Nutritional Aspects of Postpartum Diseases in Dairy Cows

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The Postpartum Period

- Most stressful period
- Several physical and hormonal changes
- High nutritional requirements
- Increased mortality
- High risk of being culled

Nutritional and Management Problems vs. Infectious Diseases
(Non-contagious vs. Contagious Diseases)
The Transition Period

3 wk before to 3 wk after parturition (Grummer, 1995)

Pregnant
Non-lactating

Non-pregnant
Lactating

Most infectious and metabolic diseases in dairy cows occur during or soon after this time and are the main reasons for culling.
When Cows Leave the Herd

624,614 Cows Leaving From ~2,800 herds

% Cows Leaving within Each 21 Day Period

21 DIM Interval

(MN DHI 10/96 - 10/01) Godden et al., 2003
Reasons for Culling Dairy Cows

Early LactaGon

– Metabolic Diseases
  • Ketosis
  • Fa3y Liver
  • Hypocalcemia (Milk Fever)
  • Displacement of Abomasum

– InfecGous Diseases
  • Retained Placenta
  • Puerperal MetriGs
  • Clinical/Subclinical EndometriGs
  • MasGGs

Nutritional Management
Metabolic Diseases:

- Ketosis
- FaQy Liver Syndrome
- Displacement of Abomasum
- Milk Fever
Metabolic Disease:

Ketosis
Fat Liver Syndrome
Displacement of Abomasum
Milk Fever
Ketosis
Rise in blood ketone bodies due to fat mobilization

Glucose Demand during the Transition Period

Adapted from Overton (1998)
Lower DMI Increases Fat Mobilization

Grummer, 1993
Ketosis

Occurrence:
• Occurs 2 to 4 weeks after calving (peak about 3 wk)
• Common in high producing cows (sub-clinically)

Symptoms:
• Anorexia, drop in milk yield;
• Decreased rumen motility
• Weight loss, gaunt appearance, and dullness

Detection:
• Changes in blood related to liver functions
  – Decrease in blood glucose (<50 mg/100 ml)
  – Rise in BHBA (>14.4 mg/dl)
• Ketonuria:
  – BHBA; Acetone; Aceto-acetic acid
Early Postpartum Energy Requirement

- Last week of fetal development the fetus uses approx. 46% of maternal glucose (Bell, 1995)
- Mammary gland uses 60 to 70% of blood glucose for lactose synthesis (Rigout et al., 2002)

<table>
<thead>
<tr>
<th>Holstein Cow</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Weight</td>
<td>600 Kg</td>
</tr>
<tr>
<td>Blood Volume</td>
<td>10% (8 – 10%)</td>
</tr>
<tr>
<td>Blood Volume</td>
<td>60L</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>35% - 21L</td>
</tr>
<tr>
<td>Plasma</td>
<td>65% - 39L</td>
</tr>
<tr>
<td>Glucose (blood)</td>
<td>50 mg/dL</td>
</tr>
<tr>
<td></td>
<td>(40 – 60 mg/dL)</td>
</tr>
<tr>
<td>Glucose (blood)</td>
<td>0.5g/L</td>
</tr>
<tr>
<td>39L x 0.5g/L</td>
<td>19.5 g Glucose</td>
</tr>
<tr>
<td>Lactose</td>
<td>5 % (2 - 8%)</td>
</tr>
<tr>
<td>Milk Prod./d</td>
<td>30 L (1.03g/ml)</td>
</tr>
<tr>
<td>Total Lactose</td>
<td>1,500g</td>
</tr>
<tr>
<td></td>
<td>750g Glucose</td>
</tr>
</tbody>
</table>
Ketosis: Consequences

Incidence of Ketosis is associated with:

- Decreased milk production
- Increased culling
- Increase of 2 to 3 days until first AI
- 4 to 10% fewer pregnancies from first service
- Increased incidence of ovarian cysts
- Increased incidence of displaced abomasum
- Increased expenses with treatments
Ketosis: Treatment and Prevention

Prevention

- Avoid excessive BCS at calving
- Smooth dietary changes over the transition period
- Supplementation with:
  - Niacin (Niashure®)
  - Choline (Reashure®)
  - Chromium (KemTRACE®)

Treatment

- Dextrose IV (several Games per day)
- Propylene glycol drench
Metabolic Diseases:

- Ketosis
- FaQy Liver Syndrome
- Displacement of Abomasum
- Milk Fever
Lower DMI Increases Fat Mobilization

Week Relative to Calving

DMI Kg/d

NEFA µm/l

30 -35% Intake Depression

300% Increase in Fat Mobilization

Grummer, 1993
**FAQy Liver Syndrome**

**Definition:**
Accumulation of fat within the cow's liver

Although considered a postpartum disorder, it usually develops prior to and during parturition.
Why Do Cows Develop FaQy Liver?

