Mechanisms of Reproductive Diseases Postpartum in Dairy Cows

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2016 UMN China Dairy Conference
Yinchuan - China
Expendable processes:
Fat deposition, reproduction

Reeductible processes:
Thermoregulation, locomotion, growth, lactation

Essential processes:
Cellular functions, circulation, neural activity

Importance of Adequate Nutrition, Welfare, and Health

Wade and Jones (2004)
Am. J. Regul. Integr. Comp. Physiol. 287:R1277-1296
Occurrence of Diseases in the First 65 DIM
Occurrence of Diseases in the First 65 DIM

5,719 dairy cows (8 studies in 7 dairies in the US)

- **Postpartum disease**: 44.2%
- **Calving problems**: 14.6%
- **Metritis**: 16.1%
- **Clinical endometritis**: 20.8%
- **Fever**: 21.0%
- **Mastitis**: 12.2%
- **Ketosis**: 10.4%
- **Lameness**: 6.8%
- **Pneumonia**: 2.0%
- **Indigestion**: 2.8%

Occurrence of Diseases in Grazing Dairy Herds

- Clinical diseases: 37.5% (n = 957)
- Calving problems: 8.5%
- Metritis: 5.3%
- Clinical endometritis: 15.0%
- Mastitis: 15.3%
- Pneumonia: 2.5%
- Indigestion: 4.0%
- Lameness: 3.2%

Subclinical diseases: 59.0% (n = 771)
- Elevated NEFA: 20.0%
- Subclinical ketosis: 35.4%
- Subclinical hypocalcemia: 43.3%
- Healthy: 27.0%

Ribeiro et al. (2013) J. Dairy Sci. 96:5682-5697
Major Reproductive Disorders in Dairy Cows

**Dystocia and stillbirth**

- ↑ Risk of death
  - Calving ease 5 = +10%
  - Stillbirth = +11%

- ↓ Herd life in 1st lactation = -180 days

- ↓ Milk yield = 704 kg/305d
  - *Dematawewa and Berger (1997) J. Dairy Sci. 80:754-761*

- ↓ Reproductive performance
  - -25% P/AI
  - +67% pregnancy loss

Calving Problems

Calving

Use Sires to Reduce Stillbirth and Increase Calving Ease

- **Sire Calving Ease (SCE)**
  - % births considered difficult in first lactation animals

- **Daughter Calving Ease (DCE)**
  - % bull’s daughters that have difficult births during their first calving

- **Sire Stillbirth (SSB)**
  - % born dead to first lactation animals

- **Daughter Stillbirth (DSB)**
  - % bull’s daughters that give birth to a dead calf in their first lactation
Use Sires to Reduce Stillbirth and Increase Calving Ease

SPECIAL ATTENTION FOR HEIFERS
**Effect of Vulvovaginal Laceration at Calving**

Vulvovaginal Laceration Score (VLS)

- **VLS = 0**
  - No laceration

- **VLS = 1**
  - Laceration < 2 cm (dorsal commissure)

- **VLS = 2**
  - Laceration ≥ 2 cm (dorsal commissure)

Veira-Neto et al. (2016)
*J. Dairy Sci.* 99:4629-4637
### Effect of Vulvovaginal Laceration at Calving

**Diagram:**
- **Calving Problems**
  - BCS
  - MC
  - VLS
  - MC
  - MC
  - MC - PVD
  - Cyclicity
  - US

<table>
<thead>
<tr>
<th>DIM</th>
<th>0</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>32±3</th>
<th>50±3</th>
<th>64±3</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level (no.)</th>
<th>VLS0, %</th>
<th>VLS1, %</th>
<th>VLS2, %</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parity</td>
<td>Prim (280)</td>
<td>3.9</td>
<td>37.9↑</td>
<td>58.2↑↑</td>
<td>7.6</td>
<td>5.4–10.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Mult (380)</td>
<td>36.8</td>
<td>45.5</td>
<td>17.6</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Dystocia</td>
<td>Yes (75)</td>
<td>21.3</td>
<td>24.0↑</td>
<td>54.7↑↑</td>
<td>1.6</td>
<td>1.0–2.7</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>No (585)</td>
<td>23.1</td>
<td>44.6</td>
<td>32.3</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

