STUDIES ON CERTAIN HAEMATOLOGICAL PROFILES IN NORMAL CALVING AND DYSTOCIA AFFECTED CROSS BREED COWS

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AUGUST, 2012

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Thesis submitted to the

KARNATAKA VETERINARY, ANIMAL AND FISHERIES SCIENCES UNIVERSITY, BIDAR

In partial fulfillment of the requirements for

the award of the degree of

MASTER OF VETERINARY SCIENCES

in

VETERINARY GYNAECOLOGY AND OBSTETRICS

By

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CERTIFICATE

This is to certify that the thesis entitled ***"STUDIES ON CERTAIN HAEMATOLOGICAL PROFILES IN NORMAL CALVING AND DYSTOCIA AFFECTED CROSS BREED COWS"*** submitted by **Mr. MOHAMMAD HAKIM, ID. No. MVHK 1026** in partial fulfillment of the requirements for the award of **MASTER OF VETERINARY SCIENCE in VETERINARY GYNAECOLOGY AND OBSTETRICS** of the Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar is a record of bonafide research work carried out by him during of period his study in this University under my guidelines and supervision, and the thesis has not previously formed the basis for the award of any degree, Diploma, Associate ship, Fellowship or other similar title.

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Dedicated to

My Beloved Parents

and

My Family Members

ACKNOWLEDGEMENT

First and above all, I praise God, the almighty for providing me this opportunity and granting me the capability to proceed successfully, and my Father ***Mr. Mohammad Amin Niazmand*** *and* ***my kind Mother*** *who introduced me to the joy of reading from birth, enabling me to study at this place today.*

I would like to sincerely thank the ***Government of Afghanistan*** *specially* ***Ministry of higher education*** *for providing this scholarship to improve my knowledge.*

I take this opportunity to express my deep sense of gratitude, indebtedness and warm regards to ***Dr. T.G. Honnappa****, Associate Professor, Department of Veterinary Gynaecology and Obstetrics and Chairperson of my Advisory committee who has been very helpful to me throughout the course of my study. His guidance, inspiration, genuine interest, advice, valuable suggestions, whole hearted encouragement and blessings helped me to grow in my professional and academic competence. I will always remember him with gratitude for the innumerable ways he has influenced my life during my course of my study.*

It's my pleasure to acknowledge and offer sincere thanks to ***Dr. V.C. Murthy****, Associate Professor, Department of Veterinary Gynaecology and Obstetrics and member of my advisory committee for his valuable help, suggestion, inspiring guidance and support during my research period and preparation of manuscript.*

I wish to express heartfelt thanks to ***Dr. N.B. Shridhar*** *Associate Professor, Department of Veterinary Pharmacology and Toxicology. Veterinary College, Hebbal, Bangalore and member of my advisory committee for his moral support, constant encouragement and valuable suggestions that has helped me in completing the research.*

I wish to express my deep and heartfelt gratitude to ***Dr. M.R. Jayashankar,*** *Professor, Department of Animal Genetic & Breeding, Veterinary College, Hebbal, Bangalore and a member of my Advisory Committee for his valuable help and inspiring guidance rendered during my research work.*

It's my pleasure to express my sincere thanks to ***Dr. A. Krishnaswamy,*** *Professor and Head, Department of Veterinary Gynaecology and Obstetrics, for his moral support and valuable suggestions that helped me in completing the research work and thesis. I am indebted to him.*

I take this opportunity to sincerely thank ***Dr. G. Sudha****, Assistant Professor, Department of VGO, for providing valuable information for my research and thesis.*

It's my pleasure to express my sincere thanks to ***Dr. Narasimha Murthy****, Assistant Professor, Department of Veterinary Gynaecology and Obstetrics, Veterinary College, Shivmoga who has helped me a lot during clinical work and writing thesis.*

I would like to sincerely thank my dear uncles ***Mr. shams-u-din Nasrat*** *and* ***Mr. Akhgar*** *for their guidance and support throughout this study and especially for their confidence in me.*

I wish to express my deep and heartfelt gratitude to ***Prof. Ab. Rahim Omid, Dr. Mohammad Quraish Fazli, Dr. M.M. Trawat, Prof. M. Alam Ghoryar, Dr. Ab. Q. Fakhry, Dr. Hayati, Dr. Ab. S. Azizi, Dr. Ab. H. Karimzadah, Dr. Ab. M.Karimi***

My cordial and sincere thanks to my most special friends ***Dr. Gh. Mahboob, Dr. Homayoon Sultani, Eng. Rozbih, Eng. Omid Akhgar, Mr. Jawid. Rahmani, Mr. Ahmad Siroos popal. Also Dr. Shakhes, Dr. Mohmand, Dr. Tookhy, Dr. Matin, Dr. Pyman, Dr. sayed Ab.Wahed Qattali, Dr. Karimizadah, Dr. Shahab, Eng. Mahboob Shah Sultani….***

And also it's my pleasure to express my sincere thanks to senior students of Department of Veterinary Pharmacology and Toxicology Veterinary College, Hebbal, Bangalore, ***Dr. Vinay P. Tikare, Dr. Chandrashekar, G*** *and* ***Dr. Reshu Kumar*** *who have helped me a lot during analysis work which helped me in completing the research.*

I extend my hearty thanks to my classmates ***Dr. Assadullah Dost, Dr. Shwetha, Dr. Vibha, Dr. Navya, Dr. Ashwartha*** *and* ***Dr. Kavya*** *for their timely help during my research work in department.*

I also extend my heartly thanks to my Junior ***Dr. Ashok, Dr. Prashant, Dr. Sowmya, Dr. Harsha, Dr. Yathish, Dr. Chithra*** *and* ***Dr. Amaregouda*** *for their timely help during my research work in department.*

I would also like to express my gratitude to the other supporting staff of the department, ***Ms. Vijayalakshmi, Mr. Siddaram, Mr. Sathish*** *and* ***Mr. Rajanna*** *who helped me in my endeavour.*

I take this opportunity to express my deep sense of gratitude, indebtedness and warm regards to ***family members*** *including* ***beloved wife, cute children,*** *my only brother* ***Mr. Mohammad Azim Niazmand*** *and loving* ***sisters*** *who have helped me to get an admission in Veterinary College, Hebbal, Bangalore. They strengthened me at the time of confusion and difficulties and blessed me with all of their graces to succeed in my studies and life. First of all I thank for all their goodness and blessings showered upon me.*

To all my friends, thank you for your understanding and encouragement in my moments of crisis. Your friendship makes my life a wonderful experience. I cannot list all the names here, but you are always on my mind.

Bangalore
August, 2012 ***(Mohammad Hakim)***

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LIST OF ABBREVATIONS

RBC	Red blood cell
WBC	White blood cell
PCV	Pack cell volume
MCV	Mean corpuscular volume
MCH	Mean corpuscular haemoglobin
MCHC	Mean corpuscular haemoglobin concentration
Mg	Magnesium
Hb	Haemoglobin
TLC	Total leukocyte count
DLC	Differential leukocyte counts
RMF	Retained fetal membranes
°C	Degree (s) Celsius
mg	Milligram
Fig	Figure
G	Gram
g/dl	Gram per deciliter
mg/dl	Milligram per deciliter
m mol/ L	Millie mol per liter
g/dl	Gram per liter
%	Percentage
±	Plus or minus
SE	Standared error
L	Liter
h	Hour

Introduction

I. INTRODCTION

Difficult calving, termed as dystocia, is characterized as abnormal birth that requires assistance and it occurs in 3 to 25% of cattle pregnancies. Dystocia has been a long-standing problem in dairy cows and is one of the most serious complications of buffalo and cattle at parturition. It is believed to be influenced by numerous factors such as pelvic area, calf's birth weight, age of dam, twin pregnancy, presentation, disposition, hormonal control and nutrition of dam (Noakes *et al.,* 2001). Dystocia is one of the most importance reproductive disorders resulting in an increased incidence of other calving related disorders and a loss of milk production ultimately affecting economics of the farmer (Lorenz *et al.,* 2011).

The process of parturition, though physiological, is a stressful event (Guidry *et al*., 1976; Sathya *et al.,* 2005; Sathya *et al.,* 2007) for both the dam and the fetus even in uncomplicated cases (Hudson *et al.,* 1976). Abnormal parturition further adds to the stress of calving (Nakao and Grunert, 1990; Prabhakar *et al*., 1999).

Blood is of crucial importance for the maintenance of physiological equilibrium in the body (Geneser, 1986). However, this equilibrium may be disturbed due to certain physiological and pathological conditions. The knowledge of haematological values is useful in diagnosing various pathological and metabolic disorders, which can adversely affect the productive and reproductive performance of cows, resulting in great economic losses to the dairy farmers (Pyne and Maira, 1981). Since blood profile changes during various reproductive stages, it is imperative to study haematological constituents during normal and abnormal calving. The erythrocyte parameters and total and differential

leukocyte counts are affected by various physiological determinants (Klinkon, 1992) as well as factors from the environment. Steinhardt *et al.* (1994) reported decrease in haemoglobin with advancing lactation and pregnancy, which increased at parturient stage. It was reported that higher white blood cells (WBC) and lower lymphocytes concentrations in parturient cows (Mallard *et al.*, 1998 and Meglia *et al*., 2005). At parturition, the concentrations of calcium and inorganic phosphorus were significantly lower, whereas, concentration of magnesium was higher in Holstein cows (Nazifi and Sami, 1997).

Prabhakar *et al.* (2000) reported significantly lower levels of PCV and haemoglobin in dystocia affected buffaloes at presentation. Prabhakaran *et al.* (2006) reported that the mean pocked cell volume (PCV) and red blood cells (RBC) counts did not differ significantly in both maternal and fetal dystocia, with a significantly lower level of haemoglobin being observed in buffaloes with maternal dystocia, while the mean WBC counts in buffaloes with both maternal and foetal dystocia was significantly higher when compared to the normally calved buffaloes. Phogat *et al.* (1992) and Prabhakar *et al.* (1999) recorded higher PCV and haemoglobin values on the day of calving in buffaloes. Pattabiraman and Pandit (1980) and Phogat *et al.* (1992) observed marginally lower values of haemoglobin, significantly higher total leukocyte counts in buffaloes affected with uterine torsion. Phogat *et al.* (1992) observed that the total leukocyte counts decreased significantly with neutrophilia and lymphocytopenia at parturition buffaloes. Yıldız *et al.* (2011) observed that in cows suffering from dystocia, white blood cells (WBC), red blood cells (RBC), haemoglobin, mean corpuscular haemoglobin (MCH), eosinophils, basophils, lymphocytes and monocytes were non significantly

different from the normal calving cows. A significant increase in the mean corpuscular volume (MCV) and neutrophils was noticed in the dystocia cows as compared to the normal calving cows. However, mean corpuscular haemoglobin concentration (MCHC) and the haematocrit in dystocia affected animals was lower than in normally calving cows. Ali *et al*. (2011) observed a significant increase in monocytes and phosphorus and decreases in mean corpuscular haemoglobin concentration in the buffaloes with uterine torsion. Information regarding the haematological parameters in dystocia and eutocia crossbred cattle is scanty and greatly variable reports were available on the level of these haematological constituents.

Therefore, the present study was planned with the following objectives

1- To study the effects of dystocia on certain haematological and macro mineral profiles in crossbred cows.

2- To compare the variations if any, in the haematological and macro mineral concentrations with normal calving cows.

3- To associate possible changes if any in maternal and foetal dystocia cross breed cows.

Review of Literature

II. REVIEW OF LITERATURE

2.1. Total red blood cell count (RBC)

Kaur and Singh (1993) observed RBC count of 6.5 ± 0.2 (10^6/µl) in genital prolapsed buffaloes and also investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean total erythrocytes count (10^6/µl) of 5.40 ± 0.20, 6.50 ± 0.20, 6.20 ± 0.40 and 6.70 ± 0.60 respectively in buffaloes with uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean total erythrocytes count was found to be significantly lower in buffaloes with uterine torsion.

Klinkon and Zadnik (1999) found the mean erythrocyte (RBC) count of 6.70 ± 0.65 (10^6/µl) at parturition in Black and White dairy cows.

Ahmed *et al*. (2005) observed the mean red blood cell (10^6/µl) count of 6.26 ± 0.76, 6.42 ± 0.58 and 6.10 ± 0.43 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. However, no difference in red blood cell count was observed between vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes.

Ahmed *et al*. (2005) observed the mean red blood cell (10^6/µl) count of 6.31 ± 0.69 and 6.10 ± 0.43 respectively in buffaloes with genital prolapse and in control group of buffaloes, the difference in the mean red blood cell count was not significant between buffaloes with genital prolapse and in control group of buffaloes.

Prabhakaran *et al*. (2006) reported the mean total erythrocyte count (10^6/µl) of 8.60± 0.17, 7.95 ± 0.29, and 8.10 ± 0.13, respectively in normal calving, maternal, and foetal dystocia buffaloes and showed a non significant decrease in both maternal and foetal dystocia buffaloes when compared to normal calved buffaloes.

Amer and Hashem (2008) reported the mean total erythrocyte count of 8.09 ± 0.32 and 6.78 ± 0.15 (10^6/µl) in buffaloes without and buffaloes with uterine torsion respectively and the mean total erythrocyte were significantly lower in buffaloes with uterine torsion as compared to the buffaloes without torsion. Sattar and Mirza (2009) reported the mean red blood cell (RBC) count of 4.72 ± 0.29 (10^6/µl) in Holstein-Friesian and Jersey parturient cows. Ahmed *et al*. (2009) reported 4.21 ± 0.11 and 5.57 ± 0.11 (10^6/µl) of total RBC count respecting in normally calved buffaloes with and without placental retention and observed a significant decrease in the RBC count in buffaloes with placental retention.

Skuja and Antane (2010) compared haematological indices in normal parturient cows and cows with retained fetal membranes and reported the mean total erythrocytes count (10^6/µl) of 6.34 ± 0.18 and 6.55 ± 0.008 respectively in normal parturient cows and cows with retained foetal membranes. No significant variations were reported in the total erythrocytes count between cows having retention of foetal membranes as compared to the cows without retained foetal membranes.

Ali *et al.* (2011) in their investigations in buffaloes with uterine torsion to characterize the related alterations in blood constituents reported that the mean red blood

cells (10^6/µl) count of 6.10 ± 2.20 and 5.90 ± 1.90 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. There were no significant differences in the mean values of red blood cells counts between buffaloes with uterine torsion and normal pregnant buffalo cows.

Yıldız *et al*. (2011) recorded the mean red blood cell counts (RBC) (10^6/µl) in normal parturition cows and cows with dystocia as 7.51 ± 0.31 and 7.52 ± 0.69, respectively, and mean red blood cell count did not differ between the two groups.

Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean erythrocyte count of 7.45 ± 0.71 and 8.14 ± 0.67 (10^6/µl) respectively in cows before and after relieving dystocia. The mean RBC count was found to be significantly increased following relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia.

2.2. Haemoglobin concentration (Hb)

Yiltenburg *et al*. (1991) reported the mean haemoglobin concentration in cows 1-2 days before and at calving to be 7.70 ± 0.40 and 8.60 ± 0.90 (mmol /l) respectively. A statistically significant difference was found haemoglobin concentration in the dams between week 1 and 2 before and at delivery. The previous study also reported that in cows (Junid and Krad, 1987) maternal haemoglobin increased at the time of birth as compared to the values measured during the last weeks of pregnancy. Physiological changes during pregnancy and the stress of delivery have been mentioned as possible causes for these haematological changes. Phogat *et al*. (1991) found to be marginally low

levels (9.84 ± 0.29 g/dL) in torsion affected buffaloes as compared to the control group of buffaloes (9.96 ± 0.14 g/dL) on the day of parturition.

Kaur and Singh (1993) reported the mean haemoglobin concentration (g/dL) of 10.20 ± 0.30, 12.20 ± 0.20, 11.30 ± 1.30, and 11.50 ± 0.20 in buffaloes with uterine torsion, genital prolapse, dystocia and normal calving buffaloes respectively. The haemoglobin levels were found be lower in uterine torsion and buffaloes affected with dystocia. Kaur and Singh (1993) reported a significant decrease in haemoglobin concentration in buffaloes with genital prolapse as compared to the normal control group of buffaloes.

Steinhardt *et al*. (1994) reported that haemoglobin concentration increased several weeks before parturition and reached its highest value shortly after birth. While in dystocia cows no difference in haemoglobin values of the cows when compared to the normal calving cows.

Klinkon and Zadnik (1999) found the highest mean haemoglobin concentrations of 12.77 ± 9.03 g/dL from the samples taken on the day of parturition in Black and White dairy cows. Prabhakar *et al*. (1999) observed mean haemoglobin concentration of 11.80 ± 0.09 g/dl in buffaloes on the day of calving.

Tiwari *et al*. (2001) observed the mean haemoglobin concentration of 10.06 ± 0.10 and 9.93 ± 0.07 g/dl in the normal parturient cows and in cows with retained placenta respectively and the haemoglobin concentration did not differ between normal calving and cows with cows retained placenta.

Ahmed *et al*. (2005) observed the haemoglobin concentration of 11.59 ± 0.98, 10.66 ± 1.33 and 14.05 ± 0.84 g/dL respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. A significant decrease in haemoglobin concentration was observed in buffaloes with vaginal prolapse and uterine prolapse as compared to the control group.

Prabhakaran *et al*. (2006) reported a mean haemoglobin level of 12.00 ± 0.59, 10.00 ± 0.57 and 11.50 ± 0.70 g/dL respectively in normal calving buffaloes, buffaloes with maternal and fetal causes of dystocia. The haemoglobin concentrations in buffaloes with maternal dystocia were significantly lower than fetal dystocia buffaloes and were not significant when compared to the normally calved buffaloes.

Amer and Hashem (2008) reported the mean haemoglobin concentration of 12.09 ± 0.51 and 9.59 ± 0.09 g/dL in buffaloes without and with uterine torsion respectively and the mean total erythrocytes were significantly lower in buffaloes with uterine torsion as compared to the buffaloes without torsion. Sattar and Mirza (2009) observed the mean haemoglobin concentration in Holstein-Friesian and Jersey parturient cows to be 10.82 ± 0.38 (g/dL).

Ahmed *et al*. (2009) reported 14.90 ± 0.34 and 11.51 ± 0.28 g/dl of haemoglobin concentration in normally calved buffaloes with and without placental retention a significant decrease in the haemoglobin concentration in buffaloes with placental retention.

Ali *et al*. (2011) in their investigations in buffaloes with uterine torsion to characterize the related alterations in blood constituents reported that the mean haemoglobin (g/dL) concentration of 11.10 ± 2.20 and 11.80 ± 2.30 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. There were no significant differences in the mean haemoglobin (g/dL) concentration between buffaloes with uterine torsion and normal pregnant buffalo cows.

Yıldız *et al*. (2011) recorded the mean haemoglobin concentration (g/dL) in normal parturition cows and cows with dystocia as 10.59 ± 0.66 and 10.27 ± 0.66, respectively, and there was no difference between the two groups.

Skuja and Antane (2010) compared haematological indices in normal parturient cows and cows with retained foetal membranes and reported the mean haemoglobin (g/dL) of 10.86 ± 0.22 and 10.68 ± 0.13 respectively in normal parturient cows and cows with retained fetal membranes. No significant variations were reported in the haemoglobin value between cows having retention of foetal membranes as compared to the cows without retained foetal membranes.

Yuksel *et al*. (2011) evaluated the haemoglobin profile before and after parturition in cows suffering from dystocia and reported the mean concentration of 10.37 ± 0.67 and 9.90 ± 0.48 g/dL respectively in cows before and after relieving dystocia. The haemoglobin concentration decreased significantly after relieving dystocia in cows and the decrease changes in the haemoglobin was attributed due to dystocia.

2.3. Packed cell volume (PCV)

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean PCV levels (%) of 29.50 ± 0.80, 33.00 ± 1.50, 33.80 ± 1.20, and 34.00 ± 1.00 respectively in buffaloes uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean PCV level was found to be significantly lower in buffaloes with uterine torsion.

Raajora and Pachaurf (1994) reported that blood profiles in pre-parturient and post-parturient cows and in milk-fever cases observed that the packed-cell volume (mmol/liter) on pre-parturient week was 0.29 ± 0.022 and the packed-cell volume (mmo1/liter) on the post-parturient week was 0.267 ± 0.011.

Klinkon and Zadnik (1999) recorded the highest mean packed cell volume (PCV) value of 0.38 ± 0.04 (mmol/l) in cows at parturition. Prabhakar *et al*. (1999) observed mean packed cell volume (PCV) of 34.80 ± 0.66 per cent in buffaloes on the day of calving. Prabhakar *et al*. (2000) observed significantly low levels of PCV in dystocia affected buffaloes at presentation as compared to the normally calving buffaloes.

