Estrus Synchronization Programs in Dairy Cattle

Andrew Fidler, DVM
April 30, 2009
Introduction

• ↑ milk production ➔ ↓ reproductive performance
  – Due to declining conception rates (70% ➔ 35%) and estrus detection rates (32%)

  – Solution: Selecting for fertility in strategic breeding program
    • Takes generations to see results

• Immediate solution: hormonal intervention
  – Ex. Ovsynch doesn’t rely on estrus detection
Introduction

• Grazing/Seasonal calving
  – Yearly calving interval
  – If not, culled, or carried over to next breeding period

• Confinement
  – Conception within a window that maximizes her profitability
Introduction

• Typical Scenario
  – Spontaneous estrus → inseminated
  – Anestrous → hormonal intervention

• Intensive approach
  – Programmed breeding for all cows
    • Controls time of first insemination, time of subsequent insemination in open cows, and treats anestrous cows
Estrus Synchronization

• Use of hormones that are identical to, or analogs of, the reproductive hormones naturally found in the body

• 1960’s – exogenous progestogens to block ovulation
  – Good synchrony; low conception rate

• 1970’s – PGF$_{2\alpha}$ = uterine luteolysin

• Combined progestogens and PGF$_{2\alpha}$
  – Low conception rates, especially with prolonged progestogen treatment

• 1990’s – persistent DF causes depressed fertility
  – Developed programs that control follicle development, luteal phase length, and time of ovulation
Estrus Synchronization

• Most systems use a method for:
  1) Controlling follicular wave development
  2) Preventing premature ovulation in cyclic cows
     - and promoting ovulation in anestrous cows
  3) Regressing the CL in cyclic cows
  4) Synchronizing estrus and/or ovulation at the end of treatment

GnRH
PGF
Controlling Follicular Wave Development

• Follicular development occurs in waves
  – 2-3 waves per cycle
  – 8-10 days per wave
  – DF resulting from each wave undergoes ovulation or atresia

  • Luteal regression/progesterone withdrawal
    → final DF maturation
    → ↑ estradiol
    → LH surge
    → ovulation
Controlling Follicular Wave Development

• GnRH-induced LH release causes ovulation or luteinization of the *physiologically mature* DF
  – Loss of the DF leads to emergence of a new follicular wave

• Estradiol can be used for follicular wave synchronization, but is not approved for use in dairy cattle in the U.S.
POP QUIZ

• We achieve follicular wave synchronization with the use of . . . .
  – GnRH
Progestogen Supplementation

• Three primary advantages
  1) Suppresses LH surge and estrous behavior
  2) Effective method for treating anestrous
     - increases DF development
     - primes estrous expression and LH surge
  3) Effective method for treating cystic ovaries
     - decreases LH pulsatility in cystic cows → turnover of the cystic follicle
POP QUIZ

• Our most commonly used tool for progestogen supplementation is . . .
  – CIDR

• What does CIDR stand for?
  – Controlled Internal Drug Release
Regressing the CL in Cyclic Cows

• Luteolytic dose of PGF$_{2\alpha}$
  – Efficacious beginning at day 5-7 after estrus
  – Variation in interval to estrus
    • Can be minimized if given when DF is mature but not atretic
      – Days 7-9 or 14-16 after estrus

  – Give PGF$_{2\alpha}$ in a series (11-14 day interval), or 7 days after follicular synchronization
POP QUIZ

What are common names of prostaglandin products?
- Lutalyse
- Estrumate
- Prostamate
Synchronizing Estrous Expression and/or Ovulation

- Ovulatory GnRH dose typically given 48 hours after a luteolytic dose of PGF$_{2\alpha}$

- Timed AI systems induce fertile ovulation without estrous expression
POP QUIZ

- What are common names of GnRH products?
  - Cystorelin
  - Factrel
  - Fertagyl
  - Ovacyst
Synchronizing First Insemination

• Remember:
  – Herds with many anestrous cows will respond poorly, regardless of treatment
  – Estrus expression and conception will be affected by metabolic status
Synchronizing First Insemination