*Veira-Neto et al. (2016) J. Dairy Sci. 99:4629-4637*
Effect of Vulvovaginal Laceration at Calving


VD = 5

VLS 0 = 42.4%
VLS 1 = 52.0% (OR = 1.5, P = 0.10)
VLS 2 = 69.1% (OR = 2.6, P < 0.001)
Effect of Vulvovaginal Laceration at Calving


VLS 0 = 43.1%
VLS 1 = 46.6% (OR = 1.3, \( P = 0.29 \))
VLS 2 = 56.5% (OR = 1.7, \( P = 0.01 \))
Effect of Vulvovaginal Laceration at Calving

VLS 0 = 86.8%
VLS 1 = 81.0% (OR = 0.7, \( P = 0.21 \))
VLS 2 = 70.0% (OR = 0.4, \( P = 0.001 \))
Major Reproductive Disorders in Dairy Cows

<table>
<thead>
<tr>
<th>Status</th>
<th>RFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal range</td>
<td>4 to 11%</td>
</tr>
<tr>
<td>Abortion</td>
<td>62%</td>
</tr>
<tr>
<td>Twinning</td>
<td>37%</td>
</tr>
<tr>
<td>Stillbirth</td>
<td>19%</td>
</tr>
<tr>
<td>C-section</td>
<td>62%</td>
</tr>
<tr>
<td>Dystocia</td>
<td>13%</td>
</tr>
</tbody>
</table>

Other risk factors:
- Multiparous cows
- Hypocalcemia
- Weight loss prepartum
- Heat stress prepartum
- Nutritional deficiencies

> 12 hours after parturition

Adapted from J.E.P. Santos and R.C. Chebel
Non-Infectious Risk Factors for RFM

Stress/Immunosuppression

- ↓ IL-8
- ↓ Neutrophils
- ↓ chemotaxis
- ↓ function
- ↓ Ca$^{+2}$
- ↑ NEFA

Metabolic unbalance

Oxidative stress

- ↓ vitamin E
- ↓ selenium
Uterine Infection Postpartum and Development of Metritis

1. *Escherichia coli*
2. *Trueperella pyogenes*

*Sheldon et al. (2009) Biol. Reprod. 81:1025-1032*
Uterine Infection Postpartum and Development of Metritis

Uterine Infection Postpartum and Development of Metrits

Major Reproductive Disorders in Dairy Cows

Calving

Metritis

RFM

Calving Problems

| Calving | 10 | 20 |

Adapted from J.E.P. Santos
Evaluation of Vaginal Discharge in Dairy Cows

1 = clear or translucent mucus
2 = mucus containing flecks of white or off-white pus
3 = ≤ 50% white or off-white mucopurulent material
4 = > 50% purulent material
5 = watery, reddish or brownish color of foul smell
Metritis in High-Producing Dairy Cows

- First 2 weeks postpartum
- Metritis
  - Fetid watery brownish/reddish vaginal discharge
  - Enlarged uterus (no corrugations)
- Puerperal metritis
  - Fetid watery brownish/reddish vaginal discharge
  - Enlarged uterus (no corrugations)
  - Fever (> 39.5 ºC)
  - Systemic symptoms (low milk yield, inappetence)

VD = 5
Major Reproductive Disorders in Dairy Cows

http://www.partners-in-reproduction.com

J.E.P. Santos

F.S. Lima

Calving

<table>
<thead>
<tr>
<th>RFM</th>
<th>Calving Problems</th>
<th>Metritis</th>
<th>Clinical Endometritis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calving</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

