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Impact of parity on the efficiency of ovulation synchronization protocols in Holstein cows

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ABSTRACT

The objective of this study was to elucidate the impact of parity on the efficiency of three different protocols to synchronize time of ovulation in Holstein cows. All cows enrolled in this trial were categorized into primiparous and multiparous ($M_1 = 2–3$ and $M_2 \geq 3$ parities). Conception (P/AI at Day 28) and pregnancy (P/AI at Day 75) rates in the Presynch and CIDRsynch (31.7% and 35.5%; 26.3% and 28.4%, respectively) groups were significantly greater than that in spontaneous estrus (SE; 24.7 and 20.4%, respectively) group ($P = 0.048$ and 0.024; 0.041 and 0.011, respectively); however, no significant differences were detected between the SE and Ovsynch group for conception, pregnancy, and embryonic loss rates. Conception and pregnancy rates in the Presynch group decreased from 37.8% and 33.5%, respectively in primiparous cows to 29.6% and 23.1%, respectively in M_1 cows ($P = 0.022$ and 0.007, respectively). However, conception and pregnancy rates using the CIDRsynch regimen were increased from 31.1% and 23.8% in primiparous cows to 41.4% and 34.7% in M_1 cows ($P = 0.017$ and 0.008, respectively), and 40.9% and 33.6% in M_2 cows ($P = 0.021$ and 0.019, respectively). Embryonic loss rate using the CIDRsynch protocol was decreased from 22.9% in primiparous cows to 15.1% and 18.2% in M_1 and M_2 cows ($P = 0.013$ and 0.130, respectively). On the contrary, embryonic loss rate using the Ovsynch protocol was increased from 11.5% in primiparous cows to 22.1% and 21.8% in M_1 and M_2 cows ($P = 0.001$ and 0.003, respectively). The Cox proportional-hazards model of embryonic loss showed significant associations for parity and season of calving with the hazard of embryonic loss ($P = 0.001$ and 0.016, respectively). Multiparous cows (M1 and M2) had a higher risk of embryonic loss than primiparous cows (Hazard ratio = 1.32 and 1.89, respectively). Our results indicate that use of the CIDRsynch regimen may achieve satisfactory conception and pregnancy rates in multiparous Holstein cows. However, synchronizing time of ovulation in primiparous cows with use of the Presynch treatment increases the fertility indices.

1. Introduction

In the last few decades, genetic selection for milk production has been associated with decreased reproductive efficiency [1]. The effectiveness of reproduction has been considered as a crucial factor of productivity and profitability in the dairy sector [2]. Furthermore, management of reproduction is a valuable economic component in the success of a dairy operation [3]. Incorrect detection of estrus is related to the loss of profit due to extended calving intervals, milk loss, and related veterinary costs [4]; however, synchronization of ovulation has been developed to help farmers to construct more efficient reproductive strategies [5]. Accordingly, timed artificial insemination (TAI) protocols have been developed to reduce dependence on the detection of estrus in different programs of reproductive management [6]. Most of these hormonal protocols are based on the use of Ovsynch;

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however, others include presynchronization with progesterone, prostaglandin, and gonadotropin-releasing hormone to improve synchronization and fertility rates after TAI [7].

The Ovsynch protocol is the most predominant GnRH-based regimen for synchronizing the time of ovulation in dairy farms [6]. There have been several trials regarding the incorporation of the progesterone treatment into the Ovsynch protocol, which was used through the insertion of a controlled internal drug-release (CIDR) between the Day 0 and the Day 7 of this regimen [8,9]. The impact of inserting the CIDR into the Ovsynch protocol on conception was controversy across studies, where some trials reported no amelioration in response in either heifers or multiparous cows [8,10]. In other studies, however, incorporation of the CIDR enhances the conception rate in acyclic cows or those without a CL at the initiation of the treatment protocol [11,12]. The use of two PGF2α doses administered 14 days apart considers an economically inexpensive and practical system for estrous synchronization and has been used widely in lactating dairy cows [13]. Such a program is expected to synchronize the majority of cyclic cows to express estrus within a 7-day period. Thus, using two PGF2α injections to presynchronize cows to start the TAI protocol at the required early luteal phase should improve subsequent pregnancy rates.

