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Hiren M Barot
Ph.D. Scholar, Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand, Gujarat, India

Kirat R Chaudhari
Post-Graduate Scholar, Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Sardarkrushinagar, Gujarat, India

PB Patel
Professor and Head, Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Sardarkrushinagar, Gujarat, India

Bhairavi N Sodagar
Post-Graduate Scholar, Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Sardarkrushinagar, Gujarat, India

CF Chaudhari
Associate Professor, Department of Veterinary Gynecology and Obstetrics, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Sardarkrushinagar, Gujarat, India

Corresponding Author
Hiren M Barot
Ph.D. Scholar, Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand, Gujarat, India

Physiological and hematobiochemical effects of proximal paravertebral administrated ropivacaine and lignocaine in bovine

Hiren M Barot, Kirat R Chaudhari, PB Patel, Bhairavi N Sodagar and CF Chaudhari

Abstract
The present investigation was conducted on 18 bovines (16 buffalo and 2 cattle) to study physiological, haemato-biochemical and serum cortisol changes after proximal paravertebral administration of 0.5 percent ropivacaine, 0.75 percent ropivacaine and 2 percent lignocaine. Ropivacaine was found to have no clinically relevant effects on heart rate, respiration rate and rectal temperature. Ropivacaine did not show any adverse clinical effect on the haematological parameters. Non-significant decreased in serum cortisol was observed 30 minutes after administration of local anesthetics compare to before administration of local anesthetics in all groups and quantified that the local anaesthetic reduced surgical stress during surgical procedures. From the present study, it was concluded that ropivacaine effectively administrated in paravertebral space in physiologically impaired animals.

Keywords: Lignocaine, haemato-biochemical, physiological, proximal paravertebral, ropivacaine, serum cortisol

Introduction
Local anesthetics are a group of chemically related compounds that bind sodium channels and block impulse conduction in nerve fibers (Butterworth and Strichartz, 1990) [5]. Lignocaine a first amino amide type local anaesthetics, was first synthesized under the name of xylocaine by Swedish chemist Nils lofgren in 1943 (Lofgren and Lundqvist, 1943) [19]. Lignocaine remains the most versatile and most widely used local anesthetic in veterinary medicine because of its fast onset, moderate duration of effect, and moderate toxicity. Ropivacaine is a new amino amide local anaesthetic that has both anaesthetic and analgesic properties. It generates surgical anaesthesia at high doses and analgesia (sensory block) with limited and non-progressive motor block at low doses. Because it is less lipophilic and less prone to enter big myelinated motor neurons, it causes less motor blockage (Amarpal *et al.*, 2004) [3]. According to Graf *et al.* (2002) [14] reduced lipophilicity of ropivacaine is associated with decreased potential for central nervous system toxicity and cardiotoxicity. Ropivacaine was found to be less cardio-depressant, arrhythmogenic, and neurotoxic than bupivacaine in various trials. There is less information available regarding clinico-physiological effect of ropivacaine using paravertebral anaesthesia in bovines. Therefore, the present study is designed to study clinico-physiological of 0.5 percent ropivacaine, 0.75 percent ropivacaine and 2 percent lignocaine in bovine using proximal paravertebral anesthesia.

Materials and Methods
Design of study
The study on physiological and haematobiochemical evaluation of three local anesthetics *viz.*, 0.5 percent ropivacaine, 0.75 percent ropivacaine and 2 percent lignocaine using proximal paravertebral anaesthesia was planned and executed on eighteen clinical cases of bovines (16 buffalo and 2 cattle) presented at Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, Sardarkrushinagar, Gujarat, India for various surgical procedure. The animals were randomly divided into three groups and each groups consisting six animals. All the local anaesthetics used in present study does not contain epinephrine or any other preservative.

Table 1: Detail design of study

Groups	No. of animals	Drugs	Dose rate	Surgical approach
I	6	0.5 percent Ropivacaine HCL	2.5 mg/kg	Left flank laparotomy (N=4) Right flank laparotomy (N=2)
II	6	0.75 percent Ropivacaine HCL	1 mg/kg	Left flank laparotomy (N=6)
III	6	2 percent Lignocaine HCL	0.65 mg/kg	Left flank laparotomy (N=5) Right flank laparotomy (N=1)

Physiological parameters

The physiological parameters *viz.* rectal temperature, respiration rate and heart rate was recorded before anaesthesia, 10 minutes, 30 minutes, 90 minutes after onset of anaesthesia and after recovery from anaesthesia.

