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Alterations in some important hematological attributes in *Gir* cattle during varying study points of peripartum period

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Abstract
The peripartum period is a critical time period for cows because they have to cope with physiological, metabolic, hormonal, and various other factors related to environment stress. The knowledge of hematological attributes in this period is very important as these can be used as an indicator of the health status in cows. This study aims to measure the some important hematological attributes in *Gir* cattle during the varying study points (week 3, 2 and 1 of ante-partum, day 0 and week 1, 2 and 3 of post-partum) of peripartum period. Blood samples were collected from ten *Gir* cattle at weekly interval from the last three weeks of the gestation (ante-partum) and three weeks after parturition (post-partum) and on day 0 (within 12 hours) that represents day of calving (partum). The average values (Mean±SEM) of Hb (g/dl) were 9.85±0.24, 11.08±0.33, and 9.06±0.33, RBC count (x 10^6/µl) were 5.83±0.20, 7.19±0.32, and 6.01±0.18, WBC count (x 10^3/µL) were 8.79±0.36, 10.43±0.42, and 8.96±0.26 and PCV (%) were 29.57±0.57, 31.05±0.84, and 26.18±0.45 during ante-partum, partum and post-partum period, respectively. This study showed the significant (p<0.05) influence of peripartum phases and varying study points of peripartum period on hematological attributes except RBC count in which non-significant (P≥0.05) variations were observed between varying study points of peripartum period. The values of all the studied hematological attributes raised from 3 weeks before parturition with the highest value at partum (except PCV) thereafter, decreasing trend was observed through varying study points of post-partum, however, slight increase from 2 week of post-partum in RBC and WBC count and 3 week of post-partum in Hb and PCV were observed.

Keywords: *Gir* cattle, red blood cell, white blood cell, hemoglobin, packed cell volume, peripartum period

Introduction
The peripartum period in dairy cow as 3 week before to 3 week after parturition is generally accepted the most critical period with respect to changes in physiology. In this critical period the mammary gland undergoes marked haematological, cellular and immunomodulatory changes to accommodate involution, to prepare for parturition, to withstand the stress of parturition, to transform colostrum into milk, and then for the attainment of peak milk production that makes the transient cows vulnerable to various health problems or diseases related to environmental stress and management factors. A suboptimal immune response triggers this event and also a negative energy balance factor (Aleri *et al*., 2016) [1]. Livestock health in the peripartum period is very important, because it determines the success of the current production and reproductive performance of the next period (Wankhade *et al*., 2017) [28]. Laboratory testing is an important tool that helps practitioners to monitor the cow health at the individual and herd level basis. The knowledge of hematological attributes is useful in diagnosing various pathological and metabolic disorders. Therefore the present study was planned to investigate various hematological changes occurring in *Gir* cows during peripartum period.

Experimental material and method
A total of 10 advanced pregnant (expected day of calving at 21 days later) females apparently healthy *Gir* cattle, aging between 3 and 9 years were selected from the cattle farm of Livestock Research Station (LRS) under RAJUVAS, Bikaner that is located at College of Veterinary and Animal Science, Navania, Vallabhnagar, Udaipur, Rajasthan. The selected cows were fed with the same diet as stall feeding of total mixed rations and silage as well as similar management practices were adopted during the study.

All the selected *Gir* cattle moved onward into three peripartal phases viz. ante-partum (21 days), partum (0 day) and post-partum (21 days) period. Total 3 ml whole blood samples were collected in EDTA from jugular vein from each cattle under standard managemental conditions at weekly interval i.e. on day 21, day 14 and day 7 with respect to expected day of calving (ante-partum) and day 7, day 14 and day 21 of calving (post-partum) and on day 0 (within 12 hours) that represents day of calving (partum). Hematological attributes were analysed instantly on fresh samples. Hb, RBC, WBC and PCV were estimated by using fully automatic haemato-analyzer (Rescholar, RM-303-03).

