

ULTRASONOGRAPHIC STUDY OF OVARIAN FOLLICULAR DYNAMICS IN JERSEY CROSSBRED COWS

S.Satheshkumar¹

Department of Animal Biotechnology
Madras Veterinary College
Chennai – 600 007, Tamilnadu.

ABSTRACT

*Ovarian follicular developmental pattern in Jersey crossbred (*Bos indicus* x *Bos Taurus*) cows was studied. Ultrasonographic monitoring of ovarian follicular development throughout the oestrous cycle revealed that out of six cows, three (50%) cows exhibited two waves (days of emergence on $1.33 + 0.90$ & $10.0 + 0.34$) and three (50%) exhibited three waves per cycle (days of emergence on $1.67 + 0.34$, $9.67 + 0.67$ & $15.33 + 0.88$) and the mean length of oestrous cycle was $22.50 + 0.83$ days. The mean maximum diameter of final wave dominant (ovulatory) follicle was larger than the anovulatory dominant follicles of previous waves. A comparatively slower growth rate of ovulatory wave dominant follicle was recorded in our study. It was found that, 57.14 per cent of dominant follicles developed in the ovary having corpus luteum than the contralateral ovary.*

Key words: Ultrasonography– follicular wave pattern- Jersey crossbred cows

Follicular development within the bovine ovaries is a dynamic process, which occurs in a wave like pattern characterised by the synchronous growth of number of small follicles, followed by selection of a dominant follicle and subsequent regression of subordinates (Bo et al., 1993). Follicular dynamics had been reported in *Bos indicus* (Zeitoun et al., 1996) and *Bos Taurus* (Wolfenson et al., 2004) cows. However there are only limited reports on follicular wave pattern studies in crossbred (*Bos Taurus* x *Bos indicus*) cattle (Taniguchi et al., 2007). In India, where crossbred cattle forms the considerable part of livestock population, investigation of ovarian follicular growth in crossbred cattle would enable us for better understanding of their physiology and provide basis for improving fertility. So the objective of the study was to

monitor ultrasonographically the ovarian follicular wave pattern in normal oestrous cycles of Jersey crossbred cows.

MATERIALS AND METHODS

Six healthy regularly cyclic Jersey crossbred pluriparous cows maintained at Centralised Embryo Biotechnology Unit, Department of Animal Biotechnology, Madras Veterinary College, Madhavaram, Chennai - 600051 were selected for the study. All the cows were maintained under ideal and identical stall fed conditions through out the study. They were daily fed with adequate concentrates, green fodder, paddy straw and ad libidum water. All the experimental cows were monitored regularly for oestrus symptoms and cyclicity of the animals was confirmed by frequent rectal examination.

1. Associate Professor and Head i.c., Teaching Veterinary Clinical Complex, Veterinary College and Research Institute, Orathanadu – 614 625, Thanjavur; Email: drsatheshkumar6@rediffmail.com

Follicular development pattern was studied in a total of twelve oestrous cycles (two cycles / cow). The ovaries of each cow were examined ultrasonically every other day throughout an oestrous cycle starting from observed oestrus (Day 0) to the subsequent standing oestrus (Sianangama and Rajamahendran, 1996) using a real time ultrasound scanner (SONOVET 600) equipped with 7.5 MHz transrectal transducer. Data collection involved recording diameter of all detectable follicles $4 > \text{mm}$ in each ovary with the inbuilt scale provided with the ultrasound instrument. Each ovary was scanned and imaged in more than one plane to assure that all measurable follicles were detected. Diameter of each follicle was determined by taking the mean of the length and width of the follicle (Zeitoun et al., 1996). During each examination, a sketch of the ovaries was made recording the location and diameter of corpus luteum and of individual identified follicles of $> 4 \text{ mm}$. If the follicle was not detected until it was $>5 \text{ mm}$, a growth rate of $1.5 \text{ mm} / 24 \text{ h}$ was used to retrospectively determine the first examination when the follicle would have been $< 4.5 \text{ mm}$ (Bergefelt et al., 2003). The day of wave emergence was determined as the day the dominant follicle was first detected or retrospectively identified at a diameter of $4\text{-}5\text{mm}$ (Bo et al., 1993). The single data set was used to profile the day – to-day diameters of individual follicles by identity method, as described by Ginther (1993).