Haematobiochemical parameters

The blood collection was done for haematological and biochemical study. Ten ml of blood was collected from jugular vein, before analgesia, 10 minutes, 30 minutes after onset of analgesia and after recovery from analgesia.

Haematological parameters *viz.* hemoglobin, Packed Cell Volume (PCV), Total Erythrocyte Count (TEC), Total Leukocyte Count (TLC) and Differential Leukocyte Count (DLC) *viz.* granulocyte, lymphocyte and monocyte were measured by automated blood analyzer.

The biochemical parameters *viz.* Serum sodium, potassium and chloride were estimated using fully automated biochemical analyzer.

Serum Cortisol estimation

Serum cortisol concentrations were measured as indicators of physiological stress in animals. Serum cortisol level was determined before onset of analgesia, 10 minutes and 30 minutes after onset of analgesia and after recovery from analgesia. Serum cortisol concentration was measured by standard Enzyme Linked Immuno Sorbent Assay (ELISA) technique.

Statistical Analysis

All data were presented as mean ± SE for each treatment. Physiological, haematological and biochemical parameters were analyzed using two way repeated measure ANOVA with terms for group, time period and their interactions. A value of $P<0.05$ was considered as a significant. Data analysis was done with SPSS software.

Result

Physiological parameters

Heart rate (beats per minute)

In group I, the mean ± SE heart rate was 74.00±4.26 on before anaesthesia, whereas, it was 71.33±3.37, 70.17±3.66, 76.33±2.33 and 69.67±4.66 on 10, 30, 90 minutes after onset of analgesia and after recovery from anaesthesia, respectively. In group II, the mean ± SE heart rate was 67.17±3.33 on before anaesthesia, whereas, it was 63.50±3.69, 59.67±0.97, 62.67±4.06 and 64.67±4.28 on 10, 30, 90 minutes after onset of analgesia and after recovery from anaesthesia, respectively. In group III, the mean ± SE heart rate was 60.17±5.62 on before anaesthesia, whereas, it was 58.83±3.90, 58.08±4.26, 57.17±4.71 and 59.17±4.31 on 10, 30, 90 minutes after onset of analgesia and after recovery from anaesthesia, respectively.

The comparison of heart rate within the groups at different intervals of the present study revealed that there was no significant ($P>0.05$) difference. No significant changes occur in heart rate at different intervals when compared between group except, significantly ($P<0.05$) increased in heart rate observed in group I and group II as compared with group III at 90 minutes after onset of analgesia.

Respiration rate (breath per minute)

The Mean ± SE values of rectal temperature at before anaesthesia were 18.50±2.03, 12.33±0.80, and 20.17±3.29 in Groups I, II and III, respectively. 10 minutes after anaesthesia the mean ± SE values in Groups I, II and III were 16.17±1.64, 14.17±0.91 and 20.00±3.21 respectively. After 30 minutes of anaesthesia the mean ± SE values in Groups I, II and III were 17.17±1.51, 14.33±1.31, and 18.50±3.58 respectively. The values were 19.50±3.48, 14.33±1.09 and 18.00±3.17 in Groups I, II and III respectively after 90 minutes of anaesthesia. After recovery from anaesthesia mean ± SE values in Groups I, II and III were 16.67±1.98, 15.67±1.50 and 19.00±3.56 respectively.

The comparison within the groups and between the groups at different intervals of the present study revealed that there was no statistically significant ($P>0.05$) difference in the rectal temperature. The rectal temperature fluctuated within normal physiological limits at all the intervals of the study and in all the groups of animals.

Rectal temperature (°F)

In group I, the mean ± SE rectal temperature was 97.83±1.02 on before anaesthesia, whereas, it was 98.55±0.85, 98.85±0.64, 98.43±0.60 and 98.23±0.99 on 10, 30, 90 minutes after onset of analgesia and after recovery from anaesthesia, respectively. In group II, the mean ± SE rectal temperature was 99.62±0.87 on before anaesthesia, whereas, it was 99.72±0.65, 98.72±0.97, 98.77±0.96 and 99.33±1.04 on 10, 30, 90 minutes after onset of analgesia and after recovery from anaesthesia, respectively. In group III, the mean ± SE rectal temperature was 99.80±0.93 on before anaesthesia, whereas, it was 100.43±0.66, 100.58±0.39, 100.40±0.48 and 100.67±0.33 on 10, 30, 90 minutes after onset of analgesia and after recovery from anaesthesia, respectively.