Several factors affect fertility, including the environmental and climatic conditions, and particularly characteristics of the cow itself [14]. One of these characteristics, however, is parity number. Differences in reproductive performance between primiparous and multiparous cows are controversial. While some trials report better reproductive performance in multiparous cows [15–17], others recorded either no difference or superior performance in primiparous cows [18–20]. Reports on parity-dependent differences concerning the success of reproductive management protocols are scarce [21,22]. Furthermore, studies comparing the fertility aspects of primiparous and multiparous cows have given inconsistent results depending on the synchronization regimen used [23]. The substantial differences between age groups might justify a selective use of synchronization protocols for primiparous or multiparous cows. Moreover, such fertility differences between the cow groups and among different synchronization treatments might be associated with the incidence of metabolic disorders during early lactation [19]. Several authors reported greater conception rates in primiparous cows after using TAI-based Ovsynch protocol than in older cows [24–26]. Other researchers did not demonstrate this effect [27,28]. These contradictory findings of all the former trials have made it difficult to construct clear guidelines for dairy farm practice. Therefore, the aim of the present study was to elucidate the impact of parity on the efficiency of different ovulation synchronization protocols after the first AI in primiparous and multiparous Holstein cows.

2. Materials and methods

2.1. Animals and management

This study was performed at EXPANDED herd, Ismailia Road, Cairo, Egypt. This herd consisted mainly of 1596 purebred Holstein cows. All cows in the farm were housed in a free stall barn and were milked three times daily with milk production recorded at each milking. The cows were supplied with pedometers to promote detection of estrus. The total mixed ration (TMR) was offered twice daily for all cows. The diet was mixed daily and adjusted according to the level of milk production and body condition score of the cows. The TMR was constructed to meet the optimum requirements of energy, protein, minerals, and vitamins. Monthly, a sample of the TMR was analyzed by wet chemistry methods. The primary analysis of TMR comprise neutral detergent fiber (24.83%), crude protein (16.91%), and net energy for lactation (MJ/kg = 7.36). The ration during the nonlactating period was formulated to establish the nutrient requirements recommended by NRC. The reproductive data (insemination, reproductive problems, and so forth) were tracked and recorded using a commercial on-farm computer software program (AfiFarm version 4.1).

2.2. Reproductive performance and TAI protocols

Close veterinary supervision has been practiced for all cows in the farm. All cows confirmed to have an abnormal puerperium period, such as dystocia, twinning, retained placenta, ovarian cysts, primary metritis (diagnosed during the first 2 week postpartum), or ketonuria were eliminated from the study. The body condition scores of the cows were recorded using a 5-point scale: 1 = thin to 5 = fat [29]. Cows assigned scores of 2.6 to 3.5 (2.9 ± 0.3) were considered to be in a reasonable body condition. The average number of days from calving to first AI was 51.5 ± 6 days (range 42–71 days). The average daily milk yield on Day 45 postpartum was 36.4 ± 5.8 kg, ranging from 29 to 48 kg. Many efforts were made to reduce variation in the nutritional regimen and general health aspects of the animals, so that estimated impacts of the treatment and parity could not be referred to uncontrolled factors such as nutritional protocol or the clinical status of the cows. Moreover, all observations were restricted to the first AI in spontaneous estrus (SE) and synchronization groups. The reproductive performance traits, including conception and pregnancy rate and gestation period, were recorded for all cows at the farm over a period of 6 years, between September 2008 and November 2014. All cows enrolled in the present trial were monitored from the first to seventh parity. Parities were categorized into three levels: primiparous, 2 to 3 (M_1), and greater than 3 (M_2) parities. The exact date of insemination was recorded for each cow. The insemination processes have been performed by three expert technicians with similar efficiency records.

Cows suspected to be in spontaneous estrus, based on the activity recorded by the pedometer, were examined for signs of the estrus and confirmed by palpation per rectum. At palpation per rectum, the CL was manually estimated to be either less than10 mm in diameter or not detectable in the cows to be considered in a proper physiological state for artificial insemination. The largest follicle had a tenuous fluctuation on touch and was of approximately 12 to 25 mm in diameter. Moreover, the uterus had considerable tone, and opened external orifice of the cervix [30].