RESULTS AND DISCUSSION

The follicular wave pattern and properties of dominant follicles of various waves during the oestrous cycle of jersey crossbred cows were presented in Figure 1 and Table 1.

Monitoring the follicular wave pattern revealed that out of six cows, three (50%) cows exhibited two waves and three (50%) exhibited three waves per cycle. Savio et al. (1988) and Sirois and Fortune (1988) have supported the three wave hypotheses and stated that 80 per cent of the oestrous cycles had more than two follicular

waves, while Wolfenson et al. (2004) indicated that two wave cycles were more abundant (79%) than three wave cycles (21%) in Holstein (*B. taurus*) cows. Zeitoun et al. (1996) stated that the greater proportion ($>50\%$) of Brahman (*B. indicus*) cows had three follicular waves per cycle.

The mean length of oestrous cycle for the Jersey crossbred cows under study was 22.50 ± 0.83 days. Eventhough the cycle length was longer in three wave cycles there was no significant difference when compared with two wave cycles. A similar cycle length was reported in *B. indicus* cows (Zeitoun et al., 1996). However, Parker et al. (2003) recorded 25.3 days of oestrous cycle in HF cows with three waves.

In the present study, the mean days of emergence of follicular waves in two wave cycles were 1.33 ± 0.90 and 10.0 ± 0.34 , while in three wave cycles the waves emerged on days 1.67 ± 0.34 , 9.67 ± 0.67 and 15.33 ± 0.88 . Similar days of emergence of follicular waves in two and three wave oestrous cycles were reported by Ginther et al. (1989) in *B. taurus* cows. In a similar study, it was stated that the third wave emerged on day 14.6 in *B. indicus* cows (Bo et al., 2003) and on day 16.7 in Holstein cows (Wolfenson et al., 2004).

In the present study, the mean maximum diameter of final wave dominant (ovulatory) follicle was non-significantly larger than the previous anovulatory follicles. Savio et al. (1988) reported similar observations and suggested that the progesterone concentration during the stage of the cycle at which maximum size was reached was significantly different for each dominant follicle. On the contrary, Ginther et al. (1989) reported that the diameter of the ovulatory follicle was not different from the diameter of the dominant follicle of anovulatory wave during the static phase.

The growth rate of dominant follicles among the various follicular waves ranged from $1.05 - 1.90 \text{ mm} / \text{day}$. It was reported that the

growth rate of dominant follicles in *B. indicus* cows ranged between 1.1 – 1.5mm / day (Bo et al., 2003), whereas the dominant follicles of *B. taurus* heifers tended to grow faster at the rate of 1.7 – 2.0 mm/day (Bodensteiner et al., 1996). The analysis of the rates of growth and atresia suggest that the rate of growth is slowest during mid-cycle. Viana et al. (2000) concluded that this might be due to the fact that the second wave emerged during higher progesterone production by the corpus luteum.

In our study it was found that, 57.14 per cent of dominant follicles developed in the ovary having corpus luteum than the contralateral ovary. Savio et al. (1988) also reported that the number of dominant follicles that developed in the ovary ipsilateral to the corpus luteum was greater than the contralateral ovary.

Thus, it was found that the Jersey crossbred cows under study exhibited both two and three follicular waves per cycle with characteristics of dominant follicles intermediary to that of *B. taurus* and *B. indicus* cows. In conclusion, the present ultrasonographic study have thrown light on ovarian follicular wave pattern in jersey crossbred cows under stall fed conditions, which would enable us to design the oestrus synchronization and superovulation induction protocol with more precision.

