Health – Metabolic Diseases

Metabolic Disease
- or Metabolic Disorder
- Caused by over-exertion of the cow’s normal metabolism
- Generally seen during early lactation
  - Most occur 1st two weeks
  - Peak yields
  - Negative energy balance
  - Input – Output Imbalance

Common Metabolic Diseases
- Milk Fever (hypocalcemia)
- Ketosis (acetonemia)
- Fatty Liver
- Laminitis
- Displaced Abomasum
- Retained Placenta

Lost Milk Production 1st 30 Days per 100 Cows

Risk Ratio of Culling Cows

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Days in Lactation When Culled</th>
<th>Days in Lactation When Culled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 – 30</td>
<td>121 – 180</td>
</tr>
<tr>
<td>Milk Fever</td>
<td>2.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Displaced</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Ketosis</td>
<td>1.8</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Lost Milk During 1st 30 Days of Lactation

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Lost Milk (% of daily yield)</th>
<th>Lost Milk (lbs 1st 30 days/100 cows)</th>
<th>Loss ($/cwt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Fever</td>
<td>4.7</td>
<td>609</td>
<td>60.90</td>
</tr>
<tr>
<td>DA (3%)</td>
<td>16.0</td>
<td>1,037</td>
<td>103.70</td>
</tr>
<tr>
<td>Retained</td>
<td>4.1</td>
<td>709</td>
<td>70.90</td>
</tr>
<tr>
<td>Ketosis (5%)</td>
<td>7.6</td>
<td>821</td>
<td>82.10</td>
</tr>
<tr>
<td>Metritis (8%)</td>
<td>3.8</td>
<td>657</td>
<td>65.70</td>
</tr>
<tr>
<td>Total</td>
<td>3,833</td>
<td>383.30</td>
<td></td>
</tr>
</tbody>
</table>
Milk Fever

Miscellaneous Information
- Also known as
  - Hypocalcemia
  - Parturient Paresis
- Hallmark symptom – severe hypocalcemia
- Factors associated with
  - Occurs at onset of lactation
  - Advancing age
  - Breed
  - Diet

Clinical Symptoms
- Inappetance
- Tetany
- Lateral recumbancy
- Inability to urinate/defecate
- Coma and death if untreated

First Milking
- 20 lbs milk = 23 g Ca
  - 9x entire plasma pool
- Ca lost from Ca pool replaced by
  - Increased intestinal absorption
  - Increased bone resorption
- Nearly all cows experience some degree of milk fever the 1\textsuperscript{st} day of milk
- I.V. 8 – 10 g of Ca

Economic Loss
- Decrease productive life 3.4 yrs
- Average loss/case = $334
  - Treatment cost
  - Production losses
  - 8x more likely ketosis and mastitis
  - Retained placenta and DA

Calcium Metabolism
- Parathyroid Hormone (PTH)
- 1,25 dihydroxyvitamin D\textsubscript{3}
- Parathyroid produces PTH in response to low plasma Ca
  - Increase bone resorption
  - Increase intestinal absorption and bone resorption through 1,25 D
- PTH is the key
Predisposing Factors

- Breed
  - Jersey more susceptible – lower 1,25 D receptors compared to Holsteins
- Age
  - decreased bone resorption ability
  - decreased 1,25 D production
- Diet
  - High Ca and K** diets

Prevention

- Vitamin D analogs
- Ca gels
  - Given orally before and/or after calving
    - CaCl₂
    - Caustic
    - Ca propionate

Prevention – Diet Manipulation

- Cation – Anion Difference (CAD)
  - CAD meq/100 g DM = (Na + K) – (Cl + S)
- How does it work?
  - Anions cause acidic blood pH - leads to Ca resorption to maintain blood pH
  - Mild metabolic acidosis increases tissue responsiveness to PTH
  - Underlying cause of milk fever may be mild metabolic alkalosis

Prevention – Diet Manipulation

- CAD (meq/100 g DM) =
  \[(0.38 \text{ Ca} + 0.3 \text{ Mg} + \text{ Na} + \text{ K}) – (\text{Cl} + 0.2 \text{ S})\]
- Target CAD = -10 meq/kg DM
- If CAD >25 meq/100 g DM
  - Difficult to add enough anions
  - OSU Dairy
    - 34 meq/100 g DM using simple equation