Adapted from J.E.P. Santos
Major Reproductive Disorders in Dairy Cows

- 3rd week postpartum
- Diagnosis based on uterine/vaginal discharge
  - Vaginoscopy
  - Vaginal palpation
  - Metricheck device

RFM
Calving Problems

<table>
<thead>
<tr>
<th>Calving</th>
<th>Metritis</th>
<th>Clinical Endometritis</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from J.E.P. Santos
## Major Reproductive Disorders in Dairy Cows

- ↑ presence of polymorphonuclear cells
- > 28 DIM
- Risk factors
  - RFM – 2.12-fold increase (29.7 vs. 15.7%)
  - Metritis – 1.95-fold increase (31.1 vs. 17.0%)

Cerri et al. (2009) Theriogenology 71: 1127-1137*

<table>
<thead>
<tr>
<th>RFM</th>
<th>Calving Problems</th>
<th>Metritis</th>
<th>Clinical Endometritis</th>
<th>Subclinical Endometritis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calving</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
</tr>
</tbody>
</table>

Adapted from J.E.P. Santos
Effect of DMI on Uterine Health Postpartum

# Management of BCS and Uterine Health Postpartum

<table>
<thead>
<tr>
<th>Item</th>
<th>Gained</th>
<th>No change</th>
<th>-0.25 to -0.50</th>
<th>≤ -0.75</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>1,384</td>
<td>3,852</td>
<td>3,551</td>
<td>202</td>
</tr>
<tr>
<td>Stillbirth</td>
<td>0.9</td>
<td>Ref.</td>
<td>1.4</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>(0.6 to 1.2)</td>
<td></td>
<td>(1.1 to 1.7)</td>
<td>(0.7 to 2.5)</td>
</tr>
<tr>
<td>RFM</td>
<td>0.9</td>
<td>Ref.</td>
<td>1.6</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>(0.6 to 1.2)</td>
<td></td>
<td>(1.3 to 2.1)</td>
<td>(1.3 to 3.9)</td>
</tr>
<tr>
<td>Metritis</td>
<td>0.8</td>
<td>Ref.</td>
<td>1.3</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>(0.7 to 1.0)</td>
<td></td>
<td>(1.2 to 1.5)</td>
<td>(1.4 to 2.8)</td>
</tr>
<tr>
<td>Other diseases</td>
<td>1.0</td>
<td>Ref.</td>
<td>2.0</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>(0.7 to 1.5)</td>
<td></td>
<td>(1.5 to 2.6)</td>
<td>(2.6 to 7.1)</td>
</tr>
<tr>
<td>Culling &lt; 60 DIM</td>
<td>1.0</td>
<td>Ref.</td>
<td>1.7</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>(0.8 to 1.4)</td>
<td></td>
<td>(1.4 to 2.0)</td>
<td>(2.4 to 5.6)</td>
</tr>
</tbody>
</table>

*Courtesy of R.C. Chebel Mendonça and Chebel (unpublished data)*
Management of BCS and Uterine Health Postpartum

- 8,989 lactations (6,183 Holstein cows)
- 2 herds located in California
- BCS at dry-off and calving

305-d milk:
- 22,350 kg
- 12,250 kg
- 4,300 kg

Courtesy of R.C. Chebel
Mendonça and Chebel (unpublished data)
Management of BCS and Uterine Health Postpartum

Delayed time to pregnancy ↑ over-conditioned cows at dry-off

BCS at dry off
Most important predisposing factor for BCS loss during dry period

Reproduction
Most important risk factor for high BCS at dry off

8,989 lactations (6,183 Holstein cows)
2 herds located in California
BCS at dry-off and calving

Courtesy of R.C. Chebel
Mendonça and Chebel (unpublished data)
Effect of Hypocalcemia on Uterine Health

- Calving
- ↓[Ca]
- Subclinical Hypocalcemia: [Ca] < 8.59 mg/dL
  - ↓ Ca\(^{+2}\) availability for cellular activity
  - Impaired innate immunity

