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Original Research Article

Paravertebral anaesthesia in goats: a comparative study of various local analgesic agents

M. A. Akter*, M. N. Islam, M. M. Alam, M. R. Alam

Department of Surgery and Obstetrics, Bangladesh Agricultural University, Mymensingh, Bangladesh

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***Correspondence:**
Dr. M. A. Akter,
E-mail: antora41292@bau.edu.bd

ABSTRACT

Background: Paravertebral nerve block is commonly used as a method of choice for surgical procedures in ruminants. The aims of this study were to compare the effects of different local analgesic agents for paravertebral nerve block.
Methods: In this study, fifteen apparently healthy female goats weighing 10-13 kg were allocated into three groups: group A (2% Lidocaine HCl: 4 mg/kg BW), group B (2% lidocaine HCl with epinephrine: 4 mg/kg BW), and group C (0.5% bupivacaine: 1 mg/kg BW). All these local analgesic agents were injected to block the T13, L1 and L2 spinal nerves.
Results: Among all groups of animals, group B had the longest period of anesthesia followed by group C and group A. All the animals in groups A, B, and C exhibited a substantial change ($p<0.05$) in their clinical parameters while receiving local anesthesia. During this study, the value of hemoglobin, packed cell volume, total erythrocyte count, and total leukocyte count were altered significantly ($p<0.05$) in the animals of group A, B and C at different time intervals after paravertebral administration of different local analgesic regimens. In terms of serum biochemistry, throughout the analgesic period, substantial ($p<0.05$) alterations were observed in alanine transaminase (ALT), aspartate transaminase (AST), urea, cortisol, and electrolyte level of all experimental groups.
Conclusions: Based on the results, it can be inferred that the paravertebral injection of 2% lidocaine with epinephrine results in longest duration of analgesic effect with some undesirable systemic effects on renal and hepatic responses.

Keywords: Anaesthesia, Goats, Haemato-biochemistry, Local analgesics, Reflexes

INTRODUCTION

Anaesthesia is a chemical restraining in surgical procedure with a reversible process, aiming to perform with minimal distress, soreness, anxiety, and harmful effects to the patients.[1] Various types of analgesic drugs are used in small ruminant's anaesthesia practice whereas ruminants are often regarded as inappropriate for general anesthesia.[2,3] Nowadays, surgical management is conducted on ruminants in a safe and humane manner by utilizing a mix of local or regional anesthesia.[4] The paravertebral block is a technique that involves the regional anesthesia of the dorsal and ventral branches of the thirteenth thoracic (T13) and the first and second lumbar (L1 and L2) nerves. This blocks the flank region to provide anesthesia for abdominal surgery, including caesarean sections, rumenotomy, and the correction of gastro-intestinal displacement in animal.[3,5] Local anesthesia is a collection of pharmacological substances that are chemically linked and bind to sodium channels, therefore inhibiting impulse transmission in nerve fibers.[5] Lignocaine continues to be the most extensively used and adaptable local anesthetic in veterinary medicine due to its minimal toxicity, quick onset, and moderate duration of action.[6] The addition of vasoconstrictor drugs enhances the effects of a local anesthetic medication.[7] The analgesic drugs are slowly absorbed from the injection site because of vasoconstriction effects of vasoconstrictor agents and the duration of local analgesia is extended by this activity.[8] Epinephrine is frequently used to extend the effects of local anesthetic medications and bupivacaine is a long-acting amino-amide local analgesic agent, which has been used for epidural, intra-articular and brachial plexus nerve block in ruminants.[6,9-11] During the surgery there is a

requirement for an analgesic agent that would have a rapid onset but also provide a prolonged effect. There is less information available about the comparative effect of different local analgesic agents during paravertebral anaesthesia in small ruminants. The current study hypothesized that lidocaine with epinephrine may exhibit the longer duration of local anaesthesia during surgery of animals. Therefore, the present study is implied to explore the duration with clinical and hemato-biochemical effects of 2% lidocaine, 2% lidocaine with epinephrine and 0.5% bupivacaine during paravertebral anaesthesia in goats.