Ahmed *et al*. (2005) observed the mean (%) packed cell volume (PCV) of 35.54 ± 2.26, 36.00 ± 2.24 and 42.10 ± 2.23 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. A highly significant decrease in PCV was observed in buffaloes with vaginal prolapse and uterine prolapse as compared to the control group.

Prabhakaran *et al.* (2006) reported the mean packed cell volume concentrations of 34.50 ± 0.29 %, 32.62 ± 0.29 %, and 33.10 ± 0.52 %, respectively in normal calving, maternal, and foetal dystocia buffaloes and showed a non significant decrease in both maternal and foetal dystocia buffaloes when compared to the normal calved buffaloes.

Amer and Hashem (2008) reported the mean packed cell volume of 36.25 ± 0.49 and 31.37 ± 0.60 (%) in buffaloes without and with uterine torsion respectively and the mean packed cell volume was significantly lower in buffaloes with uterine torsion as compared to the buffaloes without torsion. Sattar and Mirza (2009) reported the mean PCV value of 30.38 ± 1.12 % Holstein-Friesian and Jersey parturient cows.

Ahmed *et al*. (2009) reported 31.80 ± 0.37 % and 36.62 ± 0.18 % of PCV concentration in normally calved buffaloes with and without placental retention and the PCV concentration in buffaloes with placental retention showed a significant decrease. Skuja and Antane (2010) compared haematological indices in normal parturient cows and cows with retained foetal membranes and reported the mean PCV (%) of 30.88 ± 0.57 and 30.83 ± 0.39 respectively in normal parturient cows and cows with retained foetal membranes. No significant variations were reported in the PCV value between cows having retention of foetal membranes as compared to the cows without retained fetal membranes.

Yıldız *et al*. (2011) recorded the mean packed cell volume or haematocrit value (%) in normal parturition cows and cows with dystocia as 35.37 ± 4.26 and 32.40 ± 4.91, respectively, and the mean packed cell volume was significantly higher in normal parturition cows as compared to the cows with dystocia**.**

Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean packed cell volume of 35.70 ± 4.29 and 30.81 ± 4.17 per cent respectively in cows before and after relieving dystocia. The haematocrit concentration decreased significantly after relieving dystocia in cows and those changes were attributed due to dystocia.

Ali *et al*. (2011) in their investigated the alterations in PCV levels in buffaloes with uterine torsion and reported that the mean haematocrit (%) level of 35.00 ± 6.70 and 32.10 ± 9.30 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. The volumes did not vary significantly with uterine torsion and normal pregnant buffalo cows.

2.4. Mean corpuscular value (MCV)

Kaur and Singh (1993) reported the mean MCV concentration (fl) of 55.20 ± 2.10, 50.50 ± 1.20, 56.80 ± 4.40, and 50.30 ± 1.70 respectively in buffaloes uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean MCV concentration was found to be significantly higher in buffaloes with uterine torsion.

Ahmed *et al*. (2005) observed the mean MCV values (fl) of 64.82 ± 6.73, 56.20 ± 5.33 and 69.39 ± 6.98 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. However, no difference in mean MCV values were observed between vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes.

Amer and Hashem (2008) reported the MCV value of 34.62 ± 0.02 and 34.37 ± 0.60 (%) in buffaloes without and with uterine torsion respectively and the mean MCV values did not differ significantly between buffaloes with and without torsion. Sattar and Mirza (2009) observed the mean MCV levels in Holstein-Friesian and Jersey parturient cows to be 65.26 ± 1.96 (fl).

Skuja and Antane (2010) compared MCH level in normal parturient cows and cows with retained foetal membranes and reported the mean MCV (fl) of 49.10 ± 1.05 and 47.08 ± 0.51 respectively in normal parturient cows and cows with retained foetal membranes. No significant variations were observed in the MCV values between cows having retention of foetal membranes and cows without retained foetal membranes.

Yıldız *et al*. (2011) recorded the mean corpuscular volume (MCV) (fl) in normal parturition cows and cows with dystocia as 53.35 ± 7.67 and 58.66 ± 6.22, respectively and the mean corpuscular volume was significantly higher cows with dystocia as compared to the normal parturition cows.

Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean corpuscular volume (MCV) value of 58.42 ± 6.55 and 52.17 ± 6.88 fl respectively in cows before and after relieving dystocia. The MCV concentration decreased significantly after relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia. Ali *et al*. (2011) related alterations in blood constituents with uterine torsion reported that the mean corpuscular volume (fl) level of 61.10 ± 14.00 and 52.90 ± 3.50 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively.

There were no significant differences in the mean values of (MCV) between buffaloes with uterine torsion and normal pregnant buffalo cows.

2.5. Mean corpuscular hemoglobin concentration (MCHC)

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean MCHC concentrations (g/dl) of 35.10 ± 0.50, 37.40 ± 2.50, 34.10 ± 0.60, and 33.80 ± 0.30 respectively in buffaloes uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean MCHC concentrations did not vary significantly among the groups of buffaloes investigated.

Ahmed *et al*. (2005) observed the mean MCHC values (g/dl) of 32.73 ± 3.31, 29.90 ± 4.94 and 33.29 ± 2.32 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. However, no difference in mean MCHC value was observed between vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes.

Amer and Hashem (2008) reported the MCHC value of 34. 29 ± 1.34 and 30.99 ± 1.29 (%) in buffaloes without and with uterine torsion respectively and the mean MCHC value did not differ significantly between buffaloes with and without torsion.

Sattar and Mirza (2009) observed the mean MCHC count in Holstein-Friesian and Jersey parturient cows to be 35.75±0.99 g/dL.

Skuja and Antane (2010) compared haematological indices in normal parturient cows and cows with retained fetal membranes and reported the mean MCHC value (g/dL) of 35.21 ± 0.35 and 34.73 ± 0.08 respectively in normal parturient cows and cows

with retained foetal membranes. No significant variations were observed in the MCH values between cows having retention of fetal membranes and cows without retained foetal membranes.

Yıldız *et al*. (2011) recorded the mean corpuscular haemoglobin concentration (MCHC) (g/dL) in normal parturition cows and cows with dystocia as 33.18 ± 3.60 and 29.41 ± 3.72, respectively, and the mean corpuscular haemoglobin concentration was significantly higher in normal parturition cows as compared to the cows with dystocia.

Ali *et al*. (2011) in their studies in buffaloes with dystocia due to uterine torsion reported significant decreases in mean corpuscular haemoglobin concentration in the affected buffaloes. Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean corpuscular haemoglobin (%) value of 29.47 ± 3.97 % and 32.70 ± 4.35 % respectively in cows before and after relieving dystocia. The mean corpuscular haemoglobin increased significantly following relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia. Ali *et al*. (2011) reported the mean corpuscular haemoglobin concentration (%) of 32.40 ± 6.70 and 38.30 ± 4.10 in dystocia affected buffalo-cows due to uterine torsion and normal pregnant buffalo cows near term respectively. Significant decreases in mean corpuscular haemoglobin concentration in buffaloes with uterine torsion were observed.

2.6. Mean corpuscular hemoglobin value (MCH)

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean MCH concentrations (pg) 19.30 ± 0.70,

18.80 ± 0.90, 19.30 ± 1.30, and 17.00 ± 0.10 respectively in buffaloes uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean MCH concentrations did not vary significantly among the groups of buffaloes investigated.

Ahmed *et al*. (2005) observed the mean MCH values (pg) of 18.75 ± 2.68, 16.60 ± 2.63 and 23.04 ± 2.32 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. A highly significant decrease in MCH values in buffaloes with vaginal prolapse and uterine prolapse was observed as compared to the control group.

Sattar and Mirza (2009) reported the highest MCV, MCH and MCHC levels in Holstein-Friesian and Jersey parturient cows. Amer and Hashem, (2008) reported the MCH value of 14.96 ± 1.67 and 14.54 ± 1.05 pg in buffaloes without and with uterine torsion respectively and the MCH did not differ significantly between buffaloes with and without torsion. Sattar and Mirza (2009) reported the mean MCH value of 23.50 ± 1.31 (pg) in Holstein-Friesian and Jersey parturient cows.

Skuja and Antane (2010) compared haematological indices, in normal parturient cows and cows with retained foetal membranes and reported the mean MCH (pg) of 17.26 ± 0.36 and 16.49 ± 0.45 respectively in normal parturient cows and cows with retained foetal membranes. The MCH values did not differ significantly between cows having retention of foetal membranes and cows without retained foetal membranes.

Ali *et al.* (2011) related alterations in blood constituents in buffaloes with uterine torsion to characterize reported that, the MCH concentration of 19.60 ± 5.10 and 20.40 ±

2.60 pg in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. There were no significant differences in the MCH between buffaloes with uterine torsion and normal pregnant buffalo cows.

Yıldız *et al*. (2011) recorded the mean corpuscular hemoglobin (MCH) (pg) in normal parturition cows and cows with dystocia as 17.46 ± 0.95 and 17.09 ± 1.55, respectively and there was no difference between the two groups. Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean corpuscular haemoglobin concentration (pg) values of 17.03 ± 1.55 and 16.79 ± 0.79 respectively in cows before and after relieving dystocia. The mean corpuscular haemoglobin concentration decreased significantly after relieving dystocia in cows and the change in the levels was attributed due to dystocia.

2.7. Total WBC count

Phogat *et al*. (1991) recorded mean total leucocytes count (10^3/µl) of 11.30 ± 0.24 (10^3/µl) and 10.05 ± 0.49 (10^3/µl) respectively in buffaloes with uterine torsion and in control group of buffaloes the day of parturition. An increase in total leucocytes count was noticed in torsion group of buffaloes as compared to the control group of buffaloes on the day of parturition. Mallard *et al.* (1998) and Meglia *et al.* (2005) reported higher WBC and lower lymphocytes in parturient cows.

Klinkon and Zadnik (1999) recorded the highest total leukocyte (WBC) count was recorded at parturition 9.25 ± 3.53 (10^3/µl) in Black and White dairy cows. Rakuljic-Zelov and Zadnik (2002), in their studies on uterine torsion in cows and the haematological and biochemical profile revealed significant changes in the white blood

cells count were observed, including leucocytosis, neutrophilia and lymphopenia. The last two are the consequence of increased blood concentration of ACTH and adrenaline.

Ray *et al*. (2004) reported the mean values of total leucocytes (10^3/µl) of 7.70 ± 0.72 and 8.06 ± 0.12 respectively for cows with retained foetal membranes (RFM) and normal parturient cows. The mean leucocytes count did not vary significantly between the cows with RFM and normal parturient cows.

Ahmed *et al*. (2005) reported the mean WBC (10^3/µl) count of 12.83 ± 0.75, 12.80 ± 1.65 and 6.63 ± 0.56 respectively in buffaloes with vaginal prolapse, uterine prolapse and in the control group of buffaloes. A significant increase in WBC count was observed in vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes. However, no difference in WBC count was observed between vaginal prolapsed and uterine prolapsed buffaloes.

Prabhakaran *et al.* (2006) reported the mean total leucocytes count of 6.75 ± 0.14(10^3/µl), 10.25 ± 0.28 (10^3/µl), and 8.75 ± 0.03 (10^3/µl), respectively in normal calving, maternal and foetal dystocia buffaloes and showed a significant increase in both maternal and foetal dystocia buffaloes when compared to the normal calved buffaloes.

Pandey *et al*. (2007) compared haematological indices, in normal parturient buffaloes and buffaloes with retained foetal membranes and reported the mean total leucocytes count (10^3/µl) of 7.77 ± 0.19 and 7.58 ± 0.18 respectively in normal parturient buffaloes and buffaloes with retained foetal membranes. The total leucocytes count for buffaloes having retention of foetal membranes and normal parturient buffaloes were

non–significantly different. Amer and Hashem (2008) reported the total leukocyte count of 9.27 ± 0.29 and 13.10 ± 0.44 (10^3/µl) in buffaloes without and with uterine torsion respectively and the mean total leukocyte count was significantly higher in buffaloes without torsion as compared to the buffaloes with torsion.

Ahmed *et al*. (2009) reported 8.24 ± 0.90 and 6.07 ± 0.36 of Total WBC (10^3/µl) count in normally calved buffaloes with and without placental retention and leucocytosis was noticed in buffaloes with placental retention. Sattar and Mirza (2009) observed the mean WBC concentration in Holstein-Friesian and Jersey parturient cows to be 6.35 ± 0.72 (10^3/µl).

Skuja and Antane (2010) compared haematological indices, in normal parturient cows and cows with retained foetal membranes and reported the mean white blood cell (10^3/µl) of 13.94 ± 1.59 and 9.09 ± 0.76 respectively in normal parturient cows and cows with retained foetal membranes. The total leucocytes count for cows having retention of foetal membranes was found to be significantly lower as compared cows without retained foetal membranes.

Yıldız *et al*. (2011) recorded the mean total white blood cells (WBC) counts (10^3/µl) in normal parturition cows and cows with dystocia as 6.07 ± 0.32 and 6.03 ± 0.47, respectively, and mean total white blood cells count did not differ between the two groups.

Yuksel *et al*. (2011) evaluated the haematological Profile before and after parturition in cows suffering from dystocia and reported the mean total white blood cells

count of 6.12 ± 0.45 (10^3/µl) and 5.90 ± 0.29 (10^3/µl) respectively in cows before and after relieving dystocia. The mean total white blood cells count decreased significantly after relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia.

Ali *et al.* (2011) in their investigations in buffaloes with uterine torsion to characterize the related alterations in blood constituents reported that the mean white blood cells (10^3/µl) count of 10.50 ± 3.40 and 8.90 ± 3.90 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. There were no significant differences in the mean values of white blood cells between buffaloes with uterine torsion and normal pregnant buffalo cows.

2.8. Neutrophils count (%)

Phogat *et al*. (1991) reported that mean neutrophils count in buffaloes with uterine torsion was 50.63 ± 1.43 %, which was significantly higher than the mean value recorded for normal parturition buffaloes (41.34 ± 0.99 %) on the day of parturition.

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean neutrophils count (%) in of 43.20 ± 2.40, 39.30 ± 0.70, 36.30 ± 2.10 and 35.20 ± 0.80 respectively in buffaloes uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean neutrophils counts were significantly higher in buffaloes with uterine torsion and genital prolapse.

Klinkon and Zadnik (1999) evaluated the dynamics of white blood picture in dairy cows during the pre-parturient period and reported the highest mean absolute

segmented neutrophils value of 50.20 ± 13.04 in Black and White dairy cows at parturition. Tiwari *et al*. (2001) reported the mean blood neutrophils count (%) in cows with parturient complications. They observed the mean neutrophils count of 38.95 ± 0.75 and 36.87 ± 1.17 in the normal parturient cows and in cows with retained placenta respectively and the neutrophils count did not differ significantly between groups of cows investigated.

Rakuljic-Zelov and Zadnik (2002) in their studies on uterine torsion in cows and the hematological and biochemical profile revealed significant changes in the white blood cells count were observed, including leucocytosis, neutrophilia and lymphopenia. The last two changes were attributed to the consequence of increased blood concentration of ACTH and adrenaline.

Ray *et al*. (2004) reported the mean neutrophils count (%) of 25.30 ± 2.17 and 39.41 ± 0.68 respectively for cows with retained foetal membranes (RFM) and normal parturient cows. The mean neutrophils count was significantly higher in normal parturient cows as compared to the cows with RFM.

Ahmed *et al*. (2005) reported the mean per cent neutrophils count (%) of 36.00 ± 4.67, 40.29 ± 4.46 and 31.20 ± 3.46 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. A significant increase in neutrophils count was observed in vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes. However, no difference in neutrophils count was observed between vaginal prolapsed and uterine prolapsed buffaloes.

Pandey *et al*. (2007) compared haematological indices, in normal parturient buffaloes and buffaloes with retained foetal membranes and reported the mean neutrophils (per cent) of 41.00 ± 1.25 and 25.66 ± 1.22 respectively in normal parturient buffaloes and buffaloes with retained foetal membranes. The neutrophils (%) in buffaloes with retention of foetal membranes were found to be significantly lower than buffaloes having normal parturition.

Amer and Hashem, (2008) reported the total neutrophils value of 3.96 ± 0.14 and 5.82 ± 0. 07 (10^3/µl) in buffaloes without and with uterine torsion respectively and the mean neutrophils count were significantly lower in buffaloes without torsion as compared to the buffaloes with torsion. Sattar and Mirza (2009) observed the mean neutrophils count in Holstein-Friesian and Jersey parturient cows to be 32.60 ± 4.71 per cent.

Ahmed *et al*. (2009) reported 39.55 ± 2.18 and 41.08 ± 1.15 of neutrophils (%) count in normally calved buffaloes without and with placental retention. Skuja and Antane (2010) compared haematological indices, in normal parturient cows and cows with retained foetal membranes and reported the mean neutrophils (%) count of 43.44 ± 1.87 and 43.18 ± 0.70 respectively in normal parturient cows and cows with retained foetal membranes. The neutrophils values for cows having retention of foetal membranes did not differ significantly between cows with and without retained foetal membranes.

Yıldız *et al*. (2011) recorded the mean neutrophils count (%) in normal parturition cows and cows with dystocia as 26.05 ± 3.51 and 28.25 ± 1.75 respectively and the mean neutrophils count was significantly higher cows with dystocia as compared to the normal parturition cows.

Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean neutrophils count of 28.33 ± 1.35 and 28.25 ± 2.28 (%) respectively in cows before and after relieving dystocia. The mean neutrophils count decreased significantly after relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia.

Ali *et al*. (2011) in their investigations in buffaloes with uterine torsion to characterize the related alterations in blood constituents reported that the mean neutrophils (10^3/µl) count of 5.60 ± 2.10 and 4.40 ± 1.70 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. There were no significant differences in the mean values of eosinophils between the buffaloes with uterine torsion and normal pregnant buffalo cows.

2.9. Lymphocytes count (%)

Phogat *et al*. (1991) recorded the mean lymphocytes count of 36.32 ± 1.44 and 47.16 ± 0.90 per cent respectively in buffaloes affected with uterine torsion and normal parturition buffaloes. The mean lymphocytes count was significantly higher in normal parturition control buffaloes as compared to the buffaloes with uterine torsion.

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean total lymphocytes count (10^3/µl) of 14.30 ± 0.80, 13.50 ± 0.20, 11.20 ± 0.60 and 9.90 ± 1.10 respectively in buffaloes with uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean total lymphocytes count was significantly higher in buffaloes with uterine torsion, genital prolapse and dystocia.

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean lymphocytes count (%) in of 53.50 ± 2.60, 58.00 ± 1.20, 59.50 ± 1.80, and 58.30 ± 1.10 respectively in buffaloes with uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean lymphocyte count did not vary significantly among the groups of buffaloes investigated.

Klinkon and Zadnik (1999) found the lowest mean absolute lymphocytes value of 34.09 ± 11.16 at parturition in Black and White dairy cows. Tiwari *et al*. (2001) reported the mean blood lymphocytes count (%) in cows with parturient complications. They observed the mean lymphocyte count of 52.24 ± 0.80 (%) in the normal parturient cows, while it was 54.38 ± 1.18 in cows with retained placenta, the variations in the blood serum lymphocytes counts among the groups of cows did not differ significantly.

Rakuljic-Zelov and Zadnik (2002), in their studies on uterine torsion in cows and the haematological and biochemical profile revealed significant changes in the white blood cells count were observed, including leucocytosis, neutrophilia and lymphopenia. The last two are the consequence of increased blood concentration of ACTH and adrenaline.

Ray *et al*. (2004) reported the mean lymphocytes count (per cent) of 60.00 ± 1.67 and 45.38 ± 0.57 respectively for cows with retained foetal membranes (RFM) and normal parturient cows. The mean lymphocytes count varied significantly between the cows with RFM and normal parturient cows.

Ahmed *et al*. (2005) observed the mean per cent lymphocytes count (%) of 50.77 ± 4.42, 49.00 ± 4.16 and 54.20 ± 4.57 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. A significant increase in lymphocytes count was observed in vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes. However, no difference in lymphocytes count was observed between vaginal prolapsed and uterine prolapsed buffaloes.

Pandey *et al*. (2007) compared haematological indices, in normal parturient buffaloes and buffaloes with retained fetal membranes and reported the mean lymphocytes (%) of 46.33 ± 1.33 and 58.50 ± 2.04 respectively in normal parturient buffaloes and buffaloes with retained foetal membranes. The lymphocytes (%) for buffaloes with retention of foetal membranes were found to be significantly higher than the normal parturient buffaloes. Amer and Hashem (2008) reported the lymphocytes count (10^3/µl) of 4.64 ± 0.30 and 3.67 ± 0.33 in buffaloes without and with uterine torsion respectively and the mean lymphocytes count did not differ significantly between buffaloes with and without torsion.