Prevention – Diet Manipulation

- Add anions (Cl and/or SO₄)
  - Reduce blood pH to prevent mild metabolic alkalosis
  - Cl and SO₄ salts of Ca, ammonium, and Mg
- Palatability problems
  - Cl less palatable than SO₄ but Cl 4 – 5x more acidifying
- Monitor urine pH
  - Jersey = 5.8 – 6.3
  - Holstein = 6.2 – 6.7

Prevention – Diet Manipulation

- Add anions (Cl and/or SO₄)
  - Should not exceed 0.4% Mg, 0.4% S, 0.5% Cl
  - Bio-Chlor & Animate palatable comm source
- Remove dietary Cations
  - Can not remove below requirement
    - Ca – 0.4 % of DM, Na – 0.10%, Mg – 0.16%, K – 0.65%
  - K is a problem
    - Inorganic or organic fertilizer application
    - Grasses < K compared to legumes
Treatment

- IV Ca
  - Ca gluconate
  - Ca dextrose
- Be Careful
  - Hypercalcemia – cardiac arrest
  - 15 min/bottle

Cause of Disorder

- Mobilization of fatty acids (FA) (NEFA) in early lactation [negative E balance]
- Liver uptake of FA related to plasma concentration
- Fates of FA in liver
  - Oxidation, partially oxidized to acetyl-CoA, or esterified to triglycerides (TG)
  - Need glucose for oxidation

Cause of Disorder

- When the rate of FA uptake and esterification by the liver exceeds FA oxidation or export as TG fatty liver occurs
- Ruminant liver does not export TG very efficiently
  - VLDL problem
  - Accumulation of TG impair liver function

Energy Balance of Transition Cows
Plasma NEFA during the Transition Period

Fatty Liver Starts at Calving

Prepartum NEFA Levels Affect Postpartum Disease Incidence

Effect of Fatty Liver on Glucose

Diagnosis

Prevention

- Minimize cows >3.75 BCS
- Palatable, balanced rations
- Niacin
  - Blocks fat mobilization, but expensive
- Propylene glycol
  - Feed additive or drench
- Ca gluconate, Ca dextrose
- Protected choline
Effect of Body Condition on Fat Metabolism

Cause of Disorder
- Excessive acetyl-CoA from fat mobilization
- Lack of TCA intermediates leads to conversion to acetoacetate and beta-hydroxybutyrate

Diagnosis
- Depressed appetite, low milk yield
- Sweet smelling breath
- Ketone tests
  - Milk
  - Urine – false positives
  - Blood – false negatives
- Prevention/Treatment
  - Similar to fatty liver

Diagnostic Interpretation
- $\beta$-Hydroxybutyrate best to use
- Cut-point is $>1400$ $\mu$moles/l (same as 14.4 mg/dl)
- $\uparrow$ DA, $\uparrow$ clinical ketosis, and $\downarrow$ milk
- Clinical ketosis is about $>26$ mg/dl
- Critical level is about 10% of cows above 14.4 mg/dl

Ketosis

Displaced Abomasum (DA)
What is DA?
- Abomasum moves to the left under the rumen and up to the left flank (LDA)
- Abomasum moves up right side and can twist counterclockwise (RDA)
- Cause
  - Displacement due to fetus
  - Diet related (nutritional factors)

How Does It Occur?
- High concentrate diets produce large amounts of VFA
- VFA pass to abomasum, which decreases motility
- Combine reduced motility with increased flow – accumulation of digesta and gas production = abomasal distension and displacement

Cost and Occurrence
- Lost milk = 1,000 lb ($100)
- Treatment = $100 – 200/case
- 10% are culled or die the next day
- 90% are LDA
- Incidence rates
  - 1.4 – 5.8% mean yearly from several studies
  - 5% (0 – 22%) (Pehrson & Shaver, 92)
  - 3.3% (0 – 14%)

Prevention
- Maintain prepartum DMI
  - Reduced rumen fill – migration of abomasum
- Postpartum Disorders
  - Ketosis – 11.9x
  - Retained Placenta – 6.8x
  - Metritis – 4.7x
  - Milk fever – 4.9x
  - Cows with LDA – 50x ketosis

