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Short Estrous Cycle Post-ovulation in Peri-pubertal Sahiwal and Jersey Crossbred Heifers

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Authors' contributions

This work was carried out in collaboration among all authors. Author Pururava Sharma wrote the first draft of manuscript. Author PK performed sonography and analysis of study. Author AS designed the study. Authors VN and HK managed the literature searches and author Pankaj Sood approved the final manuscript.

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ABSTRACT

This investigation focuses on analysing the follicular dynamics exhibited during peri-pubertal period in Sahiwal and Jersey crossbred heifers. The aim of the study was to assess first ovulation in the heifers following puberty (N=20; 10 for each breed). Heifers were subjected to alternate day trans-rectal ultrasonography (TRUS) when the diameter of dominant follicle surpassed 9 mm diameter. Transrectal ultrasonography (TRUS) was performed to observe and assess first ovulation in heifers. The size of the first pre-ovulatory follicle in Sahiwal and Jersey Crossbred heifer in peri-pubertal

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stage was 10.52±0.13 and 10.15±0.51 mm, respectively and the corpus luteum attained its maximum size of 13.89 and 11.26 mm, was significantly different ($p<0.01$) at day 8.6±0.4 and 8.2±0.48 in Sahiwal and Jersey crossbred heifers, respectively. The regression of corpus luteum (CL) adjudged by the Colour Doppler initiated on 10.6±0.4 and 11.0±0.63 day for Sahiwal and Jersey crossbred heifers, respectively. Some other follicular dynamics parameters i.e. day of wave onset, number of follicles recruited, inter-wave duration along with maximum diameter of dominant follicle, day of maximum diameter, growth rate, length of growth and static phase, duration of static phase and onset of atresia was recorded, however, no significant difference ($p>0.05$) was recorded between breeds. On an interesting note, the next estrous cycle for heifers did not lead to ovulation despite having follicular size more than10 mm in both the breeds.

Conclusion: In peroration, peri-pubertal Sahiwal and Jersey crossbred heifers had notably precocious luteal regression after first ovulation, without subsequent ovulation in next estrous cycle.

Keywords: Corpus luteum; Follicular dynamics; jersey crossbred; peri-pubertal period; Sahiwal; short estrous cycle.

1. INTRODUCTION

Puberty is the gradual process of attaining reproductive and productive competence [1]. It is defined as the age when sexual organs are functionally developed and further characterized by the ovulation, plasma progesterone above 1ng/mL and period of normal luteal phase [2]. The secretion of gonadotropin releasing hormone (GnRH) is highly sensitive to estradiol negative feedback during the pre-pubertal period whereas just before the commencement of puberty (50-60 days) the peri-pubertal period is accompanied by decrease in negative feedback to GnRH and increase in frequency and amplitude of luteinizing hormone (LH) [3]. Follicular growth begins with follicular recruitment, which is characterized as a wave of small follicles with a diameter of 3-4 mm entering a developing pool [4]. Growth of the follicles during pre-and post-puberty occurs in a wave like manner with absence of luteal tissue in the earlier [5]. The effective reproductive management of cattle requires a fundamental understanding of the estrous cycle since the percentage of cows becoming pregnant during a breeding season strongly affects overall profitability [6].

Keeping in view these aspects, the present study was focused on understanding the follicular dynamics following first ovulation in Sahiwal and Jersey crossbred heifers during peri-pubertal period.

2. MATERIALS AND METHODS

The research was carried out in the Livestock Farm Complex, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur during a period of June 2021 to April 2022, after the approval of the Institutional Animal Ethics Committee (IAEC). Pre-pubertal clinically healthy Sahiwal and Jersey crossbred heifers (N=20; 10 in each group; aged 12-18 months) were enrolled in the study. When the heifers attained almost 60% of the adult weight (calculated as described by [7]) the ovarian structures were scanned to evaluate the antral follicles above 9 mm diameter and the absence of luteal tissue using a portable ultrasound machine (Mindray Z5; VETMODEL 75L50EAV) fitted with a linear rectal transducer of 7.5 MHz frequency [8].