Ahmed *et al*. (2009) reported 53.42 ± 0.29 and 60.16 ± 2.68 of lymphocytes (%) count in normally calved buffaloes with and without placental retention and significant lymphopenia was noticed in buffaloes with placental retention.

Sattar and Mirza (2009) reported the mean lymphocytes percentage of 56.70 ± 5.16 in Holstein-Friesian and Jersey parturient cows. Skuja and Antane (2010) compared haematological indices, in normal parturient cows and cows with retained fetal membranes and reported the mean lymphocytes (%) count of 42.81 ± 1.69 and 40.66 ±

0.45 respectively in normal parturient cows and cows with retained foetal membranes. The lymphocytes values for cows having retention of foetal membranes differ significantly as compared to the cows without retained foetal membranes.

Yıldız *et al.* (2011) recorded the mean lymphocytes count (%) in normal parturition cows and cows with dystocia as 66.25 ± 3.69 and 65.20 ± 2.92 respectively and there was no difference between the two groups.

Yuksel *et al.* (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean lymphocytes count (%) of 65.07 ± 2.57 and 66.85± 2.62 respectively before and after relieving dystocia in cows. The mean lymphocytes count increased significantly following relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia.

Ali *et al.* (2011) in their investigations in buffaloes with uterine torsion to characterize the related alterations in blood constituents reported that the mean lymphocytes (10^3/µl) count of 2.80 ± 1.20 and 3.90 ± 2.00 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. There were no significant differences in the mean values of lymphocytes between buffaloes with uterine torsion and normal pregnant buffalo cows.

2.10. Monocytes count (%)

Phogat *et al.* (1991) reported the mean monocytes count (%) of 4.14 ± 0.86 and 4.00 ± 0.51 respectively in uterine torsion affected buffaloes and for normal parturition control buffaloes on the day of parturition.

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean monocytes count (%) in of 2.20 ± 0.30, 1.70 ± 0.80, 2.60 ± 0.30, and 4.00 ± 0.10 respectively in buffaloes uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean monocytes count did not vary significantly among the groups of buffaloes investigated.

Tiwari *et al*. (2001) reported the mean blood monocytes count (%) of 2.89 ± 0.34 and 3.13 ± 0.45 respectively in the normal parturient cows and in cows with retained placenta. The monocytes counts among the different groups of cows did not differ significantly. Ray *et al*. (2004) reported the mean monocytes count (%) of 6.73 ± 1.46 and 7.40 ± 2.18 respectively for cows with retained foetal membranes (RFM) and normal parturient cows. The mean monocytes count did not vary significantly between the cows with RFM and normal parturient cows.

Ahmed *et al*. (2005) observed the mean per cent monocytes count of 7.92 ± 1.80, 7.42 ± 2.94 and 9.20 ± 1.55 respectively in buffaloes with vaginal prolapse, uterine prolapse and in **c**ontrol group of buffaloes. A significant increase in monocytes count was observed in vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes. However, no difference in monocytes count was observed between vaginal prolapsed and uterine prolapsed buffaloes.

Pandey *et al*. (2007) compared haematological indices, in normal parturient buffaloes and buffaloes with retained fetal membranes and reported the mean monocytes (%) of 4.83 ± 0.72 and 6.33 ± 0.80 respectively in normal parturient buffaloes and buffaloes with retained foetal membranes. The monocytes per cent had no significant

difference in buffaloes with retention of foetal membranes from that of normal parturient buffaloes.

Amer and Hashem (2008) reported the monocytes count of 0.38 ± 0.07 and 3.38 ± 0.45 (10^3/µl) in buffaloes without and with uterine torsion respectively and the mean monocytes count was significantly lower in buffaloes without torsion as compared to the buffaloes with torsion. Sattar and Mirza (2009) reported the mean monocytes percentage of 6.40 ± 0.45 in Holstein-Friesian and Jersey parturient cows.

Ahmed *et al*. (2009) reported 1.24 ± 0.60 and 3.45 ± 0.26 of monocytes (%) count in normally calved buffaloes without and with placental retention and significant monocytosis was noticed in buffaloes with placental retention.

Skuja and Antane (2010) compared haematological indices, in normal parturient cows and cows with retained foetal membranes and reported the mean monocytes (%) count of 6.75 ± 0.54 and 7.07 ± 0.34 respectively in normal parturient cows and cows with retained foetal membranes and. The monocytes values for cows having retention of foetal membranes did not differ significantly between cows with and without retained foetal membranes.

Yıldız *et al*. (2011) recorded the mean monocytes (%) count in normal parturition cows and cows with dystocia as 2.45 ± 1.39 and 3.02 ± 1.67, respectively, and there was no difference between the two groups. Ali *et al*. (2011) in their investigations in buffaloes with uterine torsion to characterize the related alterations in blood constituents reported that the mean monocytes (10^3/µl) count of 0.80 ± 0.70 and 4.40 ± 1.70 in buffaloes with

uterine torsion and normal pregnant buffalo cows near term respectively. The mean monocytes counts did not vary significantly between buffaloes with uterine torsion and normal pregnant buffalo cows.

Ali *et al*. (2011) reported the mean monocytes count (10^3/µl) of 0.80 ± 0.70 and 0.40 ± 0.40 in dystocia affected buffalo-cows due to uterine torsion and normal pregnant buffalo cows near term respectively. A significant increase in monocytes counts were observed in the buffaloes with uterine torsion and normal pregnant buffalo cows.

Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean monocytes count of 3.00 ± 1.59 (%) and 1.66 ± 0.87 (%) respectively before and after relieving dystocia in cows. The mean monocytes count decreased significantly following relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia.

2.11. Eosinophils count (%)

Phogat *et al*. (1991) studied the eosinophils count (10^3/µl) profile of torsion group was compared with control group of buffaloes on the day of parturition. The uterine torsion affected buffaloes had higher eosinophils counts 7.02 ± 0.57 (per cent) as compared to the mean values of 5.16 ± 0.47 (percent) in control group.

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean eosinophils count (%) in of 1.20 ± 0.30, 0.70 ± 0.40, 1.20 ± 0.30, and 2.40 ± 0.10 respectively in buffaloes uterine torsion, genital

prolapse, dystocia and normal calving buffaloes. The mean eosinophils count did not vary significantly among the groups of buffaloes investigated.

Klinkon and Zadnik (1999) found the lowest mean absolute eosinophils value of 409.00 ± 379.00 at parturition in Black and White dairy cows.

El-Ghoul *et al.* (2000) observed no significant differences in leukocytes except for a decrease in eosinophils after calving. This change was previously reported and may result from the stress (cortisol mediation) associated with parturition.

Tiwari *et al*. (2001) reported the mean eosinophils count (%) in the normal parturient cows and in cows with retained placenta as 4.89 ± 0.31 and 4.23 ± 0.45 and the variations in the eosinophils levels among the different groups of cows did not differ significantly.

Ray *et al*. (2004) reported the mean eosinophils count (percent) of 8.79 ± 1.11 and 12.28 ± 1.34 respectively for cows with retained foetal membranes (RFM) and normal parturient cows. The mean eosinophils count was significantly higher in the cows with RFM as compared to the normal parturient cows.

Ahmed *et al*. (2005) observed the mean eosinophils count (%) of 4.08 ± 2.00, 3.00 ± 1.41 and 0.80 ± 0.92 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. However, no difference in eosinophils count was observed between vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes.

Pandey *et al*. (2007) compared haematological indices, in normal parturient buffaloes and buffaloes with retained foetal membranes and reported the mean eosinophils (percent) of 7.66 ± 0.69 and 9.33 ± 0.77 respectively in normal parturient buffaloes and buffaloes with retained foetal membranes. The eosinophils percents had no significant difference in buffaloes with retention of foetal membranes from that of normal parturient buffaloes.

Amer and Hashem (2008) reported the eosinophils count of 0.46 ± 0.07 and 0.19 ± 0.02 (10^3/µl) in buffaloes without and with uterine torsion respectively and the mean eosinophils count was significantly higher in buffaloes without torsion as compared to the buffaloes with torsion.

Ahmed *et al*. (2009) reported 1.25 ± 0.56 and 1.96 ± 0.48 of eosinophils (%) count in normally calved buffaloes without and with placental retention. Sattar and Mirza (2009) reported the mean eosinophils count of 3.90 ± 0.75 per cent in Holstein-Friesian and Jersey parturient cows.

Skuja and Antane (2010) compared haematological indices, in normal parturient cows and cows with retained foetal membranes and reported the mean eosinophils (%) count of 2.38 ± 0.53 and 2.81 ± 0.28 respectively in normal parturient and cows with retained foetal membranes. The eosinophils values for cows having retention of foetal membranes did not differ significantly between cows with and without retained foetal membranes.

Yıldız *et al*. (2011) recorded the mean eosinophils count (per cent) in normal parturition cows and cows with dystocia as 2.85 ± 2.25 and 2.37 ± 1.33, respectively, and there was no difference between the two groups.

Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean eosinophils count of 2.48 ± 1.36 % and 2.62 ± 1.33 % respectively in cows before and after relieving dystocia. The mean eosinophils count increased significantly following relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia.

Ali *et al*. (2011) in their investigations in buffaloes with uterine torsion to characterize the related alterations in the blood constituents reported that the mean eosinophils (10^3/µl) count of 1.20 ± 2.40 and 0.20 ± 0.10 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. There were no significant differences in the mean values of eosinophils between buffaloes with uterine torsion and normal pregnant buffalo cows.

2.12. Basophils count (%)

Phogat *et al*. (1991) compared the basophils counts of buffaloes with uterine torsion and normal parturition and recorded increase basophils count (2.01 ± 0.49) buffaloes with uterine torsion as compared to the mean value of 1.84 ± 0.30 in normal parturition control buffaloes on the day of parturition.

Kaur and Singh (1993) investigated the haematological profiles in buffaloes with reproductive disorders and reported the mean basophils count (%) in of 0.10 ± 0.90, 0.30

± 0.21, 0.40 ± 0.17, and 0.02 ± 0.03 respectively in buffaloes uterine torsion, genital prolapse, dystocia and normal calving buffaloes. The mean basophils count did not vary significantly among the groups of buffaloes investigated.

Tiwari *et al*. (2001) reported the mean blood basophils count (%) of 0.40 ± 0.10 in the normal parturient cows, whereas, in cows with retained placenta, the respective values registered was 0.50 ± 0.17 and the basophils counts did not vary significantly among the different groups of cows studied. Tiwari *et al*. (2001) reported the mean levels (g/dl) of haemoglobin, neutrophils, lymphocytes, monocytes, eosinophils and basophils counts in normal calving Frieswal cows respectively as 10.06 ± 0.10 (g/dL), 38.95 ± 0.75 per cent, 52.24 ± 0.80 per cent, 2.89 ± 0.34 per cent, 4.89 ± 0.31 per cent, and 0.40 ± 0.10 per cent.

Ray *et al*. (2004) reported that the mean basophils count (%) of 5.12 ± 1.64 and 6.69 ± 1.32 respectively for cows with retained foetal membranes (RFM) and normal parturient cows. The mean basophils count did not vary significantly between the cows with RFM and normal parturient cows.

Ahmed *et al*. (2005) observed the mean per cent basophils count of 1.38 ± 1.50, 0.57 ± 0.54 and 0.80 ± 0.92 respectively in buffaloes with vaginal prolapse, uterine prolapse and in the control group of buffaloes. However, no difference in the basophils count was observed between the vaginal prolapsed and uterine prolapsed buffaloes as compared to the control group of buffaloes.

Pandey *et al*. (2007) compared the haematological indices in normal parturient buffaloes and buffaloes with retained foetal membranes and reported the mean basophils (per cent) of 0.16 ± 0.15 and 0.16 ± 0.15 respectively in normal parturient buffaloes and buffaloes with retained foetal membranes. The basophils percents had no significant difference in the buffaloes with retention of foetal membranes from that of normal parturient buffaloes.

Ahmed *et al*. (2009) reported 1.25 ± 0.56 and 1.96 ± 0.48 of basophils (%) count in normally calved buffaloes without and with placental retention. Sattar and Mirza (2009) reported the mean basophils count of 0.40 ± 0.22 per cent in Holstein-Friesian and Jersey cows' parturient cows.

Skuja and Antane (2010) compared haematological indices in normal parturient cows and cows with retained foetal membranes and reported the mean basophils (%) count of 1.00 ± 0.00 and 1.00 ± 0.00 respectively in normal parturient cows and cows with retained foetal membranes. The basophils (%) values for cows having retention of foetal membranes did not differ significantly between the cows with and without retained foetal membranes. Yıldız *et al*. (2011) recorded the mean basophils count (per cent) in normal parturition cows and cows with dystocia as 0.90 ± 1.02 and 1.11 ± 0.67, respectively, and there was no difference between the two groups.

Yuksel *et al*. (2011) evaluated the haematological profile before and after parturition in cows suffering from dystocia and reported the mean basophils count of 1.07 ± 0.67 (%) and 0.96 ± 0.80 (%) respectively before and after relieving dystocia in cows.

The mean basophiles count decreased significantly following relieving dystocia in cows and the changes in the haematological parameters was attributed due to dystocia.

Ali *et al*. (2011) reported the mean basophils count (10^3/µl) of 0.00 ± 0.00 and 0.00 ± 0.00 in dystocia affected buffalo-cows due to uterine torsion and normal pregnant buffalo cows near term respectively. No significant differences in the basophils counts between the buffaloes with uterine torsion and normal pregnant buffalo cows were reported.

2.13. Serum calcium concentrations *(*mg/dL**)**

Bostedt (1974) observed that the serum calcium concentrations in cows and heifers with dystocia were higher than those in cows with normal parturition.

In studies (Shukla *et al*., 1983 and Zhang *et al*., 1992) carried out on blood samples taken from cows prior to parturition, 24 hours after parturition and post partum first week, They observed the serum calcium concentration of 6.27 ± 0.18 (mg/dL) in RFM cows, which was lower than that in cows without RFM 7.40 ± 0.18 (mg/dL).

Hypocalcaemia was observed in cows with cervico-vaginal or uterine prolapse as compared to the non prolapsed cows (Marques *et al*. 1996, Salmanoglu and Salmanoglu, 1998) and buffaloes (Mandali *et al*. 2002 and Ahmed *et al*. 2005), contrary to the above reports, Paul *et al*. (2000) did not observe any variations in the serum calcium concentrations of cows with or without cervico-vaginal or uterine prolapse.

Sevcik *et al*. (1980) observed that the blood serum calcium, concentrations did not differ between normal cows and those with dystocia. Sevcik *et al*. (1980) observed that

the blood serum calcium concentrations did not differ between normal cows and those with dystocia. On the other hand, Bostedt (1974) observed that the serum Ca and Mg concentrations in cows and heifers after dystocia were higher than those in cows with normal parturition., in a yet other study, no differences were seen in respect of Ca, Zn, Mg, K or Na levels between the normal cows and those with dystocia(Akar and Yildiz, 2005)

Altıntafl and Fidancı (1993) reported that normal serum calcium concentrations for dairy cows as 9.7-12.4 (mg/dl). Sharma *et al*. (1991) also reported that the calcium values (mg/100ml) were estimated as 10.41 ± 0.12 (control group), 9.23 ± 0.14 in retained after birth cows, 8.75 ± 0.48 in cow with dystocia. Sharma *et al*. (1991) reported that the estimated values in cow with dystocia were significantly lower ($P<0.005$) as compared to the control group.

Sharma *et al*. (1991) investigated the blood serum macro mineral concentrations in cows with parturient complications. They recorded the mean blood serum concentration of 10.41 ± 0.12, 9.23 ± 0.14 and 8.75 ± 0.48 mg/dL in the normal parturient cows, retained placenta and dystocia cows respectively. The estimated blood serum calcium levels in cows with retained foetal membranes and dystocia were significantly lower as compared to the normal parturient cows.

Mohanty *et al.* (1994) reported that the levels of calcium blood with relation to retention of placenta and on the day of parturition in bovines that the serum calcium (mg/%) on the day of parturition without retention of foetal membranes 9.17 ± 0.20 and the serum calcium (mg/%) on the day of parturition with retention of foetal membranes

was 8.32 ± 0.25. A highly significant difference was observed (P<0.01) in the calcium level of cows with retention of placenta and the day of parturition reported.

Bari *et al*. (1996) reported the mean serum calcium concentration of 1.66 ± 0.01 in cows with retained placenta. Where as in cows without retained placenta the calcium concentration was 2.15 ± 0.04 (mmol/1). The cows with retained placenta had significantly (P<0.05) lower levels of serum calcium, magnesium and phosphorus as compared cows without retained placenta.

Bari *et al*. (1996) recorded that the serum calcium concentrations of 6.65 and 6.37 (mg/dl) respectively in dairy cows during and 12 / h after parturition, respectively. Bari *et al*. (1996) reported the mean serum calcium concentration was 6.89, 6.65 and 6.37 (mg/dl) one week before, during and 12 / h after parturition, respectively, On the other hand, these values were reported as 9.09, 8.61 and 8.53 (mg/dL), respectively, in cows without RFM and concluded that calcium affected the development of RFM in cows.

Akar *et al*. (2005) reported that serum calcium (Ca) level of 7.93 ± 0.38 (mg/dL) and 8.51 ± 0.39 (mg/dL) in normal calving cows with and without retained placenta, respectively, and the difference between the groups was not significant.

Ocal *et al.* (1999) recorded the mean blood serum calcium concentration of 9.12 ± 0.17 (mg/dL) and 9.53 ± 0.34 (mg/dL) respectively in cows with retained placenta and cows without retained placenta following normal parturition and serum calcium concentrations did not differ significantly between the cows with and without retained placenta.

Patel *et al*. (1999) reported that the mean value of serum calcium, in buffaloes with RFM, on 1st day post partum, was significantly ($P<0.05$) lower 8.24 ± 0.08 (mg / %) than in the control animals 9.8 ± 0.24 (mg / %).

Kumar *et al*. (2000) observed the blood serum calcium concentration of 10.56 ± 0.77 (mg/dL) and 11.21 ± 0.93 (mg/dL) in pre-partum and post-partum cows respectively. While the respectively serum calcium concentrations for buffaloes during the respective periods were 11.83 ± 1.17 mg/dl and 11.66 ± 1.14 mg/dL.

Goff *et al*. (1999, 2000, 2004) reported that the drop in serum calcium concentrations that occurs at parturition or in the 1st days after calving.

Hypocalcaemia was observed in cows with cervico-vaginal or uterine prolapse as compared to the non prolapsed cows (Marques *et al*., 1996, Salmanoglu and Salmanoglu., 1998) and buffaloes (Mandali *et al*., 2002 and Ahmed *et al*., 2005), contrary to the above reports Paul *et al*. (2000) did not observe any variations in the serum calcium concentrations of cows with or without cervico-vaginal or uterine prolapse.

Hussain *et al*. (2001) reported that the mean blood calcium concentration in buffaloes cows at parturition time as 6.90 ± 0.02 mg/dL. Tiwari *et al*. (2001) reported the mean blood serum calcium levels (mg / %) in cows with parturient complications. They observed the mean calcium concentration of 10.46 ± 0.29 (mg/dL) in the normal parturient cows, whereas, in cows with retained placenta, the respective values registered was 9.92 ± 0.10 (mg/dL), and the variations in the blood serum calcium concentration among the different groups of cows did not differ significantly.

Hussain *et al*. (2001) reported the mean serum calcium, magnesium, and phosphorus concentrations in Nili-Ravi buffaloes as 6.90, 2.61 and 4.76 (mg/dL), respectively at the time of parturition. The concentrations of calcium (Ca) and phosphorus (P) were significantly lower at the time of parturition. The value of magnesium (Mg) was significantly higher at the time of parturition.

Mandali *et al*. (2002) in their investigations on blood biochemical profiles in buffaloes with pre-parturient disorders, observed the mean blood serum calcium concentration of 8.07 ± 0.21 (mg/dL), 5.52 ± 0.12 (mg/dL), 6.27 ± 0.13 (mg/dL) and 6.03 ± 0. 13 (mg/dL), respectively in normal parturition, buffaloes with RFM, pre-partum genital prolapsed and post-partum genital prolapsed buffaloes respectively.

Akar *et al*. (2002) noted the serum calcium levels in the normal parturition cows with or without retained placenta and reported 7.93 ± 0.38 (mg/dL) and 8.51 ± 0.39 (mg/dL) respectively and observed no difference in the calcium concentration of between the cows with or without retained placenta. Ray *et al*. (2004) reported the mean blood serum calcium concentration (mg/dL) of 8.55 ± 0.08 and 8.75 ± 0.10 respectively for cows with retained foetal membranes (RFM) and normal parturient cows. The mean blood serum calcium concentration did not vary significantly between the cows with RFM and normal parturient cows.

