



## Effect of BCS and parity on uterine involution, ovarian rebound and various fertility parameters in postpartum dairy cows

AKSHAY SHARMA<sup>1</sup>, MADHUMEET SINGH<sup>2</sup>, AMIT SHARMA<sup>3</sup> and PRAVESH KUMAR<sup>4</sup>

Himachal Pradesh Agricultural University, Palampur, Himachal Pradesh 176 062 India

Received: 9 September 2017; Accepted: 14 December 2017

### ABSTRACT

The objective of present study was to investigate the effect of body condition score and parity on uterine involution, resumption of ovarian cyclicity and subsequent fertility parameters after calving in Jersey crossbred cows. Primiparous (10) and pluriparous cows (13) having normal parturition were examined. Body condition score was recorded at the time of calving and a significant difference was observed between primiparous and pluriparous cows. The monitoring of uterine involution of previous gravid and non-gravid uterine horn and first postpartum ovulatory follicle (OF) and subsequent corpus luteum (CL) was performed by transrectal ultrasound scanning at weekly interval upto 43 days postpartum. Uterine involution was significantly faster in primiparous cows as compared to pluriparous cows. However, ovarian rebound was significantly earlier in pluriparous cows based on the presence of first postpartum OF and subsequent CL. Monitoring of fertility parameters (days to first artificial insemination, number of inseminations per conception and days open) was done until next conception. Days to first artificial insemination and days open were significantly less in pluriparous cows as compared to primiparous cows. Also, the number of inseminations required for conception were less in pluriparous cows. In conclusion, as the parity increases, postpartum fertility parameters improve despite the rapid uterine involution in primiparous cows.

**Key words:** Body condition score, Ovarian rebound, Parity, Post-partum fertility parameters, Ultrasonography, Uterine involution

Success in cattle reproduction is one of the most important goals in dairy farming. The duration of postpartum period has an important influence on reproductive performance (Lucy 2006, Peter *et al.* 2009). So, the next pregnancy depends on the completion of uterine involution and the cyclic function of ovaries (Kindahl *et al.* 1999). Reproductive performance is one of the major and most important factors determining the profitability of cattle farming, with the ideal goal to be achieved being one calf per cow per year (Rekwot *et al.* 2000). Interaction of several factors, such as genetics (breed), stage of lactation, age, parity, nutrition, metabolism and body condition score (BCS), reproductive health, season of insemination and calving, and management is required for resumption of ovarian activity in post-partum cows (Elmetwally 2004, Tomomi *et al.* 2008). At calving, BCS is important in determining the length of anestrus period (De Rensis *et al.* 2008). In addition, low BCS at calving may result in delay to first estrus and calving to conception interval after calving (Richards *et al.* 1986, Mouffok *et al.* 2011).

However, effect of parity on the resumption of the ovarian activity indicated that primiparous cows took a longer period than pluriparous cows (Tanaka *et al.* 2008). However, primiparous cows present shorter anestrus period than pluriparous cows (Kawashima *et al.* 2006). The objective of present study was to investigate the effect of BCS and parity on uterine involution, resumption of ovarian cyclicity and subsequent fertility parameters after calving in Jersey crossbred cows.

### MATERIALS AND METHODS

The present study was carried out on dairy cattle having normal parturition (Jersey crossbred cows; 23) at University Dairy Farm. Cows were reared in a loose housing system under standard management conditions, fed a total mixed ration (once daily, *ad lib.*), and had unrestricted access to water. Cows were milked twice daily (04:00 and 15:00 h) and were divided into 2 groups, i.e. primiparous (10) and pluriparous with parity number between 2–5 (13). Transrectal ultrasonography (TRUS) was performed to assess the uterine involution and ovarian rebound, using linear transducer of frequency 7.5 MHz (Sonosite M turbo; Sonosite India Pvt. Ltd.), on a weekly interval basis between day 8 to 43 postpartum. Uterine involution was considered complete when both gravid and non-gravid horns were nearly in symmetrical measure and no further change took