Trans-rectal ultrasonography (TRUS) was carried out every 48 hours to assess the first ovulation in heifers along with different parameters of follicular dynamics *viz*. day of wave onset, number of follicles recruited, inter-wave duration along with maximum diameter of dominant follicle, day of maximum diameter, growth rate, length of growth and static phase, duration of static phase and onset of atresia. Data on follicle was obtained by drawing a conventional ovarian sketch [9]. The recorded data was statistically analysed using Students' T test with software NCSS 2022, USA.

3. RESULTS AND DISCUSSION

On perusal of Table 1, the size of the first pre-ovulatory follicle of Sahiwal and Jersey crossbred heifers was 10.52±0.13 and 10.15±0.51 mm. The maximum diameter of the corpus luteum was significantly different ($p<0.01$) for both the breeds i.e., 13.89±0.69 and 11.26±0.45 mm, on day 8.6±0.4 and 8.2±0.48 ($p>0.05$) after ovulation (Fig. 1).

The follicular dynamics parameters i.e., the day of onset of first wave was 0.6±0.24 and 0.4±0.24

and the day of maximum diameter of dominant follicle did not vary significantly (p>0.05) for Sahiwal and Jersey crossbred heifers. Other follicle parameters such as growth rate, duration of dominance, length of growth phase and inter-wave duration did not vary significantly (p>0.05) between both the breeds (Table 2).

Dominant follicle entered the static phase of 2.4±0.4 and 1.6±0.4 day for Sahiwal and Jersey crossbred heifer and no subsequent ovulation took place. Although the onset of regression of the first corpus luteum in first ovulation was similar in Sahiwal and Jersey crossbred heifers occurred at day 10.6±0.4 and 11.0±0.63, with precocious luteolysis of the CL occurring before day 11 of estrous cycle. After the precocious luteolysis, none of the heifers had subsequent ovulation and again successive anovulatory waves of follicles were recorded. The TRUS of the premature luteolysis and follicular growth pattern is depicted in Fig. 2.

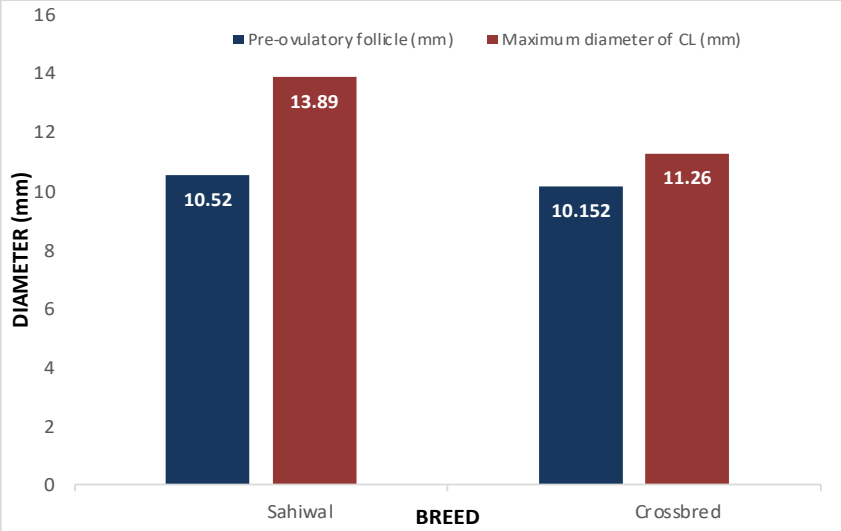

Fig. 1. Size of pre-ovulatory follicle (mm) and maximum diameter of the corpus luteum in Sahiwal and Jersey crossbred heifers

Table 1. Luteal parameters in Sahiwal and Jersey crossbred heifers (N=20) following first ovulation (Mean±S.E.)