Prevention
- BCS at parturition
  - <3.25 – 3.1% DA
  - 3.25 to 4.0 – 6.3% DA
  - >4.0 – 8.2% DA
    - Ketosis, greater DMI prepartum depression, slower postpartum DMI increase
- Close-up dry cow group
  - Increase papillae length and VFA absorption capacity

Diagnosis & Treatment
- Ping
- Roll and tack (toggle)
  - Suture abomasum to abdominal wall
  - Success rate lower than surgery
- Surgery
  - Open the cow on the right flank and move abomasum back underneath the rumen and suture
  - Success 100%, but secondary infections
Lameness

Incidence and Cost
- 90% of lameness involves foot, 90% in rear foot
- FL DHI – 35% clinical lameness
- 3 – 6 lb milk/day 2 wk after diagnosis
- NY study - $90/case
  - Lost milk, repro inefficiencies, discarded milk, labor, culling

Laminitis - What Is It?
- Inflammation of the sensitive tissues of the foot lying immediately under the horn
- Causes
  - Nutrition
  - Infection
  - Stress
  - Foot environment

Acidosis and Laminitis
- High starch diets and/or low fiber diets can cause acidosis
  - Acidosis reduces blood flow to corium, laminar separation (ischemic)
  - Minimum ADF 19%
  - Minimum 20% NDF from forage (eNDF)
  - Maximum NFC 45%

Laminitis - Other Causes
- Mastitis and Metritis
- Environment
  - Cows standing
  - Rubber mats in feed lanes and traffic lanes
  - Wet concrete 83% more abrasive than dry
  - New (green) concrete very abrasive

Laminitis - Treatment
- Prevention is the key
- No specific treatment
  - Anti-inflammatory drugs for pain
  - Regular hoof trimming
Foot Rot

- Infectious disease seen in confinement
- Necrotic lesion between claws
  - *Fusobacterium necrophorum* – GI tract
- Prevention
  - Dry environment
  - Footbaths – Cu sulfate
- Treatment
  - Topical and/or injectable antibiotics

Footwarts

- First described in Italy 1974
- CA in mid-80’s
- Pappillomatous Digital Dermatitis
- Footwarts, Heel Warts, Hairy Footwarts
- Causes
  - No virus detected
  - 96% have invasive spirochetes
  - 95% responsive to antibiotics

Footwarts - Treatment

- Antibiotics
  - Topical
  - Footbaths

Retained Placenta (RP)

- Part or all of placenta is retained in uterus
  - Fails to separate from uterus
  - 12 h after calving
  - Foul, putrid odor
  - US incidence = 7.7% (1974)
  - 709 lbs lost milk = $70/case
  - Lack of uterine tone only one of 8 possible factors causing RP

Retained Placenta

- Risk Factors
  - Milk fever = 4x more likely to retain
  - Dystocia and abortion
- Nutritional Risk Factors
  - Protein, Se, and Vit E deficiencies
- Manual removal not recommended
  - Results in impaired fertility
  - Trauma and hemorrhage
  - Cotyledons may remain attached

Reproductive Diseases
Retained Placenta

- Drugs that increase uterine motility
  - Prostaglandin
  - Oxytocin
    - Works best shortly after calving when estrogen levels
  - Estrogens
    - Increase uterine sensitivity to oxytocin
    - ECP (estradiol cypionate – Upjohn)

Metritis

- Inflammation of uterine wall
- 650 lbs lost milk = $65/case
- Cause
  - Invasion of tract by bacteria & fungi
  - Systemic by IBR, BVD, Lepto
  - RP increases incidence (80%)
- Diagnosis
  - Discharge, inappetance, milk yield, fever

Metritis

- Impairs fertility
  - Increases period from involution to ovulation
  - Direct damage to ova and sperm by toxins
- Treatment
  - Intrauterine infusion of antibiotics and/or disinfectants
  - PGF$_{2\alpha}$ - works if cow has CL

Health – Infectious Diseases

Infectious Diseases

- Infectious Bovine Rhinotracheitis (IBR)
  - Upper respiratory disease
  - Abortions
- Bovine Viral Diarrhea
  - GI tract
  - Small calves, defects
  - Repro problems

Infectious Diseases

- Bovine Respiratory Syncytial Virus (BRSV)
  - Lower respiratory tract infection
- Parainfluenza-3 Virus (PI3)
  - Difficult to diagnose
- Brucella and Leptospirosis
  - abortions