The comparison within the groups and between the groups at different intervals of the present study did not reveal any significant ($P>0.05$) difference in the rectal temperature. The rectal temperature fluctuated within the normal physiological limits at all the intervals of the study and in both the groups of animals.

Haematological parameters

Haemoglobin (g/dl)

The mean ± SE values of haemoglobin in group I was 10.85±0.52 on prior to paravertebral anaesthesia, 10.74±0.65, 10.51±0.64 on 10, 30 minutes after anaesthesia and 9.62±0.52 after recovery from anaesthesia. The mean ± SE values of haemoglobin in group II was 9.97±0.40 on prior to paravertebral anaesthesia, 10.42±0.73, 10.36±0.81 on 10, 30 minutes after anaesthesia and 10.27±0.46 after recovery from anaesthesia. The mean ± SE values of haemoglobin in group III was 10.68±1.08 on prior to paravertebral anaesthesia,

10.72±1.14, 10.68±1.16 on 10, 30 minutes after anaesthesia and 10.77±1.16 after recovery from anaesthesia.
The comparison within the groups and between the groups at different intervals of the present study revealed that there was no statistically significant (P>0.05) difference in the haemoglobin concentration.

Packed cell volume (per cent)
The mean ± SE values of PCV in group I was 31.93±1.77 at before giving local anesthetic, 30.17±1.70, 30.61±2.18 on 10, 30 minutes after anaesthesia and 28.07±2.05 after recovery from anaesthesia. The mean ± SE values of PCV in group II was 29.83±1.15 at before giving local anesthetic, 30.46±1.96, 30.51±2.38 on 10, 30 minutes after anaesthesia and 30.45±1.48 after recovery from anaesthesia. The mean ± SE values of PCV in group III was 32.37±3.46 at before giving local anesthetic, 32.33±3.39, 32.40±3.68 on 10, 30 minutes after anaesthesia and 31.62±3.63 after recovery from anaesthesia. PCV was found to be non-significant (P>0.05) in within and between groups at different intervals.

Total erythrocyte count (10^6 cells/cumm)
The mean ± SE values of TEC before anaesthesia in group I, group II and group III were 6.15±0.25, 6.73±0.26 and 6.62±0.97, respectively. The mean ± SE values of TEC at 10 minutes after onset of analgesia in groups I, II and III were 6.05±0.24, 6.66±0.24 and 6.41±0.87, respectively. The mean ± SE values of TEC were 5.89±0.22, 6.48±0.34, and 6.01±0.65 on 30 minutes after onset of anaesthesia in groups I, group II and group III, respectively. The mean ± SE of TEC after recovery from anaesthesia in group I, group II and group III was 5.34±0.20, 6.31±0.26 and 6.17±0.66, respectively.
In present study, significantly (P<0.05) decreased total erythrocyte count observed in group I after recovery of anaesthesia as compared to before onset of anaesthesia. In group II and III total erythrocyte count was found to be non-significant (P>0.05) in within group at different intervals. Total erythrocyte count was found to be non-significant (P>0.05) in between groups at different intervals.

Total leukocyte count (10^3 cells/cumm)
In group I, II and III before giving local anaesthesia, the Mean ± SE values of TLC were 10.65±1.00, 7.56±1.05 and 6.87±0.97, respectively. The mean ± SE values TLC at 10 minutes after onset of anaesthesia were 9.93±1.04, 7.56±1.13 and 6.50±0.90 in group I, II and III, respectively. The mean ± SE values of TLC were 9.12±1.21, 7.14±1.03, and 6.30±0.95 on 30 minutes after onset of anaesthesia in groups I, II and III, respectively. The mean ± SE of TLC after recovery from anaesthesia in group I, II and III was found to be 8.83±1.12, 7.45±1.15 and 6.72±1.30, respectively.
In group I significantly (P<0.05) decreased TLC observed after recovery of anaesthesia as compared to before onset of anaesthesia. In group II and III total leukocyte count was found to be non-significant (P>0.05) in within group at different intervals. Total erythrocyte count was found to be non-significant (P>0.05) in between groups at different intervals.

