REVIEW OF BASIC PRINCIPLES
STAGING THE CYCLE
SYNCHRONIZATION
EMBRYO TRANSFER
ARTIFACTS
FETAL SEXING
QUIZ TIME

REVIEW OF BASICS
Pregnancy vs. Open
25 days vs. 30+

Accuracy of Ultrasound - Cows

Accuracy of Ultrasound - Heifers

Juan Romano, et al, Therio 2006
<table>
<thead>
<tr>
<th></th>
<th>Ultrasound</th>
<th>Palpation</th>
<th>Biopryn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preg/open dx</td>
<td>27+ days</td>
<td>34+ days</td>
<td>30+days, &gt;90 DIM</td>
</tr>
<tr>
<td>Viability</td>
<td>Yes</td>
<td>No</td>
<td>Maybe</td>
</tr>
<tr>
<td>Twins</td>
<td>Yes</td>
<td>Maybe</td>
<td>No</td>
</tr>
<tr>
<td>Gender</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Ovaries</td>
<td>Accurate</td>
<td>Inaccurate</td>
<td>No</td>
</tr>
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</table>

New Methods for Early Pregnancy Diagnosis in Dairy Cattle

Paul Fricke, PhD University of Wisconsin

EMBRYONIC and FETAL DEATH
Cardinal signs of fetal death

• Lack of heartbeat
• No movement (>60 days)
• Cloudy amnionic or allantoic sac (<60 days)
• Severe separation of chorioallantoic membrane (<60 days)

Signs of fetal distress

• Heartbeat less than 130bpm
• Mild separation of chorioallantoic membrane (<60 days)
• Fetus smaller than expected for age
• Fetal abnormalities
TWIN DIAGNOSIS

Check ovaries

50% of pregnant cows with double ovulations had twins (Thatcher)

Monozygous twins are rare – 4.7% (Fricke)

Image by Giovanni Gnemmi, DVM
Look for a “twin line”

Notice the sharing of the chorioallantois and some of its circulation.

Dr. Maarten Drost
Recheck after 60 days

Day 36/42 to day 90: 8% loss of bilateral twins, 32% loss of unilateral twins, 6.2% reduction (Lopez-Gatius)

Abortion distribution, unilateral

39% overall

Arturo Scheidegger
Abortion distribution, bilateral

Month of Gestation:

- 25% overall

Milk Production:

- 2005: 33.2
- 2006: 35.2
- 2007: 39.9
- 2008: 42.4

Correlation of Milk Production and Twins in 20,000 Cows:

- 2005: 5.3
- 2006: 5.3
- 2007: 33
- 2008: 33.6

Correlation of Milk Production and Twins in One Herd:

- 2005: 3.7
- 2006: 5.6
- 2007: 12
- 2008: 22
Ovaries
(photos courtesy of Dr. Maarten Drost)
Fetal Aging

Fetal length in mm + 18 = fetal age in days (works until about day 50)

45 days
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Earliest Mean</th>
<th>Range</th>
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<tbody>
<tr>
<td>Embryo proper</td>
<td>20.3</td>
<td>19-24</td>
</tr>
<tr>
<td>Heartbeat</td>
<td>20.9</td>
<td>19-24</td>
</tr>
<tr>
<td>Allantois</td>
<td>23.2</td>
<td>22-25</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>29.1</td>
<td>26-33</td>
</tr>
<tr>
<td>Forelimb buds</td>
<td>29.1</td>
<td>28-31</td>
</tr>
<tr>
<td>Amnion</td>
<td>29.5</td>
<td>28-33</td>
</tr>
<tr>
<td>Eye orbit</td>
<td>30.2</td>
<td>29-33</td>
</tr>
<tr>
<td>Hindlimb buds</td>
<td>31.2</td>
<td>30-33</td>
</tr>
<tr>
<td>Placentomes</td>
<td>35.2</td>
<td>33-38</td>
</tr>
<tr>
<td>Split hooves</td>
<td>44.6</td>
<td>42-49</td>
</tr>
<tr>
<td>Fetal movement</td>
<td>44.8</td>
<td>42-50</td>
</tr>
<tr>
<td>Ribs</td>
<td>52.8</td>
<td>51-55</td>
</tr>
</tbody>
</table>

**STAGING THE CYCLE**

![Graph showing two follicular waves and progesterone levels with ovulation points](image_url)

*Slide courtesy of Paul Fricke, PhD, University of Wisconsin*
Day 1-4

Ultrasound
No or small CL
Small follicles
No follicles >7mm

Day After Ovulation
Slide courtesy of Paul Fricke, PhD, University of Wisconsin

Day 5-10

Ultrasound
Large CL
No small follicles
1 or 2 follicles >7mm

Day After Ovulation
Slide courtesy of Paul Fricke, PhD, University of Wisconsin

Day 11-15

Ultrasound
Large CL
Small follicles
1 or 2 follicles >7mm

Day After Ovulation
Slide courtesy of Paul Fricke, PhD, University of Wisconsin
Progesterone

Ovulation Day 16-21

Ultrasound
Regressing CL
No small follicles
1 or 2 follicles >7mm

Day After Ovulation

Follicular Size

Ovulation

Uterine Character

- **Intraluminal fluid** increases 3 days before ovulation and reaches maximum 1-2 day before. By 1-2 day after ovulation it is back to baseline.