Ahmed *et al*. (2005) reported the mean serum calcium concentration of 6.48 ± 1.04 (mg/dL), 6.30 ± 1.12 (mg/dL) and 10.96 ± 0.95 (mg/dL) respectively in buffaloes with vaginal prolapse uterine prolapse and in control group of buffaloes. No significant difference in serum calcium levels was observed between vaginal prolapsed and uterine

prolapsed buffaloes, but the serum calcium concentrations were significantly lower in buffaloes suffering with genital prolapse.

Akar and Yildiz (2005) reported significantly higher concentrations of blood serum calcium 9.41 ± 0.39 (mg/dL) in normal parturition cows than those cows with RFM 6.48 ± 0.32 (mg/dL).

Semacan and Sevun (2005) compared the liver function of cows with retained placenta with that of cows without retained placenta and reported the mean blood serum calcium concentration of 7.89 ± 0.10 and 8.75 ± 0.21 (mg/dL) respectively in cows with and without retained placenta. A significant decrease in serum levels of calcium were observed in cows with retained placenta as compared to cows without placental retention.

Akar and Yildiz (2005) reported the mean calcium concentration (mg/dL) of 7.51 ± 1.17 and 9.96 ± 1.09 respectively in cows with dystocia and normal parturition without retention of fetal membranes. Akar and Yildiz (2005) in their studies on effect of type of parturition on retention of fetal membranes reported the mean blood serum calcium concentrations of 6.47 ± 0.51 and 6.48 ± 0.39 (mg/dL) respectively in RFM cows with dystocia and normal parturition cows. While in dystocia cows and normal parturition cows without RFM the respectively concentrations were 7.51 ± 1.17 and 9.96 ± 1.09 (mg/dL). They concluded that the blood serum calcium concentrations did not vary significantly between the cows with RFM and without RFM depending on the type of parturition.

Pandey *et al*. (2007) compared blood biochemical indices, in normal parturient buffaloes and buffaloes with retained foetal membranes and reported the mean calcium (mg/dL) of 7.98 ± 0.07 and 5.53 ± 0.14 respectively in normal parturient buffaloes and buffaloes with retained fetal membranes. The mean blood serum calcium concentrations were significantly lower in buffaloes with retention of foetal membranes than normal parturient buffaloes.

Hashem and Amer (2008) compared blood biochemical indices, in cows which delivered placenta normally and cows affected with retained fetal membranes (RFM) and reported the mean blood serum calcium concentrations of 10.12 ± 1.22 (mg/dL) and 6.00 ± 0.21 (mg/dL) respectively in cows which delivered placenta normally and cows affected with retained fetal membranes. Cows with RFM showed a significantly decreased concentration of calcium concentration as compared to the cows which delivered placenta normally.

Ozyurtlu *et al*. (2008) observed the mean concentration of calcium (Ca) as 7.93 ± 0.36 and 9.26 ± 0.32 (mg/dL) in normally calved Brown-Swiss cows with and without retained placenta respectively and the levels of serum calcium were found lower in cows with RFM than those without RFM.

Akhtar *et al*. (2008) reported the mean serum calcium concentration in buffaloes suffering with vaginal prolapse as 6.75 ± 0.13 mg/dL, while in healthy pregnant counterparts it was 9.12 ± 0.16 mg/dL. Mean serum calcium concentration was significantly lower in buffaloes suffering with vaginal prolapse compared with that of healthy pregnant buffaloes.

Singh *et al*. (2009) investigated the blood biochemical profiles of buffaloes profiles before and after obstetrical maneuvering and reported the mean blood serum calcium concentration of 7.61 ± 0.11 and 8.74 ± 0.12 mg/dL respectively in the dystocia buffaloes before and after obstetrical maneuvering. Further, they observed that the calcium concentration exhibited significantly ($P<0.05$) high values after obstetrical maneuvering than before instituting any treatment.

Skuja and Antane (2010) compared haematological indices in normal parturient cows and cows with retained foetal membranes and reported the mean blood serum calcium concentration of 2.10 ± 0.08 and 2.10 ± 0.04 mmol/l respectively in normal parturient cows and cows with retained foetal membranes. The serum calcium concentration for cows having retention of foetal membranes did not differ significantly between cows with and without retained foetal membranes.

Yokus *et al*. (2010) in their comparative studies on the blood serum biochemical profiles in dystocia and normal parturition cows at pre-partum and post-partum, reported the mean blood serum calcium concentration of 9.06 ± 1.02 and 9.21 ± 1.66 mg/dL respectively in dystocia cows during pre-partum and post-partum periods respectively. While similar concentrations respectively during pre-partum and post-partum periods in normal parturition cows were found to be 8.7 ± 0.84 and 9.04 ± 1.25 mg/dL.

The same workers reported the mean blood serum calcium concentration of 9.06 ± 1.02 and 8.7 ± 0.84 mg/dL in dystocia and normal parturition cows respectively. They also recorded the mean blood serum calcium concentration (mg/dL) in cows with dystocia due to absolute birth weight, twin pregnancy, presentation disposition and in

cows with and normal parturition as 8.89 ± 0.73, 9.09 ± 1.58, 9.35 ± 1.12 and 8.7 ± 0.84 respectively. The serum calcium concentrations showed a non significant increase in the dystocia in all sub groups, compared with cows control in pre-partum.

Ali *et al*. (2011) reported the mean blood serum calcium concentration (mmol/l) of 1.60 ± 0.60 and 1.70 ± 0.50 in dystocia affected buffalo-cows due to uterine torsion and normal pregnant buffalo cows near term respectively. No significant difference in the blood serum calcium between buffaloes with uterine torsion and normal pregnant buffalo cows were reported.

Akhtar *et al*. (2012) reported the mean serum calcium concentration in buffaloes suffering with vaginal prolapse and in healthy pregnant counterparts as 6.64 ± 0.15 and 9.30 ± 0.16 mg/dL and the serum calcium concentrations were significantly lower in buffaloes suffering with pre-partum vaginal prolapse as compared to healthy pregnant buffaloes.

Swelum *et al*. (2012) investigated the relationship blood serum calcium concentration in buffalo with uterine torsion before rolling, and reported that the calcium level significantly ($P<0.05$) decreased with increasing duration and severity of uterine torsion, however, it was higher in cases where a live foetus was delivered compared with a dead one. Animals with low levels of calcium (< 8.44 mg/dL) did not usually respond to rolling or suffer from uterine rupture during calving. They concluded that calcium levels can be used as indicators for the prognosis of mechanical treatment of uterine torsion in buffaloes.

2.14. Blood serum phosphorus concentrations *(*mg/dL)**

The studies of Nanda and Sharma (1982), Mandali *et al*. (2002) and Ahmed *et al*. (2005) revealed that the mean serum phosphorus concentration in buffaloes suffering with vaginal prolapse and in cows with cervico-vaginal or uterine prolapse (Marques *et al*., 1996) was significantly lower compared to healthy pregnant buffaloes or cows. However, studies of Khan *et al*. (1984) and Singh (1998) reported non-significantly lower phosphorus concentration in buffaloes suffering with vaginal prolapse compared with that of healthy buffaloes. Altıntafl and Fidancı (1993) reported that normal serum phosphorus concentrations for dairy cows as 6.00 mg/dL.

Sharma *et al*. (1991) reported the mean blood serum phosphorus levels in cows with parturient complications. They observed the mean inorganic phosphorus concentration of 5.85 ± 0.22 mg/dL in the normal parturient cows, whereas, in cows with retained placenta and dystocia, the respective values registered were 4.03 ± 0.33 and 5.08 ± 0.19 (mg/dL), and the variations in the blood serum phosphorus concentration among the different groups of cows did not differ significantly.

Bari *et al*. (1996) reported the mean serum phosphorus values of 1.68 ± 0.00 and 1.81 ± 0.00 mmol/1 were in cows with and without retained placenta at the time of parturition respectively. The cows with retained placenta had significantly ($P<0.05$) lower levels of serum phosphorus as compared cows without retained placenta.

Akar *et al*. (2005) reported that serum phosphorus concentration of 6.02 ± 0.52 and 6.18 ± 0.50 mg/dL in normal calving cows with and without retained placenta, respectively, and the difference between the groups was not significant.

Ocal *et al.* (1999) recorded the mean blood serum phosphorus concentration of 5.30 ± 0.18 and 5.03 ± 0.33 mg/dL, respectively in cows with retained placenta and cows without retained placenta following normal parturition and serum phosphorus concentrations did not differ significantly between the cows with and without retained placenta.

Patel *et al.* (1999) reported that the mean value of serum inorganic phosphorus, of 1st day post-partum, was significantly ($P<0.05$) lower 4.07 ± 0.03 (mg/%) in animal with RFM, as compared to these with normal parturition 5.17 ± 0.14 (mg / %).

Kumar *et al*. (2000) observed the blood serum phosphorus concentration of 4.95 ± 0.16 mg/dL and 5.68 ± 0. 30 mg/dL were in pre-partum and post-partum cows respectively. While the blood serum phosphorus concentration for buffaloes during the respective periods were 4.84 ± 1.44 mg/dL and 5.17 ± 0.71 mg/dL.

Hussain *et al.* (2001) recorded that the mean blood phosphorus concentration (mg/dl) in cows at parturition time as 3.77 ± 0.08. Tiwari *et al*. (2001) reported the mean blood serum phosphorus levels (mg/dv) in cows with parturient complications. They observed the mean inorganic phosphorus concentration of 5.28 ± 0.16 mg/dL and 5.08 ± 0.06 mg/dL in the normal parturient cows and in cows with retained placenta, respectively and the variations in the blood serum phosphorus concentration among the different groups of cows did not differ significantly.

Mandali *et al.* (2002) reported blood biochemical profiles in buffaloes with per-parturient disorders, observed the mean blood serum phosphorus concentration of 3.80 ±

0.08, 5.22 ± 0.15 and 3.29 ± 0.08 mg/dL, respectively in pre-partum genital prolapsed, normal advanced pregnant and post-partum genital prolapsed buffaloes respectively.

Akar *et al*. (2002) recorded the mean concentration of blood serum phosphorus were found to be respectively, 6.02 ± 0.52 and 6.18 ± 0.50 mg/dL in cows with and without retained placenta and was not difference the concentration of phosphorus between the groups of cows was not significant.

Ray *et al.* (2004) reported the mean blood serum phosphorus concentration (mg/dL) of 5.13 ± 0.20 and 5.17 ± 0.14 respectively for cows with retained foetal membranes (RFM) and normal parturient cows. The mean blood serum phosphorus concentration did not vary significantly between the cows with RFM and normal parturient cows.

Ahmed *et al*. (2005) reported the mean serum phosphorus concentration (mg/dL) of 3.05 ± 0.90, 2.61 ± 0.74 and 5.50 ± 1.61 respectively in buffaloes with vaginal prolapse, uterine prolapse and in control group of buffaloes. No significant difference in serum phosphorus levels was observed between vaginal prolapsed and uterine prolapsed buffaloes, but a significant ($P<0.01$) decrease in serum phosphorus level in prolapsed animals was noticed as compared to the control group.

Semacan and Sevun (2005) compared the liver function of cows with retained placenta with that of cows without retained placenta and reported the mean blood serum phosphorus concentration (mg/dL) of 4.43 ± 0.27 and 5.78 ± 0.43 respectively in cows with and without retained placenta. A significant decrease in serum levels of phosphorus

were observed in cows with retained placenta as compared to the cows without placental retention.

Akhtar *et al.* (2008) reported the mean serum phosphorus concentration in the serum of buffaloes suffering with vaginal prolapse was 3.02 ± 0.09 mg/dL, versus 5.95 ± 0.10 mg/dL in healthy pregnant counterparts and serum phosphorus concentration differed significantly in affected buffaloes in comparison with healthy pregnant buffaloes.

Ozyurtlu *et al.* (2008) observed the mean blood serum phosphorus concentrations of 4.68 ± 0.18 mg/dL and 4.67 ± 0.19 mg/dL respectively in dairy cows with and without retained placenta. However, differences between both groups were statistically not significant.

Hashem and Amer (2008) compared blood biochemical indices, in cows which delivered placenta normally and cows affected with retained fetal membranes (RFM) and reported the mean blood serum phosphorus concentrations of 5.17 ± 0.12 mg/dL and 4.00 ± 0.16 mg/dL respectively in cows which delivered placenta normally and cows affected with retained fetal membranes. Cows with RFM showed a significantly decreased concentration of phosphorus concentration as compared to cows which delivered placenta normally.

Ozyurtlu *et al.* (2008) reported the mean serum phosphorus concentration of 4.68 ± 0.18 and 4.67 ± 0.19 mg/dL, respectively in normal calving cows with and without

RFM respectively and the phosphorus levels between cows with and without RFM did not vary significantly.

Singh *et al*. (2009) investigated the blood biochemical profiles of buffaloes profiles before and after obstetrical maneuvering and reported the mean blood serum inorganic phosphorous concentration of 4.67 ± 0.13 and 5.41 ± 0.16 mg/dL, respectively in the dystocia buffaloes before and after obstetrical maneuvering. Further, they observed that the inorganic phosphorous concentration exhibited significantly ($P<0.05$) high values after obstetrical maneuvering than before instituting any treatment.

Yokus *et al*. (2010) reported the blood serum biochemical profiles in dystocia and normal parturition cows at pre-partum and post-partum, reported the mean blood serum phosphorus concentration of 5.86 ± 1.91 mg/dL and 8.2 ± 1.48 mg/dL respectively in dystocia cows during pre-partum and post-partum periods respectively. While similar concentrations respectively during pre-partum and post-partum periods in normal parturition cows were found to be 6.2 ± 1.18 mg/dL and 7.95 ± 1.36 mg/dL. They also reported that the mean blood serum phosphorus concentrations *(*mg/dL*)* in dystocia cows due to absolute birth weight, twin pregnancy, presentation disposition and normal parturition cows respectively as 6.11 ± 2.24, 6.62 ± 1.35, 4.57 ± 1.28 and 6.2 ± 1.18.

Skuja and Antane (2010) compared hematological indices in normal parturient cows and cows with retained foetal membranes and reported the mean blood serum phosphorus concentration (mmol /L) of 1.70 ± 0.16 and 1.60 ± 0.18 respectively in normal parturient cows and cows with retained foetal membranes. The serum phosphorus

concentration for cows having retention of foetal membranes did not differ significantly between cows with and without retained foetal membranes.

Ali *et al.* (2011) reported in buffaloes with uterine torsion to characterize the related alterations in blood biochemical constituents reported that the mean phosphorus (mmol/L) concentration of 1.00 ± 0.40 and 1.60 ± 0.60 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. They observed that the phosphorus concentration was significantly lower in buffaloes with uterine torsion as compared to normal pregnant buffalo cows near term

Akhtar *et al*. (2012) reported the mean serum phosphorus concentration in buffaloes suffering with vaginal prolapse and in healthy pregnant counterparts as 3.09 ± 0.07 and 5.99 ± 0.16 mg/dL and the serum phosphorus concentrations were significantly lower in buffaloes suffering with pre-partum vaginal prolapse as compared to healthy pregnant buffaloes.

2.15. Blood serum magnesium concentrations *(*mg/dL*)*

A significantly higher serum magnesium concentration in buffaloes suffering with vaginal prolapse was reported by Pandit *et al*. (1982) as compared to healthy pregnant buffaloes, while non-significant differences in the magnesium concentration between prolapse affected and healthy buffaloes were reported by Khan *et al*. (1984) and Vicenti *et al*., (1992) for cows. Contrary to these reports, Ahmed *et al*. (2005) reported significantly lower serum magnesium concentration in buffaloes suffering with vaginal prolapse Bostedt (1974) observed that the serum magnesium concentrations in cows and heifers with dystocia were higher than those in cows with normal parturition.

Altıntafl and Fidancı (1993) reported that normal serum magnesium concentrations for dairy cows as 1.8-2.3 mg/dL. Bari *et al.* (1996) reported the mean serum magnesium level in cows with retained placenta at the time of parturition as 1.08 ± 0.00 mmol /L. Whereas, in case of cows without retained placenta the magnesium values for the same period was 1.23 ± 0.00 mmol/L.The cows with retained placenta had significantly ($P<0.05$) lower levels of serum magnesium as compared cows without retained placenta.

Kumar *et al*. (2000) observed the blood serum magnesium concentration of 1.66 ± 0.67 mg/dL and 2.10 ± 0. 40 mg/dL were in pre-partum and post-partum cows respectively. While the blood serum magnesium concentration for buffaloes during the respective periods were 1.88 ± 0.26 and 2.37 ± 0.27 mg/dL. Hussain *et al.* (2001) reported the mean blood magnesium concentration in cows at parturition time as 2.78 ± 0.07 mg/dL.

Ahmed *et al*. (2005) reported the mean serum magnesium concentration of 1.52 ± 0.61 mg/dL, 1.46 ± 0.40 mg/dL and 2.40 ± 0.53 mg/dL respectively in buffaloes with vaginal prolapse uterine prolapse and in control group of buffaloes. No significant difference in serum magnesium levels was observed between vaginal prolapsed and uterine prolapsed buffaloes, but a significant ($P<0.01$) decrease in serum magnesium level in prolapsed animals was noticed as compared to the control group.

Akar and Yildiz (2005) reported the mean magnesium concentration (mg/dL) of 1.79 ± 0.40 and 2.18 ± 0.25 respectively in cows with dystocia and normal parturition without retention of foetal membranes. Akar and Yildiz (2005) reported mean blood

serum magnesium concentrations of 2.19 ± 0.13 and 2.14 ± 0.24 mg/dL respectively in normal parturition cows and those cows with RFM.

Akar and Yildiz (2005) observed as cows with dystocia and normal parturition with or without retention of foetal membranes, reported that the mean blood serum magnesium concentrations of 2.30 ± 0.21 and 2.05 ± 0.12 mg/dL, respectively in RFM cows with dystocia and normal parturition cows. While in dystocia cows and normal parturition cows without RFM, the respective concentrations of magnesium were 1.79 ± 0.40 and 2.18 ± 0.25 mg/dL. They concluded that the blood serum magnesium concentrations did not vary significantly between the cows with RFM and without RFM depending on the type of parturition.

Akar and Yildiz (2005) studied effect of type of parturition (normal or dystocia) on the levels of serum minerals with regard to the development of retention of foetal membranes in cows and reported that the mean blood serum magnesium concentrations of 2.30 ± 0.21 and 2.05 ± 0.12 mg/dL respectively in cows with placental retention following dystocia and normal parturition. While the similar values for cows without placental retention following dystocia and normal parturition recorded were 1.79 ± 0.40 and 2.18 ± 0.25 mg/dL respectively. Akar and Yildiz (2005) indicated that the blood serum magnesium concentrations did not differ between normal cows and those with dystocia.

Ozyurtlu *et al.* (2008) observed the mean concentration of magnesium as 2.55 ± 0.19 and 2.94 ± 0.17 mg/dL in normally calved Brown-Swiss cows with and without

retained placenta respectively. However differences between both groups were statistically not significant.

Hashem and Amer (2008) compared blood biochemical indices, in cows which delivered placenta normally and cows affected with retained fetal membranes (RFM) and reported the mean blood serum magnesium concentrations of 2.65 ± 0.06 mg/dL and 1.89 ± 0.11 mg/dL respectively in cows which delivered placenta normally and cows affected with retained fetal membranes. Cows with RFM showed a significantly decreased concentration of magnesium concentration as compared to cows which delivered placenta normally.

Akhtar *et al.* (2008) reported the mean serum mean magnesium concentration in the serum of buffaloes suffering with vaginal prolapse was 2.35 ± 0.02 mg/dL, while in healthy pregnant counterparts it was 2.17 ± 0.01 mg/dL and magnesium concentration in affected buffaloes was significantly higher compared with the healthy pregnant buffaloes.

Ozyurtlu *et al*. (2008) reported the mean serum magnesium concentration of 2.55 ± 0.19 and 2.94 ± 0.17 mg/dL respectively. In normal calving cows with and without RFM respectively and the magnesium levels between cows with and without RFM did not vary significantly.

Yokus *et al.* (2010) in their comparative studies on the blood serum biochemical profiles in dystocia and normal parturition cows at pre-partum and post-partum, reported that the mean blood serum magnesium concentration of 3.33 ± 1.95 and 6.89 ± 1.26 mg/dL respectively in dystocia cows during pre-partum and post-partum periods respectively. While similar concentrations respectively during pre-partum and post-

partum periods in normal parturition cows were found to be 4.1 ± 1.92 and 6.98 ± 1.08 mg/dL.