Present address: <sup>1</sup>MVSc Scholar (akshays482@gmail.com), <sup>2</sup>Professor and Head (madhumeet2004@gmail.com), <sup>3,4</sup>Assistant Professor (vet50amy@gmail.com, pk9919@gmail.com), Department of Veterinary Gynaecology and Obstetrics, College of Veterinary and Animal Sciences.

place between two consecutive examinations in diameter of horns or cervix (Abdel-Khalek *et al.* 2013). First postpartum ovulating follicle (OF, >10 mm) and subsequent corpus luteum (CL) formation was observed to assess resumption of ovarian cyclicity. Also, the size of OF in primiparous and pluriparous cows were taken into observation. BCS of all the animals was recorded immediately after calving using five point scale of scoring (Edmonson *et al.* 1989). Postpartum reproductive performance was assessed by the study of days to first artificial insemination (AI), number of inseminations per conception and calving to conception interval (days open) in all groups. The data were statistically analyzed using one way ANOVA with SAS (Statistical Analysis Software), SAS® 9.2 TS Level version 2M2 for windows.

## RESULTS AND DISCUSSION

Ultrasonographic evaluation of genitalia of dairy cattle in the present study revealed that the time required for uterine involution was significantly shorter ( $P < 0.01$ ) in primiparous cows ( $23.40 \pm 3.13$  d) as compared to pluriparous cows ( $31.80 \pm 3.62$  d). Hajurka *et al.* (2005) reported that average time taken for completion of uterine involution in cows having normal parturition was  $23.0 \pm 5.3$  d in primiparous and  $27.3 \pm 5.5$  d in pluriparous cows. Also, Peter *et al.* (1987) and Poyam and Tiwari (2015) reported faster involution in primiparous cows. Contrarily, Rekwot *et al.* (2000) reported that uterine involution is rapid in pluriparous cows.

Ovarian cyclic activity initiation was assessed on the basis of the presence of first postpartum ovulatory follicle (OF, >10 mm diameter) and followed by CL formation. In our study, the appearance of an OF and subsequent CL formation was significantly shorter ( $P < 0.05$ ) in pluriparous cows as compared to primiparous cows. Also, the size of OF was significantly less ( $P < 0.01$ ) in pluriparous cows. The mean time required for the appearance of OF was  $23.90 \pm 5.50$  days postpartum in pluriparous cows, while in primiparous cows, this duration was  $31.80 \pm 3.83$  days postpartum, respectively (Table 1). In agreement to our studies, shorter intervals from calving to estrus and ovulation in pluriparous cows were reported by Darwash *et al.* (1997). Onset of post-partum ovarian activity may

take longer interval in primiparous cows (Lucy *et al.* 1992). This may be due to the fact that most pluriparous cows have the second pattern of follicular development as compared to primiparous which have the first pattern during the post-partum period; so, it leads to the repetition follicular wave of non-ovulatory follicles in primiparous cows. Also, a pre-ovulatory rise in estradiol concentration was observed during the process of growth of the first dominant follicle in pluriparous cows as compared to low level estradiol concentration in primiparous cows regardless of development of the first dominant follicle (Tomomi *et al.* 2008). Also, decreased LH and insulin like growth factor- I (IGF-I) can compromise ovarian follicular growth and development leading to increase in incidence of inactive ovaries, ovarian cysts and non-functional corpora lutea in the post-partum cows, resulting in a prolonged interval to first ovulation after calving and delayed post-partum resumption (Hemanta *et al.* 2005). According to Zhang *et al.* (2010), days from calving to ovulation (first and second) and the number of follicular waves to first ovulation are more in primiparous cows than in pluriparous cows. Parity and resumption of ovarian activity are negatively related to each other. However, Bulman and Lamming (1978) stated that age and parity has no influence over post-partum ovarian activity.