METHODS

Experimental animals

Fifteen apparently healthy goats of either sex weighing approximately 10-13 kg and aged between 1 to 2 years were used in this experiment. The animals were vaccinated against PPR (P.P.R vaccine® LRI, Bangladesh). The animals were housed in controlled environmental conditions (temperature, relative humidity, air changes and light). They were allowed to graze in the pasture for 4-5 hours a day and concentrated feed was provided from 4 pm to 5 pm and fresh water was available ad libitum.

Experimental design

The experimental animals were divided into three groups consisting of 5 goats in each group. Group A: 2% lidocaine HCL, group B: 2% lidocaine HCL with epinephrine (0.0005%), and group C: 0.5% bupivacaine.

Group A

Goats were injected with 2% lidocaine HCL (G-Lidocaine, Gonoshasthaya Pharmaceuticals Ltd, Bangladesh) para-vertebrally (proximal) at dosage level of 4 mg/kg bw.

Group B

Goats were injected with 2% lidocaine HCL with epinephrine (0.0005%) (G-Lidocaine with epinephrine, Gonoshasthaya Pharmaceuticals Ltd, Bangladesh) paravertebrally (proximal) at the dosage level of 4 mg/kg body weight.

Group C

Goats were injected with 0.5% bupivacaine (Anawin Heavy, Neon Pharmaceuticals Ltd, India) paravertebrally (proximal) at the dose rate of 1 mg/kg body weight for local anaesthesia.

Experimental animal preparation

The experimental animals were carefully observed for twenty-four hours leading up to anaesthesia. Heart rate, respiration rate and rectal temperature were recorded before analgesic administration to ascertain that they were not suffering from any infectious diseases or disorder. Every anesthetic trial involved trimming the paravertebral and flank areas and applying a povidone iodine solution coating to facilitate aseptic puncture.

Procedure of anaesthesia

Before anaesthesia animal was kept on standing position. Then the local anesthetic agents were injected using 23-gauge, 8.9 cm spinal needle with syringe after identifying the space between T13 and L1, L1 and L2 spinal nerves. During injection, the correct needle placement into the thoracolumbar and lumbosacral space was verified through the suspended drop test and/or the absence of resistance. One ml of local analgesic solution was injected to desensitize the ventral branch of T13. The needle was withdrawn approximately 1 cm dorsal to the surface of the transverse process and an additional 1 ml of the analgesic was injected to desensitize the dorsal branch of T13. The first and second lumbar nerves were blocked in the same manner.

Clinical evaluation

Heart rate, respiration rate, and body temperature were monitored before the injection (0 min) and at 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 minutes after the administration of the analgesic agents. Following the injection, the local anesthesia was monitored based on muscle tremor, rumen movement, limping, pupil dilation, tail flagging every 5 minutes' interval until the end of anaesthesia for all groups. The interval between the injection and the disappearance of muscle tremor was identified as the "onset time".

Collection of blood samples

Jugular venipuncture was used to obtain blood samples. Before the collection of blood samples, the area of jugular vein was aseptically prepared by using povisep. After immediate collection of blood with the help of 5 ml disposable syringe, 2 ml blood was transferred into vacuum tube containing potassium EDTA for hematological test and 3 ml into blood clot activator tube for serum separation as well as biochemical and hormone examinations.

Biochemical examinations

The serum samples were analyzed for alanine transaminase (ALT), aspartate aminotransferase (AST), urea, sodium, potassium, chloride and cortisol. The serum biochemistry was performed by using a semiautomatic blood chemistry analyzer (Clindiag® SA-20, Belgium) at the determined wavelength. The hormonal examination (cortisol) was performed commercially by fluorescence immunoassay (FIA) method with POCT hormone analyzer.

Hematological examinations

Blood samples collected from the experimental goats with anticoagulant (EDTA) were analyzed for the assessment of total erythrocyte count (TEC), total leukocyte count (TLC), packed cell volume (PCV) and haemoglobin (Hb). Hematological examinations were performed by using automatic veterinary hematology analyzer (DYMIND®, DF56VET, Japan).