Granulocyte (per cent)
The mean ± SE values of granulocyte were 54.73±4.27, 58.58±2.78 and 51.56±4.55 before onset of analgesia; 56.74±4.49, 52.55±2.63 and 50.36±5.11 at 10 minutes after injecting of local anesthetic; 59.07±2.88, 58.43±2.33, and 52.44±5.64 at 30 minutes after onset of anaesthesia and 53.51±4.06, 60.46±2.80 and 57.91±4.69 after recovery from anaesthesia group I, II and III, respectively. The mean ± SE value of granulocyte in different groups showed a non-significant (P>0.05) change within and between groups at different time intervals.

Lymphocyte (per cent)
The mean ± SE values of lymphocyte were 36.40±4.61, 33.57±2.65 and 41.26±5.37 before onset of analgesia; 32.87±4.86, 38.81±2.37 and 45.08±5.45 at 10 minutes after injecting of local anesthetic; 29.82±3.70, 33.61±1.89, and 37.09±6.02 at 30 minutes after onset of anaesthesia and 31.76±3.20, 32.00±3.11 and 32.41±4.57 at after recovery from anaesthesia group I, II and III, respectively.
In group II significant (P<0.05) increases in lymphocyte 10 minutes after onset of analgesia and thereafter decreased at the end of observations. In group III lymphocyte significantly (P<0.05) decreased 30 minutes after onset of anaesthesia when compared to 10 minutes after injecting of local anesthetics. In group I, there was non-significant (P>0.05) decreases in lymphocyte occurs upto 30 minutes after onset as compared with baseline values.

Monocyte (per cent)
The mean ± SE values of monocyte were 8.87±0.85, 7.85±0.48 and 7.02±1.84 before onset of analgesia; 10.39±0.94, 8.64±0.51 and 8.41±2.49 at 10^{th} minutes after injecting of local anesthetic; 11.01±1.51, 7.97±0.64, and 9.32±2.90 at 30^{th} minutes after onset of anaesthesia and 13.12±2.43, 7.55±1.23 and 8.03±2.69 after recovery from anaesthesia group I, group II and group III, respectively. The mean ± SE value of monocyte in different groups showed a non-significant (P>0.05) change within and between groups at different time intervals.

Biochemical parameters
Sodium (mmol/L)
In group I, mean ± SE sodium values were 127.08±5.14, 126.17±5.28, 126.20±5.25 and 126.42±4.06 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaesthesia, respectively. In group II, mean ± SE sodium values were 127.55±1.95, 128.20±1.46, 128.05±1.05 and 130.02±1.33 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaesthesia, respectively. In group III, mean ± SE sodium values were 133.55±1.04, 133.08±0.93, 132.98±0.73 and 131.82±1.65 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaesthesia, respectively. The mean ± SE value of sodium in different groups showed a non-significant (P>0.05) change within and between groups at different time intervals.

Potassium (mmol/L)
In group I, mean ± SE potassium values were 4.24±0.34, 4.65±0.33, 4.28±0.46 and 4.65±0.34 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaethesia, respectively. In group II, mean ± SE potassium values were 4.47±0.45, 4.24±0.42, 4.76±0.5 and 4.43±0.49 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaethesia, respectively. In group III, mean ± SE potassium values were 4.15±0.17, 4.12±0.18, 3.92±0.22 and 4.20±0.31 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaesthesia, respectively. The mean ± SE value of potassium within and

between group at different intervals showed non-significant (P>0.05) difference and fluctuation within normal level.

Chloride (mmol/L)

In group I, mean ± SE chloride values were 93.35±3.68, 93.38±4.04, 92.47±4.23 and 93.47±3.90 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaethesia, respectively. In group II, mean ± SE chloride values were 95.10±2.06, 95.42±1.71, 95.55±1.69 and 97.48±1.34 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaethesia, respectively. In group III, mean ± SE chloride values were 99.62±0.80, 100.45±0.69, 99.85±1.02 and 99.13±0.70 before analgesia, 10, 30 minutes after onset of analgesia and after recovery from anaethesia, respectively. The mean ± SE value of chloride within and between group at different intervals showed non-significant (P>0.05) difference and fluctuation within normal level.