Yokus *et al*. (2010) recorded the mean blood serum magnesium concentration (mg/dL) in cows with dystocia due to absolute birth weight, twin pregnancy, presentation disposition and in normal parturition cows respectively as 3.19 ± 2.12, 3.35 ± 1.79, 3.6 ± 2.25 and 4.10 ± 1.92. Further, they observed that the cows with dystocia had significantly lower serum concentration of magnesium) ($P<0.05$), compared with cows without dystocia in pre-partum. Except for presentation disposition, lower serum magnesium concentrations was also observed in other sub groups as compared with the normal pregnancy ($p<0.05$). They have also reported the mean blood serum magnesium concentration of 3.33 ± 1.95 and 4.10 ± 1.92 mg/dL in dystocia and normal parturition cows respectively.

Ali *et al.* (2011) reported the mean magnesium (m mol/l) concentration of 1.00 ± 0.30 and 0.70 ± 0.30 in buffaloes with uterine torsion and normal pregnant buffalo cows near term respectively. The serum magnesium concentration did not vary significantly between the buffaloes with uterine torsion and normal pregnant buffalo cows near term.

Akhtar *et al*. (2012) reported the mean serum magnesium concentration in buffaloes suffering with vaginal prolapse and in healthy pregnant counterparts as 2.33 ± 0.02 and 2.17 ± 0.01 mg/dL and the mean serum magnesium concentrations were significantly higher in buffaloes suffering with pre-partum vaginal prolapse as compared to healthy pregnant buffaloes. Magnesium concentrations between the buffaloes with uterine torsion and control group of buffaloes.

Materials and Methods

III. MATERIAL AND METHODS

3.1. Animals

The present study was conducted on cows brought to the clinic of the Department of Veterinary Gynecology and Obstetrics, Veterinary College, Hebbel, Bangalore or cows maintained by the farmers in and around Bangalore city. For this purpose, a total of 41 cross bred cows (Holstein Friesian x Jersey) of 3-8 years age were selected. Out of these, 28 were suffering from dystocia. These dystocia cows included parturient cross bred cows brought into the Veterinary Clinics of Veterinary College, Bangalore for the treatment of dystocia from various parts of the Bangalore urban and rural district within 24-36 hours of onset of parturition (i.e. abdominal straining in cases of dystocia due to torsion of uterus or rupture of allantois without further progress in delivery in other cases was taken as the time of onset of parturition). The remaining 13 cows which calved normally (control) were selected from University Dairy Farm. Complete history regarding the clinical status of the dystocia cows was obtained and detailed Obstetrical and Gynecological examination of each case carried out to ascertain the cause of dystocia. Based on the cause of dystocia, cows were again sub grouped in to maternal and foetal dystocia cows. These animals were given the necessitated obstetrical (included manipulative delivery, foetotomy, uterine detorsion or caesarean section) treatment.

3.1.1. Blood sampling schedule

Blood samples were collected from eutocia cross breed cows within fifteen minutes after parturition. Cows suffering from dystocia were sampled before obstetrical treatment on the day of assisted delivery.

3.1.2. Blood collection and processing

About 20 ml of blood was collected in two parts, one with and other without anticoagulant, from each animal aseptically in clean, sterilized test tubes by jugular vein-puncture method. The blood samples containing anticoagulant were used for estimating haematological parameters including red blood cells (RBC) count, packed cell volume (PCV), haemoglobin (Hb) concentration, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), white blood cell (WBC) count and differential leukocytic counts. Serum was separated from blood samples without anticoagulant and stored at -20°C until analyses for calcium, phosphorus and magnesium contents. The blood serum calcium, phosphorous and magnesium were estimated by spectrometric methods using commercial kits as per the instructions of the manufacturer.

3.2. Statistical analysis

Mean values (± SE) for the concentrations of various haematological and macromineral parameters for eutocia and dystocia cows were computed. In order to ascertain the magnitude of variation in concentrations of various haematological and macromineral parameters among cows of eutocia, maternal and foetal dystocia cows, the data were analyzed statistically using Analysis of Variance (Steel *et al*., 2006). Duncan's multiple range test (Duncan, 1955) was applied for multiple means comparison, where necessary. In order to ascertain magnitude of variation in various parameters between eutocia and dystocia cows, the data were subjected to unpaired T-test. For all tests, values of $P<0.05$ were considered significant.

Results

IV. RESULTS

4.1. Haematology

4.1.1. Erythrocyte indices

The mean values of various erythrocyte indices in dystocia and eutocia crossbred cows are given in Table 1.

4.1.2. Total erythrocyte count (10^6/µl)

In the present study, the mean total erythrocyte count (10^6/µl) in eutocia and dystocia cross breed cows were 5.20 ± 0.12 and 5.40 ± 0.12 respectively (Table: 1). While dystocia cows had numerically higher erythrocyte count compared with that of the eutocia cows, however, the difference was non-significant.

4.1.3. Haemoglobin (g/dL) concentration

In the present study, mean haemoglobin (g/dL) concentration in cows suffering with dystocia was10.00 ± 0.25 g/dL, while in eutocia counterparts cows, it was 10.00 ± 0.37 g/dL. However, the difference in haemoglobin levels between dystocia and eutocia cows was not significant (Table 1).

4.1.4. Haematocrit concentration or packed cell volume (PCV)

In the present study, the mean (± SE) haematocrit concentration (PCV) in cows suffering with dystocia was 29.00 ± 0.61 per cent versus 29.00 ± 0.84 per cent in normal parturient (eutocia) cows. However, the difference in PCV levels between dystocia and eutocia cows was not significant (Table 1).

4.1.5. Mean corpuscular volume (MCV)

The mean MCV (fl) values recorded for dystocia and eutocia cross breed cows in the present study are depicted in (Table 1). It is observed that the mean (± SE) MCV concentration in the cows suffering with dystocia was 53.00 ± 1.10 (fl) and in spontaneously calving (eutocia) cows it was 51.00 ± 1.20 (fl). Although the mean MCV levels were numerically higher in dystocia affected cows compared with that of the eutocia cows, the difference was, however, non-significant.

4.1.6. Mean corpuscular haemoglobin concentration (MCHC)

Mean values of MCHC (mg/dL) in dystocia and eutocia cows were 32.00 ± 0.40 and 32.00 ± 0.78, respectively (Table 1). However, the levels of MCHC between dystocia and eutocia cows were not significant.

4.1.7. Mean corpuscular haemoglobin (MCH)

In the present study, mean MCH (pg) concentrations in dystocia and normal calving cows (eutocia) were 17.00 ± 0.27 and 20.00 ± 0.61, respectively, numerically lower in dystocia affected cows compared with that of the eutocia cows, the difference was, however, non-significant (Table 1).

4.2. Leukocytic indices

The mean values of total leukocytes count (TLC) and differential leukocytes counts (DLC) in normal calving (eutocia) and dystocia cross bred cows are given in table 2.

4.2.1. Total leukocytes count (TLC)

In the present study, the mean TLC in cows suffering with dystocia was 7.00 ± 0.36 (10^3/µl), while in spontaneously calving (eutocia) counterparts it was 7.70 ± 0.28 (10^3/µl). The mean TLC was significantly lower ($P<0.05$) in cows suffering with dystocia compared with that of healthy eutocia cows (Table 2).

4.2.2. Neutrophils count

In the present study, differential leukocytic count revealed that the mean neutrophils count in dystocia and eutocia cows were 21.90 ± 3.08 per cent and 32.60 ± 4.71 per cent, respectively (Table 2). The mean neutrophil count was found to be significantly lower ($P<0.05$) in cows suffering with dystocia compared with that of healthy eutocia cows.

4.2.3. Lymphocytes count

In the present study, the mean (± SE) lymphocytes count of cows suffering with dystocia was 69.10 ± 2.55 per cent, versus 56.70 ± 5.16 per cent in healthy eutocia cows. Lymphocyte count was significantly higher ($P<0.05$) in dystocia affected cows in comparison with eutocia cows (Table 2).

4.2.4. Monocytes count

In the present study, the mean (± SE) mean monocytes (per cent) count of cows suffering with dystocia was 5.40 ± 0.81 per cent, while in healthy eutocia counterparts it was 6.40 ± 0.45 per cent. The monocytes count did not differ significantly ($P<0.05$) between dystocia affected cows and eutocia cows (Table 2).

4.2.5. Eosinophils count

In the present study, the mean eosinophils count was rerecorded as 3.90 ± 0.75 per cent and 3.00 ± 0.67 per cent in eutocia and dystocia affected cows, respectively but the difference was not significant (P>0.05) (Table 2).

4.2.6. Basophil count

The present study revealed, the mean basophil count in dystocia cows was 0.60 ± 0.40 per cent as compared to a level of 0.40 ± 0.22 (per cent) in eutocia cows, the difference in basophils count between cows with dystocia and eutocia cows was not significant (P>0.05), (Table 2).

4.3. Effect of dystocia on macro mineral concentrations:

Mean serum values (± SE) for calcium, phosphorus and magnesium in eutocia and dystocia affected cross breed cows are presented in table 3.

4.3.1. Blood serum calcium concentration

In the present study, the mean blood serum calcium concentration in cows suffering with dystocia was 9.00 ± 0.19 mg/dL, while in spontaneously calving (eutocia) counterparts it was 7.50 ± 0.19 mg/dL. The mean serum calcium concentration was observed to be significantly higher (P<0.05) in cows suffering with dystocia compared with that of healthy eutocia cows (Table 3).

4.3.2. Blood serum phosphorus concentration

In the present study, the mean (± SE) phosphorus concentration in the blood serum of cows suffering with dystocia was 6.10 ± 0.16 mg/dL, versus 4.70 ± 0.19 mg/dL in healthy eutocia cows. Serum phosphorus concentration was found to be significantly higher ($P<0.05$) in dystocia affected cows as compared to cows with eutocia (Table 3).

4.3.3. Blood serum magnesium concentration

In the present study, the mean (± SE) mean magnesium concentration in the serum of cows suffering with dystocia was 2.90 ± 0.12 mg/dL, while in eutocia counterparts it was 2.90 ± 0.21 mg/dL. Serum magnesium concentration did not differ significantly ($P<0.05$) between dystocia affected cows and eutocia cows (Table 3).

4.4. Effect of maternal and fetal dystocia on hematological attributes

4.4.1. Erythrocyte indices

The mean values of various erythrocyte indices in eutocia, maternal and foetal dystocia crossbred cows are given in table 4.

4.4.2. Total erythrocyte count (RBC)

In the present study, mean total RBC counts in cow with maternal, foetal and normal parturient cross breed cows were 5.00 ± 0.22, 5.50 ± 0.14 and 5.20 ± 0.12 (10^6/µl), respectively, being higher in foetal dystocia cows (Table 4 and Fig 1). The RBC did not differ among the normal parturient cows, cows with maternal and foetal dystocia.

4.4.3. Haemoglobin (g/dL) concentration

In the present study, no significant difference in haemoglobin concentration in eutocia (10.00 ± 0.37 g/dL), maternal (9.70 ± 0.64 g/dL) and foetal (10.00 ± 0.24 g/dL) dystocia cows were observed (Table 4 and Fig 2).

4.4.4. Haematocrit concentration or packed cell volume (PCV)

The mean PCV (%) in eutocia, maternal, and foetal dystocia cows were 29.00 ± 0.84, 28.00 ± 1.40 and 30.00 ± 0.63, respectively. Although the mean PCV levels were insignificantly higher in foetal dystocia affected cows and eutocia cows compared with that of the maternal dystocia cows, the difference was, however, non-significant (Table 4 and Fig 3).

4.4.5. Mean corpuscular volume (MCV)

In the present study, the mean MCV (fl) in eutocia, maternal, and foetal dystocia cows were 51.00 ± 1.20, 56.00 ± 2.00 and 51.00 ± 1.20, respectively. Although the mean MCV values were insignificantly higher in maternal dystocia affected cows compared with that of the eutocia cows and foetal dystocia cows, the difference was, however, non-significant (Table 4 and Fig 4).

4.4.6. Mean corpuscular haemoglobin concentration (MCHC)

In the present study, mean MCHC (mg/dL) levels in eutocia cows was found to be 32.00 ± 0.78, while the MCHC levels in cows with maternal and foetal dystocia, respectively were 32.00 ± 0.90 and 33.00 ± 0.45. Statistical analysis revealed no

significant difference (P<0.05) in the MCHC (mg/dL) levels between eutocia, maternal and foetal dystocia cows (Table 4 and Fig 5).

4.4.7. Mean corpuscular haemoglobin (MCH)

In the present study, mean serum MCH (pg) concentration in eutocia cows was 20.00 ± 0.61cows, while in cows with maternal and foetal dystocia; it was 18.00 ± 0.38 and 17.00 ± 0.33. The mean MCH concentration was significantly lower (P<0.05) in cows suffering with maternal and foetal dystocia compared with that of normal calving (eutocia) cows. However, differences between the maternal and foetal dystocia cows were not significant (Table 4 and Fig 6).

4.5. Leukocytic indices

The mean values of TLC and DLC in eutocia, maternal and foetal dystocia cross bred cows are given in table 5.

4.5.1. Total leukocytic count (TLC)

In the present study, mean total leukocytic count (10^3/µl) revealed in eutocia, maternal dystocia and foetal dystocia cows were 7.70 ± 0.28, 6.70 ± 0.75 and 7.10 ± 0.41, respectively (Table: 5 and Fig: 7). The mean total leukocytic count was found to be lower in cows suffering with maternal and foetal dystocia compared with that of healthy eutocia cows. However, the differences among these cows were statistically not significant.

4.5.2. Neutrophils count

In the present study, differential leukocytic count revealed that the mean neutrophils count in eutocia, maternal and foetal dystocia cows were 32.60 ± 4.71, 28.30 ± 3.20 and 25.40 ± 5.00 (per cent), respectively (Table 5). The mean neutrophils count was found to be significantly lower ($P<0.05$) in cows suffering with dystocia compared with that of healthy eutocia cows. However, the differences in the neutrophil count between maternal and dystocia cows were not significant.

4.5.3. Lymphocyte count

The mean lymphocyte count (per cent) was found to be significantly ($P<0.05$) higher in maternal (59.30 ± 3.11 per cent) and foetal dystocia cows (64.40 ± 6.63) as compared to eutocia cows (56.70 ± 5.16). However, the difference in the lymphocyte count between maternal and foetal dystocia cows was not significant (Table 5).

4.5.4. Monocyte count

Mean monocyte count (per cent) in normal calving (eutocia), maternal and foetal dystocia cows were 6.40 ± 0.45, 7.20 ± 0.74 and 5.70 ± 1.16 percent, respectively. The variations in the monocytes count among eutocia, maternal and fetal dystocia cows were statistically not significantly ($P<0.05$) (Table 5).

4.5.5. Eosinophils count

In the present study, the mean eosinophils count was rerecorded as 3.90 ± 0.75, 4.40 ± 1.25 and 3.80 ± 1.57 per cent in eutocia maternal and foetal dystocia cows,

respectively but the difference in the eosinophils count were not significant (P>0.05) among the eutocia maternal and foetal dystocia cows (Table 5).

4.5.6. Basophil count

The present study, the mean basophils count in eutocia, maternal dystocia and fetal dystocia cows were recorded as 0.40 ± 0.22, 0.80 ± 0.33 and 0.70 ± 0.26 per cent, respectively. The differences in the basophils count were not significant (P>0.05) among the eutocia maternal and foetal dystocia cows (Table 5).

4.6. Effect of maternal and fetal dystocia on macro mineral concentrations:

4.6.1. Blood serum calcium concentration

Mean serum values (± SE) for calcium in eutocia maternal and foetal dystocia affected cross breed cows are presented in Table 6 and Fig 8.

In the present study, the mean concentrations of serum calcium in eutocia, maternal and fetal dystocia cows were 7.50 ± 0.19, 9.00 ± 0.34 and 9.00 ± 0.24 g/dL, respectively. The results indicated that serum calcium level of maternal and fetal dystocia cows were significantly (P<0.01) higher than eutocia. However, the calcium levels in cows with maternal and foetal dystocia cows were not significant (P>0.05).

4.6.2. Blood serum phosphorus concentration

Mean serum values (± SE) for phosphorus in eutocia, maternal and foetal dystocia affected cross breed cows are presented in Table 6 and Fig 9.

Blood serum phosphorus level was found to be significantly ($P<0.05$) higher in maternal (6.00 ± 0.30 mg/dL) and foetal dystocia (6.10 ± 0.24 mg/dL) cows as compared to eutocia cows (4.70 ± 0.19 mg/dL). However, the difference between maternal and foetal dystocia cows was not significant.

4.6.3. Blood serum magnesium concentration

In the present study, the mean magnesium (mg/dL) concentrations in eutocia, maternal, and foetal dystocia cows were 2.90 ± 0.21, 2.80 ± 0.19 and 2.90 ± 0.15, respectively. Although the mean magnesium values were insignificantly higher in eutocia and foetal dystocia affected cows compared with that of the maternal dystocia cows, the difference was, however, non-significant (Table 6 and Fig 10).

Table 1: Erythrocyte indices in dystocia and eutocia crossbred cows

No	Parameters	Cows with Normal Calving (n=13)	Cows with Dystocia (n=28)
1	Total RBC ($x10^6$/µl)	5.20 ± 0.12	5.40 ± 0.12
2	Hemoglobin (mg/dL)	10.00 ± 0.37	10.00 ± 0.25
3	PCV (%)	29.00 ± 0.84	29.00 ± 0.61
4	MCV (fl)	51.00 ± 1.20	53.00 ± 1.10
5	MCHC (mg/dL)	32.00 ± 0.78	32.00 ± 0.40
6	MCH (pg)	20.00 ± 0.61	17.00 ± 0.27

Table 2: Total leukocyte count (TLC) and differential leukocyte counts (DLC)

No	Parameters	Cows with Normal Calving (n=13)	Cows with Dystocia (n=28)
1	Total WBC ($x10^3$/ µl)	7.70 ± 0.28[a]	7.00 ± 0.36[b]
2	Neutrophils (%)	32.60 ± 4.71[a]	21.90 ± 3.08[b]
3	Lymphocytes (%)	56.70 ± 5.16[b]	69.10 ± 2.55[a]
4	Monocytes (%)	6.40 ± 0.45[a]	5.40 ± 0.81[a]
5	Eosinophils (%)	3.90 ± 0.75[a]	3.00 ± 0.67[a]
6	Basophils (%)	0.40 ± 0.22[a]	0.60 ± 0.40[a]

Note: The means bearing different alphabets in rows differ significantly ($P<0.05$)

Table 3: Serum concentration for calcium, phosphorus and magnesium in eutocia and dystocia affected cross breed cows

No	Parameters	Cows with Normal Calving (n=13)	Cows with Dystocia (n=28)
1	Calcium (mg/dL)	7.50 ± 0.19^{b}	9.00 ± 0.19^{a}
2	Phosphorus (mg/dL)	4.70 ± 0.19^{b}	6.10 ± 0.16^{a}
3	Magnesium (mg/dL)	2.90 ± 0.21	2.90 ± 0.12

Note: The means bearing different alphabets in rows differ significantly ($P<0.05$)

Table 4: Erythrocyte indices in eutocia, maternal and fetal dystocia crossbred cows

No	Parameters	Normal calving (n=13)	Maternal dystocia (n=8)	Fetal dystocia (n=20)
1	Total RBC ($x10^{6}$/µl)	5.20 ± 0.12	5.00 ± 0.22	5.50 ± 0.14
2	Hemoglobin (mg/dL)	10.00 ± 0.37	9.70 ± 0.64	10.00 ± 0.24
3	PCV (%)	29.00 ± 0.84	28.00 ± 1.40	30.00 ± 0.63
4	MCV (fl)	51.00 ± 1.20	56.00 ± 2.00	51.00 ± 1.20
5	MCHC (mg/dL)	32.00 ± 0.78	32.00 ± 0.90	33.00 ± 0.45
6	MCH (pg)	20.00 ± 0.61^{a}	18.00 ± 0.38^{b}	17.00 ± 0.33^{b}

Note: The means bearing different alphabets in rows differ significantly ($P<0.05$)

Table 5: The mean values of TLC and DLC in eutocia, maternal and fetal dystocia crossbred cows

No	Parameters	Normal calving (n=13)	Maternal dystocia (n=8)	Fetal dystocia (n=20)
1	Total WBC (10^3/ µl)	7.70 ± 0.28	6.70 ± 0.75	7.10 ± 0.41
2	Neutrophils (%)	32.60 ± 4.71[a]	28.30 ± 3.20[b]	25.40 ± 5.00 [b]
3	Lymphocytes (%)	56.70 ± 5.16[b]	59.30 ± 3.11[a]	64.40 ± 6.63[a]
4	Monocyte (%)	6.40 ± 0.45[a]	7.20 ± 0.74[a]	5.70 ± 1.16[a]
5	Eosinophils (%)	3.90 ± 0.75[a]	4.40 ± 1.25[a]	3.80 ± 1.57[a]
6	Basophils (%)	0.40 ± 0.22[a]	0.80 ± 0.33[a]	0.70 ± 0.26[a]

Note: The means bearing different alphabets in rows differ significantly (P<0.05)