Statistical analysis

The expression of all the data was mean±standard error of mean (SEM). Heart rate, respiratory rate, and rectal temperature values were compared by analysis of variance (ANOVA) for repeated measures with time and treatment as factors, followed by Duncan's test. A one-way ANOVA followed by Tukey's test was used to compare the onset time and duration of anesthesia among anesthetic agents. The means of the haematological and serum chemistry values at the time points were compared using ANOVA followed as appropriate by Tukey- Kramer multiple comparisons. Statistical analysis was undertaken using statistical package for the social sciences (SPSS) version 20.0 (SPSS, MicroMaster, PA, USA). Differences were considered statistically significant when $p<0.05$.

RESULTS

Influence of various anesthetic agents on clinical parameters in goats

The heart rate of the animals in group A was considerably ($p<0.05$) lower at 20 and 30 minutes than the pre-anesthetic control values. Nevertheless, the heart of the animals in group B exhibited a substantial rise ($p<0.05$) during the anesthesia period in comparison to the pre-anesthetic control value. As compared to the preanalgesic control value, the heart rate of the animals in group C decreased significantly ($p<0.05$) at 10 minutes and subsequently increased for the duration of the analgesic time (Figure 1).

Regarding the animals in group A, respiratory rate (RR) was significantly ($p<0.05$) increased at 10 min and decreased at 40 min as compared to pre-anesthetic control values. There were significant ($p<0.05$) changes in respiratory rate was recorded at different time interval (except 50 min and 70 min) in the animal of group B. Among the animals in group C, RR pointedly ($p<0.05$) decreased at 20 min and increased throughout the time interval during anaesthesia as compared to pre-anesthetic control values (Figure 2).

Throughout the anesthetic period, the rectal temperature of the animals in group A declined significantly ($p<0.05$). However, it was considerably ($p<0.05$) elevated in the animals of group B during the time interval in comparison to the preanesthetic control values. Among the animals of group C, rectal temperature was considerably ($p<0.05$) elevated at 10 min and decreased at 40 min and 60 min post anaesthesia (PA) as compared to pre-anesthetic control values (Figure 3).

Comparison of the reflex responses of various local analgesic regimens in goats

Tail flagging was absent from 10 min to 20 min post analgesia then gradually returned after 20 min and continued up to recovery in group A. On the other hand, in the animals of group B and group C tail flagging lost within 1 min and returned 35 min and 30 min respectively after of paravertebral block. After administration of local analgesic agents, all the experimental animals of group A, B and C lost their muscle tremor reflex within 1 min and returned after 15 min of paravertebral block in the animals of group A, 50 min in the animals of group B, and 30 min in the animals of group C. Pupils were normal in the animals of group A and B throughout the analgesic period but in group C pupil was dilated up to 10 min of paravertebral block. Limping reflex was present throughout the analgesic period in the animals of group A and group B. On the contrary, it was absent up to 30 min in the animals of group C. All the animals of group A, B and C lost their rumen movement within 1 min and returned at 15 min (A), 25 min (B) and 20 min (C) respectively.

Examining the effects of various analgesic regimens on the induction and durationn of anaesthesia in goats

Table 1 shows the effects of several anesthetic drugs on the duration and commencement of induction of anesthesia in goats. The mean value of the onset of induction period in group A, group B and group C were 3±0 min, 3±0.23 min and 1±0.17 min. The longest induction period was found in the animals of group A. The highest duration of anaesthesia was found in the animals of group B (1.33±0.19 hour) followed by group C (1.14±0.08 hour) and group A (1.00±0.12 hour) and the changes of anesthetic duration was statistically significant ($p<0.05$).

Effects of different local analgesic agents on haematological parameters in goats

Effects of different local analgesic agents on haematological parameters in goats are shown in Table 2. In the animals of group A and group B, the PCV was significantly ($p<0.05$) increased at the different time interval as compared to pre-anesthetic control values. Whereas, when compared to the values before anesthesia, the PCV in group C animals was found to be considerably higher at 15 and 30 minutes and significantly lower at 45 minutes ($p<0.05$). In the animals of group A, the level of Hb was significantly ($p<0.05$) increased at 45 min and decreased at other time interval as compared to pre-anesthetic control values. The level of Hb was considerably ($p<0.05$) declined during the analgesic period as compared to pre-anesthetic control value (9±0.29) in the animals of group B. In the animals of group C, the value

of Hb was significantly ($p<0.05$) decreased at 45 min and 60 min as compared to pre-anesthetic control values.