Parameters	Sahiwal	Jersey crossbred
Pre-ovulatory follicle (mm)	10.52±0.13	10.15±0.51
Maximum diameter of CL (mm)	13.89±0.69[a]	11.26±0.45[b]
Day of maximum diameter of CL	8.6±0.4	8.2±0.48
Day of onset of regression of CL	10.6±0.4	11±0.63

[a,b] Values with different superscripts within the row are significantly different (p<0.01)

Table 2. Follicular parameters in Sahiwal and Jersey crossbred heifers (N=20) at first ovulation (Mean±S.E.)

Parameters	Sahiwal	Jersey crossbred
Day of wave onset	0.6±0.24	0.4±0.24
Number of follicles recruited	8.4±0.74	6.6±0.87
Interwave duration	11.4±0.74	10.6±0.74
Dominant Follicle		
Maximum diameter (mm)	10.39±0.38	10.63±0.38
Day of maximum diameter	9.0±0.63	9.8±0.48
Growth rate (mm/day)	1.16±1.16	1.19±0.07
Duration of dominance	11.0±0.63	10.6±0.74
Length of growth phase	8.6±0.4	9.0±0.89
Duration of static phase	2.4±0.4	1.6±0.4
Onset of atresia (day)	11.4±0.74	11.0±0.89