Statistical analysis

The data were presented as mean±standard error. Special computer programme WASP - Web Based Agricultural Statistics Software Package, designed by ICAR-Central Coastal Agricultural Research Institute was employed for analyses of variance (https://ccari.icar.gov.in). Mean comparison was done via Post hoc Tukey HSD test for the haematological attributes among varying study points of peripartum as well as peripartal phases. Variations between groups in peripartum period of $p<0.05$ were considered to be statistically significant.

Results and Discussion

Mean±SEM values and mean changes of hematological attributes presented in tables 1 and depicted in figure A, respectively during varying study points of peripartum period in *Gir* cattle.

The average values (Mean±SEM) of Hb (g/dl) were 9.85±0.24, 11.08±0.33, and 9.06±0.33, RBC count (x 10^6/µl) were 5.83±0.20, 7.19±0.32, and 6.01±0.18, WBC count (x 103/µL) were 8.79±0.36, 10.43±0.42, and 8.96±0.26 and PCV (%) were 29.57±0.57, 31.05±0.84, and 26.18±0.45 during ante-partum, partum and post-partum period, respectively, in *Gir* cattle.

The values of all the studied hematological attributes raised from 3 weeks before parturition with the highest value at partum (except PCV) thereafter, decreasing trend was observed through varying study points of post-partum, however, slight increase from week 2 of postpartum in RBC and WBC count and week 3 of post-

Table 1: Mean±SEM values of hematological attributes during peripartal phases in *Gir* cattle

SN	Hematological attributes	Ante-partum			Partum	Post-partum		
		-3 week (n=10)	-2 week (n=10)	-1 week (n=10)	Day 0 (n=10)	1 week (n=10)	2 week (n=10)	3 week (n=10)
1.	Hemoglobin (Hb, gm %)	9.27^{bc} ±0.45	9.46^{abc} ±0.42	10.27^{ab} ±0.36	11.08^{a} ±0.33	9.26^{bc} ±0.53	8.48^{c} ±0.67	9.52^{bc} ±0.52
	Average	9.85^{b}±0.24			11.08^{a}±0.33	9.06^{c}±0.33		
2.	Red blood cells (RBCx10^6/µl)	5.87 ±0.39	5.99 ±0.28	6.51 ±0.36	6.72 ±0.32	5.86 ±0.32	6.22 ±0.28	6.33 ±0.32
	Average	5.83^{b}±0.20			7.19^{a}±0.32	6.01^{b}±0.18		
3.	White blood cells (WBCx10^3/µl)	8.24^{c} ±0.61	8.69^{bc} ±0.63	9.43^{abc} ±0.62	10.43^{a} ±0.42	8.19^{c} ±0.41	8.98^{abc} ±0.39	9.73^{ab} ±0.46
	Average	8.79^{b}±0.36			10.43^{a}±0.42	8.96^{b}±0.26		
4.	Packed cell volume (PCV, %)	28.12^{bc} ±1.05	28.96^{ab} ±0.89	31.61^{a} ±0.90	31.05^{a} ±0.84	27.51^{bcd} ±0.74	25.0^{d} ±0.68	26.03^{cd} ±0.74
	Average	29.57^{a}±0.57			31.05^{a}±0.84	26.18^{b}±0.45		

Means bearing different superscripts within a row differ significantly ($p<0.05$)

