Synchronization and Artificial Insemination Strategies in Dairy Herds

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KEYWORDS

• Estrus • Ovulation • Gonadotropin-releasing hormone • $PGF_{2\alpha}$ • Timed AI

KEY POINTS

- Presynchronization of estrous cycles using prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) injections before the standard Ovsynch timed AI program produces a greater percentage of inseminations resulting in pregnancy.
- Presynchronization programs incorporating gonadotropin-releasing hormone (GnRH) and $PGF_{2\alpha}$ improve pregnancy outcomes at first service compared with standard Presynch $PGF_{2\alpha}$ programs.
- Resynchronization programs that include administering GnRH 7 days before starting a Resynch-Ovsynch program improve pregnancy outcomes compared with a standard Resynch-Ovsynch programs alone.
- In resynchronization programs, $PGF_{2\alpha}$ facilitates estrus expression and reduces the proportion of cows requiring timed AI; GnRH administration inhibits estrus expression and increases the proportion of cows requiring timed AI.
- Five-day timed AI programs can produce acceptable pregnancy outcomes in replacement dairy heifers.

INTRODUCTION

Overall pregnancy risk of lactating dairy cows in North America has decreased since the 1950s,[1] whereas annual milk yield per cow has increased nearly 4-fold from 5313 to 20,576 lb. Based on a sample of less-productive dairy cows in the United Kingdom, fertility also decreased from 1975 to 1982 and from 1995 to 1998.[2] During that period, conception risk after first services decreased from 56% to 40% despite similar intervals to first service, whereas calving intervals increased from 370 to 390 days. Given this potential inverse relationship between milk yield and fertility, it is no wonder that a genetic antagonism may exist between some reproductive traits and milk yield, which is manifested particularly in first lactation cows.

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Since 2000, an apparent change in the genetic estimate of daughter pregnancy rate has occurred.[3] For every unit increase or decrease in daughter pregnancy rate (a value derived from days open), the 21-day pregnancy rate (proportion of breeding eligible cows that become pregnant every 21 days) of a sire's daughters increase or decrease by 1%. During the past decade, while milk yield continues to increase, a dramatic increase of approximately 5% in daughter pregnancy rate has occurred, which should translate into a reduction of 20 days open for their daughters when they become cows.

Although benefits of improving reproduction are apparent, specific causes of poor reproductive performance are difficult to identify and not easily resolved. To improve reproductive efficiency, the limiting factors must be identified. In earlier days, detecting estrus was the major limitation to achieving a pregnancy. Today, to maximize the chances of a renewed pregnancy for every heifer and cow that calves requires attention to a number of important time-dependent components of the estrous cycle of cows during the voluntary waiting period and in the active AI breeding period. Some of these solutions are found in improved rates of detected estrus and strategic application of hormones to manipulate ovarian follicular growth, corpus luteum (CL) life span, ovulation, and time of semen placement in various fixed timed AI programs.

VOLUNTARY WAITING PERIOD

A number of physiologic changes, including uterine involution and recrudescence of ovarian follicular waves and normal estrous cycles, must occur early postpartum to facilitate good fertility at first AI breeding. Many factors affect these outcomes, including but not limited to body condition, energy balance (milk yield and dry matter intake), parity, season, and disease.[3]

A recent review[3] reported that most dairy cows have emergence of their first postpartum ovarian follicular wave between 5 and 10 days postpartum, with 50% to 80% of cows ovulating the first dominant follicle.

- First ovulation occurs between 15 and 25 days postpartum and is uncommonly preceded by estrus.
- More than 70% of cycles are short after first ovulation.
- First estrus occurs between 25 and 45 days postpartum. Most dairy cows have 2 follicular waves per cycle.
- Regulators of luteinizing hormone pulse frequency necessary to induce first postpartum ovulation include increasing energy balance, body condition and weight at calving, increasing dry matter intake, and absence of disease.

TIMED ARTIFICIAL INSEMINATION PROGRAMS BEFORE FIRST SERVICES FOR LACTATING DAIRY COWS

Ovsynch

The most common timed AI system is a 7-day Ovsynch (**Fig. 1**). Some variations have included a 5-day program with doses of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) given on days 5 and 6 and timed AI on day 8 (0–16 hours after the second gonadotropin-releasing hormone [GnRH] injection; see **Fig. 1**). In the peer-reviewed literature,[4] hundreds of articles have cited the original Ovsynch article (Google Scholar = 860; Web of Science = 557), and numerous articles use the term Ovsynch in the title (n = 76) or in the abstract (n = 256). Obviously, the "Ovsynch" term and technology have become an integral part of bovine research and of the dairy cattle industry during the 20 years since the original