- **Echotexture of uterus** most heterogeneous beginning 5 days before ovulation, maximum one day before, and minimum by 1 after.
Metestrus (Corpus hemorrhagicum)

Early diestrus (7 day) CLs

Diestrus CLs and uterus

Proestrus CLs
Late proestrus/estrus uterus and ovary
Synchronization Programs With Ultrasound
Effect of a Implementation of a Systematic Reproduction Management Program in Dairy Herds

- Herds beginning Ovsynch protocols achieved 3-4 point improvements in preg rate
- Herds beginning Ovsynch along with ultrasound added an extra point

LeBlanc, S.J., 2008, Bovine Practitioner

**OVSYNCH**

Ovsynch success affected by

- Compliance
- Cow health/cyclicity
- Whether or not a follicle ovulates to G1
- Whether or not a CL is present at G1
Importance of CL and Ovulation at G1

CL at G1, 38 day preg rates
- ovulation: 42.2
- no ovulation: 37.7

No CL at G1, 38 day preg rates
- ovulation: 27.7
- no ovulation: 15.4


CL Diagnosis

Ultrasound with >22mm cut-off size for CL at 24 days post-AI for progesterone >1ng/ml
- Sensitivity 89.5%
- Specificity 89.4%

Palpation to identify CL producing >1ng/ml progesterone (three palpators)
- Sensitivity 33.3-60%
- Specificity 77-93%


Ovulation Response to First GNRH

Pursley, Michigan State University
Ultrasound Applications with Ovsynch

Attempt to precisely predict stage of cycle and schedule Ovsynch accordingly

OR

Examine ovaries to determine presence or absence of a corpus luteum on the day of G1.

PRESYNCH

Two Follicular Waves

Slide courtesy of Paul Fricke, PhD, University of Wisconsin
OVULATION RESPONSE TO PRESYNCH

Follicular Size

Progesterone

Ovulation

Pursley, Michigan State University

Research Data

Conception rates for CYCLING cows:
Ovsynch: 31.1%
Presynch: 52.3%

O. Moreira, C. Risco, Bill Thatcher, University of Florida, 2001
Conception rates for ANOVULAR cows (23.4% of cows in this study)

Ovsynch: 22.4%
Presynch: Not recorded, presumed no difference

Ultrasound Application with Presynch

Examine cows on day of first GNRH injection to determine if ovulating or anovular. Use this to determine type of synchronization protocol and to assess reproductive health.

RESYNCH
Resynch Data

<table>
<thead>
<tr>
<th>Days post bred to resynch</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 (GNRH to all prior to preg exam) N=120</td>
<td>23%</td>
</tr>
<tr>
<td>26 (GNRH to open only) N=121</td>
<td>34%</td>
</tr>
<tr>
<td>33 (GNRH to open only) N=143</td>
<td>38%</td>
</tr>
</tbody>
</table>

• Fricke and Welle, 2003.

Ultrasound Application with Resynch

Schedule pregnancy examinations for an optimal stage of cycle to resynchronize open cows. Examine ovaries of open cows to determine if ovulating or anovular. Use this to determine type of synchronization protocol and to assess reproductive health.

CIDR SYNCH

![CIDR SYNCH Diagram]

1. CIDR
2. 7 days
3. 16-48 hours
4. 10 hours
Research Data

Anovular cows
Ovsynch conception rate: 22.2%
CIDR Synch conception rate: 36%

Milo Wiltbank, PhD, University of Wisconsin, 2004

ANOVULAR CONDITIONS

Follicular cysts

Inactive ovaries

IMPORTANCE (OR LACK) OF CYSTIC STRUCTURE

Jeff Stevenson, Hoard’s Dairyman, 2006

584 cows examined by palpation, 51 found with cystic structures (8.7%)
– 19 had cyst with CL
– 12 had cyst with no CL but ovulated after GNRH
– 14 had moderate to high progesterone – luteal cysts
– Only 6 cows had functional follicular cyst
Ultrasound Application with CIDRSynch

Use ultrasound to help determine if the cow is truly anovular, reducing unnecessary CIDR use.