Table 6: Mean serum values (± SE) for calcium in eutocia maternal and fetal dystocia affected cross breed cows

No	Parameters	Normal calving (n=13)	Maternal dystocia (n=8)	Fetal dystocia (n=20)
1	Calcium (mg/dL)	7.50 ± 0.19[b]	9.00 ± 0.34[a]	9.00 ± 0.24[a]
2	Phosphorus (mg/dL)	4.70 ± 0.19[b]	6.00 ± 0.30[a]	6.10 ± 0.24[a]
3	Magnesium (mg/dL)	2.90 ± 0.21	2.80 ± 0.19	2.90 ± 0.15

Note: The means bearing different alphabets in rows differ significantly (P<0.05)

Fig. 1: Total RBC counts (10^6/µl) on normal calving, maternal dystocia and fetal dystocia

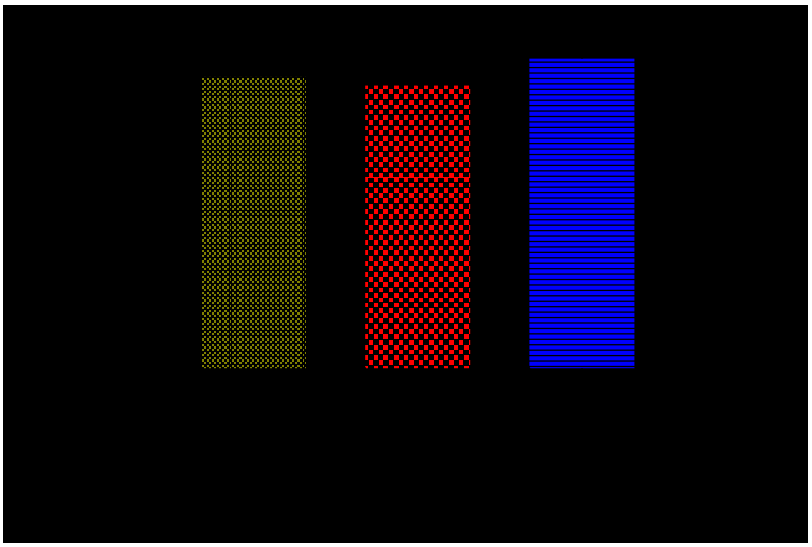


Fig. 2: Haemoglobin count on normal calving, materal dystocia and fetal dystocia

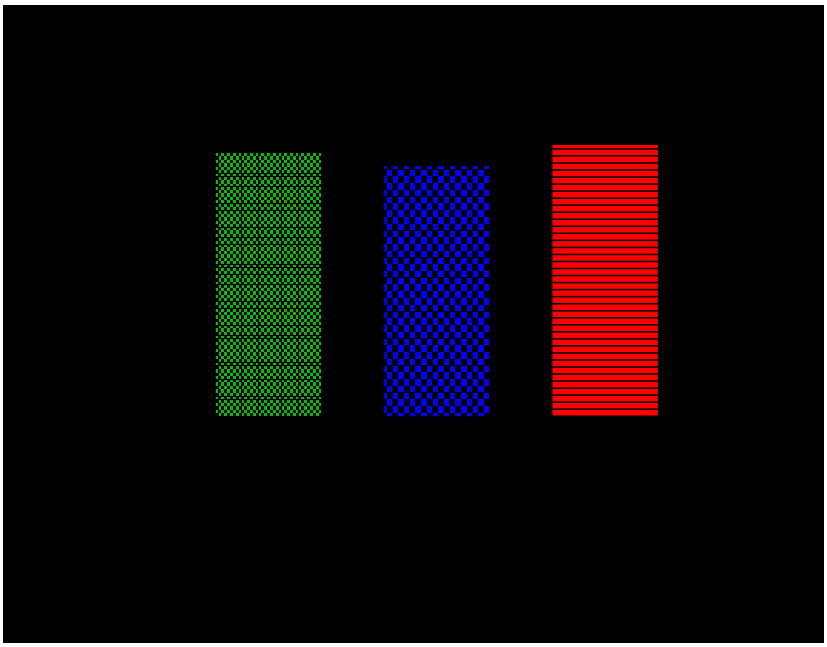


Fig. 3: PCV level on normal calving, maternal dystocia and fetal dystocia

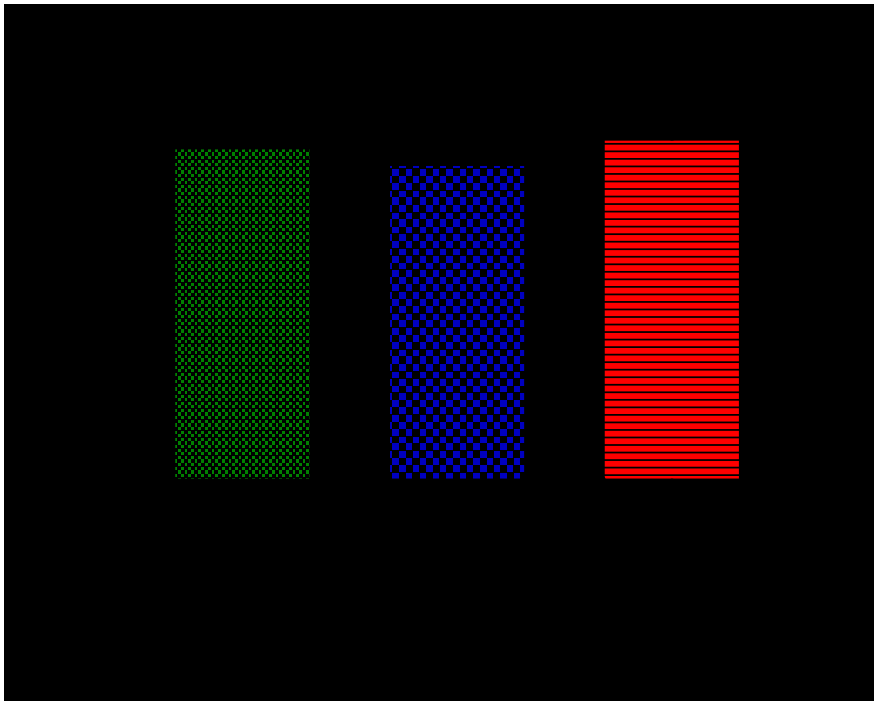


Fig. 4: MCV level on normal calving, maternal dystocia and fetal dystocia

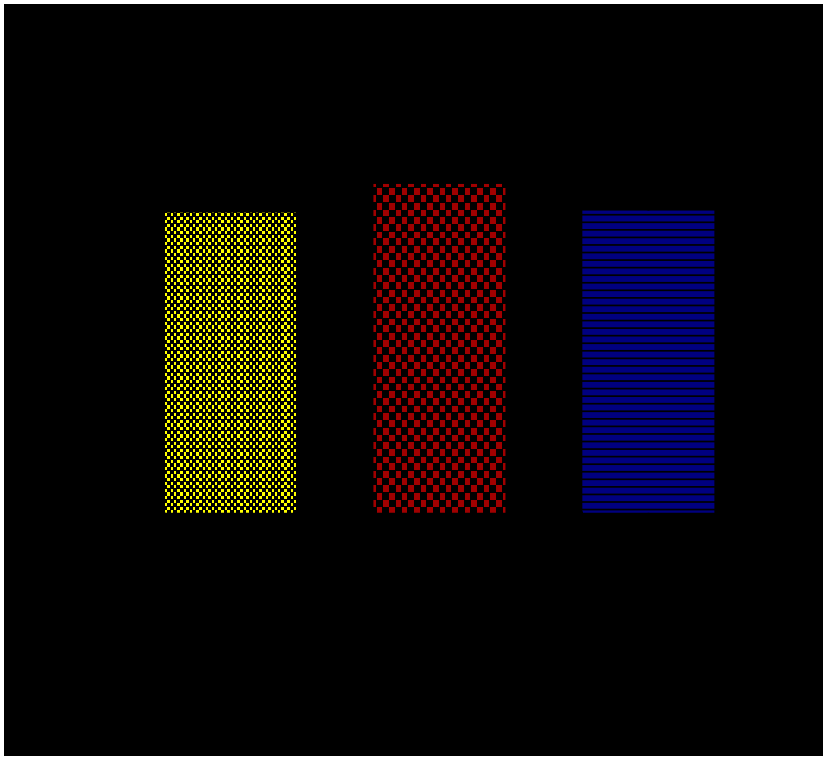


Fig. 5: MCHC count on normal calving, maternal dystocia and fetal dystocia

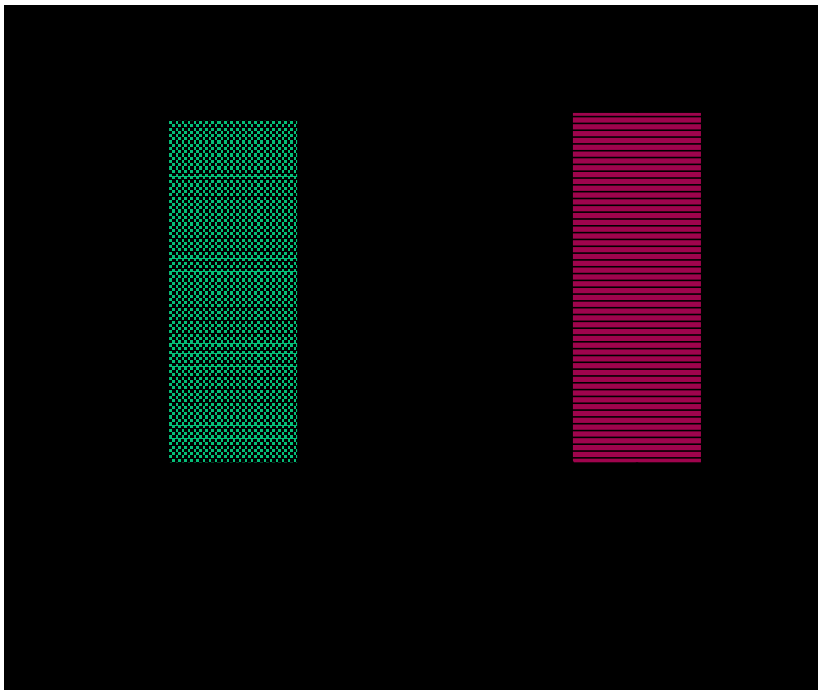


Fig. 6: MCH level on normal calving, maternal dystocia and fetal dystocia

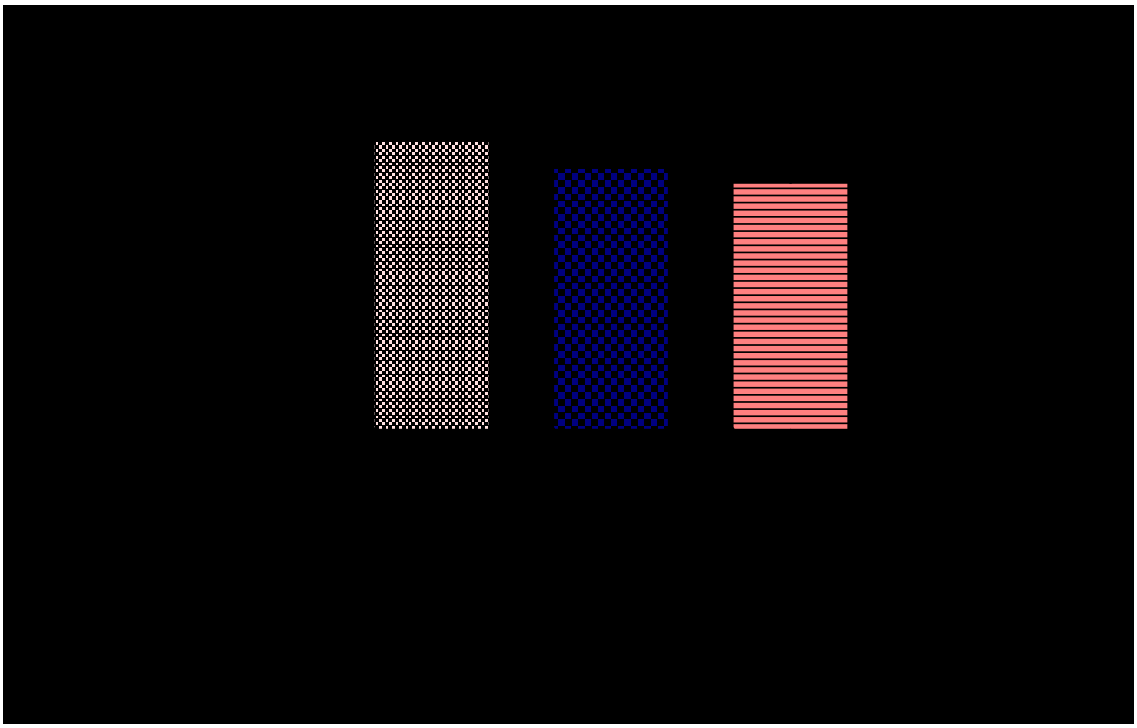


Fig. 7: WBC count on normal calving, maternal dystocia and fetal dystocia

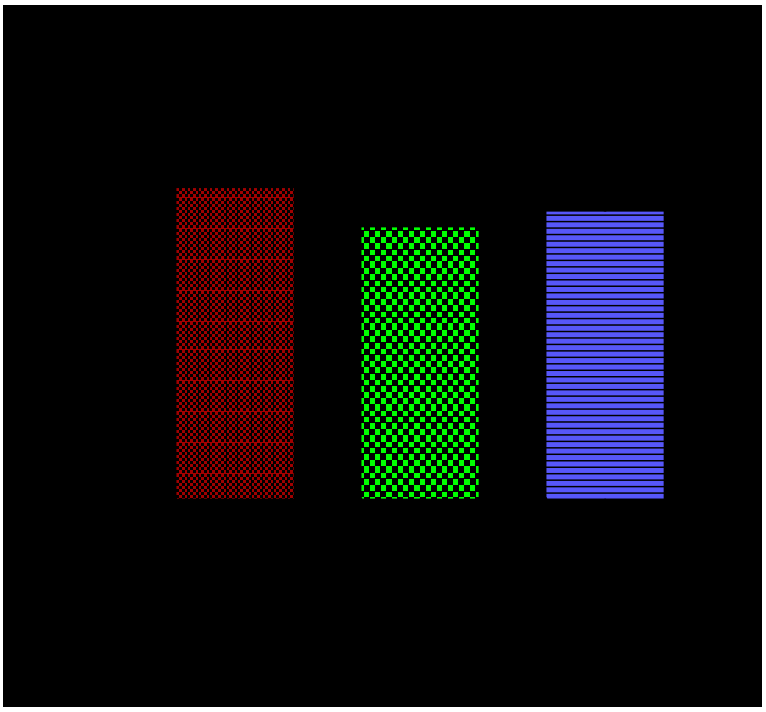


Fig. 8: Blood calcium concentrations in normal calving, maternal dystocia and fetal dystocia

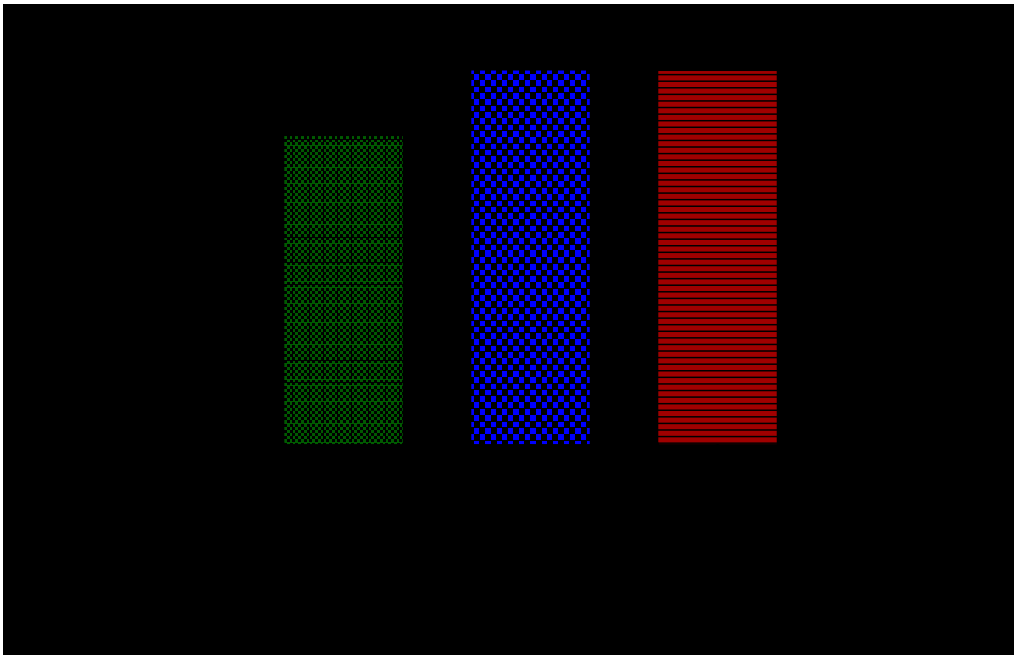


Fig. 9: Phosphorus concentration (mg/dl) on normal calving, maternal dystocia and fetal dystocia

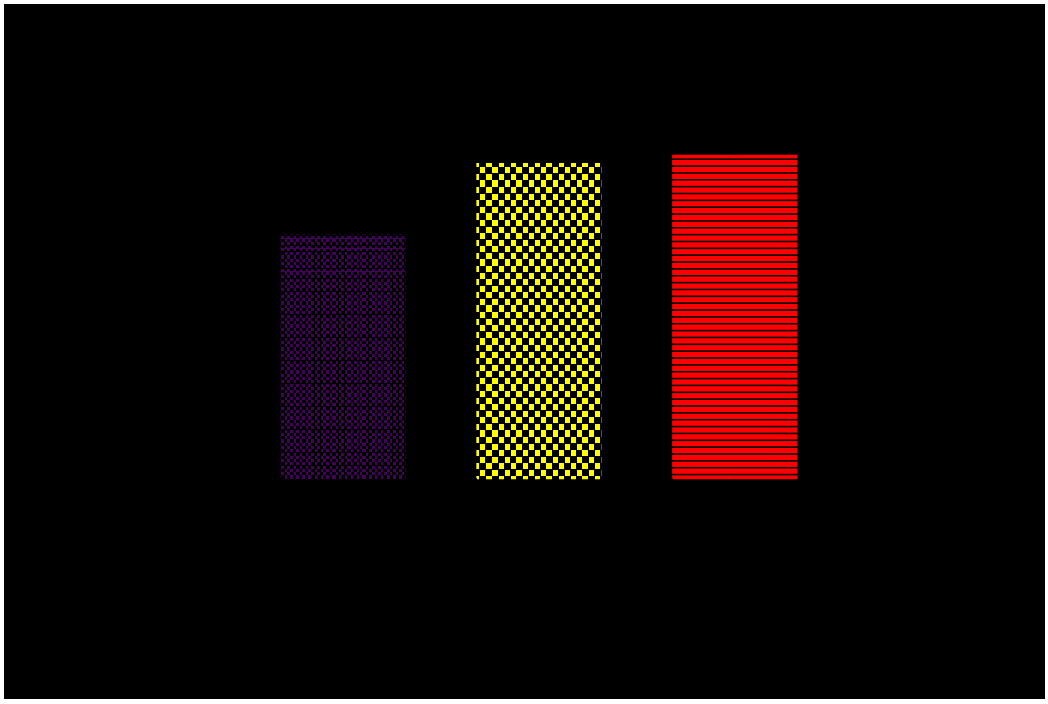
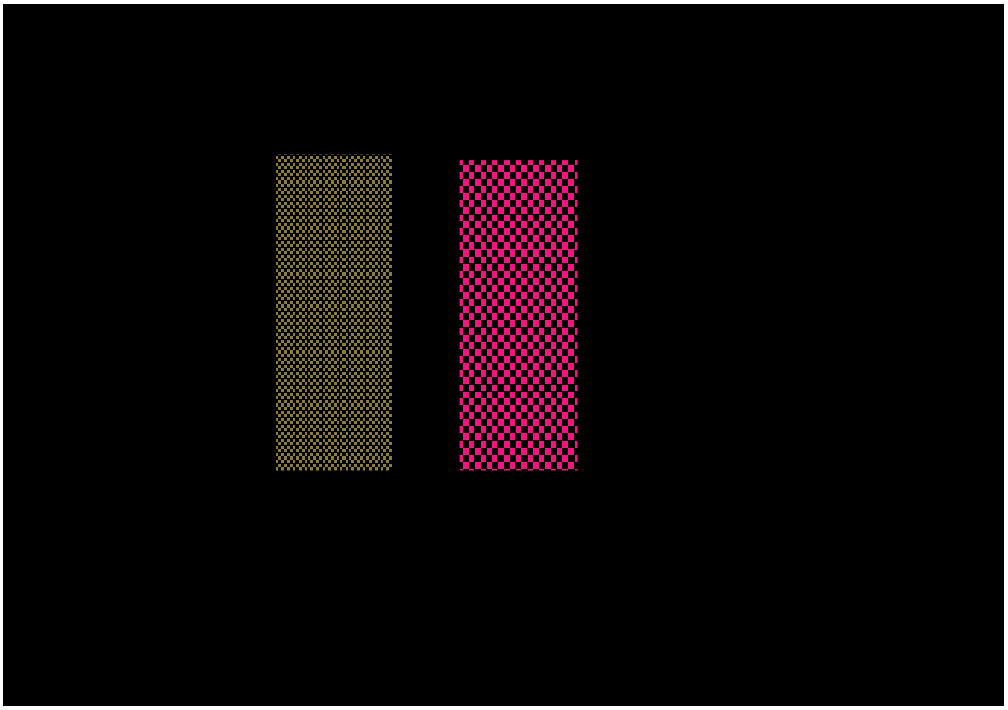


Fig. 10: Blood magnesium concentrations on normal calving, maternal dystocia and fetal dystocia



Discussion

V. DISCUSSION

5.1. Red blood Cell (RBC) level

The studies on the effect of dystocia on RBC counts in cows are very few, Prabhakaran *et al*. (2006), no significant changes in RBC counts between dystocia affected and normal calving buffaloes(Ali *et al*., 2011) and cows (Yıldız *et al*., 2011) are reported. Similarly, no significant difference in red blood cell count was observed between vaginal prolapsed and uterine prolapsed buffaloes (Ahmed *et al*., 2005) which usually occur as a sequel to dystocia. Contrary to these observations, a significant decrease in RBC counts were observed in buffaloes with uterine torsion (Amer and Hashem, 2008), buffaloes with placental retention (Ahmed *et al*., 2009), while no significant variations in cows (Skuja and Antane, 2010) and buffaloes having retention of foetal membranes (Pandey *et al*., 2007) were reported. In the present study, it was observed that the RBC counts did not vary significantly between normal parturient cows and cows with dystocia (Table 1). These finding are inline with those reported by previous workers (Ahmed *et al*., 2005, Prabhakaran *et al*., 2006; Skuja and Antane, 2010; Ali *et al.*, 2011 and Yıldız *et al*., 2011).

