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Effect of controlled internal drug release insert on conception rate of repeat breeder cows

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High incidence (10–25%) of repeat breeding is one of the most common problems faced by the farmers as well as veterinarians (Bartlett *et al.* 1986). Main causes of repeat breeding are estrus detection errors, endocrine dysfunction, ovulatory defects, poor fertilization rates and/or early pregnancy loss (Nanda and Singh 2008). The main reason for repeat breeding has been attributed to hormonal asynchrony around estrus, therefore, synchronization of estrus can be an effective technique to alleviate the problem of estrus detection and hormone asynchrony during early stages of follicular maturation and/or during pre-ovulatory period (Singh *et al.* 2019). Also, the principal hormone controlling establishment of pregnancy is progesterone, which stimulates the production of endometrial secretions that are beneficial for the successful development of the embryo and its survival (Graham and Clarke 1997). Insufficient circulating concentrations of progesterone during the pre-implantation phase have been linked to poor embryo development and failure to prevent the development of the luteolytic signal in dairy cows (Mann and Lamming 2001, Reshma *et al.* 2018). Hence the present study was carried out with the hypothesis that progesterone supplementation through intra-vaginal CIDR insertion post-insemination for improvement in conception rate of repeat breeder cows.

Cows present at Teaching Veterinary Clinical Complex (TVCC), Instructional Livestock Farm Complex (ILFC) of CSK Himachal Pradesh Krishi Vishvavidyalya, Palampur and nearby field institutions around Palampur (32.6°N, 76.3°E, altitude 1290.8 m) were enrolled. Total 43 cows showing clear discharge at the estrus were selected for the study. The protocols for synchronization of estrus and ovulation were applied from day 6 of estrous cycle. The cows were divided into two treatment and one control groups. In treatment group cows, CIDR-I and II were applied according to Reshma *et al.* (2018) whereas control group consisting of 18 cows were not given any treatment and artificial insemination (AI) was done on the day of observed estrus after the examination of clear cervico-vaginal discharge. Size of cyclic corpus luteum was recorded at the time of AI and pregnancy diagnosis was done at 45 post-insemination by rectal examination/ ultrasonography method, using linear transducer of frequency 7.5 MHz (Mindray, Model Z5 Vet) in cows that did not return to estrus within this duration. After compilation of the data, conception rates were calculated. The obtained data were statistically analyzed using one way ANOVA for size of cyclic corpus luteum and Chi-square test for conception rate using NCSS 20.0.1 statistical software.

The mean diameter of cyclic corpus luteum in synchronized repeat breeder cows was significantly lower ($p<0.01–0.05$) as compared to control group (Table 1). In the present study, the adequate luteolysis due to $PGF_2\alpha$ administration led to lesser size of cyclic corpus luteum at AI and probably, lower progesterone concentrations as compared to control group cows as suprabasal concentrations of progesterone (≥0.3 ng/ml) around the period of LH surge has been known to interfere with nuclear and cytoplasmic maturation of oocytes by affecting LH surge parameters, and hence, subsequent embryo development (Duchens *et al.* 1996). Further, the reduced endometrial thickness that accompanies slight elevations in progesterone (Souza *et al.* 2011) may also lead to other major effects of progesterone on the blood flow and functionality of the uterus and lead to restricted embryo development (Wiltbank *et al.* 2014).

The conception rate for cows treated with CIDR protocols was non-significantly higher ($p>0.05$), i.e. 58.33 and 61.54% respectively, as compared to control group, i.e. 22.22% (Table 1). The results of our study are very much comparable to the findings of Friedman *et al.* (2012), Jeong *et al.* (2016) and Barkhori-Mehni *et al.* (2018), who reported 58, 51.10 and 55% conception rate, respectively. However, Monteiro *et al.* (2015), Reshma *et al.* (2018) and Yamamoto *et al.* (2018) had reported higher conception rate

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Table 1. Relationship between size of corpus luteum albicans (mm) at induced or spontaneous estrus and conception rate on first insemination following pre- and post-insemination CIDR-based treatment or no treatment for estrus synchronization and conception in repeat breeder cows (N=43) (Mean±SE)

Treatment protocol	Mean diameter of corpus luteum albicans (mm)	First insemination conception rate (%)
CIDR-I (n=12)	12.24 ± 0.79^{Y} (9.95–14.65; n=5)	58.33 (7/12)
CIDR-II (n=13)	11.60 ± 0.48^{B} (10.00–13.85; n=7)	61.54 (8/13)
Control (n=18)	14.81 ± 0.52^{AX} (13.40–17.20; n=14)	22.22 (4/18)

Values with different superscripts within the same column for the same parameter are significantly different ($^{A,B}p<0.01$ and $^{X,Y}p<0.05$).

of 66.70, 63.33 and 66.70 respectively, with post-insemination CIDR insertion which is mainly attributed to tight follicular wave synchrony and repeated insemination at two intervals helping to cover the timing of ovulation as delay in insemination time (at 58-60 h) after CIDR removal results in improved conception rate in repeat breeder cows (Malik *et al.* 2012).

Almost similar pregnancy rates were observed in both the post-insemination CIDR insertion protocols where the first protocol (CIDR-I) may have balanced the relationship between progesterone and estradiol in circulation during the first two weeks post-insemination as the ratio of progesterone to estradiol concentrations during this period plays a crucial role in the maintenance of luteal function and therefore, pregnancy itself (Inskeep 2004). However, the second protocol (CIDR-II) kept a check on early and late embryonic mortality caused due to luteal insufficiency and lower progesterone concentrations (Villaroel *et al.* 2004). Embryonic mortality is more common during early embryonic period, i.e. day 8 to 16, when hatching of blastocyst and initiation of elongation and commencement of implantation occurs (Dunne *et al.* 2000) and about 80% of this loss occurs before days 16 to 17, while 10 to 15% between days 17 to 42 (Parmar *et al.* 2016). Therefore, progesterone supplementation in cows with post-ovulatory progesterone deficiency has been done to develop an embryotrophic environment allowing the embryo to grow, develop and prevention of luteolysis by secretion of the luteotrophin, interferon-τ (Mann and Lamming 2001).

In conclusion, pre- and post-insemination progesterone supplementation through CIDR led to improvement in conception rate, thus, can be an effective method in management of functional form of infertility in repeat breeder cows.

SUMMARY

The present study was aimed at improving the conception rate in repeat breeder cows (N=43) suffering from functional form of infertility with the use of controlled internal drug release device (CIDR) pre- and post-insemination. Repeat breeder cows were divided into two treatment, i.e. CIDR-I (n=12) and CIDR-II (n=13), and one control group (n=18). The overall conception rate in first and second treatment group, i.e. 58.33 and 61.54%, respectively, were non-significantly higher as compared to control group (22.22%). In conclusion, CIDR protocols fared better in achieving conception in repeat breeder cows.

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