Day 1

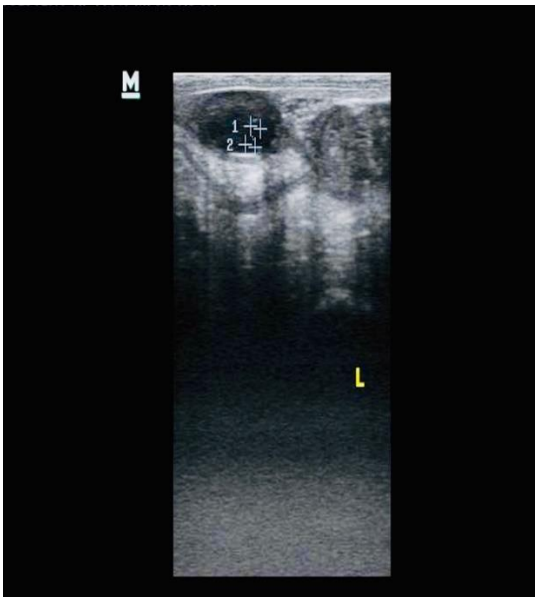

Fig. 2A. Left ovary: Recruitment of multiple antral follicles

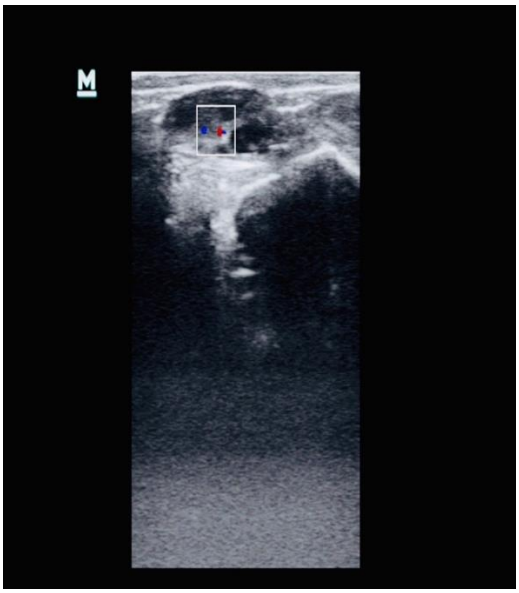

Fig. 2B. Right ovary: Corpus hemorrhagicum on day 1 after estrus

Day 3

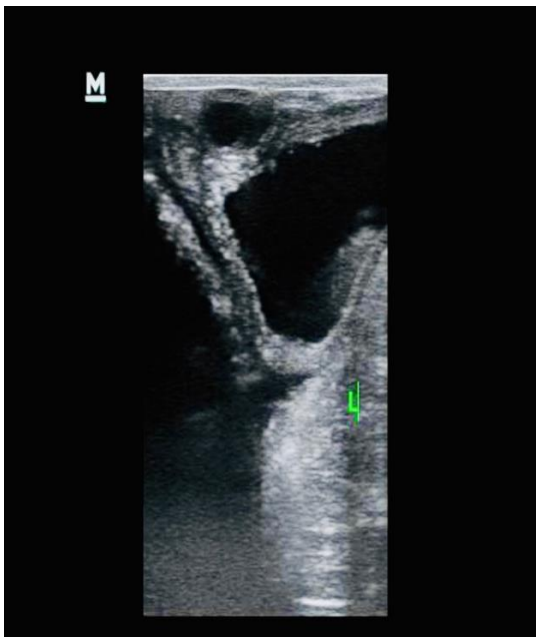

Fig. 2C. Left ovary: Increase in diameter of antral follicle.

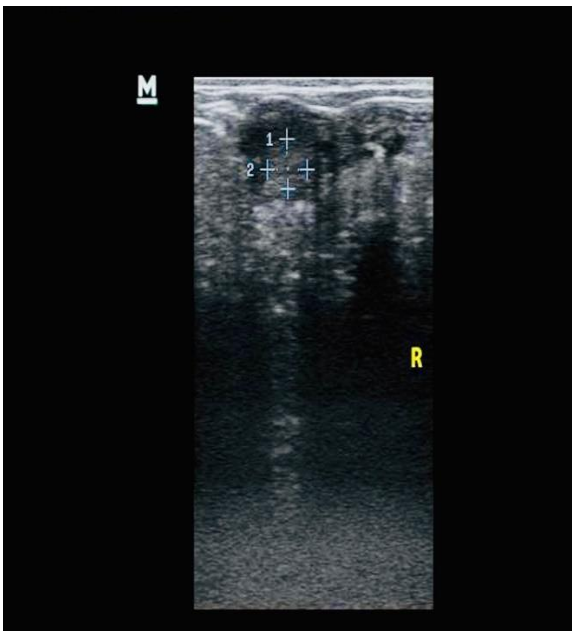

Fig. 2D. Right ovary: Luteal tissue (Measuring 7.4mm)

Day 5

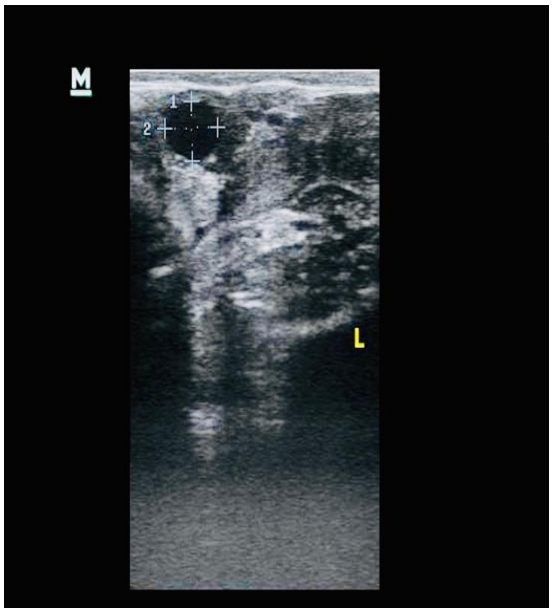

Fig. 2E. Left ovary: Increase in diameter of the antral follicle (Measuring 7.2mm)

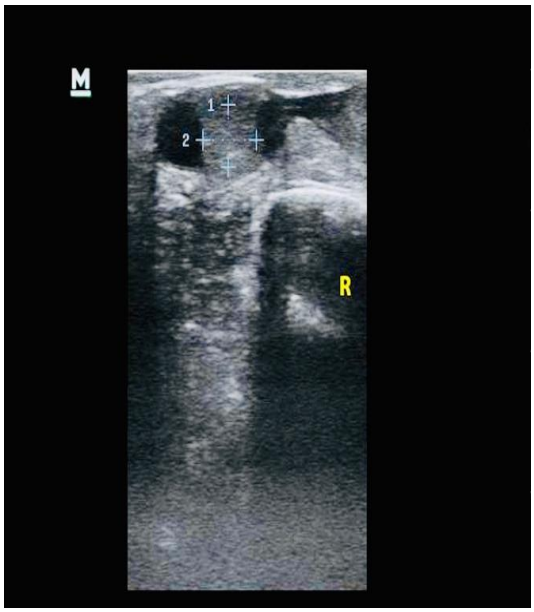

Fig. 2F. Right ovary: Luteal tissue (Measuring 9.7 mm)