In the present study, comparisons of RBC counts between eutocia, maternal and foetal dystocia cows also revealed no significant variations (Table 4). These observations suggest that stress of dystocia has negligible influence on RBC values in cows. These findings are well supported by the findings of Prabhakaran *et al*. (2006) who also reported no significant variations in RBC count among eutocia (normal calving), and buffaloes with maternal and foetal dystocia. Further, Ali *et al.* (2011) reported no

significant variations in RBC count in buffaloes with uterine torsion. This is one of the causes of maternal dystocia. However, Amer and Hashem (2008) reported significantly lower RBC counts in buffaloes with uterine torsion as compared to buffaloes without torsion. However, erythrocytes counts for all groups were within the normal ranges (Ahmed *et al*., 2005, Ferzaneh *et al*., 2006, Pandey *et al*., 2007, Amer *et al*., 2008 and Yıldız *et al*., 2011).

5.2. Haemoglobin concentration (Hb)

In the present study, haemoglobin concentrations did not differ between the dystocia and normally calving cows (Table 1). The published reports pertaining to the effect of dystocia on haemoglobin levels is very few, Phogat *et al*. (1991) and Ali *et al*. (2011) reported no significant changes in haemoglobin values between normal calving and dystocia affected buffaloes and cows with dystocia (Steinhardt *et al*., 1994; Yıldız *et al*., 2011) and in cows with retained placenta (Tiwari *et al*., 2001 and Skuja and Antane, 2010). Similar to the findings of the present study, (Phogat *et al*., 1991, Steinhardt *et al*., 1994, Yıldız *et al*., 2011 and Ali *et al*., 2011) have also observed no significant variations in the haemoglobin concentrations among eutocia and dystocia affected buffaloes and cows. The results of the present study confirmed their observations. Further, it has been observed that the haemoglobin levels tend to change during pregnancy and at parturition due to the stress (Junid and Krad, 1987 and Yiltenburg *et al*., 1991). In the present study no significant variations in the haemoglobin levels were observed among eutocia and dystocia cows (Table 4), this finding suggests that stress of dystocia may not significantly affect the haemoglobin levels. In the light of the observations made in the present study, as well as the observations of Junid and Krad (1987) and Yiltenburg *et al*. (1991), it is

suggested that irrespective of quantum of stress during parturition and dystocia, the haemoglobin may not change significantly. Contrary to these reports, lower haemoglobin levels in buffaloes with uterine torsion and dystocia buffaloes affected was reported as compared to the genital prolapse and normal calving buffaloes (Kaur and Singh, 1993). A significant decrease in haemoglobin concentration in buffaloes with vaginal prolapse and uterine prolapse was observed by Kaur and Singh (1993) and Ahmed *et al*. (2005). In buffaloes with uterine torsion by Amer and Hashem (2008) and in buffaloes with placental retention (Ahmed *et al*., 2009).The mean haemoglobin concentration decreased significantly after relieving dystocia in cows Yuksel *et al*. (2011).

The comparisons of haemoglobin levels among eutocia, maternal and foetal dystocia cows in the present study revealed no significant variations (Table 4). This finding is in partial agreement with those of Prabhakaran *et al*. (2006) who reported significantly lower haemoglobin levels in maternal dystocia than foetal dystocia buffaloes but was not significant when compared to normally calved buffaloes. Further, Ali *et al*. (2011) reported no significant differences in the haemoglobin concentration between buffaloes with uterine torsion and pregnant buffaloes. These observations again point out that haemoglobin levels may not be influenced by type of calving.

5.3. Packed cell volume (PCV)

The studies on the effect of dystocia on packed cell volume in cows are very few, Prabhakaran *et al*. (2006) and Ali *et al.* (2011) reported no significant changes in PCV values between normal calving and dystocia affected buffaloes and in cows with retention of foetal membranes (Skuja and Antane, 2010). Contrary to these reports, Yıldız *et al*.

(2011) reported significantly higher PCV values in normal calving cows as compared to the dystocia affected cows. Yuksel *et al*. (2011) observed that the mean haematocrit concentration was found to be significantly higher before relieving dystocia in cows. In other investigations ,significantly lower levels of PCV in buffaloes with uterine torsion (Kaur and Singh, 1993 and Amer and Hashem, 2008) and in buffaloes with dystocia (Prabhakaran *et al*., 2006), in buffaloes with vaginal and uterine prolapse (Ahmed *et al*., 2005), buffaloes with placental retention (Ahmed *et al*., 2009) were reported.

In the present study, it was observed that the PCV counts did not vary significantly between normal parturient cows and cows with dystocia (Table 1). These finding are inline with the previous reports of Prabhakaran *et al*. (2006) and Ali *et al.* (2011), who also observed non significant variations in PCV values between normal calving and dystocia affected buffaloes. The results of the present study, contradicts the observations of Yıldız *et al*. (2011) who reported significantly higher PCV values in normal calving cows as compared to dystocia affected cows and higher levels of PCV in cows with dystocia, Yuksel *et al*. (2011), Kaur and Singh (1993) and Amer and Hashem (2008) who observed significantly lower haematocrit concentration in buffaloes with uterine torsion and dystocia (Prabhakaran *et al*., 2000). The decrease in PCV values in dystocia affected animals was possibly attributed to release of antidiuretic hormone as a result of stress, anorexia and toxaemia (Kinney, 1967). In the present study, comparisons of PCV values between eutocia, maternal and foetal dystocia cows also revealed no significant variations. These observations suggest that stress of dystocia has negligible influence on PCV values in cows. Similar to the findings of the present study, Prabhakaran *et al*. (2006) also reported no significant variations in RBC count among

eutocia (normal calving) and buffaloes with maternal and foetal dystocia. These findings lend support to the observations made in the present and the results of the present study confirm their observations. Further, Ali *et al.* (2011) reported no significant variations in RBC count in buffaloes with uterine torsion, which is one of the causes of maternal dystocia.

5.4. MCV concentration

In the present study, no significant variations in the MCV values were observed among eutocia and dystocia cows (Table 1). Similarly, the MCV concentration did not differ significantly between dystocia and normal calving buffaloes (Kaur and Singh, 1993), dystocia due to uterine torsion in buffaloes (Kaur and Singh, 1993 and Ali *et al*., 2011), in buffaloes with vaginal and uterine prolapse (Kaur and Singh, 1993 and Ahmed *et al*., 2005). Thus the previous findings lend credence to the present findings. Similarly, MCV values did not differ in cows with and without retention of foetal membranes (Skuja and Antane, 2010).

Contrary to the observations of the present study, Yıldız *et al*. (2011) reported significantly higher MCV in cows with dystocia as compared to the normal parturition cows. In the present study, numerically, MCV values were higher in maternal dystocia cows as compared eutocia and foetal dystocia cows, the difference being statistically non significant (Table 4). This increase in MCV values in maternal dystocia cows as compared to the normal calving cows might be due to regenerative anemia because of immature RBC, which is released from the bone marrow into the peripheral blood at times of increase demand, is bigger in size than mature red blood cells (Jain, 1986).

Moreover, estradiol-17ß hormone plays an important role in the erythrocytic picture, which leads to hydraemia in the circulation (El-Baghdady, 1979) and results in macrocytic hypochromic anaemia. This type of anemia may be relatively due to more loss of blood during labor (Coles, 1986) and in cases of maternal dystocia cows due to uterine torsion. However, Klinkon and Zadnik (1999) reported that the periparturient period in cattle did not significantly affect MCV values.

5.5. Mean corpuscular haemoglobin concentration (MCHC)

In the present study, no significant variations in the MCHC values were observed among eutocia and dystocia cows (Table 1). Similarly, the MCHC concentration did not differ significantly between dystocia and normal calving buffaloes (Kaur and Singh, 1993), dystocia due to uterine torsion in buffaloes (Kaur and Singh, 1993 and Amer and Hashem, 2008), genital prolapse (Kaur and Singh, 1993 and Ahmed *et al*., 2005), dystocia and normal calving buffaloes (Kaur and Singh, 1993) and in vaginal prolapse and uterine prolapsed buffaloes (Ahmed *et al*., 2005) as compared to the control group of buffaloes and cows. Similarly, MCHC levels did not differ significantly between cows with and without retained foetal membranes (Skuja and Antane, 2010).The results of the present study are in accordance with observations of the previous studies (Ahmed *et al*., 2005, Kaur and Singh, 1993 and Amer and Hashem, 2008).

Contrary to the observations of the present study, Yıldız *et al*. (2011) reported significantly higher MCHC cows with dystocia as compared to the normal parturition cows. In the present study, numerically, MCHC values were lower in maternal dystocia cows as compared to the foetal dystocia cows, the difference being statistically non

significant (Table 4). This decrease in MCHC and increase in MCV values in maternal dystocia cows as compared to the normal calving cows might be due to regenerative anemia because of immature RBC, which is released from the bone marrow into the peripheral blood at times of increased demand, is bigger in size than mature red blood cells (Jain, 1986). Moreover, estradiol-17ß hormone plays an important role in the erythrocyte picture, which leads to hydraemia in the circulation (El-Baghdady, 1979) and resulted in macrocytic hypochromic anaemia. This type of anaemia might be relatively due to more loss of blood during labor (Coles, 1986), in cases of maternal dystocia cows due to uterine torsion. In contrast to the present findings, MCHC concentration was found to be significantly higher in normal parturition cows as compared to cows with dystocia (Yıldız *et al*., 2011), and in uterine torsion affected buffaloes (Ali *et al*., 2011), while corpuscular haemoglobin increased significantly following relieving dystocia in cows (Yuksel *et al*., 2011).

5.6. Mean corpuscular haemoglobin level (MCH)

In the present study, MCH did not differ between the dystocia and normally calving cows (Table 1). Similar to the findings of the present study, Yıldız *et al*. (2011) have also observed no significant variations in the MCH concentrations among eutocia and dystocia cows. Similar findings in dystocia associated cows and buffaloes have also been reported by earlier investigators (Kaur and Singh, 1993; Amer and Hashem; 2008, Ali *et al.,* 2011). The MCH concentrations did not vary significantly among buffaloes with uterine torsion, genital prolapse, dystocia and normal calving buffaloes (Kaur and Singh, 1993) and in buffaloes with and without torsion (Amer and Hashem, 2008, Ali *et al.,* 2011). The MCH concentrations did not vary significantly among buffaloes with

uterine torsion, genital prolapse, dystocia and normal calving buffaloes Kaur and Singh (1993), buffaloes with and without torsion (Amer and Hashem, 2008, Ali *et al.*, 2011). MCH values did not differ significantly between cows having retention of foetal membranes and cows without retained foetal membranes (Skuja and Antane, 2010). These findings lend support and confirm the findings of the present study.

The comparisons of MCH values among eutocia, maternal and foetal dystocia cows made in the present study revealed significant variations (Table 4). The MCH levels were significantly lower in both maternal and fetal dystocia cows as compared to the eutocia cows. These findings again indicated that MCH values are influenced by the type of calving. Similarly, a highly significant decrease in MCH value in buffaloes with vaginal prolapse and uterine prolapse was observed by Ahmed *et al*. (2005). This was attributed to stress of dystocia. Although the MCH values were lower in both maternal and fetal dystocia cows as compared to the eutocia cows, however, their levels were well within the physiological limits.

5.7. White Blood Cells count (%)

In the present revealed that the WBC count was found to be significantly lower in dystocia cows as compared and normally calving cows (Table 2). Similar findings have also been reported earlier by Yuksel *et al*. (2011) who also recorded significantly lower WBC counts in cows after relieving dystocia. In contrast to the present findings, a significant increase in the WBC count was observed in cows (Rakuljic-Zelov and Zadnik, 2002) and buffaloes (Amer and Hashem, 2008) with uterine torsion, buffaloes with vaginal and uterine prolapse (Ahmed *et al*., 2005), in buffaloes with dystocia

(Prabhakaran *et al*., 2006). On the other hand, no significant variation in total white blood cell count were reported in buffaloes with uterine torsion (Ali *et al*., 2011), vaginal prolapsed and uterine prolapsed buffaloes (Ahmed *et al*., 2005) and in cows with dystocia (Yıldız *et al*., 2011) as compared to the normal calving animals. In another study, Yuksel *et al*. (2011) reported that the total white blood cell count decreased significantly after relieving dystocia in cows.

While the WBC count were found to be higher in buffaloes with placental retention (Ahmed *et al*., 2009), it was significantly lower in cows with retention of foetal membranes (Skuja and Antane, 2010). In contrast, no significant differences in WBC counts were reported in buffaloes (Pandey *et al*., 2007) and in cows (Farzaneh *et al*., 2006) with and without retention of foetal membranes.

The present study revealed that the mean WBC counts in both maternal and foetal dystocia cows were significantly lower as compared to the eutocia cows (Table 5). The present findings are in contrast to the findings of Prabhakaran *et al*. (2006), who observed significantly higher total WBC counts in buffaloes with maternal and foetal dystocia when compared to the normally calved buffaloes. The significant increase in the WBC counts in dystocia affected buffaloes was ascribed due to stress of non infectious nature as reported by Phogat *et al.* (1991). However, total leukocyte counts for eutocia and both maternal and foetal dystocia cows were within the normal ranges (Ahmed *et al.*, 2005, Ferzaneh *et al*., 2006, Pandey *et al*., 2007, Amer *et al.*, 2008 and Yıldız *et al*., 2011).

5.8. Neutrophils count (%)

The present study revealed that the mean neutrophil count decreased significantly in dystocia-affected cows as compared to the normal calving cows (Table 2). The results of the present study contradicts the reports of Phogat *et al*. (1991), Kaur and Singh (1993) and Amer and Hashem (2008) in buffaloes and in cows (Rakuljic-Zelov and Zadnik, 2002) with uterine torsion, in buffaloes with genital prolapse (Kaur and Singh, 1993 and Ahmed *et al*., 2005) and in cows with dystocia (Yıldız *et al*., 2011) , who reported significant increase in the neutrophils count as compared to the normal calving cows. Significant increase in the neutrophil counts in vaginal and uterine prolapsed cows has also been reported by Kaur and Singh (1993) and Ahmed *et al*. (2005). The increase in the neutrophil count was attributed due to increased level of cortisol because of stress (Amer *et al*., 2008). However, neutrophilia has also been reported during excitement, exercise, adrenaline and ACTH release (Rakuljic-Zelov and Zadnik, 2002). Other studies revealed that the neutrophils counts in cows with retained placenta (Tiwari *et al*., 2001, and Skuja and Antane, 2010) showed no significant difference as compared to the normal parturient cows. However, significantly lower (Ray *et al*., 2004) and higher neutrophil counts (Ahmed *et al*., 2009. and Pandey *et al*., 2007) were reported in the cows and buffaloes respectively.

The present study revealed that the neutrophil count was found to be significantly lower in cows with maternal and foetal dystocia cows as compared to the eutocia cows (Table 5). The results of the present study is in line with observations of Ray *et al*. (2004) but contradicts the findings of Ali *et al*. (2011) and Ahmed *et al*. (2005), who reported no significant variations in neutrophils count among buffaloes with uterine

torsion and in buffaloes with vaginal prolapsed and uterine prolapse. It has been previously reported that the estrodiol 17β concentrations was found to be significantly lower in buffaloes with dystocia (Ali *et al*., 2011). It has also been reported that neutrophil counts around estrus period was found be higher in cows than anoestrus cows. The significantly lower neutrophil counts encountered in cows with dystocia may possibly be attributed to the immune suppressive effect of cortisol as well to the decreased levels of estrogen in cows suffering with dystocia.

5.9. Lymphocytes counts (%)

A significant increase in lymphocytes counts in dystocia affected cows as compared to the normally calving cows was recorded in the present study (Table 2). In contrast to the present observations, no significant variations in lymphocytes count were reported in buffaloes (Amer and Hashem, 2008, and Ali *et al*., 2011) and cows with uterine torsion (Rakuljic-Zelov and Zadnik, 2002), between normal parturition cows and cows with dystocia (Yıldız *et al.,* 2011) and in buffaloes with vaginal and uterine prolapse (Ahmed *et al*., 2005). However, lymphocytes count was found to increase significantly following relieving dystocia in cows (Yuksel *et al*., 2011). However, Phogat *et al*. (1991) reported significantly lower lymphocytes count in buffaloes with uterine torsion. In contrast to this, Kaur and Singh (1993) noticed significantly higher lymphocytes count in buffaloes with uterine torsion, genital prolapse and dystocia. In retained placenta cows, lymphocytes count showed no significant (Tiwari *et al*., 2001) and significant (Ray *et al*., 2004) variations among cows with RFM and normal parturient cows. In another study in buffaloes with retention of foetal membranes, Pandey *et al*. (2007) observed significantly higher lymphocytes count, while investigations of Ahmed

et al. (2009) in buffaloes and cows with retained placenta (Skuja and Antane, 2010) observed lymphopenia. The results of the present study are in consonance with the reports of Kaur and Singh (1993) who also noticed significantly higher lymphocytes count in buffaloes with uterine torsion, genital prolapse and dystocia and their observations lend support to the present findings. The significant increase in lymphocytes count as observed in the present study may possibly be due to decrease in neutrophils, which in turn elevated the lymphocytes count. The other possible cause for this increase in lymphocytes may be due to increase in cortisol levels in dystocia, which might have caused lymphocytosis.

In the present study, the lymphocyte counts were found to be significantly higher in both maternal and foetal dystocia cows (Table 5). These findings are well supported by the observations of Kaur and Singh (1993) who also noticed significantly higher lymphocytes count in buffaloes with uterine torsion, genital prolapse and dystocia. Thus the present findings confirm the observations of Kaur and Singh (1993). However, lymphocytes counts for eutocia and dystocia cows were within the normal ranges (Ahmed *et al*., 2005, Ferzaneh *et al*., 2006, Pandey *et al*., 2007, Amer *et al.,* 2008 and Yıldız *et al*., 2011).