Calcium secretion in colostrum
Low ingestion/absorption of calcium
Inadequate calcium mobilization from bones

Infectious diseases
Metritis

Phagocytosis and destruction of C3b-coated bacteria

Courtesy of J.E.P. Santos
Effect of Hypocalcemia on Uterine Health

Martinez et al. (2012) J. Dairy Sci. 95:7158-7172
**Effect of Hypocalcemia on Fertility Postpartum**

<table>
<thead>
<tr>
<th>Ca status</th>
<th>Low-risk group</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normocalcemia</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>Metritis,(^{3,4,5}) % (no./no.)</td>
<td>14.3 (4/28)</td>
<td>40.7 (11/27)</td>
<td></td>
</tr>
<tr>
<td>Puerperal metritis,(^{4,6}) % (no./no.)</td>
<td>0.0 (0/28)</td>
<td>29.6 (8/27)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ca status</th>
<th>High-risk group</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normocalcemia</td>
<td>SCH</td>
<td></td>
</tr>
<tr>
<td>Metritis,(^{3,4,5}) % (no./no.)</td>
<td>20.0 (2/10)</td>
<td>77.8 (35/45)</td>
<td></td>
</tr>
<tr>
<td>Puerperal metritis,(^{4,6}) % (no./no.)</td>
<td>10.0 (1/10)</td>
<td>53.5 (24/45)</td>
<td></td>
</tr>
</tbody>
</table>

**Martinez et al. (2012) J. Dairy Sci. 95:7158-7172**

**Population-Attributable Risk**

* Reduction in metritis incidence if cows did not have SCH

**Metritis = 66.6%**

**Puerperal metritis = 91.2%**
Effect of Uterine Diseases on Reproductive Efficiency

UTD = uterine diseases (metritis and retained placenta)

Breeding: $P = 0.20$
UTD: $P = 0.03$
Interaction: $P = 0.91$

## Effect of Uterine Diseases on Reproductive Efficiency

<table>
<thead>
<tr>
<th>Health status</th>
<th>P/AI d 60, % (AOR – 95% CI)</th>
<th>Pregnancy loss, % (AOR – 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>51.4</td>
<td>8.9 Ref.</td>
</tr>
<tr>
<td>Calving problems</td>
<td>40.3*** 0.75 (0.63 - 0.88)</td>
<td>15.9** 1.67 (1.16 - 2.40)</td>
</tr>
<tr>
<td>Metritis</td>
<td>37.8*** 0.66 (0.56 - 0.78)</td>
<td>11.3 1.01 (0.71 - 1.60)</td>
</tr>
<tr>
<td>Clinical endometritis</td>
<td>38.7*** 0.62 (0.52 - 0.74)</td>
<td>15.1* 1.55 (1.04 - 2.32)</td>
</tr>
</tbody>
</table>

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

---

### Effect of subclinical endometritis (SCE) on P/AI after first service postpartum

<table>
<thead>
<tr>
<th></th>
<th>SCE</th>
<th>Healthy</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvão et al. (2009)</td>
<td>28.8%</td>
<td>41.3%</td>
<td>0.06</td>
</tr>
<tr>
<td>Gilbert et al. (2005)</td>
<td>11.0%</td>
<td>36.0%</td>
<td>0.01</td>
</tr>
<tr>
<td>Kasimanickam et al. (2004)</td>
<td>18.0%</td>
<td>32.0%</td>
<td>0.05</td>
</tr>
<tr>
<td>Rutigliano et al. (2008)</td>
<td>18.3%</td>
<td>35.7%</td>
<td>0.002</td>
</tr>
<tr>
<td>Lima et al. (2013)</td>
<td>13.7%</td>
<td>40.5%</td>
<td>0.03</td>
</tr>
</tbody>
</table>

**Major Reproductive Disorders in Dairy Cows**

- **RFM**
  - Calving Problems
  - Metritis

- **Pyometra**
  - Clinical Endometritis
  - Subclinical Endometritis

<table>
<thead>
<tr>
<th>Calving</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
</table>