Table 1: Different analgesic regimens on the onset of induction and duration of anaesthesia in goats.

Group	Anesthetic agents	Onset of Action (min)	Duration (hours)
A	2% Lidocaine HCL	3 ± 0.58^{a}	1.00 ± 0.12^{b}
B	2% Lidocaine with Epinephrine	3 ± 0.23^{a}	1.33 ± 0.19^{a}
C	Bupivacaine	1 ± 0.17^{b}	1.14 ± 0.08^{a}
	P value	0.004**	0.001**

a and b in the same column differed significantly at 5% level of significance

Among the animals in group A, the TEC was considerably ($p<0.05$) decreased at 60 min (4.6±0.00) as compared to pre-analgesic control value. In animals belonging to group B, TEC was considerably ($p<0.05$) increased at 15 min and decreased at 45 min as compared to pre-analgesic control value. In the animals of group C, the TEC was considerably decreased at 30 min and 45 min as compared to pre-analgesic control value.

Effects of different analgesic agents on total leukocyte count (TLC) in goats are shown in Figure 2d. The TLC of the animals in group A was considerably ($p<0.05$) reduced at various time intervals throughout the anesthetic period in comparison to the pre-analgesic control value in this investigation. In contrast, the TLC of the animals in group B was considerably ($p<0.05$) higher at various time intervals than the pre-analgesic control value. Conversely, compared to the pre-anesthetic control values, the TLC of the animals in group C was significantly ($p<0.05$) lower after 30 minutes and steadily ($p<0.05$) increased during the analgesic period.

Effect of different local analgesic agents on serum biochemical parameters in goats

Effects of different local analgesic agents on serum biochemical parameters in goats are presented in Table 3. In this investigation, the ALT level of the animals in group A was considerably ($p<0.05$) lowered at 45 minutes and significantly ($p<0.05$) raised at various time intervals in comparison to the pre-analgesic control value. In the animals of group B, the value of ALT was significantly ($p<0.05$) increased at 45 min and then decreased at other time interval as compared to pre-analgesic control values. Compared to the pre-analgesic control values, the ALT levels in the animals of group C were considerably ($p<0.05$) lower at 45 min and higher at 15 min and 30 min.

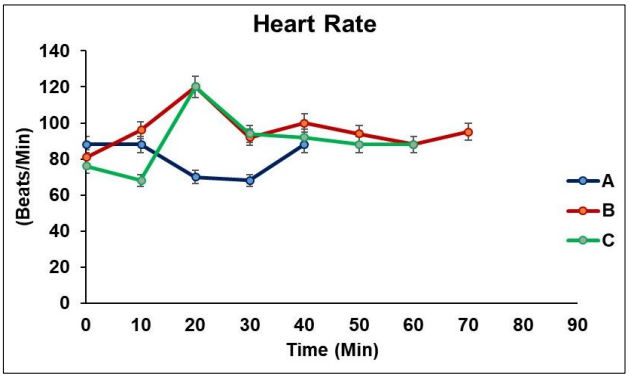

Figure 1: Effect of paravertebral nerve block by different local analgesic agents on heart rate in goats.

Table 2: Effects of different analgesic agents on hematological parameters.