Serum Cortisol Estimation (nmol/L)

In group I, the mean ± SE value of serum cortisol before onset of analgesia was 38.27±16.74. While, it was 44.57±12.85, 40.95±11.98 and 66.21±12.53 10, 30 minutes after onset of analgesia and after recovery of anaesthesia, respectively. In group II, the mean ± SE value of serum cortisol before onset of analgesia was 43.29±10.48, While, it was 63.85±12.98, 58.29±17.87 and 93.73±19.70 10, 30 minutes after onset of analgesia and after recovery of anaesthesia, respectively. In group III, the mean ± SE value of serum cortisol before onset of analgesia was 24.88±8.5. While, it was 29.25±12.42, 21.30±6.71 and 44.73±16.8 at 10, 30 minutes after onset of analgesia and after recovery of anaesthesia, respectively.

In groups I and III serum cortisol values showed non-significant (P>0.05) changes within and between groups at different intervals. In group II serum cortisol values was significant (P<0.05) increased after recovery of anaesthesia as compared to before administration of local anesthetics. However, in all groups serum cortisol values was non-significantly (P>0.05) increased at 10 minutes after onset as compared with before analgesia, but thereafter 30 minutes after onset of analgesia values were non-significantly (P>0.05) decreased.

Discussion

Heart rate (beats per minute)

In group I, following paravertebral administration of 0.5 per cent ropivacaine, non-significant decreased in heart rate observed at 10 minutes and 30 minutes after onset of action and then increased non-significantly at 90 minutes after analgesia as compared to base line value (before administration of local anesthetics). Similar findings were found earlier by Oliveira *et al.* (2016) who reported that heart rate was non-significantly decreased after administration of 0.5 per cent ropivacaine in distal paravertebral anesthesia in ewes, but thereafter non-significantly increased at the time canula insertion.

In group II and group III, changes in heart rate were found non-significant difference and fluctuated within normal physiological limit at different time intervals. Chepte *et al.* (2019) [8], Aksoy *et al.* (2012) [1] found no significant changes in heart rate when 0.75 per cent ropivacaine used in cattle. Similar findings were observed by Ghote (1996) [13], Shendage (2015) [29] and Kumar *et al.* (2020) [18] with lignocaine under paravertebral anesthesia in bovine. In contrast to present study Olifia *et al.* (2009) [22] observed significant increase in heart rate after 30 minutes administration of lignocaine in distal paravertebral anesthesia of African dwarf goats.

Paravertebral anesthesia was does not produce any cardiovascular toxicity after administration of local anesthetics. Generally, toxicity of local anesthetics is related to their plasma concentration and plasma concentrations were determined by the rate of drug absorption into the systemic circulations, so local anesthetics exhibited toxicity when given by intravenous route in toxic dose. Where in paravertebral anesthesia the local anesthetic drug is administered deposited into nerve, therefore a more gradual absorption from the injection site into the systemic circulation offsets the achievement of toxic doses (Garcia, 2015) [11].

Respiration rate (breath per minute)

In group I and group II, respiration rate was non-significantly increased after 90 minutes of anaesthesia as compared to initial value. Khajuria *et al.* (2014) [16] opined that non-significant increased respiration rate occurred when 0.5 per cent ropivacaine used for epidural analgesia in goats. Whereas, Prashant (2016) [24] found that respiration rate was fluctuated within normal physiological limits after different regional nerve block in buffalo with 0.5 per cent ropivacaine. Similar observations for 0.75 per cent ropivacaine were reported by Araujo *et al.* (2012) [4] when used in epidural space of bovine. In contrast to present study, Skarda and Muir (2001) [31] found significant reduction in respiration rate with 0.5 per cent ropivacaine in mare.

In the animals group III, no appreciable changes in the respiration rate was observed within and between group after paravertebral nerve block. Shendage (2015) [29] in bovines using paravertebral anesthesia and Maryam and Nasser (2011) [20] in sheep with thoraco lumber anesthesia also reported that 2 per cent lignocaine does not effect on respiration rate of animals. However, Runa *et al.* (2008) [26] noted significantly decreased respiration rate after lignocaine administration in lumbosacral space of goats.

Rectal temperature (°F)

In group I and group III, non-significantly increased rectal temperature observed from 10 to 90 minutes of after injecting of local anesthetics when compared to before injecting local anesthetics. Similar findings observed by Khajuria *et al.* (2014) [16] who reported that rectal temperature was non-significantly increased after administration of 0.5 per cent ropivacaine in epidural anesthesia of goats. Olifia *et al.* (2009) [22] stated that rectal temperature was remained within normal range even through elevated but not significantly in distal paravertebral space of goats using 2 per cent lignocaine. Similar trends also observed with lignocaine by Jagtap (1992) [15], Shendage (2015) [29] and Kumar *et al.* (2020) [18] in paravertebral nerve block of bovine.