BCS of the cows was taken into observation and was significantly higher ( $P < 0.05$ ) in pluriparous cows as compared to primiparous (Table 2). BCS at calving had effect on postpartum period as it is often correlated with Negative Energy Balance (NEB) and NEB affects postpartum anovulatory period. Greater NEB in the post-partum period results in lower peripheral concentrations of luteinizing hormone (LH), which leads to disrupted ovarian follicular development. Also, NEB adversely affects the number and size of large ovarian follicles and leads to lowering of plasma progesterone and estradiol-17 $\beta$  concentrations (Justyna *et al.* 2011). Also, the mean time required for days to first AI was significantly shorter ( $P < 0.05$ ) in pluriparous cows as compared to primiparous cows in the present study. Higher calving to first insemination interval in primiparous cows was also reported by Goshu *et al.* (2007) and Eiri *et al.* (2013). Rafique *et al.* (2000) also reported significant effect of parity on calving

Table 1. Days (mean $\pm$ SE) taken to complete uterine involution and resumption of ovarian activity in post-partum cows

| Parity             | Uterine involution (d)        | Size of OF                    | First OF (>10 mm) (d)         | First post-partum CL (d)      |
|--------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| Primiparous (n=10) | 23.40 $\pm$ 3.13 <sup>x</sup> | 11.27 $\pm$ 0.97 <sup>y</sup> | 31.80 $\pm$ 3.83 <sup>b</sup> | 38.80 $\pm$ 3.83 <sup>b</sup> |
| Pluriparous (n=13) | 31.80 $\pm$ 3.62 <sup>y</sup> | 10.19 $\pm$ 0.56 <sup>x</sup> | 23.90 $\pm$ 5.50 <sup>a</sup> | 30.90 $\pm$ 5.50 <sup>a</sup> |

<sup>a,b</sup>Values with different superscripts within the same column differ significantly ( $P < 0.05$ ); <sup>x,y</sup>Values with different superscripts within the same column differ significantly ( $P < 0.01$ ).

Table 2. Days (mean $\pm$ SE) taken to restore certain fertility parameters after parturition in post-partum cows

| Parity           | BCS                          | First AI post-partum (d)        | No. of AI per conception     | Calving to conception interval* (d) |
|------------------|------------------------------|---------------------------------|------------------------------|-------------------------------------|
| Primiparous (10) | 2.58 $\pm$ 0.22 <sup>a</sup> | 145.60 $\pm$ 18.20 <sup>b</sup> | 2.10 $\pm$ 0.74 <sup>b</sup> | 162.60 $\pm$ 23.85 <sup>b</sup>     |
| Pluriparous (13) | 2.75 $\pm$ 0.22 <sup>b</sup> | 122.20 $\pm$ 12.82 <sup>a</sup> | 1.20 $\pm$ 0.45 <sup>a</sup> | 138.60 $\pm$ 8.63 <sup>a</sup>      |

<sup>a,b</sup>Values with different superscripts within the same column are significantly different ( $P < 0.05$ ); \*Pregnancy diagnosis was done 60 days after successful AI.

to first insemination interval in crossbred cows in Pakistan. Number of inseminations per conception were significantly less ( $P < 0.05$ ) in pluriparous cows. Mureda and Mekuriaw Zeleke (2007) reported that parity of cows imparted significant effects on number of inseminations per conception. However, Goshu *et al.* (2007) reported that less number of inseminations per conception was needed in primiparous cows.

Calving to conception interval (days open) was significantly ( $P < 0.05$ ) shorter in pluriparous cows in the current study. Sattar *et al.* (2004) also reported that calving to insemination ( $83.00 \pm 3.07$  days post-partum) and calving to conception interval ( $140.69 \pm 13.21$  days post-partum) was shorter in pluriparous cows. Kara *et al.* (2014) and Elmetwally *et al.* (2016) reported a shorter calving to conception interval in pluriparous dairy cows which is also in agreement to our studies. Hammoud *et al.* (2010) reported that primiparous cows had a significantly higher calving to conception interval as compared to pluriparous cows. However, El-Barbary *et al.* (1992) depicted that calving to conception interval was not significantly affected by parity.