Parameters and groups	Control	15 min	30 min	45 min	60 min
Packed cell volume (%)					
A	22 ± 1.15^{ax}	22 ± 0.58^{bx}	31 ± 0.58^{ax}	25 ± 1.73^{by}	25 ± 2.89^{ay}
B	19 ± 0.58^{bx}	25 ± 1.15^{ax}	25 ± 0.58^{bx}	27 ± 1.15^{ax}	25 ± 0.58^{by}
C	20 ± 0.58^{bx}	21 ± 0.58^{bx}	21 ± 0.58^{bx}	18 ± 1.15^{by}	20 ± 1.15^{by}
Hemoglobin (g/dl)					
A	8.3 ± 0.17^{bx}	8 ± 0.58^{by}	7.3 ± 0.17^{by}	11 ± 0.00^{ax}	7 ± 0.12^{ay}
B	9 ± 0.29^{ax}	9.2 ± 0.00^{ax}	8 ± 0.58^{ay}	8.2 ± 0.12^{by}	8.5 ± 0.12^{by}
C	8 ± 0.58^{bx}	8 ± 0.58^{bx}	8 ± 0.58^{ax}	7 ± 0.58^{by}	6.2 ± 1.15^{by}
Total erythrocyte count ($\times10^{6}$)					
A	7.7 ± 0.12^{bx}	7.5 ± 0.29^{bx}	7.6 ± 0.23^{ax}	7.7 ± 0.12^{ax}	4.6 ± 0.00^{by}
B	7.8 ± 0.52^{bx}	10.3 ± 0.00^{ax}	6.1 ± 0.64^{by}	7.8 ± 0.52^{ay}	7.8 ± 0.54^{ay}
C	7.9 ± 0.64^{ax}	7.6 ± 0.00^{bx}	6.3 ± 0.75^{by}	6.5 ± 0.00^{by}	7.2 ± 0.12^{ax}
Total leukocyte count ($\times10^{3}$)					
A	24.8 ± 2.42^{bx}	16.2 ± 0.69^{by}	17.6 ± 1.27^{by}	15.2 ± 0.69^{by}	17.3 ± 0.78^{by}
B	26.2 ± 0.69^{ay}	31.7 ± 0.69^{by}	27.2 ± 1.27^{ay}	46.1 ± 0.64^{ax}	50.1 ± 0.64^{ax}
C	26.8 ± 0.52^{ax}	37.3 ± 1.33^{ay}	$23.01.15\pm^{by}$	25.8 ± 0.52^{by}	51.3 ± 0.75^{ax}

Values given in table represents mean±SEM value; values with different superscript letter in the same row (a,b) and column (x,y) differed significantly at $p<0.05$

Table 3: Effect of different analgesic agents on serum biochemical parameters.

Parameters and groups	Control	15 min	30 min	45 min	60 min
Urea (mg/dl)					
A	53.86±1.10^{bx}	39.03±1.12^{by}	36.05±1.18^{by}	37.86±0.73^{by}	35.10±1.12^{by}
B	55.17±1.14^{bx}	55.08±1.13^{ax}	55.69±1.14^{ax}	51.67±1.12^{by}	55.69±1.12^{bx}
C	57.92±1.09^{ax}	51.71±1.11^{by}	52.26±0.94^{by}	54.88±1.15^{ay}	53.34±1.17^{ay}
Alanine transaminase (U/l)					
A	28.97±1.12^{ax}	43.11±1.13^{ax}	42.82±1.12^{ax}	25.99±0.98^{by}	31.25±0.58^{ay}
B	26.82±1.13^{bx}	20.82±0.78^{by}	21.72±0.78^{by}	35.66±0.57^{ax}	24.32±0.32^{bx}
C	25.93±1.14^{bx}	27.60±0.72^{bx}	26.33±0.69^{bx}	24.66±0.84^{by}	26.44±0.94^{bx}
Aspartate aminotransferase (U/l)					
A	115.89±2.94^{bx}	146.20±2.37^{ax}	146.26±2.37^{ax}	93.65±1.27^{by}	103.21±1.17^{by}
B	117.34±1.35^{ax}	101.90±0.58^{by}	106.55±2.37^{by}	116.43±1.21^{bx}	115.34±1.35^{ax}
C	113.50±1.88^{bx}	125.17±2.90^{bx}	122.59±1.21^{by}	125.26±2.94^{ax}	121.30±1.18^{ay}
Sodium (Na) (mmol/l)					
A	145.4±3.00^{bx}	144.7±1.27^{bx}	144.1±0.99^{bx}	146.8±1.30^{bx}	142.7±1.27^{by}
B	147.4±1.27^{ax}	145.5±1.27^{ay}	144.9±1.21^{by}	146.1±2.37^{bx}	143.9±1.21^{by}
C	146.9±1.15^{ax}	145.5±1.85^{ay}	146.0±2.31^{ay}	148.9±1.15^{ax}	144.9±1.15^{ay}
Potassium (K) (mmol/l)					
A	5.21±0.12^{ax}	4.13±0.08^{by}	4.20±0.12^{ay}	4.41±0.06^{ay}	4.24±0.72^{ay}
B	4.37±0.06^{bx}	4.39±0.23^{ax}	4.26±0.09^{ay}	4.51±0.64^{ax}	4.32±0.06^{by}
C	5.12±0.07^{ax}	4.15±0.09^{by}	3.83±0.00^{by}	4.28±0.16^{by}	3.89±0.64^{by}
Chlorine (Cl) (mmol/l)					
A	111±0.58^{bx}	114.7±1.27^{ax}	114.9±2.31^{ax}	115.5±1.27^{ax}	114.3±1.33^{ax}
B	117.4±1.39^{ax}	115.7±0.69^{ay}	115.3±1.33^{ay}	115.9±1.15^{ay}	115.6±0.69^{ay}
C	113.9±1.73^{bx}	111.4±0.81^{by}	111.6±0.64^{by}	114.7±1.27^{bx}	110.8±1.10^{by}
Cortisol (µg/dl)					
A	3.05±0.03^{bx}	7.10±0.64^{ay}	5.84±0.64^{by}	3.26±0.15^{by}	2.96±0.02^{by}
B	3.62±0.12^{ax}	5.23±0.71^{by}	4.30±0.17^{by}	3.82±0.06^{by}	3.62±0.12^{ay}
C	3.16±0.09^{bx}	6.92±0.59^{by}	6.87±0.52^{ax}	6.92±0.64^{ax}	5.64±0.60^{ay}

