lymph node or systemic
- Localized in lymph nodes and internal organs
- Form abscesses which break
  - External
  - Pulmonary
- Contaminate everything

CLA – Clinical Findings

- White to greenish white pus
- Caseous
- Odourless
- Sheep
  - Onion skin appearance
- Goats
  - No onion skin

CLA – External Abscesses

- External lymph nodes
- Most common in head and neck
  - Parotid
  - Submandibular
  - Cervical
  - Pre-scapular
- Any lymph node in the body
CLAS – Internal Abscesses

• Sites
  - Pulmonary ***
  - Mediastinal ***
  - Retropharyngeal **
  - Pituitary
  - Spinal
  - Other organs
• Affect on animal
  - Unapparent
  - Sudden death
  - Chronic wasting
• Can have internal with no external evidence of disease
CLA – Laboratory Diagnosis
• Culture intact abscess
• Synergistic haemolysin inhibition test
  • UC Davis
  • High titre associated with internal abscesses but
  • Negative titre can be found in animals with abscesses
  • Low titre can be found in animals with no abscesses
• Necropsy
  • Abscesses in internal organs & lymph nodes

CLA - Treatment
• Lance and drain
• Iodine (2 ½% tincture of I) or chlorhexadine
• Do not inject formaldehyde into abscess

CLA - Control
• Environmental contamination
• Monitor animals monthly – palpate lymph nodes
  • Isolation of affected animals (abscess pen)
  • Cull chronic offenders
• Risk from fomites (feeders, milking equipment)

CLA - Control
• Shearing biosecurity
• Shearing order
• Disinfection of equipment
• Treat shearing wounds
• Flock that doesn’t have disease?
  • Should have own shearing equipment, shearing board & moccasins
  • Freshly laundered clothing
  • First visit of day
**CLA - Control**
- Vaccination of unexposed animals
  - CasBac (Colorado Serum)
  - Primary series as lambs
  - Annual or semi-annual vaccination
  - Booster about 2 weeks prior to increased risk period?
  - Licensed for sheep but not licensed or recommended for goats
  - Autogenous vaccine may work as well
- In Canada
  - Glanvac 6 (Zoetis) just (re) licensed
  - Includes clostridal antigens

---

**Enzootic Nasal Adenocarcinoma (ENA)**
- Most commonly diagnosed tumour of sheep
- Presenting Complaint
  - Thin adult sheep or goat
  - Most often with upper respiratory noise
- Etiology
  - ENA virus
    - Retroviridae family; betaretrovirus genus
    - Oncogenic

---

**ENA - Epidemiology**
- Mostly sheep but also seen in goats
- Sporadically seen as a common disease
- Adults ≥ 2 years of age
- Incidence rate 0.5% to as high as 15%
- Likely spread by nasal secretions

---

**ENA – Clinical Findings**
- Increased respiratory effort and noise
- Upper respiratory (inhaled effort)
- Nasal discharge “washed nose” appearance
- Sometimes deformed face
- Sometimes neurological signs
- Slowly progressive over several months or very rapid
- Found dead without previous signs
- 100% fatal
- DDx
  - Nose bots (*Oestrus ovis*)
ENA - Postmortem

- Typical tumor in nasal passages
- No serological test
- Virus particles found in tumor tissues
- Treatment
  - None
- Control
  - Isolate affected animals
  - Euthanize when have a diagnosis
  - Market offspring from last litter
  - PCR of nasal secretions
  - May be genetic predilection
Gastrointestinal Parasitism - adults

- Sheep develop immunity after first grazing season
  - If immunity suppressed
    - E.g. lambing, poor nutrition, Johne’s disease
  - Overwhelming challenge
    - E.g. Haemonchus contortus
  - Type II disease
    - Inhibited larvae emerge in the spring
    - May see disease in adults
  - Goats don’t develop immunity

Gastrointestinal Parasitism - Adults

- Teladorsagia circumcincta
  - Cause chronic damage and destroy abomasal digestive glands
  - Maldigestion and chronic weight loss

Teladorsagia – adult doe with chronic weight loss

Ovine Pulmonary Adenomatosis

- OPA
- Jaagsiekte (S. African = chasing sickness)
- Uncommon
  - Colorado diagnoses ~ 10 cases / year so in the USA
  - Presenting complaint
    - Sheep with weight loss and progressive respiratory signs
  - Etiology
    - Jaagsiekte retrovirus (JSRV)
    - Not recognized by immune system
OPA
- Tip sheep up and copious fluid
- Postmortem Findings
  - Tumours in dorsum of lung
  - Heavy, firm and enlarged lobes
- Treatment
  - None
- Control
  - UK PCR to detect circulating virus but poor sensitivity
  - No antibody test

Abomasal Emptying Defect
- Presenting Complaint
  - Sheep loses condition and poor appetite
- Etiology
  - Unknown
  - Likely genetic
  - Not related to forage type or scrapie
- Epidemiology
  - Sporadic
  - Suffolks, Hampshires, Rideau
  - Even more rarely goats
  - Sporadic in flock

AED
- Clinical Findings
  - Off-feed but normal TPR – usually thin or fast weight-loss
  - Enlarged right ventral abdomen
  - Very firm on ballottement
- Necropsy
  - Impacted abomasum with feed
- DDx
  - Ruminal impaction from poor quality forage or other etiology
  - Vagal indigestion
- Treatment and Control
  - None known
  - Change ram?

Lymphosarcoma
- Presenting Complaint
  - Masses present in tissue (e.g. udder)
  - Weight loss, poor appetite, afebrile
  - Adult sheep and goats
- Etiology
  - Sheep can develop tumours if infected with bovine leukemia virus
  - Goat not related to BLV
- Epidemiology
  - Sporadic
  - Second most common tumour diagnosed in SR
Lymphosarcoma

- Clinical & Necropsy Findings
  - Presentation is variable
  - Tumours present in almost any tissue
  - Diagnosis confirmed on biopsy or necropsy
  - No treatment and no control

Intestinal Adenocarcinoma

- Weight loss
- Discomfort, grinding teeth
- Usually a diagnosis on postmortem
- Not sure of etiology
- Sporadic but pretty common

Summary

- There are many conditions and diseases that cause chronic weight loss in adult sheep and goats
- Many are very important at the herd / flock level and require a health management approach to reduce losses