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Ovarian Dynamics and Blood Flow Indices during Estrus in Purnathadi Buffaloes

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ABSTRACT

The objective was to study the ovarian dynamics and ovarian arterial blood flow by pulse-wave color Doppler ultrasonography during estrus in Purnathadi buffaloes. The mean ovarian diameter of left and right ovary was 2.27±0.08 and 2.37 ± 0.12 cm of right ovary and mean pre-ovulatory follicle diameter was 1.23±0.08 cm during estrus Purnathadi buffaloes. The mean ovarian pulsatility index and resistance index was 1.45 and 0.75 during estrus. The mean ipsilateral (on the side of pre-ovulatory follicle) and contralateral ovarian artery pulsatility index during estrus did not differ significantly (1.63±0.02 and 1.62±0.02, respectively). The mean ipsilateral (on the side of pre-ovulatory follicle) and contralateral ovarian artery resistance index during estrus did not differ significantly (0.77±0.01 and 0.75±0.01, respectively). The ovarian artery indices show non-significant levels irrespective of presence of pre-ovulatory follicle in Purnathadi buffalo.

Key words: Buffalo, Ovarian artery, Preovulatory follicle, Ovarian dynamics.

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INTRODUCTION

India is rich heritage of diversified unique buffalo breeds developed according different climatic conditions. Purnathadi buffalo is recently registered as 20th buffalo breed of India. The main constraint in buffalo farming is low reproductive efficiency due to prolonged age at calving, long calving interval due more days for exhibition post-partum estrus and post-partum disorders, lower conception rate through artificial insemination. Also, the buffalo dairy owners are unaware of precise reproductive management (Kundalkar *et al.,* 2017). Reproductive ultrasonography is

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imperative tool for fertility improvement in reproductive management by early pregnancy diagnosis, diagnosis of different infertility disorders and to record physio-pathological changes in reproductive organs. The advent of color Doppler ultrasonography promotes tremendous advances in research and clinical practice in animal reproduction, because as it allows non-invasive visualization of the vascularization in the reproductive organs. A deficient blood supply to the ovaries could disturb the follicular development, maturation and ovulation leading to various pathological conditions like anoestrus and cystic ovarian degeneration ultimately leading to infertility. Thus, the ovarian hemodynamic has been considered to play a critical role in the fertility of the dairy cattle (Satheshkumar and Raja, 2020). Several studies have demonstrated the relationship of blood flow and ovarian and uterine function throughout the estrous cycle and pregnancy. Considering the importance of Doppler ultrasonography for blood flow indices, the present work was implemented with the objective to study the ovarian dynamics and ovarian arterial blood flow during estrus in Purnathadi buffaloes.

MATERIAL AND METHODS

The present research work was carried during the period of September 2022 to January 2023 on twelve Purnathadi buffaloes at Purnathadi Livestock Instructional Farm Complex, PGIVAS, Akola and Department of Animal Reproduction, Gynaecology & Obstetrics, Post Graduate Institute of Veterinary and Animal Sciences, Akola. History of buffaloes were collected and buffaloes between 4-7 years age, body weight in between 250-350 kg and in between 2-5 parity with good body condition score (≥3) were selected for the study. The buffaloes that have completed post-partum period of 45 days with normal reproductive genitalia and without clinical infection were selected randomly and divided into two groups.

The buffaloes from Group-I (n=6) were synchronized with Ovsynch protocol while exhibited spontaneous estrus after 45 days post-partum were selected for Group-II (n=6). Transrectal ultrasonography examinations were carried out using Hitachi Diagnostic Colour Doppler Ultrasound System Model F-37 with linear trans-rectal probe having frequency 5- 7.5 MHz. In Group I, the ovarian dynamics and Doppler indices were recorded after 20 hrs from second GnRH injection in Ovsynch protocol and in Group II, the observations were recorded on the day of natural estrus.

During estrus ovarian diameter measurement and follicle population with more than 3 mm size on both ovaries were counted by capturing multiple planes. The diameter of pre-ovulatory follicle was recorded based on optimum images through ultrasonography. Those images were frozen and size was determined by measuring the diameter of all pre-ovulatory follicles with inbuilt calliper and average was calculated. Doppler ultrasonographic examination of ovarian artery of ipsilateral ovary with pre-ovulatory follicle was recorded. Pulse wave Doppler mode was used and indices calculated as Pulsatility Index (PI) = (peak systolic velocity - minimal diastolic velocity) / (mean velocity) and Resistance Index (RI) = (Peak systolic velocity -End diastolic velocity)/ (Peak Systolic velocity). The buffaloes from Group-I were bred naturally after 16-20 hrs after second GnRH injection and in group-II the buffaloes were bred naturally by Purnathadi buffalo bull after 6-8 hrs after commencement of estrus. Statistical analysis of variation in pregnancy rate was carried out by Chi-square test using Web Agri Stats Package (WASP-2).