Values given in table represents mean±SEM value; values with different superscript letter in the same row (a,b) and column (x,y) differed significantly at p<0.0

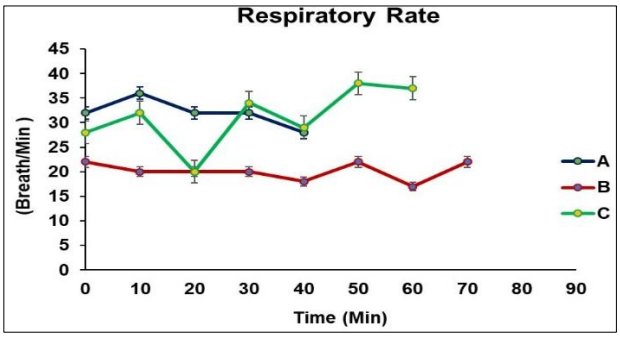

Figure 2: Effect of paravertebral nerve block by different local analgesic agents on respiratory rate in goats.

In comparison to the pre-anesthetic control values in the animals of group A, the value of AST was considerably (p<0.05) elevated at 15 min and 30 min and dropped at 45 min and 60 min in this study. Among the animals of group B, the value of AST was considerably (p<0.05) reduced at various time intervals in comparison to the pre-analgesic control values. Nevertheless, the AST value in the animals of group C was considerably (p<0.05) elevated during the analgesic period in comparison to the pre-analgesic control values.

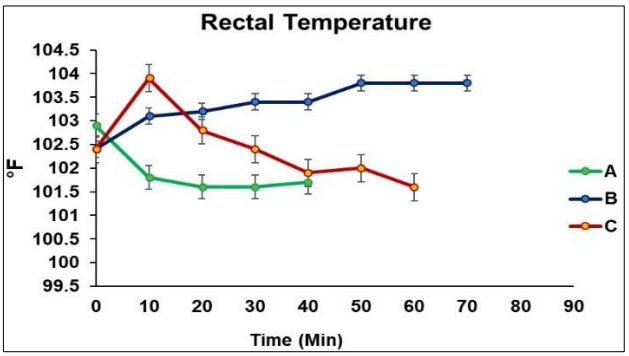

Figure 3: Effect of paravertebral nerve block by different local analgesic agents on temperature in goats.