• DMI declines the week before calving (± 30%)
• Fetal needs receive top priority in late pregnancy:
  – Glucose is the primary source of energy for fetal growth
  – Amino acid requirement for fetal growth is high
    • Dietary crude protein required for maintenance ± 400 g/d
    • Dietary crude protein required for fetal growth ± 800 g/d

• Low efficiency of metabolizable energy (ME) uGlizaGon for pregnancy (14%)

• The cow must rely on volaGle fa3y acids (VFA) and long chain fa3y acids (FA) from Gssue mobilizaGon as primary fuel for non-pregnant body funcGon
Fa3y Liver Prevention and Treatment

- No treatment is truly effective
- Prevention of excess fatty tissue mobilization – Prevention of DMI depression around calving:
  - Body condition score (BCS) management
    • Avoid BCS > 4.25 at calving
    • Prevent BCS loss during the dry period
  - Promote high dry matter intake
    • Feed good quality forage
    • Avoid rapid diet changes and unpalatable feeds
  - Provide glucose precursors
    • Propylene glycol (daily drench)
    • Calcium propionate
Metabolic Diseases:

Ketosis
FaQy Liver Syndrome
Displacement of Abomasum
Milk Fever
Cross Section Abdominal Cavity

**Normal**

Abomasum = A  C = Omasum
Rumen = B  D = Liver

**Displaced**
Displaced Abomasum (DA)

Detection
• Sharp and sudden drop in feed intake and positive “Ping Test”

Causes
• 80% of DA occur within the first month of lactation.
• Exact cause is unknown, but incidence has been associated with:
  – High concentrate diet during the transition period and/or early lactation
  – Decreased DMI and gut fill in early lactation (e.g., over-conditioned cows, overcrowding, etc.,)

Prevention
• Avoid over-conditioned cows (BCS >4.0)
• Begin concentrate feeding (0.5-0.75% of body weight) during the last three weeks before calving (“close-up” ration)
• Feed long and/or coarsely chopped good quality forage during the dry period and early lactation
• Keep a minimum of 50% forage in the diet
• Minimize stress due to other peri-parturient diseases (milk fever, ketosis)
Metabolic Diseases:

Ketosis
FaQy Liver Syndrome
Displacement of Abomasum
Milk Fever
Metabolic Disease: Milk Fever

Definition:
• Presence of low levels of serum calcium within 72 h after calving (normal blood Ca = 8.5 to 11 mg/dL)

Symptoms:
• Stage 1 = 6.5 - 8 mg/dL = ataxia, muscle fasciculations
• Stage 2 = 4.5 - 6 mg/dL = sternal recumbency, dry muzzle, depressed, altered rectal temperature
• Stage 3 = <4.5 mg/dL = laterally recumbent, bloat, flaccid, weak pulse, risk of death
Calcium

• Second Messenger
• Co-Factor
• Muscle ContracGon
  – Diaphragm
  – Rumen
  – Lungs
  – Uterus
  – Mammary Gland
• Milk and Colostrum Synthesis
### Postpartum Calcium Requirement

<table>
<thead>
<tr>
<th>Holstein Cow</th>
<th>Colostrum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Weight</strong> 600 Kg</td>
<td><strong>Ca concentration</strong> 2 g/L (2–3 g/L)</td>
</tr>
<tr>
<td><strong>Blood Volume</strong> 10% (8 – 10%)</td>
<td><strong>Colostrum Prod.</strong> 15 L (10–15 L)</td>
</tr>
<tr>
<td><strong>Blood Volume</strong> 60L</td>
<td><strong>Total calcium</strong> 30g</td>
</tr>
<tr>
<td><strong>Hematocrit</strong> 35% – 21L</td>
<td></td>
</tr>
<tr>
<td><strong>Plasma</strong> 65% – 39L</td>
<td></td>
</tr>
<tr>
<td>iCa (Blood) 9 mg/dL</td>
<td></td>
</tr>
<tr>
<td>(8.5 – 11 mg/dL) 0.09 g/L</td>
<td></td>
</tr>
<tr>
<td>39L X 0.09 g/L = <strong>3.51 g Ca</strong></td>
<td></td>
</tr>
</tbody>
</table>

Calcium requirement immediately postpartum is approximately 10 times more than the calcium in blood.
Milk Fever: Consequences

Incidence of milk fever is associated with increased incidence of:

- Dystocia
- Uterine prolapse
- Retained placenta
- MetriGs
- LDA
- MasGGs
Milk Fever: Prevention

• **Limit Ca intake prepartum to below requirements**
  – Diet < 0.3% Ca (consumption of < 20 g/d of absorbable Ca)