- Injection of PGF$_{2\alpha}$
  - Two treatments 11-14 days apart effectively synchronizes estrus, although timing is variable
  - Requires estrous detection
Synchronizing First Insemination

• Progesterone and PGF\( _{2\alpha} \)
  – PGF\( _{2\alpha} \) shortens period of progesterone exposure required and prevents progesterone-associated decrease in conception rates
Synchronizing First Insemination

• GnRH and PGF$_{2\alpha}$
  – Synchronizes both a follicular wave and subsequent estrus if given at 7 day interval
  – Estrus and ovulation 2-3 days after PGF$_{2\alpha}$
  – 10% estrus before PGF$_{2\alpha}$
    • Didn’t respond to GnRH because late in cycle
Synchronizing First Insemination

Ovsynch

1. GnRH
2. PGF$_{2\alpha}$
3. GnRH
4. Insemination

Steps:
7 days
2 days
1 day
Synchronizing First Insemination

Ovsynch

10-30% won’t synchronize
Synchronizing First Insemination

Cosynch

GnRH

PGF\textsubscript{2α}

GnRH and Insemination

7

2
Synchronizing First Insemination

Select-synch

1. GnRH
2. PGF$_{2\alpha}$
3. GnRH and Insemination

Heat Detect and AI
Synchronizing First Insemination

• GPG protocols
  – Economic return depends on heat detection ability
    • Herds with low heat detection rates see biggest benefit from a timed AI program
  – Low conception rate
    • Somewhat offset by 100% submission rate
    • Due to poor follicular wave synchrony related to response to first GnRH
Synchronizing First Insemination

• **GPG protocols**
  – More effective when started at day 5-12 of cycle
    • Pre-synchronization may improve synchronization, conception, and pregnancy rates
      – Single PGF$_{2\alpha}$ 12-14 days before GPG
      – Two injections of PGF$_{2\alpha}$ at 14 day interval
      – Combination of PGF$_{2\alpha}$ and GnRH
        » 2 day interval; GnRH 6 d before GPG

  – Is pre-synchronization worth it?
    • Lots of injections over long period of time
    • Conception rates 30-40%
    • Eliminates need for multiple daily sessions of estrous detection
Synchronizing First Insemination

• GPG + Progesterone
  – Prevents premature estrus expression during 7 days between first GnRH and PGF$_{2\alpha}$
  – Benefits anovulatory and cystic cows
  – Improves overall synchrony and pregnancy rate
• Conception rate to first insemination will be less than 100%

→ Synchronization of second insemination
POP QUIZ

• *Diagnosing a 90 day pregnancy.* . . .

  – Placentome size?
    • Dime

  – Crown-to-nose length?
    • 3 finger widths

  – Fetal size?
    • Rat
Synchronizing Second Insemination

• Synchronization of first insemination

• Less than half of open cows are detected in estrus at expected time after first insemination
  – Estrus without ovulation
  – Return to anestrous
  – Failure to express estrus
  – Long inter-estrus interval
  – Early pregnancy loss
Synchronizing Second Insemination

• Progesterone supplementation
  – For 6-8 days beginning on day 12-14 after insemination
  – Withdrawal increases synchrony in open cows
  – Can give GnRH at insertion
  – Requires estrus detection

  – May decrease preg rate to initial AI; may not improve preg rate to second AI
Synchronizing Second Insemination

• GPG after open diagnosis
  – First GnRH can be given to all cows 7 days prior to preg check
  – Open cows then receive PGF$_{2\alpha}$, then GnRH 2 days later
  – If ultrasound used on day 29, second insemination occurs on day 31 or 32

  – “Rapid resynchronization” – can skip the first GnRH of GPG
    • At 29 day preg check, open cow should be at day 5-9 of cycle, with a CL that responds to PGF$_{2\alpha}$
    • Conception rate the same, but calving-to-conception interval 22-23 days shorter
    • First insemination synchronization should provide adequate follicular wave control – first GnRH of GPG not beneficial
Synchronizing Heifers

• Ovsynch success low
  • 50-60% synch rate

• Progesterone + PGF$_{2\alpha}$
  • Synchronization, but may not improve conception rate or pregnancy rate