Various Programs at BSLLC

• Maple Ridge Dairy
  • 13,600 kg RHA, free stall facility
  • Weekly visit
  • No heat detection
  • Blind presynch (no exams before breeding)
  • DIM to 1st service 72-79
  • 1st service conception rate 47%, later services 44%, preg rate 23%

• Martin Farms
  • 13,600 kg RHA, tie stall barn
  • Every 4 weeks visit
  • Heat detection for cows >60DIM until next ultrasound visit, and for all cows bred but not confirmed. No Presynch.
  • Cows not detected in heat are examined by ultrasound and receive Ovsynch if CL, CidrSynch if no CL
  • Conception rate 52%, preg rate 27%
- Bosside Holsteins
- 12,000 kg RHA, free stall barn
- Embryo transfer herd.
- Recipients are synchronized with CIDRs and examined for quality and side of CL the day before ET vet arrives to transfer
- 85% of recipients are used, vs 70% when palpated
- 30 day pregnancy rate is 65% for heifer recips and 55% for cow recips
- More recips are used with the same preg rates

- Livin’ in the 50’s Dairy
- 8200 kg RHA
- Bull bred on pasture
- Preg rate 20%

Ultrasound With Synchronization On Large Dairies

John Lee, DVM
Atwater Veterinary Clinic
3060 North Ashby Road
Merced, CA 95348
209.363.9175
johndlee@comcast.net
Herd 1

Pre Ultrasound

Pregnancy exams concentrated at 48 days with range of 34-53 days

Post Ultrasound

Pregnancy exams concentrated at 32 days with range of 27-43 days
Herd 2

HDR 60% CR 27% PR 16%
HDR 68% CR 35% PR 24%

Pre Ultrasound

Preg exams concentrated at 40 days. Range 34-41

Post Ultrasound

Preg exams concentrated at 32 days. Range 28-40
EMBRYO TRANSFER
Courtesy of Brad Stroud, DVM

Flush Day, Good Response

Flush Day, Poor Response
Recips – Good CLs

Recip, Poor CL

Ovum Pick Up (OPU)
Courtesy of Dr. Brad Stroud
IMAGE INTERPRETATION
AND ARTIFACTS

NON-SPECULAR
REFLECTIONS (“GOOD
ARTIFACTS”)
Types of non-specular reflections

Rough interface

Small interfaces

Adapted from Ginther, 1995

BEAM WIDTH ARTIFACT

A single 2mm ultrasound beam samples 2 different densities. The resulting echo is read as one signal.

Adapted from Ginther, 1995

CRYSTAL DEFECTS
ELECTRICAL INTERFERENCE

ENHANCEMENT ARTIFACT

Occurs when ultrasound beams pass through tissues of different density. Non-echogenic tissues attenuate the beam less, resulting in greater apparent brightness of tissues below.

MIRROR IMAGE

The returning echoes produced by the structure are reflected again off the surface of the pelvis and returning to the probe a second time.
REVERBERATION ARTIFACT

Tissue/gas interface

Reverberation echo

Each subsequent echo is deeper and reduced in amplitude

O.J. Ginther, "Ultrasonic Imaging and Reproductive Events"

SHADOWING DUE TO DENSE OBJECT
Mirror Image

REFLECTION AND REFRACTION
SHADOWS

O.J. Ginther, “Ultrasonic Imaging and Reproductive Events”
SPECULAR REFLECTION

- Acoustic mismatch – different densities
- Smooth surface
- Perpendicular to ultrasound beam
- Very common during estrus

ULTRASONIC IMAGING – INTERPRETATION

O. J. GINther

Use Power DVD, end chap 3
BOVINE FETAL SEXING

REASONS FOR FETAL SEXING
• Increase sale value of pregnant females
• Early negotiation of bull contracts
• Dystocia monitoring for heifers
• Assist in culling decisions
• Replacement planning

EQUIPMENT NEEDS
• Good quality image
• 5MHz linear rectal probe
• Proper settings
ACCURACY

• 99% or more accurate
• Difficulties include:
  Larger fetuses
  Uncooperative cows
  Female fetuses
• Keep records

WHAT

• The genital tubercle will become the penis in the male and the clitoris in the female
• The GT appears as a bright white bi-lobed structure in both the male and female
• The GT may appear tri-lobed in older fetuses
• Scrotum and teats may be visualized, but the genital tubercle is the only “cardinal sign” of fetal sex
WHERE
• The GT in the male appears directly behind the umbilical cord
• The GT in the female appears under the tail in the perineal area

WHEN
• 55-90 days in dairy cattle, 55-110 in beef cattle
• 60-80 days is ideal
• Prior to day 55 the genital tubercle may not be fully migrated.

• In later gestation the fetus is out of reach or too large to orient properly.

• In later gestation the genital tubercle becomes less echogenic.

HOW

• Avoid oblique views
• Position the fetus as close to the face of the probe as possible.
Start by locating the umbilicus and looking for the male GT directly behind it.

If no male GT is found look for the female GT below the tail.

Fetal Sexing DVD

Bovine Fetal Sexing Unedited
By Brad Stroud, DVM

Numbered fetal sexing test with 52 real-time scans.
Available through Bovine Services
OTHER ORGANS

- BULL
- UMBILICUS
- TEAT
- CHEST
- LYMPH NODE
- LIVER

BULL

TESTICLE

TESTICULAR ABCESS
Chest

Image by Dr. Derek Foster

Endocarditis

Image by Dr. Derek Foster

Lymph Node

Image by Bill Croushure, DVM