Day 7

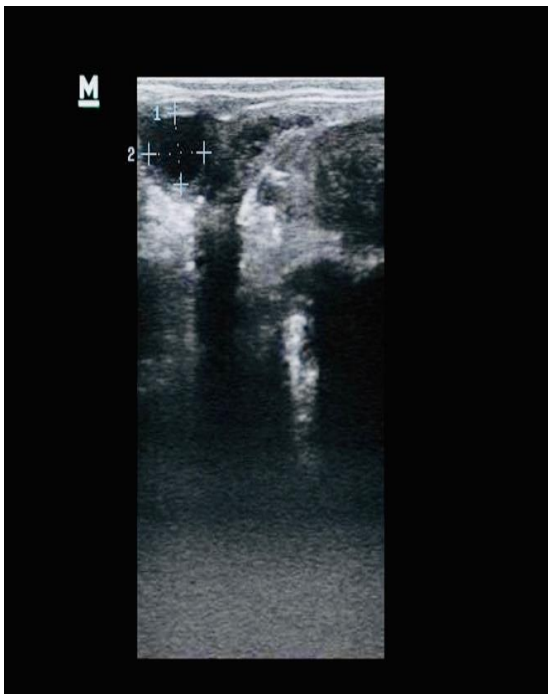

Fig. 2G. Left ovary: Dominant follicle (Measuring 9.1mm)

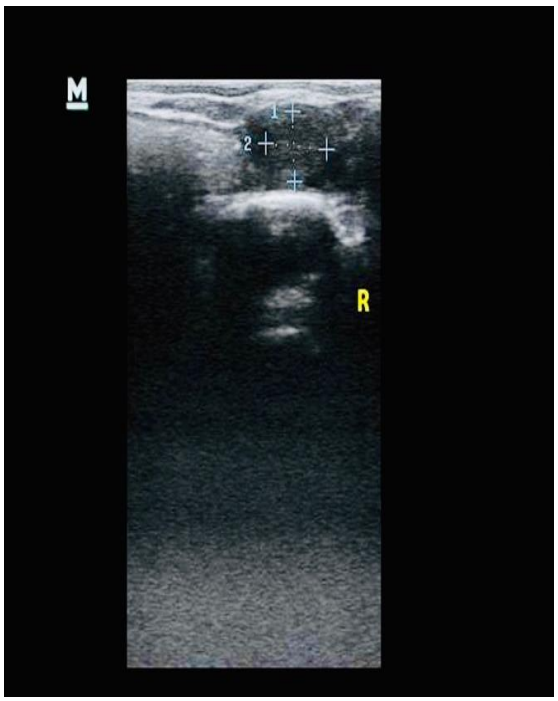

Fig. 2H. Right ovary: Luteal tissue (Measuring 10.3 mm)