RESULTS AND DISCUSSION

In group-I, the mean ovarian diameter (cm) of left ovary was 2.24±0.09 and the right ovary was 2.23 ± 0.16. In group II, the diameter (cm) of left ovary was 2.31 ± 0.14 and the right ovary was 2.50 ± 0.17. There was non-significant difference between left and right ovarian diameter in Purnathadi buffaloes during spontaneous and synchronized estrus (P<0.05). The mean number of follicles was 3.00±0.57 and 3.66±0.33 on the left and right ovary in Group-I while 2.16±0.65 and 3.16±0.40 on left and right ovary, respectively during estrus in Group-II. There was non-significant difference (P<0.05) observed for number of follicles on left and right ovary during synchronized as well as spontaneous estrus in Purnathadi buffaloes.

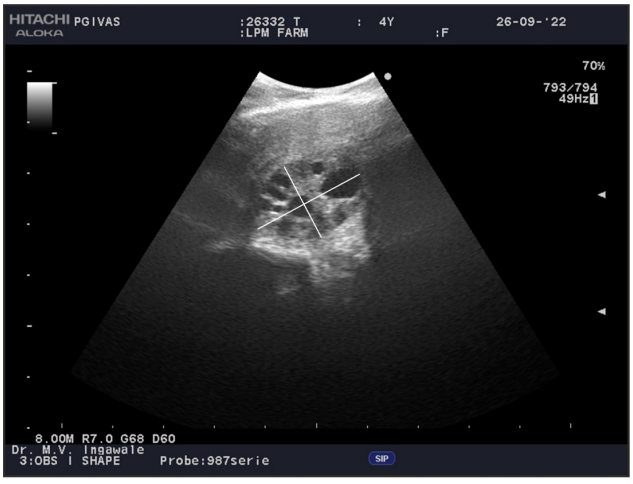

Plate 3.5. Ovarian diameter measurement by B-mode ultrasonography during estrus

Fig. 1: Ovarian diameter during estrus in Purnathadi buffalo

The ovarian diameters observed in present study are in concurrence with results reported by Nandankar (2012) recorded mean length and height of ovaries in Purnathadi buffaloes, and in Nagpuri buffalo studied by Razzaque *et al.* (2008). The slightly higher ovarian diameter than the results of present study was observed by Kachiwal (2012) in Kundhi buffaloes which are higher than Murrah and Toda breed of buffaloes, whereas lower values were recorded by Kumar *et al.* (2004). The variation in the ovarian diameter may be due to breed (Kachiwal, 2012), ovarian cyclicity (Razzaque *et al.,* 2008), ovarian stimulation (Abd-Allah *et al.,* 2013) and examination methods (Nandankar, 2012). The number of visible follicles was higher than the present study was reported by Madan *et al.* (1996). The variation in number of follicle population may be due to seasonal variation (Taneja *et al.,* 1995), ovarian cyclicity status (Sarath *et al.,* 2016), poor nutrition (Murphy *et al.,* 1991), body condition score, presence of corpus luteum, age, pregnancy status and ovarian localization (left ovary and right ovary) and follicular wave pattern (Baruselli *et al.,* 1997).

The average diameter (cm) of pre-ovulatory follicle was 1.25 ±0.16 during synchronized (Group-I) and 1.20±0.02 during spontaneous estrus in Purnathadi buffaloes. The pre-ovulatory follicle diameter had non significance (P<0.05) difference between synchronized and spontaneous estrus. The mean pre-ovulatory follicle diameter was 1.23±0.08 cm during estrus in Purnathadi buffaloes.