BCS at calving is responsible for significant effect on the various post-partum fertility parameters. Significant effects were observed on resumption of ovarian activity, days to first A.I. and calving to conception interval based on parity. Fertility in dairy cows reflects the cumulative influence of metabolic, endocrine, postpartum period, BCS and parity are the most important factor, but the complex interactions of all these factors must be considered, if we are to improve our understanding and develop new strategies to increase fertility in dairy cows.

#### ACKNOWLEDGEMENT

I would like to thank Dr Madhumeet Singh for the precious and timely guidance which helped me in completing my research work. Also, Dr Amit Sharma and Dr Pravesh Kumar helped me during my research and I would like to appreciate their efforts. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

#### REFERENCES

- Abdel-Khalek A E, El-Harairy M A, Mehrez A F and Fouad W F M. 2013. Uterine involution and reproductive performance of lactating Friesian cows treated with oxytocin and prostaglandin (PGF<sub>2α</sub>) at calving. *Journal of Animal and Poultry Production Mansoura University* **4**(6): 349–62.
- Bulman D C and Lamming G E. 1978. Milk progesterone levels in relation to conception, repeat breeding and factors influencing acyclicity in dairy cows. *Journal of Reproduction and Fertility* **54**: 447–58.
- Darwash A O, Lamming G E and Wolliams A J. 1997. The phenotypic association between the interval to postpartum ovulation and traditional measures of fertility in dairy cattle. *Animal Sciences* **65**: 9–16.
- De Rensis F, Lopez-Gatius F, Capelli T, Molina E, Techakumphu M and Scaramuzzi R J. 2008. Effect of season on luteal activity during the postpartum period of dairy cows in temperate areas. *Animal* **2**: 554–59.
- Edmonson A J, Lean I J, Weaver L D, Farver T and Webster G. 1989. A body condition scoring chart of Holstein dairy cows. *Journal of Dairy Science* **72**(1): 68–78.
- Eiri S, Samadi F and Hassani S. 2013. Influence of parity on reproductive performance in postpartum dairy cows. *Iranian Journal of Animal Science Research* **4**(4): 352–57.
- El-Barbary A S A, Khalil F F M and Mahady A E. 1992. Studies on Danish Friesian cattle in Egypt: some factors affecting reproductive traits. *Journal of Agricultural Sciences Mansoura University* **17**(6): 2130–135.
- Elmetwally M A. 2004. 'Postpartum ovarian rebound.' Master thesis, Mansoura University, Faculty of Veterinary Medicine.
- Elmetwally M A, Montaser A, Elsadany N, Bedir W, Hussein M and Zaabel S. 2016. Effects of parity on postpartum fertility parameters in Holstein dairy cows. *IOSR-Journal of Veterinary Sciences* **9**(8): 91–99.
- Goshu G, Belihu K and Berihun A. 2007. Effect of parity, season and year on reproductive performance and herd life of Friesian cows at Stella private dairy farm, Ethiopia. *Livestock Research for Rural Development* **19**(7): 1–11.
- Hajurka J, Macak V and Hura V. 2005. Influence of health status of reproductive organs on uterine involution in dairy cows. *Bulletin of Veterinary Institute Pulawy* **49**: 53–58.
- Hammoud M H, El-Zarkouny S Z and Oudah E Z M. 2010. Effect of sire, age at first calving, season and year of calving and parity on reproductive performance of Friesian cows under semiarid conditions in Egypt. *Archiva Zootechnica* **13**(1): 60–82.
- Hemanta K S, Toshihiko N, Toshihiko S, Masashi A and Tsuneo H. 2005. Relationships between body condition score, body weight, and some nutritional parameters in plasma and resumption of ovarian cyclicity postpartum during pre-service period in high-producing dairy cows in a subtropical region in Japan. *Theriogenology* **64**: 855–66.
- Justyna G, Henrik C, Kurt M, Pedersen M and Nicolas C. 2011. The relationship between postpartum vaginal discharge symptoms and progesterone profile characteristics in lactating dairy cows in Denmark. *Theriogenology* **75**: 1016–28.
- Kara N, Bounechada M and Chaib B C. 2014. Effect of body condition score and parity on resumption of post-partum ovarian activity in Montbeliard dairy cows under semi-arid area of Algeria. *Journal of Animal Science Advances* **4**(4): 787–96.
- Kawashima C, Kaneko E, Amaya C, Matsui M, Yamagishi N and Matsunaga N. 2006. Relation between the first ovulation within three week postpartum and subsequent ovarian cycles and fertility in high producing dairy cows. *Journal of Reproduction and Development* **52**: 479–86.
- Kindahl H, Bekana M, Kask K, Konigsson K, Gustafsson H and Odensvik K. 1999. Endocrine aspects of uterine involution in the cow. *Reproduction in Domestic Animals* **34**: 261–68.
- Lucy M C. 2007. Fertility in high-producing dairy cows: reason for decline and corrective strategies for sustainable improvement. *Society of Reproduction and Fertility Supplement* **64**: 237–54.
- Lucy M C, Staples C R, Thatcher W W, Erickson P S, Cleale R M and Firkins J L. 1992. Influence of diet composition, dry matter intake, milk production and energy balance on time of postpartum ovulation and fertility in dairy cows. *Animal Production* **54**: 323–31.
- Mouffok C, Madani T, Samara L, Baitiche M, Allouche L and Belkasm F. 2011. Relationship between body condition score,