Day 9

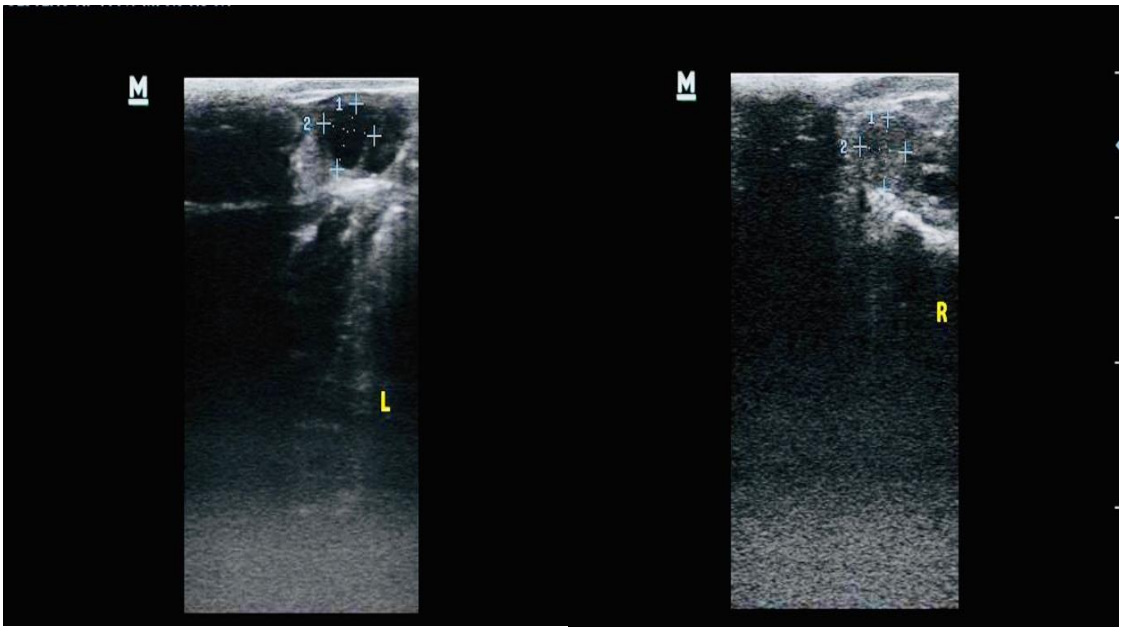

Fig. 2I. Left ovary: Constant diameter of the dominant follicle (Measuring 9.4mm)

Fig. 2J. Right ovary: Constant diameter of corpus luteum (Measuring 10.5mm)

Day 11

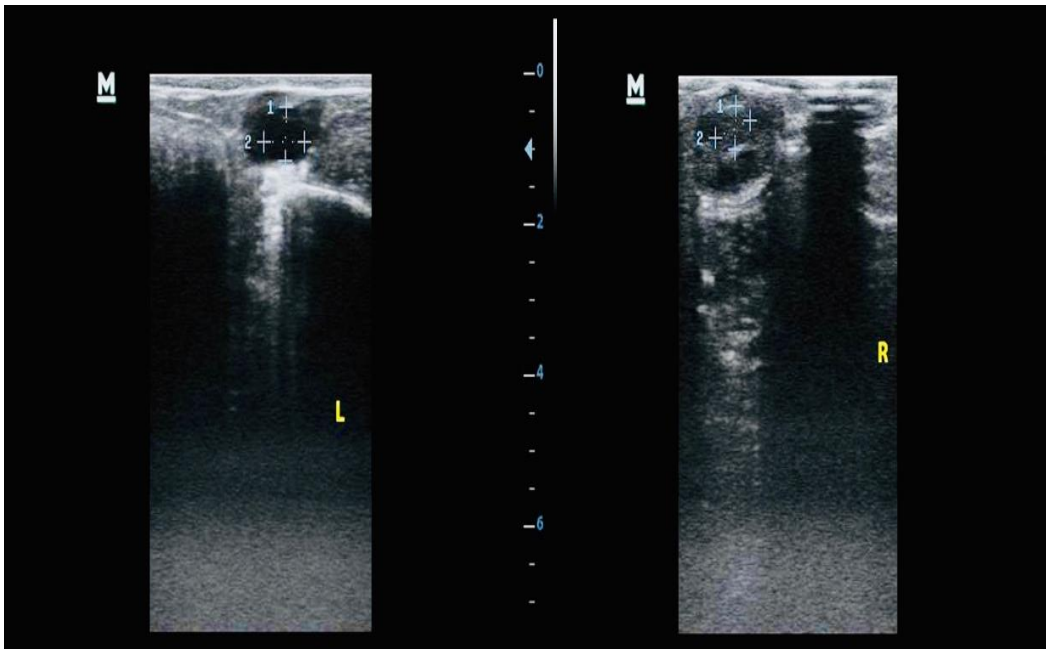

Fig. 2K. Left ovary: Atresia of the dominant follicle (Measuring 7.2 mm)