- Collection of pus in the uterine lumen
- Associated with persistent CL
- Diagnosis
  - Transrectal palpation
    - Presence of fluid without positive signs of pregnancy
  - Thickened uterine wall
  - Ultrasonography
    - Hypoecogenic contents with debris

Adapted from J.E.P. Santos and R.C. Chebel
Major Reproductive Disorders in Dairy Cows

- Anovulatory condition $\rightarrow$ no CL
- Follicles $> 17$ mm that persist for $> 8$ days

**Diagnosis**

- Transrectal palpation
  - Accuracy to detect CL: 57 to 70%
- Ultrasonography
  - Accuracy to detect CL > 85%

**Follicular Cysts**

- RFM
- Calving Problems
- Metritis

**Clinical Endometritis**

- Subclinical Endometritis

**Pyometra**

Adapted from J.E.P. Santos and R.C. Chebel
Major Reproductive Disorders in Dairy Cows

- Anovular
- Calving
- Voluntary Waiting Period (~ 50 to 60 days)
- Cows become eligible for insemination
Major Reproductive Disorders in Dairy Cows

- Pregnancy day 30: 41.1% Cyclic, 29.0% Anovular
- Pregnancy day 58: 35.8% Cyclic, 24.5% Anovular
- Pregnancy loss: 15.7% Cyclic, 26.3% Anovular

Note: a, b P < 0.05


Picture from http://www.partners-in-reproduction.com/
## Effect of Non-Reproductive Diseases on Fertility

<table>
<thead>
<tr>
<th>Health status</th>
<th>P/AI d 60, % (AOR – 95% CI)</th>
<th>Pregnancy loss, % (AOR – 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>51.4</td>
<td>Ref.</td>
</tr>
<tr>
<td>1 case of disease</td>
<td>43.3**</td>
<td>0.79 (0.69 - 0.91)</td>
</tr>
<tr>
<td>&gt; 1 cases of disease</td>
<td>34.7***</td>
<td>0.57 (0.48 - 0.69)</td>
</tr>
<tr>
<td>Type of disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calving problems</td>
<td>40.3***</td>
<td>0.75 (0.63 - 0.88)</td>
</tr>
<tr>
<td>Metritis</td>
<td>37.8***</td>
<td>0.66 (0.56 - 0.78)</td>
</tr>
<tr>
<td>Clinical endometritis</td>
<td>38.7***</td>
<td>0.62 (0.52 - 0.74)</td>
</tr>
<tr>
<td>Fever postpartum</td>
<td>39.8***</td>
<td>0.60 (0.48 - 0.65)</td>
</tr>
<tr>
<td>Mastitis</td>
<td>39.4</td>
<td>0.84 (0.64 – 1.10)</td>
</tr>
<tr>
<td>Clinical ketosis</td>
<td>28.8***</td>
<td>0.50 (0.36 - 0.68)</td>
</tr>
<tr>
<td>Lameness</td>
<td>33.3***</td>
<td>0.57 (0.41 - 0.78)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>32.4</td>
<td>0.63 (0.32 – 1.27)</td>
</tr>
<tr>
<td>Indigestion</td>
<td>36.7</td>
<td>0.78 (0.46 – 1.34)</td>
</tr>
</tbody>
</table>

* P < 0.05, ** P < 0.01, *** P < 0.001
Health management, nutrition, and cow confort
IMPROVE IMMUNITY POSTPARTUM

Benzaquen M.
Management During the Transition Period

**Management of transition cows**

- Avoid overstocking
- Increase cow comfort
- Minimize stress
- Adequate nutrition
  - Avoid BCS loss
- Grouping according to parity
- Stimulate DMI
  - Main driver of EB

*Courtesy of J.E.P. Santos*
Management During the Transition Period

Courtesy of J.E.P. Santos
Management During the Transition Period
Thank You

Rafael S. Bisinotto
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