In group II, after paravertebral injection of 0.75 per cent ropivacaine rectal temperature remained normal physiological limits. The present study results were very well comparable with Chepte *et al.* (2019) [8] under paravertebral anesthesia of cattle and Singh *et al.* (2015) [30] under epidural analgesia of goats using 0.75 per cent ropivacaine.

Haematological parameters

Haemoglobin (g/dl)

No significant difference observed in hemoglobin at different

intervals indicating that all three local anaesthetics do not effect on haemoglobin. The result of present study agreed with Moulvi (2011) [21] in epidural anesthesia of calves, Kumar *et al.* (2020) [18] in bovines paravertebral block with 2 per cent lignocaine hydrochloride.
Similar observations was recorded by Khodwe *et al.* (2013) [17] in dogs for epidural anesthesia with 0.5 per cent ropivacaine, Amarpal *et al.* (2007) [2] with two different doses of 0.75 per cent ropivacaine in epidural space of buffalo calves.

Packed cell volume (per cent)
Packed cell volume remained in the normal range throughout the period of study. No significant difference in PCV at different intervals indicating that all three local anaesthetics do not effect on PCV.
Similar observations was reported by Prashant (2016) [24] in buffalo for epidural space using 0.5 per cent ropivacaine, Chaudhary (2013) [7] in epidural block of calves using 0.75 per cent ropivacaine and Olifia *et al.* (2009) [22] under distal paravertebral nerve block effects in west African dwarf goats using 2 per cent lignocaine.

Total erythrocyte count (10^6 cells/cumm)
In groups I, decreasing trend in mean ± SE values of TEC was observed after recovery of anesthesia as compared to prior onset of anesthesia. However, the values at all stages of observation were within the normal reference range. Khodwe *et al.* (2013) [17] found total erythrocyte count did not vary significantly in dog under epidural anesthesia.
Roland *et al.* (2014) [25] stated that with acute blood loss, the RBC parameters are initially within the reference ranges because cells and plasma are lost in the same proportion. Diminished RBC count and hemoglobin can be found only after several hours, when fluid in the blood vessels is replaced and dilutes the blood.
In group II and III non-significant decreasing total erythrocyte count values observed after onset of anesthesia, but remained in normal physiological limits. Chaudhary (2013) [7] reported non-significantly decreasing trend in TEC value after epidural nerve block in calves with 0.75 per cent ropivacaine. Kumar *et al.* (2020) [18] found non-significantly decreased in TEC after paravertebral anesthesia in bovines using 2 per cent lignocaine.

Total leukocyte count (10^3 cells/cumm)
In group I, leukocytosis observed at prior to onset of anesthesia as compared after recovery of anesthesia. Possible reason of leukocytosis at prior to onset of anesthesia was ruminal impaction and urinary bladder ruptured because in group I, one animals suffering from ruminal impaction and one animals suffering from ruptured urinary bladder so, at the time presentation in these animals haematological picture showed leukocytosis. Prashant (2016) [24] did not found any significant difference in total leukocyte count in buffalo under different regional anesthesia with 0.5 per cent ropivacaine hydrochloride.
In group II and III, total leukocyte count values remained in normal reference limits and did not show any significant difference at different time intervals. Similarly, Gautam *et al.* (2017) [12] did not reveal any significant (P>0.05) variation in TLC values at different intervals using 0.75 per cent ropivacaine. Shendage (2015) [29] found non-significantly difference in TLC after paravertebral anesthesia in bovines using 2 per cent lignocaine.

Granulocyte (per cent)
The changes in granulocyte were found to be non-significant difference with 0.5 per cent and 0.75 per cent ropivacaine and 2 per cent lignocaine. Base line values (before administration of local anesthetics) and those recorded at different intervals after onset of analgesia were fluctuated within normal reference limit. Similar findings observed by Prashant (2016) [24] with regional anesthesia in buffalo using 0.5 per cent ropivacaine, Singh *et al.* (2005) in epidural space of goats using 0.75 per cent ropivacaine. Olifia *et al.* (2009) [22] reported granulocyte showed non-significant after administration of 2 per cent in thoraco lumber anesthesia in African dwarf goats.