Fig. 2L. Right ovary: Decrease in size of the corpus luteum indicative of luteal regression (Measuring 7.8mm)

Day 13

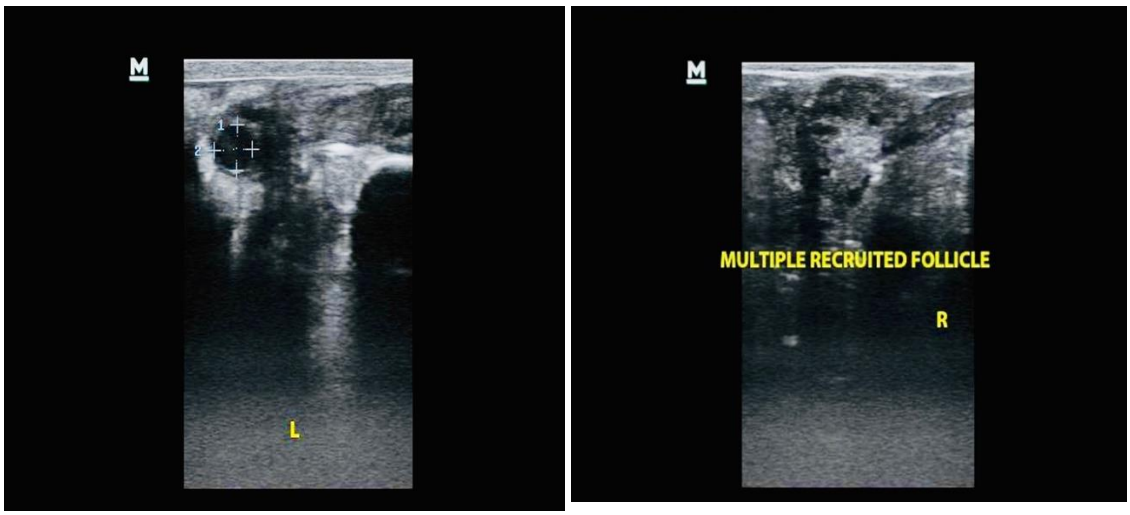

Fig. 2M. Left ovary : Atresia of the dominant follicle (Measuring 6.0 mm)

Fig. 2N. Right ovary: No luteal tissue visible and recruitment of multiple antral follicles

Fig. 2. TRUS of ovarian follicular dynamics during first ovulation in heifers (Peri-pubertal period)

Precocious luteolysis is alluded as regression of CL occurring before day 16 in estrous cycle, is more commonly observed in peri-pubertal period and postpartum cows [10] . Since the inter-estrus interval in this instance is shorter than the observed average, it is referred to as a short estrous cycle [11]. Akin to current findings, [12] and [13] reported the initial luteal phase after first ovulation ranged from 7-12 days whereas [14, 11 and 15] reported luteal phase of 5-7, 7.7 and 7 days, respectively.

Increased or premature release of, and increased sensitivity to, a luteolysin from the uterus is a better explanation for early luteal regression i.e. elevated quantities of 15-keto-13, 14 dihydro-prostaglandin F2a (PGFM) [16]. Although, abundant oxytocin receptors have been expressed in peri-pubertal heifers but uncoupled with prostaglandin synthase, thus remain unmasked before exposure of uterine tissue to progesterone [17].

Most of the work on precocious luteal regression has been carried out for the postpartum period whereas no such work has been done in the peri-pubertal heifers, therefore, as a part of discussion for follicular parameters following first ovulation, such observations have not been documented in the literature yet.

4. CONCLUSION

In peroration, upon the first ovulation, heifers undergo a unique physiological response characterized by precocious luteal regression. This phenomenon results in an estrous cycle of notably short duration, devoid of subsequent ovulation. The absence of further ovulation following the initial ovulatory cycle in peri-pubertal heifers highlights a distinct pattern in the reproductive cycle and needs to be comprehensively explored through further studies.

ETHICAL APPROVAL

Animal Ethic committee approval has been collected and preserved by the author(s)

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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