REFERENCES

- Bergfelt, D.R., Sego, L.H., Beg, M.A. and Ginther, O.J. (2003). Calculated follicle deviation using segmented regression for modeling diameter differences in cattle. *Theriogenology*, 59: 1811-1825.
- Bo, G.A., Baruselli, P.S. and Martinez, M.F. (2003). Pattern and manipulation of follicular development in *Bos indicus* cattle. *Animal Reproduction Science*, 78: 307 – 326.
- Bo, G.A., Adams, G.P., Nasser, L.F., Pierson, R.A. and Mapletoft, R.J. (1993). Effect of oestradiol valerate on ovarian follicles, emergence of follicular waves and circulating gonadotrophins in heifers. *Theriogenology*, 40: 225 –239.
- Bodensteiner, K.J., Kot, K., Wiltbank, M.C. and Ginther, O.J. (1996). Synchronization of emergence of follicular waves in cattle. *Theriogenology*, 45: 1115 – 1128.
- Ginther, O.J. (1993). A method for characterizing ultrasonically derived follicular data in heifers. *Theriogenology*, 40: 713 –724.
- Ginther, O.J., Kastelic, J.P. and Knopf, L. (1989). Composition and characteristics of follicular waves during the bovine oestrous cycle. *Animal Reproduction Science*, 20: 187 – 200.
- Parker, K.I., Robertson, D.M., Groome, N.P. and Macmillan, K.L. (2003). Plasma concentration of inhibin A and FSH differ between cows with two or three waves of ovarian follicular development in a single oestrous cycle. *Biology of Reproduction*, 68 : 822-828.
- Savio, J.D., Keenan, L., Boland, M.P. and Roche, J.F. (1988). Pattern of growth of dominant follicles during the oestrous cycle in heifers. *Journal of Reproduction and Fertility*, 83: 633-671.
- Sirois, J. and Fortune, J.E. (1988). Ovarian follicular dynamics during the oestrous cycle in heifers monitored by real time ultrasonography. *Biology of Reproduction*, 39: 308-317.
- Sianangama, P.C. and Rajamahendran, R. (1996). Characteristics of corpus luteum formed from the first wave dominant follicle following hcG in cattle. *Theriogenology*, 45: 977 – 990.
- Taniguchi, M., Ikeda, A., Arikawa, E., Shimuzu, R., Seki, M., Karaki, M., Rajamahendran, R. and Otoi, T. (2007). Ovarian follicular and corpus luteum changes, progesterone concentrations, estrus and ovulation following estradiol benzoate/progesterone based treatment protocol in crossbred cows. *Animal Reproduction Science*. 99: 389-394.

Viana, J.H.M., Ferreira, A.M., Sa, W.F. and Camagro, L.S. (2000). Follicular dynamics in zebu cattle. *Pesquisata Agropecuaria Brasileira*. 35: 2501-2509.

Wolfenson, D., Inbar, G., Roth, Z., Kaim, M., Bloch, A., and Braw-Tal, R. (2004). Follicular dynamics and concentrations of steroids

and gonadotropins in lactating cows and nulliparous heifers. *Theriogenology*, 62: 1042-1055.

Zeitoun, M.M., Rodriguez, H.F. and Randel, R.D. (1996). Effect of season on ovarian follicular dynamics in Brahman cows. *Theriogenology*, 45 : 1577- 1581.

Table 1

Characteristics of dominant follicles in three and two follicular wave oestrous cycles

S. No	Properties of dominant follicle	Three wave cycles			Two wave cycles	
		Wave I (anovulatory) Mean + SE	Wave II (anovulatory) Mean + SE	Wave III (ovulatory) Mean + SE	Wave I (anovulatory) Mean + SE	Wave II (ovulatory) Mean + SE
1	Days of emergence	1.67 + 0.34	9.67 + 0.67	15.33 + 0.88	1.33 + 0.9	10.00 + 0.34
2	Maximum size (mm)	10.33 + 0.60	10.33 + 0.72	13.33 + 0.72	13.5 + 0.76	13.67 + 0.73
3	Day at which maximum size is attained	6.67 + 0.34	17.33 + 0.34	22.67 + 1.20	9.33 + 2.84	22.33 + 1.45
4	Growth phase (days)	6.00 + 0.0	8.67 + 0.34	8.33 + 1.86	7.67 + 1.76	13.33 + 1.86
5	Growth rate (mm / day)	1.72 + 0.10	1.19 + 0.05	1.73 + 0.30	1.90 + 0.33	1.05 + 0.10
6	Static phase (days)	0.67 + 0.66	0.67 + 0.67	--	0.67 + 0.66	--
7	Regression phase (days)	8.33 + 1.77	5.00 + 1.16	--	9.33 + 0.34	--
8	Regression rate (mm / day)	1.35 + 0.28	2.31 + 0.60	--	1.45 + 0.12	--
9	Oestrous cycle length (days)	22.67 + 1.20			22.33 + 1.46	

Figure 1: Follicular wave patterns in Jersey crossbred cows