In the animals of group A and group C, the urea content was significantly (p<0.05) decreased throughout the analgesic time interval as compared to pre-analgesic control value. In comparison to the pre-analgesic control

values, the urea levels in the animals of group B were considerably ($p<0.05$) lower at 45 minutes in this investigation.

The cortisol levels in the animals in group A were considerably ($p<0.05$) lower at 60 minutes than the pre-analgesic control values. Compared to the pre-analgesic control value, the cortisol value in the animals of groups B and C increased significantly ($p<0.05$) during the anesthesia period.

The values of Na, K, and Cl in the animals of groups A, B, and C were altered during the anesthetic period; however, these changes were not statistically significant ($p>0.05$).

DISCUSSION

During this study, in the animals of group B, the heart rate was significantly increased throughout the anesthetic period in comparison with baseline values and returned to non-significant level of increase thereafter till the end of the experiment which agrees with other observations.[12-14] In general, peripheral vasoconstriction is induced by epinephrine in local analgesic solutions, and a partial sympathetic blockade triggers the activation of numerous compensatory physiological mechanisms. Consequently, an increase in heart rate serves as a compensatory mechanism to preserve blood pressure and cardiac output.[15,16] Whereas, in the animals of group A and group C, the heart was significantly decreased at 10 min then it gradually increased and returned to baseline values which agrees with the findings of Rostami and Vesal.[8] This may be attributed to the compensatory vasoconstriction that happens in rostral regions of the body because of caudal nerve activity, which is independent of the direct action of lidocaine and bupivacaine.[17,18]

In this study, in the animals of group B, the respiratory rate showed fluctuations throughout the anesthetic period in comparison with baseline values, similar reports had been reported by Rostami and Vesal when lidocaine and bupivacaine were used for paravertebral nerve block in conscious sheep.[8] In the animal of group A, respiratory rate was significantly increased at 10 min and decreased throughout the anesthetic period in comparison with baseline values. However, Runa et al noted significantly decreased respiration rate after lidocaine administration in thoracolumbar space of goats which agrees with this finding.[13] Whereas, this study is not comparable to Khajuria et al, who observed a non-significant increase in respiration rate when 0.5 percent bupivacaine was administered for epidural analgesia in goats.[19]

This investigation revealed that the rectal temperature of goats in group C increased following the injection of local anesthetics in comparison to their baseline values. Similar results were observed by Khajuria et al who reported a significant increase in rectal temperature following the administration of 0.5 percent bupivacaine during paravertebral anesthesia in goats.[19] Rectal temperatures gradually decreased in group A in comparison with baseline values. Hypothermia was due to reduced basal metabolic rate and muscle activity and depression of thermoregulatory centers. According to Kayode, the rectal temperature of goats remained within the normal range despite the use of 2 percent lignocaine, even though the temperature was elevated in the distal paravertebral space.[20] The impact of local anesthetics on body temperature has not been documented. A peripheral nerve block usually results in vasodilation because the spinal nerve always contains sympathetic fibers[16] due to peripheral vasodilation in the blockage area, the body temperature often drops.

The onset of analgesia was quicker in bupivacaine hydrochloride when compared with 2% lidocaine hydrochloride and 2% lidocaine hydrochloride with epinephrine. However, delayed (3-5 min) onset of analgesia was also noticed using 2% lidocaine hydrochloride and 2% lidocaine hydrochloride with epinephrine respectively in few other studies which is similar to this finding. It is anticipated that the onset of action will be delayed by the addition of epinephrine to lidocaine.[8,16] This will be achieved by reducing the pH of the analgesic solution, which will reduce the amount of non-ionized local anesthetic, and by producing vasoconstriction, which will reduce the spread to the site of action.[18,21]

Prolonged duration of paravertebral anaesthesia was observed in those animals who received 2% lidocaine hydrochloride with epinephrine followed by bupivacaine and 2% lidocaine hydrochloride. Contrary to this finding, Runa et al observed the duration of analgesia was 88 min after administration of 2% lidocaine hydrochloride.[13] The rate of absorption from the injection site, the rate of tissue distribution, and the rate of drug metabolism and excretion all affects the concentration of local anesthetics like lignocaine.[14]