• MGA + PGF$_{2\alpha}$
  • Takes a long time, but good pregnancy rates, cheap, and little labor required
“Can you reduce your breeding costs?”
by Jeff Stevenson  March 10, 2009

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Heat Detection</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
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<tr>
<td>Ovsynch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$8.90</td>
</tr>
<tr>
<td>Presynch + Ovsynch</td>
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<td>AI if heat after Presynch + Ov</td>
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<td>$6.21</td>
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</table>

*per cow cost (with PGF=$2.50 and GnRH=$3.20)
*assuming 80% cycling before Ovsynch initiated
POP QUIZ

• On this day in history. . .

  – April 30, 1789
    • George Washington took the presidential oath

  – April 30, 1945
    • As Allied forces were closing in on Berlin, Adolf Hitler and Eva Braun committed suicide after being married for one day

  – April 30, 1975
    • North Vietnamese troops captured Saigon, ending the Vietnam War and beginning the period of reunification of Vietnam as a communist country

  – April 30, 2009
    • Willie Nelson turns 75
Measuring Reproductive Performance

• Comparison to benchmarks, other herds, past performance
• Evaluate success of reproductive intervention
  – ex. Estrus synchronization program
• Evaluate heat detection, insemination, etc.
Herd Reproductive Parameters

• Reproductive Status
  – Fresh cows (<VWP)
  – Cows bred but not confirmed pregnant
  – Open cows
  – Pregnant lactating cows
  – Dry lactating cows
  – ‘Do not breed’ cows
  – Sold or dead cows
Herd Reproductive Parameters

• Number of pregnancies per time period
  – If a dairy intends to calve 120 animals/year, then it must produce slightly more than 10 pregnancies/month
    • Accounting for abortions and cow culling
Herd Reproductive Parameters

• **Days open** (Calving-to-conception interval)
  – An average calculated on an annual basis
    • Significant momentum and lag
    • Distorted by exclusions (‘do not breed’ cows)

• **Calving Interval**
  – The time period between calvings
  – Shortening this interval is the ultimate goal of reproductive management, but it is a weak monitor
    • Severe momentum and lag
    • Excludes first-lactation animals and culled cows
    • An average
Herd Reproductive Parameters

• Estrus detection rate
  
  \[
  = \frac{\text{number of estruses detected}}{\text{expected number of estruses}}
  \]

  - Can also be evaluated by “Days to first breeding”
    
    - If less than 18 days beyond the VWP, then estrus detection is probably acceptable
Herd Reproductive Parameters

• Conception rate
  – The proportion of breedings that result in conception
  – Can measure for pregnant cows (ignores repeat breeders), bred cows, stratified by lactation, season, or technician, etc.
  – Lag and momentum
  – Very biased because cows not bred are excluded
    • Missing heats can increase conception rate
    • A group of cows may remain open indefinitely and never be bred – not included in calculation
Herd Reproductive Parameters

• Pregnancy Rate (Pregnancy Risk)
  = the proportion of open cows that become pregnant during a specified time period (21 days)

  = the number of cows that become pregnant in 21 d
  the number of cows eligible to become pregnant

  “eligible to become pregnant”
  - past the voluntary waiting period
  - known to be open at the beginning of the 21 d period
  - may or may not include repro culls/ ‘do not breed’ cows
Pregnancy Rate

• Cross-sectional pregnancy rates
  – Divide the past year into 21 d periods of time

• Longitudinal pregnancy rates
  – Divide the time following the VWP into 21 d periods of time

• Cohort pregnancy rates
  – Follows a group of cows for a certain time period
    • Groups formed by calving date
  – Can measure success of a systematic breeding program
  – Best way to monitor changes in reproductive performance
Resources

• “The use of hormonal treatments to improve the reproductive performance of lactating dairy cows in feedlot or pasture-based management systems”

• “Current Therapy in Large Animal Theriogenology Vol. 2”
  – Youngquist and Threlfall

• LSU Therio website

• UF Dairy Reproduction Cookbook
  – www.animal.ufl.edu/extension/reproguide/index.shtml