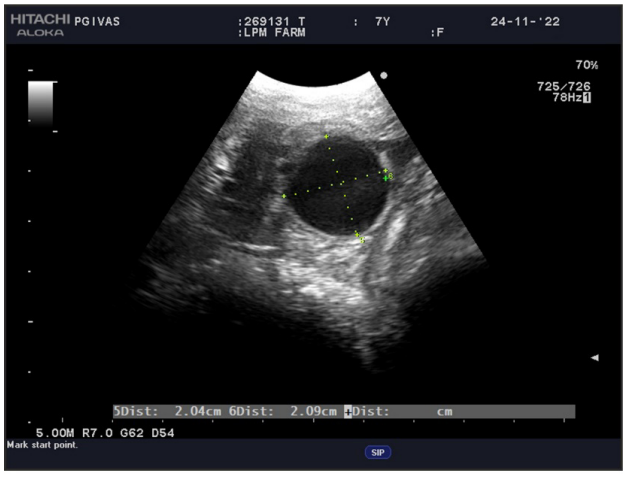

Plate 3.6. Pre-Ovualtory follicle diameter measurement by B-mode ultrasonography

Fig. 2: Pre-ovulatory follicle during estrus in Purnathadi buffalo

The results of present study for pre-ovulatory follicle diameter during estrus is in agreement with Phogat *et al.* (2018), Hassan *et al.* (2017) whereas higher diameter of pre-ovulatory follicle than present was were reported by Ellah *et al.* (2010), Nandankar (2012) and lower number observed in Egyptian buffalo (Derar *et al.*, 2012). The variation in diameter of pre-ovulatory follicle may be due to parity (Raj *et al.,* 2018), breed variation (Neglia *et al.*, 2007), left or right ovary (Azawi *et al.,* 2009), spontaneous or induced estrus (Caunce *et al.,* 2019), season and treatment protocol (Phogat *et al.*, 2018).

In the present study in group-I, the mean value of ovarian pulsatility index of left ovary was 1.42±0.24 and of right ovary was 1.64±0.04, respectively. The mean pulsatility index of left ovary was 1.38±0.23 and of right ovary was 1.37±0.23 in Group-II (Table 1). The mean pulsatility index of left and right ovary was non-significant in synchronized and spontaneous estrus.

NS - Non-significant difference pulsatility and resistance index of ovarian artery in synchronized as well as spontaneous estrus (P<0.05)

The results of present study regarding mean ovarian pulsatility index is in harmony with Satheshkumar *et al.* (2017). Higher values of ovarian pulsatility index than present result findings were reported by Abdelnaby *et al.* (2018) reported 1.66±0.02 and 1.69±0.01 ipsilateral and contralateral ovarian pulsatility index during follicular days (-5 to 0) in Frisian cows. Sayed *et al.* (2021) reported the ipsilateral ovarian PI as 1.54±0.15 and contralateral ovarian PI as 1.53±0.15 during the follicular days (-7 to 0) in Egyptian buffaloes. Variation in values of pulsatility index of ovarian artery may be due to estrus phase (Sayed *et al.,* 2021), estrus and anestrus phase (Satheshkumar *et al.,* 2017), follicular wave and intra-ovarian pattern (Hassan *et al.,* 2021) and ovulating ovary, ovulatory follicle growth and corpus luteum developmental stage (Abdelnaby *et al.,* 2018).

The mean value of ovarian resistance index of left was 0.78±0.01 and of right was 0.79±0.01, in group-I, respectively. The mean resistance index of left ovary was 0.73±0.01 and of right ovary was 0.74±0.02 in Group-II (Table 1). The mean resistance index of left and right ovary was non-significant in synchronized and spontaneous estrus. The mean value of resistance index of left ovary was

Table 1: Pulsatilty and resistance index of ovarian artery during synchronized and spontaneous estrus in buffaloes

Sr. No.	Group-I (n=6)	During synchronized estrus		Group-II (n=6)	During spontaneous estrus	
		Left OA	Right OA		Left OA	Right OA
1.	PI of ovarian artery	1.42 ± 0.24^{NS}	1.64 ± 0.0^{4NS}	PI of ovarian artery	1.38 ± 0.23^{NS}	1.37 ± 0.2^{3NS}
2	RI of ovarian artery	0.78 ± 0.01^{NS}	0.79 ± 0.01^{NS}	RI of ovarian artery	0.73 ± 0.01^{NS}	0.74 ± 0.02^{NS}

0.75 and 0.76 for right ovary. The mean ovarian resistance index was 0.755 during estrus in Purnathadi buffalo.