During this study, in the animals of group A and group B, the PCV significantly increased throughout the analgesic period in comparison with baseline values and returned to normal state at the end of experiment that is contradictory with the study of Vesal et al, Moulvi et al, and Singh et al.[22-24] This may be due to increasing the circulating blood cells in the spleen or other reservoirs secondary to decreased sympathetic activity could be the reason for the increase in packed cell volume during anaesthesia. In this investigation, in the animal of all group's haemoglobin was significantly decreased throughout the anesthetic period in comparison with baseline values and returned to non-significant level of increase thereafter till the end of the experiment which is similar with the observations of Moulvi et al, Vesal et al, and Kamal et al.[12,22,23] During this study, in the animals of group A and group B, the level of TEC was significantly decreased throughout the analgesic period as compared with baseline values that are corresponded with findings reported by Rekha et al in buffaloes.[25] This might be attributed to pooling of

circulating blood cells in the spleen or other reservoirs secondary to decreased sympathetic activity. The level of TLC was significantly decreased at different time intervals in the animals of group A. To maintain the animals' normal cardiac output during the anesthesia or sedation period, fluid may have moved from the extravascular to the intravascular compartment, which could account for the decrease in these values.[22,23,26] In the animal of group B and C the value of TLC was significantly increased throughout the anesthetic period in comparison with baseline values which agrees with other observations.[14,27] These alterations might result from epidural anesthesia's systematic alteration of hypotension and the ensuing rise in the vascular bed.

Serum ALT and AST are more liver specific enzymes and most of the analgesic undergoes metabolism in the liver and was anticipated to alter the value of liver enzymes. In this study, the value of ALT and AST was significantly altered at different time intervals throughout the analgesic cascade in the animals of group A, group B and group C. A significant increase in both AST and ALT suggests that the increase in AST might be hepatic in origin. A significant increase in AST and ALT levels after all treatments might be related to some alternations in cell membrane permeability, which may permit these enzymes to leak from the cell with intact membranes.[18] Similar observations were recorded after administration of bupivacaine in cattle and sheep.[24,28]

The levels of sodium, potassium, and chloride in all experimental groups did not exhibit any significant difference at various time intervals and fluctuated within the normal range. In general, local anesthetics produce analgesia by obstructing the initiation and propagation of nerve impulses by preventing the voltage-dependent Na+ conductance.[3,5] Furthermore, local anesthetics can bind to other membrane proteins and obstruct K+ channels in addition to Na+ channels; however, this necessitates a higher drug concentration.[3]

Although the concentration of cortisol in blood is frequently employed as a measure of stress and pain, it is important to exercise caution, as not all stressors result in cortisol levels.[3] In the animals of group B and C, the value of cortisol was significantly increased but decreased in group A throughout the period of anaesthesia as compared to pre-analgesic control value. Similar observations noted by Saidu et al in goats following rumenotomy after administration of lidocaine with epinephrine.[29] Therefore, the significant increase in cortisol level of the lidocaine with epinephrine treated groups may suggest that animals in this group felt more pain than other treated groups. In group B and C, increased serum cortisol level indicated that maximum stress throughout the ananesthetic period which might be due to longer duration of anaesthesia and prolonged recumbency in these groups. These results are similar to those previously reported in goat.[30] According to Vesal et al, surgical stress manifests itself prior to, during, and after an operative procedure.[22] It is the result of psychological stress, tissue injury, changes in circulation, anesthetic agents, and postoperative complications, such as sepsis. Jezie and Jessica noted that the cortisol response was diminished within the first 1.5 hours of surgical approaches following intramuscular and subcutaneous infiltration of local anesthetics.[31]

CONCLUSION

Based on the results of this study, lidocaine hydrochloride with epinephrine provided the longest duration of local anesthesia with some systemic effects on renal and hepatic responses. This local anesthetic agent might be beneficial in clinical practice and facilitating the completion of prolonged surgical and obstetrical procedures.

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