Lymphocyte (per cent)
The mean ± SE value of lymphocyte at after recovery from paravertebral anesthesia showed a lower mean ± SE value as compared to rest of intervals in groups II and III animals operated under 0.75 per cent ropivacaine and 2 per cent lignocaine, respectively. Reasons for lymphocytopenia include anesthetic stress, viral or bacterial infection, immune suppression, chronic renal insufficiency, and application of corticosteroids (Roland *et al*., 2014) [25]. Similar trends of lymphocytopenia observed by Gautam *et al.* (2017) [12] with 0.75 per cent ropivacaine in subarachnoid space of buffalo and stated that lymphocytopenia may caused by anesthetics stress. However, Kumar *et al.* (2020) [18] and Shendage (2015) [29] used 2 per cent lignocaine for paravertebral anesthesia and found non-significant difference in lymphocyte value.

Monocyte (per cent)
In all three groups the mean ± SE monocyte count value showed non-significant difference at different intervals of observations and fluctuations occurred within normal reference range. Similar observation reported by Khodwe *et al.* (2013) [17] in epidural space of dog using 0.5 per cent ropivacaine, Singh *et al.* (2005) in epidural 0.75 per cent ropivacaine in goats and Moulvi (2011) [21] after administration of 2 per cent lignocaine in epidural block in cow calves.

Biochemical parameters
In all three groups mean ± SE sodium, potassium and chloride levels did not showed any significant difference at different time intervals and fluctuated within normal limits.
Generally, local anesthetics produced analgesia by blocking the initiation and propagation of nerve impulse by preventing the voltage dependent Na^+ conductance (Sandhu, 2016) [28]. In addition to Na^+ channels, local anesthetics can also bind other membrane proteins and block K^+ channels but requires higher concentration of drug (Sandhu, 2016) [28]. So, in present study we checked sodium, potassium and chloride level in serum whether decreased or increased after paravertebral nerve block and found that after paravertebral nerve block serum sodium, potassium and chloride level did not change after local anesthetic solution.

Serum cortisol estimation (nmol/L)
The concentration of cortisol in blood is widely used as an indicator of stress, although caution is advised, since an increase does not occur with every type of stressor (Terlouw *et al.*, 1997) [32].

Constable *et al.* (2017) [9] reported the normal range of cortisol in healthy adult cattle as 13 to 21 nmol/L. In present study the mean ± SE cortisol level before administration of local anesthetics in all animals was significantly higher than the range given by authors.

In animals of group II mean ± SE serum cortisol values (nmol/L) significantly increased after recovery of anesthesia as compared to before administration of local anesthetics. Similar observations noted by Saidu *et al.* (2016) [27] in goats following rumenotomy. They observed serum cortisol level was significantly high at 5 hours and 8 hours post-surgery.

Carey *et al.* (1999) [6] has stated that surgical stress occurs before, during, and after an operative procedure. It arises from psychological stress, tissue injury, and alterations in circulation, anesthetic agents, and postoperative complications including sepsis.

However, in all three groups mean ± SE serum cortisol values increased at 10 minutes after onset of action as compared to before onset of action. However, 30 minutes after administration of local anesthetics all animals showed non-significant decreased serum cortisol values as compared to 10 minutes after onset of action. This has been attributed due to local anesthetics block neural transmission and reduced pain or nociceptive input during surgery and may reduce release of cortisol from adrenal cortex. Fisher *et al.* (2009) [10] stated that intramuscular and subcutaneous infiltration of local anesthetics reduced cortisol response in the first 1.5 hours after castration in pig with either method but had little effect thereafter.

Conclusions

Ropivacaine (0.5 and 0.75 percent) and 2 percent lignocaine did not produce any adverse effect on physiological parameters in present study. The changes observed in haemato-biochemical parameters after paravertebral administration of ropivacaine in bovines were transitory and compensatory. From the present study, it was concluded that ropivacaine effectively administrated in paravertebral space in physiologically impaired animals.

Stress indicator hormone serum cortisol level was high in all groups, at 10 minutes after onset of analgesia and decreased thereafter 30 minutes after administration of local anesthetics. This suggest that use of local anesthetics may reduce surgical stress during surgical procedures.

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