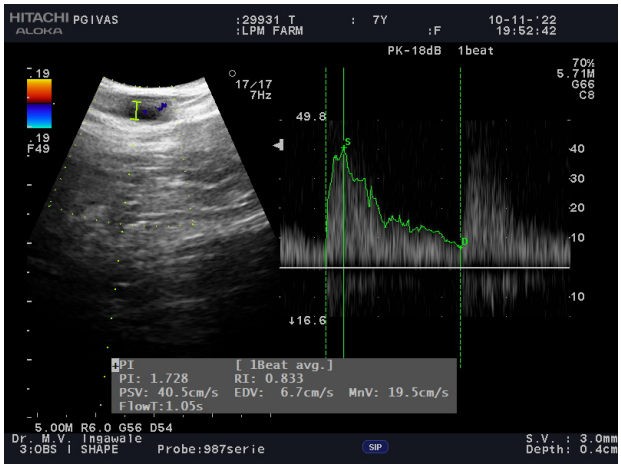

Fig. 3: Ovarian artery indices by pulse wave Doppler mode during estrus in Purnatahdi buffalo

The mean resistance index of right ovary is numerically slightly higher than left ovary. The mean ovarian resistance index of during synchronized estrus was 0.78±0.00 and 0.68±0.05 during spontaneous estrus in Purnathadi buffaloes.

The mean ovarian resistance index was non significant during synchronized and spontaneous estrus however was numerically higher in synchronized estrus. The results of present study regarding mean ovarian resistance index was in harmony with Satheshkumar *et al.* (2017) recorded ovarian artery resistance index was 0.73±0.05 ipsilateral to dominant follicle in crossbred cows while 0.65±0.03 resistivity index of dominant follicle; Hassan *et al.* (2021) reported the resistance index of ovarian artery as 0.77 on day 0 (estrus) in Sahiwal cows; Sayed *et al.* (2021) reported ipsilateral ovarian RI as 0.76±0.05 and contralateral ovarian RI as 0.75±0.06 to dominant follicle during follicular days (-7 to 0) in Egyptian buffaloes.

Contrast to present research findings, Abdelnaby *et al.* (2018) reported RI as 0.67±0.01 and 69±0.01 for ipsilateral or contralateral ovarian artery to pre-ovulatory follicle Frisian cows which is lower than present findings. Higher values of ovarian RI than present research findings were documented by Sayed *et al.* (2020) observed ipsilateral ovarian RI was 0.85+0.05 in PRID-PGF2α treated group, 0.83+0.09 in PRID+GnRH treated group and 0.77+0.09 in spontaneous group and contralateral ovarian RI in PRID-PGF2α group was 0.77+0.05, in PRID+GnRH was 0.7+0.00 and 0.73+0.10 in spontaneous estrus.

Variation in values of resistance index of ovarian artery may be due to estrus phase (Sayed *et al.,* 2021), estrous days (Hassan *et al.,* 2021) and ipsilateral or contralateral dominant follicle (Abdelnaby *et al.,* 2018) and different synchronization protocols as well as induced and spontaneous estrus (Sayed *et al.,* 2020).

The mean ipsilateral pulsatility and resistance index i.e. on the side of pre-ovulatory follicle was 1.63±0.02 and 0.77±0.0, respectively, while contralateral ovarian artery was 1.62±0.02, and 0.75±0.01, respectively during estrus and was non-significant (P<0.5) (Table 3).

CONCLUSIONS

The pulsatility and resistance index levels of ovarian artery showed no variation during synchronized and spontaneous estrus in Purnathadi buffaloes.

Table 2: Ipsilateral and contralateral ovarian artery pulsatility and resistance index during estrus in Purnathadi buffaloes.

		Ovarian artery PI		Ovarian artery RI	
Sr. No	**Group-I (n=12)**	**Ipsilateral**	**Contralateral**	**Ipsilateral**	**Contralateral**
1	G-1-1	1.58	1.62	0.79	0.78
2	G-1-2	1.70	1.71	0.83	0.81
3	G-1-3	1.62	1.70	0.81	0.79
4	G-1-4	1.79	1.80	0.80	0.80
5	G-1-5	1.60	1.58	0.78	0.77
6	G-1-6	1.56	1.56	0.74	0.75
7	G-2-1	1.56	1.56	0.74	0.72
8	G-2-2	1.58	1.52	0.81	0.78
9	G-2-3	1.61	1.58	0.79	0.76
10	G-2-4	1.61	1.61	0.71	0.70
11	G-2-5	1.74	1.70	0.74	0.70
12	G-2-6	1.71	1.54	0.70	0.71
	Mean±SE	**1.63±0.02^{NS}**	**1.62±0.02^{NS}**	**0.77±0.01^{NS}**	**0.75±0.01^{NS}**

CONFLICT OF INTEREST

None

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