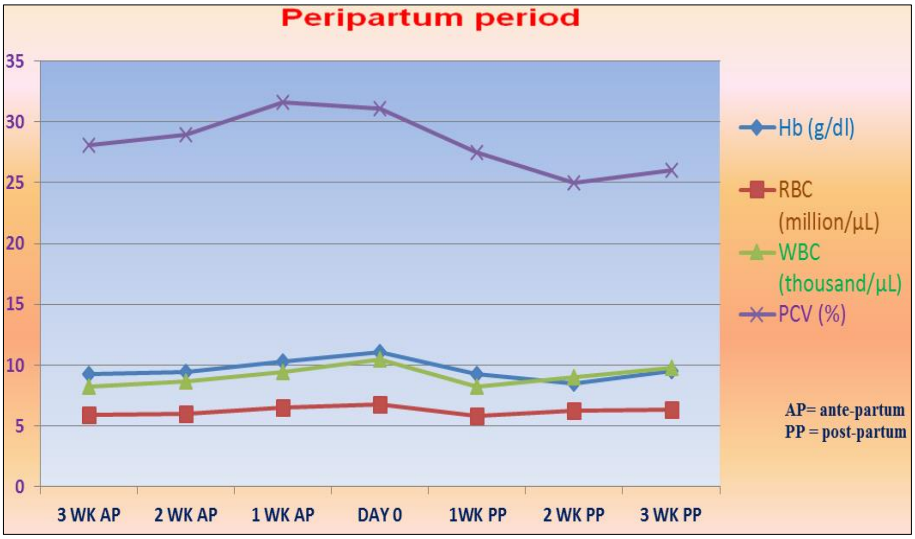

Fig 1: Depiction of mean changes in hematological attributes of *Gir* cattle during peripartum period

partum in hemoglobin and packed cell volume were observed. Analysis of variance showed a highly significant ($p<0.01$) influence of peripartal phases on mean values of Hb and PCV and significant ($p<0.05$) on mean values of RBC and WBC counts. A highly significant ($p<0.01$) influence on mean values of PCV; significant ($p<0.05$) on mean values of Hb and WBC count and non-significant ($P\geq0.05$) on RBC counts were observed between varying study points at peripartum

period.

Hemoglobin (g/dl) content was observed significantly differ among all three peripartal phases; markedly (p<0.05) higher at partum followed by ante-partum in comparison to post-partal phase. RBC count (x 10^6/µL) and WBC count (x 10^3/µL) were observed significantly higher at partum in comparison to ante- and post-partal phases. However, non-significant variations in RBC and WBC count were observed between ante- and post-partal phases. The values of PCV (%) were observed significantly (p<0.05) higher at ante-partum and partum in comparison to post-partal phase. However, non-significant variations in PCV values were observed between ante-partum and partum (day 0) (table 1).

Higher level of Hb, RBC count, WBC count and PCV level at parturition in comparison to late pregnancy and early post-partum period was also reported by earlier researchers as Jonsson *et al.* (2013), Patel *et al.* (2017) and Aswal *et al.* (2021) [12, 20, 3] in dairy cows. Higher level of Hb, RBC and WBC count at parturition than late pregnancy and early post-partum period also reported by Elzein *et al.* (2016) [7] in goats that support the findings of present study.

Similarly, higher level of Hb during ante-partum than post-partum period were reported by Nazifi *et al.* (2008), Gavan *et al.*, 2010, Elshahawy and Abdullaziz (2017), Singh *et al.*, 2017, Joshi *et al.* (2018), Yehia *et al.*, 2020 and Aswal *et al.* (2021) [19, 3, 8, 6]. However, Nazifi *et al.* (2008) and Aswal *et al.* (2021) [3, 19] noted significant variations in Hb. level between pre-and post-partum period. Similarly, non-significant (P≥0.05) variations in values of RBC count during pre-partum and post-partum were reported by Nazifi *et al.* (2008), Elshahawy and Abdullaziz (2017), Patel *et al.* (2017), Joshi *et al.* (2018), Aswal *et al.* (2021) [19, 20, 3, 6]. However, some researchers (Azab *et al.*, 1999, Gavan *et al.*, 2010, Jonsson *et al.*, 2013, Singh *et al.*, 2017 and Merdana *et al.* (2020) [12, 8] reported non-significantly higher values of RBC count at pre-partum than post-partum. Although, Yehia *et al.* (2020) reported significantly lower RBC count at 3 week post-partum than 3 week ante-partum in both primiparus and multiparus crossbred cows. Similarly, non-significantly (p≥0.05) higher values of WBC count during post-partum than pre-partum were reported by Nazifi *et al.* (2008), Jonsson *et al.* (2013) and Yehia *et al.* (2020) [12, 19]. However, some researchers (Azab *et al.*, 1999, Gavan *et al.*, 2010, Jonsson *et al.*, 2013, Patel *et al.* (2017), Singh *et al.*, (2017), Merdana *et al.* (2020) and Aswal *et al.* (2021) [12, 20, 3, 8] reported non-significantly higher values of WBC at pre-partum than post-partum. Although, Todorovic and Davidovic (2012) reported significantly higher WBC count during post-partum (15 days) than ante-partum (15 days). Singh *et al.* (2017) observed the significantly (p<0.05) higher values of WBC count at early post-partum than late pregnancy in buffalos. In current study, significantly lower values of PCV during post-partum than ante-partum was observed that is corroborated by Nazifi *et al.* (2008) [19]. Yehia *et al.* (2020) also reported significantly lower PCV values at 3 week post-partum than 3 week ante-partum in both primiparus and multiparus crossbred cows. Gavan *et al.* (2010) [8] reported lower hematocrit in post-partum (0-21 days) than 1 week of pre-calving.