• **Acidogenic diets (DCAD Diets)**
  – Slight metabolic acidosis enhances PTH activity, improves dissociation of Ca from albumin, and increases bone resorption

• **Supplement Ca as drenches or boluses in the first 24 to 48 hours after calving (CaCl₂ or Ca propionate)**
  – 50 to 100 g of Ca (> 250 g of Ca as a drench can cause hypercalcemia and death)
Milk Fever: Treatment

Treatment

- Ca gluconate – IV
- Oral drench (CaCl₂ or Ca propionate)

- Ca in excess can lead to death
Infec&ous Diseases:

Metri&s
Endometri&s
Retained Placenta
**Metri&s x Endometri&s**

**Endometri&s**
InflammaGon of the endometrium and glandular layer

**Metri&s**
InflammaGon of the endometrium, glandular and muscular layer

**Causes**
Most of the Gme infecGous
NutriGonal x Immune system interacGons
Peripartum Immune System

- Neutrophils moving and killing ability about 40%
- Lymphocyte antibodies production about 30%

Kehrli et al., 1995

Uterine Diseases

Calving

Percent of Lab Standard (Neutrophil Iodination)

Time Relative to Calving (weeks)
Metabolic Changes During the Transition Period

Hammon et al., 2006
Uterine Diseases: Consequences

Increases involuntary culling
Decreases milk production
Decreases subsequent fertility
Excessive BCS losses early postpartum
Increases expenses and labor
Uterine Diseases: Prevention and Treatment

Prevention
- Clean procedures during calving assistance/ Clean calving area
- Minimize stress / maximize DMI

Treatment
- Systemic antibioGc therapy (3 to 5 d)
  - CeMofur: 2.2 mg/Kg, IM, SID
  - Procaine penicillin: 21,000 IU/Kg, IM, BID or SID
  - Ampicillin: 4.5 to 11 mg/Kg, IM, SID

- Intra-uterine therapy
  - No products approved specifically for this purpose
  - Controversial results regarding efficacy of extra-label tmts
    - Milk residue – milk must be withheld

FOLLOW THE LABEL

Definition
- IM = Intramuscular
- IV = Intravenous
- SID = Once/day
- BID = Twice/day
Infec&ous Diseases:

Metri&s

Endometri&s

Retained Placenta
Retained Fetal Membrane (RFM)

Definition:

- Lack of detachment of the placenta from the maternal caruncles
  - 75% of cows expel their placenta by 6 h postpartum
  - Few 12 h postpartum

Detrimental effects observed:

Retention > 12 hours
Understanding RFM

Series of studies have shown the association between RFM and impaired immune function (Gunninki et al., 1984)

Lack of uterine contractions is not the cause, but hypocalcemia may contribute to reduced immune signaling and PMN cell function (Kimura et al., 2006)

![Graph showing Myeloperoxidase activity of neutrophils in cows from herds with retained placenta vs. cows without retained placenta.](image-url)

Figure 1. Myeloperoxidase activity of neutrophils in cows from both herds with retained placenta (n = 20, □) was significantly lower (disease effect, \( P < 0.01 \)) than in cows without retained placenta (n = 122, ●) before parturition.
**Mechanism of RFM**

- **Caruncle** (uterus)
- **Cotyledons** (Placenta)
- **Collagen**
- **Chemokine Lymphocytes**
- **Partum**
- **Collagenase**
- **Detachment of Fetal Membranes**
- **Collagen**
- **Retained Fetal Membranes**
- **MHC** (Major Histocompatibility Complex)
- **Hormonal Imbalance**
RFM: Consequences

Increased risk of developing:

- Metritis, Endometritis and Ovarian Cysts

Strong negative association:

RFM cows tend to have increased:

- DIM to first AI
- DIM to conception
- Days open
- Increase days open in 11 to 26 d
- Increased involuntary culling
RFM: Treatment

Several treatments have been proposed:

- **Systemic treatments have shown variable results**
  - Penicillin – No good results
  - Oxytetracycline unlikely to > than the MIC
    - IU infusion – variable \(\rightarrow\) Controversial
    - CeMofur (2.2 mg/Kg) \(\rightarrow\) ConcentraGon > MIC

- **PGF\(_{2\alpha}\), oxytocin nor estrogen have been ineffectuve in speeding the release of the RP**

- Manual removal has **NO** benefit, but can harm

FOLLOW THE LABEL
Summary

• Postpartum diseases are undesirable and can increase involuntary culling in dairy cows
• NutriGonal management during the transiGon period can help prevent postpartum diseases
• Early diagnosis of postpartum diseases increases treatment success
• Any treatment given to a cow must follow the label for indicaGons and withdrawal periods
• Always follow treatment protocols designed by the dairy in conjuncGon with the herd veterinarian
Got Questions?