- body weight, some nutritional metabolites changes in blood and reproduction in Algerian Montbelaird cows. *Veterinary World* **10**: 461–66.
- Mureda E and Mekuriaw Zeleke Z. 2007. Reproductive performance of crossbred dairy cows in eastern lowlands of Ethiopia. *Livestock Research for Rural Development*, 19. Retrieved from <http://www.cipav.org.co/lrrd/lrrd19/11/mure19161.html>
- Peter A T, Narasemhan K S, John D and Patabiraman S R. 1987. Studies on involution of the uterus in postpartum Murrah buffaloes. *Indian Journal of Animal Reproduction* **8**: 1–13.
- Peter A T, Vos P L A M and Ambrose D J. 2009. Postpartum infections in dairy cow. *Theriogenology* **71**: 1333–42.
- Poyam M R and Tiwari R P. 2015. Ultrasonographic image of uterine involution in postpartum sahiwal cows. *Indian Journal of Animal Reproduction* **36**(2): 57–59.
- Rafique M, Chaudhry M Z and Amer M A. 2000. Reproductive performance of inter se Holstein Friesian × Sahiwal crossbreds. *Pakistan Veterinary Journal* **20**(3): 109–12.
- Rekwot P I, Ogwu D and Oyedipe E O. 2000. Influence of bull biostimulation, season and parity on resumption of ovarian activity of Zebu (*Bos indicus*) cattle following parturition. *Animal Reproduction Science* **63**(1–2): 1–11.
- Richards M W, Spitzer J C and Warner M B. 1986. Effect of varying levels of postpartum nutrition and body condition at calving on subsequent reproductive performance in beef cattle. *Journal of Animal Science* **62**: 300–06.
- Sattar A, Mirza R H and Ahmad I. 2004. Reproductive efficiency of Jersey cows under subtropical conditions of the Punjab. *Pakistan Veterinary Journal* **24**(3): 129–33.
- Tanaka T, Arai M, Ohtani S, Uemura S, Kuroiwa T and Kim S. 2008. Influence of parity on follicular dynamics and resumption of ovarian cycle in postpartum dairy cows. *Animal Reproduction Science* **108**: 134–43.
- Tomomi T, Mayumi A, Shohei O, Saya U, Takenobu K and Seungjoon K. 2008. Influence of parity on follicular dynamics and resumption of ovarian cycle in postpartum dairy cows. *Animal Reproduction Science* **108**: 134–43.
- Zhang J, Deng L X, Zhang H L and Yang L. 2010. Effects of parity on uterine involution and resumption of ovarian activities in postpartum Chinese Holstein dairy cows. *Journal of Dairy Science* **93**(5): 1979–86.