In contrast to present study, Merdana *et al.* (2020) reported significant (p<0.05) decrease in Hb content, RBC count and PCV level from pre-partum (three weeks) to parturition and slight increase at post-partum (three weeks) in cattle. In contrary to present study, lower values of WBC count at day 0 in goats were reported by Tanvi *et al.* (2016) and Meena (2021). However, Schalm and Jain, (1986) reported that pregnancy did not markedly affect the WBC count. Jonsson *et al.* (2013) [12] reported non-significant changes in PCV values between pre-calving and post calving period. Singh *et al.* (2017) observed the non-significantly lower values of PCV at late pregnancy in comparison to early post-partum. However, Elzein *et al.* (2016) [7] observed the non-significant lower value of PCV (%) at partum than early post-partum period.

Increase in Hb content immediately after parturition might be due to higher demand of oxygen and requirement of higher metabolic rate (Antunovic *et al.*, 2011) [2], thereafter, lower hemoglobin levels in post-partum might be due to the lower rate of erythropoiesis (Kumar and Pachauri, 2000) [15] or to the mammary tissues' higher level of hemoglobin requirement for milk synthesis, and the concomitant rise in blood flow to the mammary glands. The lower RBC count during ante-partum period might be due to deficiency of iron as reported by and higher RBC count at calving might be due to the possible hemo-concentration not only by the reduction in water intake but also by the greater spleen contraction (Van Soest and Blosser, 1954) [27] or due to enhanced erythropoiesis as production of erythrocytes is related to oxygen demand in the body and is responded by increased release of erythropoietin in kidney tissue to stimulate the production of erythrocytes followed by increase of hemoglobin level (Pittman, 2011 and Klein, 2013) [21, 14]. Higher level of WBC count at parturition may be explained by an increase in the numbers of circulating neutrophils, and to a less extent, an increase in monocytes (Meglia *et al.*, 2001) because at calving, the levels of corticosteroids are elevated (Smith *et al.*, 1973; Guidry *et al.*, 1976 and Hussain and Daniels, 1992) [24, 9, 10] that induce neutrophilia by an increased output of neutrophils from the bone marrow while the decrease after calving is associated with the migration of the leucocytes towards the uterine lumen and mammary gland. In the present study, the higher PCV was observed on 7 day before and on the day of parturition that might be due to loss of fetal fluids during parturition. Higher PCV immediately before calving may indicate the requirement of higher red cell volume to carry more oxygen to meet the energy requirement of tissues at the time of calving (Jain, 1986) [11].

Conclusion

In this study, it can be concluded that the hematological attributes of *Gir* cattle for hemoglobin, RBC count, WBC count and PCV level experienced significant alterations during varying study points of the peripartum period. The normal values of these parameters at three weeks of ante-partum increased significantly around the parturition, thereafter, decreased at one week and again showed slight increase towards the three weeks of post-partum period.

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