5.10. Monocytes count (%)

In the present study, monocytes did not differ between the dystocia and normally calving cows (Table 2). The previous investigations have reported that the monocytes count did not vary significantly in uterine torsion affected buffaloes (Phogat *et al.,* 1991 and Ali *et al*., 2011), buffaloes with uterine torsion, genital prolapse, dystocia and normal

calving buffaloes (Kaur and Singh, 1993), in normal parturition cows and cows with dystocia (Yıldız *et al*., 2011), cows (Tiwari *et al*., 2001, Ray *et al*., 2004, Farzaneh *et al*., 2006, and Skuja and Antane, 2010) and buffaloes (Pandey *et al*., 2007) with retention of foetal membranes from that of normal parturition and between buffaloes with vaginal and uterine prolapse (Ahmed *et al*., 2005). The present study revealed no significant variations in the monocyte count among the eutocia maternal and foetal dystocia cows (Table 5). The results of the present study are in conformity with the findings of the above reports. However, significantly higher monocytes counts in buffaloes with torsion (Amer and Hashem, 2008) and in buffaloes with placental retention (Ahmed *et al*., 2009), which decreased significantly following relieving dystocia in cows (Yuksel *et al*., 2011) were reported, and these observations are in contrast to the present findings. However, monocyte counts for eutocia and dystocia cows were within the normal ranges (Ahmed *et al*., 2005, Ferzaneh *et al*., 2006, Pandey *et al*., 2007, Amer *et al*., 2008, and Yıldız *et al*., 2011).

5.11. Eosinophils count (%)

In the present study, eosinophil count did not differ between the dystocia and normally calving cows (Tale 2). Similar findings were also reported in buffaloes with uterine torsion (Kaur and Singh, 1993 and Ali *et al*., 2011), genital prolapse (Kaur and Singh, 1993), dystocia and normal calving buffaloes (Kaur and Singh, 1993) and in normal parturition cows and cows with dystocia (Yıldız *et al*., 2011), as well as among cows before and after relieving dystocia (Yuksel *et al*., 2011). Significantly higher eosinophil counts in the cows with RFM were observed by Ray *et al*. (2004). On the other hand, Tiwari *et al*. (2001) , Farzaneh *et al*., (2006), and Skuja and Antane, (2010)

recorded no variations in eosinophil counts among cow and buffaloes (Pandey *et al*., 2007 and Ahmed *et al*., 2009) with and without retained foetal membranes. In contrast to above reports, significantly lower eosinophil counts were reported by Phogat *et al*. (1991), Amer and Hashem, (2008) in buffaloes with vaginal and uterine prolapse (Ahmed *et al*., 2005). The results of the present are in agreement with those of Kaur and Singh (1993), Yıldız *et al*. (2011), Ali *et al*. (2011), and Yuksel *et al*. (2011) and indicated that eosinophil counts are not influenced by stress of dystocia cows and buffaloes. Thus, the present finding confirms findings of the previous studies.

In the present study, comparisons of eosinophils count among eutocia, maternal and foetal dystocia cows showed no significant variations (Table 5). These findings are in close conformity with those of Kaur and Singh (1993) and Ali *et al*. (2011) who also observed no significant increase in eosinophils counts in buffaloes with uterine torsion, which is one of the cause for maternal dystocia. Further, Tiwari *et al*. (2001), Farzaneh *et al*., (2006) and Skuja and Antane (2010) also recorded no variations in eosinophils counts among cow and buffaloes (Pandey *et al*., 2007, Ahmed *et al*., 2009) with retained foetal membranes, which is most common after dystocia. However, eosinophils counts for eutocia and dystocia cows were within the normal ranges (Ahmed *et al*., 2005, Ferzaneh *et al*., 2006, Pandey *et al*., 2007, Amer *et al.*, 2008, and Yıldız *et al*., 2011).

5.12. Basophils count (%)

In the present study, basophil count did not differ between the dystocia and normally calving cows (Table 2). Previous studies have also reported no difference between the buffaloes with uterine torsion, genital prolapse, dystocia and normal calving

buffaloes (Kaur and Singh, 1993), normal parturition cows and cows with dystocia (Yıldız *et al*., 2011 and Yuksel *et al*., 2011), buffaloes with uterine torsion and normal pregnant buffalo cows (Ali *et al*., 2011), in buffaloes with vaginal prolapsed and uterine prolapse (Ahmed *et al*., 2005), cows (Tiwari *et al*., 2001, Ray *et al*., 2004, Farzaneh *et al*., 2006, and Skuja and Antane, 2010) and buffaloes (Pandey *et al*., 2007) with retained placenta. The findings of above investigations lend support to the findings of the present study and results recorded in the present study confirmed the findings of the previous studies. However, Phogat *et al*. (1991) reported a significant increase in basophil count in buffaloes with uterine torsion, which is in contrast to the present findings. However, basophil counts for eutocia and dystocia cows were within the normal ranges (Ahmed *et al*., 2005; Ferzaneh *et al*., 2006; Pandey *et al*., 2007; Amer *et al*., 2008, and Yıldız *et al*., 2011).

The comparison of basophil counts among eutocia, maternal and foetal dystocia cows in the present study revealed no significant variations (Table 5). These findings are in concordance with the observations of Kaur and Singh (1993) who also reported no significant variations in basophil count among buffaloes with uterine torsion, genital prolapse, in dystocia and in normal calving buffaloes.

5.13. Serum calcium concentration

In the present study, it was observed that blood serum calcium concentrations were significantly increased in the cows with dystocia in comparison to the cows experiencing normal parturition (Table 3).

The studies on effects of dystocia on the blood serum calcium concentrations are controversial. In a few studies, an increase in blood serum calcium concentration has been found (Bostedt, 1974 and Yokus *et al*., 2010), while some other researchers (Sharma *et al*., 1991 and Swelum *et al*. 2012) reported a decreased or no significant change (Sevcik *et al*., 1980, Ali *et al*., 2011) during difficult calving as compared to the normal calving cows. In another study, serum calcium concentrations showed a non significant increase in cows with dystocia due to absolute birth weight, twin pregnancy and presentation disposition as compared to the cows with normal parturition (Yokus *et al*., 2010). The calcium concentration exhibited significantly high values after obstetrical maneuvering than before instituting any treatment (Singh *et al*., 2009).

In studies with various obstetrical pathologies in the cows and buffaloes, it was reported that serum calcium concentrations in cows decreased (Marques *et al*., 1996, and Salmanoglu, 1998) and buffaloes (Mandali *et al*., 2002, and Ahmed *et al*., 2005) with uterine prolapse, with vaginal prolapse (Akhtar *et al*., 2008, and Akhtar *et al*., 2012). Contrary to the above reports, Paul *et al*. (2000) did not observe any variations in the serum calcium concentrations of cows with or without cervico-vaginal or uterine prolapse. Significantly lower calcium levels have also been reported by a number of investigators in cows (Mohanty *et al.*, 1994, Bari *et al*., 1996, Patel *et al*., 1999, Semacan and Sevun, 2005, Ozyurtlu *et al*., 2008, and Hashem and Amer, 2008), in buffaloes with retention of foetal membranes (Mandali *et al*., 2002, Pandey *et al*., 2007, Shukla *et al*., 1983, and Zhang *et al*., 1992) which usually occurs as a sequel to difficult calving. While several studies reported that blood serum calcium concentrations did not differ significantly between cows with and without retained fetal membranes (Ocal, *et al.*, 1999,

Akar *et al*., 1999, Tiwari *et al.*, 2001, Akar *et al*., 2002, Ray *et al*., 2004, Akar and Yildiz, 2005, and Skuja and Antane, 2010). The results of the present study are in consonance with the findings of Bostedt, (1974) and Yokus *et al*. (2010) who also observed higher serum calcium levels in cows with difficult parturition. Their findings lend support to the observations made in the present study and further confirm their observations.

In the present study, the serum calcium concentrations showed a significant increase in both maternal and fetal dystocia cows, compared with normal calving cows (Table 6). It was observed in many studies (Samad, and Islam, 1989, Correa *et al*., 1990, Laven and Peters., 1996, and Akar and Yildiz, 2005) that dystocia in cows increased the incidence of retention of foetal membranes (RFM), which usually occurred after dystocia (Olujohungbe *et al*. 1998). Bari *et al*. (1996) observed serum calcium concentration in cows with and without RFM as 6.65 and 8.61 mg/dL, respectively during parturition. Sevcik *et al*. (1980) reported that the blood serum calcium concentrations did not differ between normal cows and those with dystocia. Similarly, Akar and Yildiz (2005) observed no significant differences in blood serum calcium levels between the cows with RFM and without retained foetal membranes irrespective of parturition type (dystocia and normal parturition).

On the other hand, Bostedt (1974) reported that the serum calcium concentrations in dystocia cows and heifers were higher than those in cows with normal parturition. The cause of controversial results in different studies may be influence of dystocia from different factors and the difference in the time of sample collection. Indeed, the time trend of serum calcium concentrations can be affected by the stage of pregnancy (Yokus

and Cakir, 2006). However, all studies evaluated the serum calcium concentrations after parturition in dystocia. In the present study, the significantly higher calcium level in dystocia cows than eutocia cows (P>0.05) probably is due to the increase of bone resorption because of increased parathyroid hormone (PTH) caused by estradiol, which is increased in dystocia (Yokus *et al*., 2004). Also, all subgroups in the dystocia showed significantly higher levels of serum calcium. These observations are in line with the observations of Yokus *et al*. (2010) who also observed that dystocia cows showed a tendency to higher levels of serum calcium, although this difference did not reach statistical significance.

Estrogens have been found to depress serum calcium levels while simultaneously increasing serum phosphorus levels (Kaneko and Cornelius, 1970). High levels of estrogen are thought to be a factor in the etiology of vaginal prolapse in cattle (Roberts, 1986). Cows with vaginal prolapse have been reported to have significantly lower serum calcium levels than controls (Seitaridis and Papadopoulos. 1978). High levels of estrogen in cows with uterine prolapse could have caused decreased serum calcium levels. Insufficient production of oestrone sulphate and delayed regression of the corpora lutea were suggested to be associated with dystocia in dairy cows (Zhang *et al*., 1999). Further, it has also been observed that the serum estradiol-17β concentrations were found to be lower in cows and buffaloes affected with dystocia compared to the normal calving cows (Zhang *et al*., 1999 and Ali *et al*., 2012). One of the possible reason for increased serum calcium concentrations in cows with dystocia observed in the present study may possible due to decreased estradiol-17β concentrations in dystocia cows (Zhang *et al*., 1999 and Ali *et al*., 2012).

5.14. Serum phosphorus concentration

In the present study, serum phosphorus concentration was found to be significantly higher ($P<0.05$) in dystocia affected cows as compared to the cows with eutocia (Table 3). In studies with various obstetrical pathologies in the cows and buffaloes, it was reported that the serum phosphorus concentrations were significantly lower in buffaloes with vaginal prolapse (Nanda and Sharma, 1982, Mandali *et al*., 2002, Ahmed *et al*., 2005, Akhtar *et al.*, 2008 and Akhtar *et al*., 2012), in buffaloes with uterine torsion (Ali *et al.*, 2011), or uterine prolapse (Marques *et al*., 1996) compared to the normal calving buffaloes or cows. However, studies of Khan *et al*. (1984) and Singh (1998) reported no-significant variations in phosphorus concentration in buffaloes suffering with vaginal prolapse and in buffaloes with vaginal prolapse and uterine prolapse (Ahmed *et al*., 2005) compared with the healthy buffaloes.

A significantly decreased concentration of phosphorus was also observed in cows with retained placenta (Bari *et al*., 1996, Patel *et al.*, 1999, Semacan and Sevun, 2005 and Hashem and Amer, 2008). However, other studies reported no significant variation between the cows with RFM and normal parturient cows (Sharma *et al*., 1991; Akar *et al*., 1999; Ocal, *et al.*, 1999; Ray *et al.*, 2004; Akar *et al*., 2002; Tiwari *et al*., 2001; Ozyurtlu *et al.*, 2008, and Skuja and Antane, 2010). But phosphorous concentration exhibited significantly high values after obstetrical maneuvering than before instituting any treatment in buffaloes (Singh *et al*., 2009).There are no published reports to support the findings of the present study and available reports are in contrast to present findings. In the present study, significantly higher serum calcium levels were registered in all dystocia cows (Table 6). Because of increase in calcium levels, phosphorus levels also

might have increased concurrently. Besides which, decreased levels of estradiol 17β (Ali *et al*., 2012) and increased of bone resorption because of increased parathyroid hormone (Yokus *et al*., 2004), may be the other possible reason for increased phosphorus levels in dystocia cases. In the light of the observations made in the present investigations as well as lack of any information, further investigations are needed.

5.15. Blood serum magnesium concentration

In the present study, the magnesium concentration in the serum of cows suffering with dystocia was 2.90 ± 0.12 mg/dL, while in eutocia counterparts it was 2.90 ± 0.21 mg/dl. Serum magnesium concentration did not differ significantly ($P<0.05$) between dystocia affected cows and eutocia cows (Table 3).

In bovine dystocia, a few inconsistent reports have been published concerning concentrations of blood serum magnesium. In the previous studies, blood serum magnesium concentrations did not differ between normal cows and those with dystocia (Akar and Yildiz, 2005) and in buffaloes with uterine torsion (Ali *et al.*, 2011).

On the other hand, Bostedt (1974) observed that the serum magnesium concentrations were higher in cows and heifers with dystocia than those in cows with normal parturition. In studies with various obstetrical pathologies in the cows and buffaloes, a significantly higher serum magnesium concentration was reported in buffaloes suffering with vaginal prolapse (Pandit *et al*., 1982) as compared to the healthy pregnant buffaloes, while non-significant differences in magnesium concentration between prolapse affected and healthy buffaloes were reported by Khan *et al*. (1984) and Vicenti *et al*. (1992) for cows. Contrary to these reports, no significant difference in

serum magnesium levels was observed between vaginal prolapsed and uterine prolapsed buffaloes (Ahmed *et al.,* 2005). Other studies revealed significantly higher serum magnesium in buffaloes suffering with pre-partum vaginal prolapse (Akhtar *et al.,* 2008 and Akhtar *et al*., 2012). The magnesium concentrations decreased significantly in cows with retention of foetal membranes (Bari *et al.,* 1996, and Hashem and Amer, 2008). But in other study, magnesium concentrations did not vary significantly between cows with and without RFM (Ozyurtlu *et al*., 2008).

The results of the present study revealed that the blood serum magnesium concentrations did not differ between normal cows and those with dystocia (Table 3). This finding aligns well with the observations of Akar and Yildiz (2005) and Ali *et al*. (2011) who also reported similar levels of serum magnesium in dystocia cows and buffaloes with uterine torsion as compared to normal parturient cows and buffaloes. The present findings also in consonance with the findings of Khan *et al*. (1984) and Vicenti *et al*. (1992) who also observed non-significant differences in magnesium concentration between genital prolapsed and healthy buffaloes and cows respectively. However, the present observations are in variance with those of Bostedt (1974) who reported significantly higher levels of magnesium in dystocia cows. The variations in the magnesium levels observed in the present study as compared to other reports may be possibly subscribed to variations in the type of dystocia cases studied and duration of dystocia experienced by animals.

In the present study, the mean magnesium (mg/dL) concentrations in eutocia, maternal and foetal dystocia cows were 2.90 ± 0.21, 2.80 ± 0.19 and 2.90 ± 0.15,

respectively. Although the mean magnesium values were insignificantly higher in eutocia and foetal dystocia affected cows compared with that of the maternal dystocia cows, the difference was, however, non-significant (Table 6).

The present findings are in partial agreement with the reports of Yokus *et al*. (2010), who recorded significantly lower serum concentration of magnesium in dystocia cows except for those cows suffering with dystocia due to faulty presentation disposition of foetus (foetal dystocia). Such variations are to be expected, because the alterations in the blood biochemical concentrations varied with the duration of dystocia the animals suffered, or due to lower threshold level of stress due to nature of dystocia or the length of time the animal suffered from dystocia or may be variations in the nutrition.

In conclusion, the present study revealed that stress of dystocia in cows may not significantly alter haematological attributes except for neutrophil and leukocyte, which showed neutropenia and lymphocytosis, which in turn caused a significant increase in total leukocyte in dystocia affected cows. The calcium and phosphorous levels showed a significant increase in dystocia affected cows. The possible reason for increased serum calcium may be due to increased parathyroid hormone and decrease in estradiol 17β. The endocrine imbalance may be subscribed for variations. The lack of scientific documentation for increased phosphorous levels warrants further investigation.

Summary

VI. SUMMURY

The aim of the present study was to determine the level of haematological changes and serum macro mineral contents concentrations in cows with or without difficulties during parturition. The second goal was to compare between the normal calving cows and cows calving with maternal and fetal dystocia. A total number of 41 cross breed cows at full term were included in this study. Out of them, 13 gave normal parturition, 28 cows were affected with dystocia. The group of dystocia was subdivided into two groups: maternal (n= 8) and foetal (n= 20) group. The blood samples were collected from eutocia or normal parturient cows within 15 minutes after delivery and in dystocia cows before the obstetrical manipulations. The results showed that RBC, red blood cell count (RBC), haemoglobin concentration (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) levels did not vary among eutocia and dystocia cows. The leukogram of cows with maternal, foetal dystocia cows and normal caving cows showed, higher total WBC (10^3/µl) counts in normal calving cows (7.70 ± 0.28) than those cows with fetal dystocia (7.10 ± 0.41) and maternal dystocia (6.70 ± 0.75), but they were statistically not significant, neutrophils (%) counts were significantly lower in cows with fetal dystocia (28.30 ± 3.20) and in maternal dystocia (25.40 ± 5.00) as compared to the normal calving cows (32.60 ± 4.71). The lymphocyte counts were found to be significantly higher in cows with foetal dystocia (64.40 ± 6.63) and in maternal dystocia cows (59.30 ± 3.11) than normal calving cows (56.70 ± 5.16). However, the eosinophil, monocyte and basophil counts (%) did not vary significantly among normal calving, foetal and maternal dystocia cows. It was concluded that

variations in the leukogram in cows with maternal and foetal dystocia cows as compared to the normal calving cows could be attributed to stress of dystocia condition in crossbred cows included in the study.

Effect of dystocia on macro mineral concentrations revealed, that the serum calcium, phosphorus and magnesium concentration in cows suffering with dystocia were 9.00 ± 0.19, 6.10 ±0.16 and 2.90 ± 0.12 mg/dL as against 7.50 ± 0.19, 4.70 ± 0.19 and 2.90 ± 0.21 mg/dL respectively in eutocia cows. The concentrations of serum calcium and phosphorus were significantly higher in dystocia cows, while no difference in magnesium levels were noticed among eutocia and dystocia cows.

Comparisons of red blood cell count (RBC), haemoglobin concentration (Hb), packed cell volume (PCV), MCH, MCHC values among eutocia, maternal and fetal dystocia cows did not vary. The MCH concentration was significantly lower in cows suffering with maternal and foetal dystocia compared with that of normal calving (eutocia) cows. Total leukocytic count was found to be lower in cows suffering with maternal and foetal dystocia, neutrophils count was found to be significantly lower ($P<0.05$) in cows suffering with maternal dystocia and lymphocyte count were found to be significantly higher in maternal (59.30 ± 3.11 %) and foetal dystocia cows (64.40 ± 6.63 %). The serum calcium and phosphorus levels of maternal and foetal dystocia cows were significantly higher as compared to the eutocia cows. However, magnesium levels did not vary among eutocia, maternal and foetal dystocia cows.

In conclusion, the present study revealed that stress of dystocia in cows did not significantly ($P<0.05$) alter haematological attributes except for neutrophil and leucocyte,

which showed neutropenia and lymphocytosis, which in turn caused a significant increase in total leukocyte counts in dystocia affected cows. The calcium and phosphorous concentrations showed a significant increase in dystocia affected cows. The possible reason for increased serum calcium might be due to increased parathyroid hormone and decrease in estradiol 17β. The endocrine imbalance might be subscribed for these variations. The lack of the scientific documentation for increased phosphorous levels warrants further investigation.

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Abstract

VIII. ABSTRACT

Blood samples were collected from 41 crossbred cows belonging to one of the three groups i.e. normal calving (eutocia) (n=13), maternal (n=8) and fetal dystocia (n=20) were used to investigate hematological and serum macro mineral contents. The hematological parameters including red blood cells count (RBC), haemoglobin concentration (Hb), packed cell volume (PCV); mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC), total leukocytic count (TLC), and differential leukocytic count, The results revealed that the values of RBC, Hb, PCV, MCV, and MCHC did not vary significantly between normal calving cows as compared maternal or fetal dystocia cows. The MCH (pg) concentrations were significantly higher in normal calving cows than those cows with maternal dystocia and fetal dystocia. Total WBCs counts in normal calving cows than those cows with fetal dystocia and maternal dystocia were statistically not significant. Neutrophils counts were significantly lower in cows with fetal dystocia and in maternal dystocia as compared to normal calving cows. The lymphocyte counts were found to be significantly higher in were higher in cows with fetal dystocia and in maternal dystocia cows than normal calving cows. However, the eosinophils, monocyte and basophils counts did not vary significantly among normal calving, fetal and maternal dystocia cows. In the dystocia cows, the blood serum concentrations of calcium and phosphorus were significantly higher, while serum magnesium levels were not affected. It is concluded that hematological indices are not affected by stress of dystocia except for total WBC, neutrophils and lymphocytes counts.