East African Medical Journal Vol. 98 No. 1 January 2021
EFFECTS OF RUMENOTOMY PLUS INFUSION OF TWO SALINE CRYSTALLOID SOLUTIONS ON SERUM BIOCHEMICAL PARAMETERS AND ERYTHROCYE OSMOTIC FRAGILITY OF WEST AFRICAN DWARF GOATS
Chineneye N. Omeh, Department Of Veterinary Surgery, Faculty Of Veterinary Medicine, University Of Nigeria, Nsukka, Rita Ijeoma Udegbunam, Department Of Veterinary Surgery, Faculty Of Veterinary Medicine, University Of Nigeria, Nsukka, Chinedu Athanacius Eze Department Of Veterinary Surgery, Faculty Of Veterinary Medicine, University Of Nigeria, Nsukka Nnamdi Henry Okereke, Department Of Veterinary Surgery, Faculty Of Veterinary Medicine, University Of Nigeria, Nsukka.

Corresponding author: Okereke Nnamdi Henry, Department of Veterinary Surgery, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, P.O. Box 3236, Nsukka 410001, Enugu State, Nigeria. Email: nnamdi.okereke@unn.edu.ng

EFFECTS OF RUMENOTOMY PLUS INFUSION OF TWO SALINE CRYSTALLOID SOLUTIONS ON SERUM BIOCHEMICAL PARAMETERS AND ERYTHROCYE OSMOTIC FRAGILITY OF WEST AFRICAN DWARF GOATS

C. N. Omeh, I. R. Udegbunam, C. A Eze and N. H. Okereke

ABSTRACT

Objectives: **Fifteen West African dwarf (WAD) goats were randomly assigned to three experimental groups to study the effects of dextrose saline (DS) and normal saline (NS) infusions solutions on serum biochemical parameters and erythrocyte osmotic fragility of rumenotomized goats.**

Design: **Post rumenotomy, goats in groups 1 and 2 were administered with NS and DS while group 3 goats received no fluid. Serum concentrations of total plasma protein (TPP), blood urea nitrogen (BUN), chloride, sodium, potassium, calcium and bicarbonate were subsequently assayed. Body weights, blood glucose and erythrocyte osmotic fragility were determined**

Results: **On day 1 post rumenotomy (PSRT), mean TPP concentration of group 1 was significantly ($P<0.05$) higher than that of groups 2 and 3 whereas mean BUN concentrations of groups 1 and 3 were significantly ($P<0.05$) higher than BUN of group 2. Mean body weight of group 3 was significantly ($P<0.05$) lower than those of groups 1 and 2 throughout the study. Mean glucose concentration of group 3 was significantly ($P<0.05$) highest on days 1, 3 and 7 PSRT. Mean sodium concentrations of groups 1 and 2 were significantly ($P<0.05$) higher than those of group 3 on day 1 PSRT. The osmotic effect of normal saline was significantly ($P<0.05$) more than that of dextrose saline on PSRT days 2 and 3.**

Conclusion: **The outcome of this study showed that fluid infusion ameliorated the biochemical changes PSRT. However, normal saline exerted more osmotic effect on erythrocytes of goats.**

INTRODUCTION

Rumenotomy is a commonly performed procedure in cattle and other ruminants for treatment and diagnostic purpose [1-3]. This procedure is commonly carried out in small ruminants to relief rumen impaction [4]. Other indications include surgical treatment of toxic indigestion of rumen origin, relief of obstruction of the rumino-reticular or reticulo-omasal orifices, a prelude to the treatment of omasal and abomasal impaction and removal of neoplasm such as papillomas at the cardia of the rumen [5]. Rumenotomy is also performed during in-vivo nutritional studies where it usually accompanies implantation of rumen fistula alone or together with intestinal cannula [6].

Rumenotomy if performed correctly is a safe procedure and animals usually recover with no obvious complication. However, despite its safety, studies have shown that marked haematological and biochemical changes characterized the early post-surgical period [7-8]. In goats after burdizzor castration, significant increase in white blood cell counts and serum levels of protein, creatinine and urea were noted [7]. Also, in goats, post-enterectomy, the number of white blood cells, neutrophils, monocytes and band neutrophils in blood significantly increased [9]. These leucocytic changes were attributed to acute inflammatory response after injury. In addition to these haematologic and biochemical changes, alterations in acid-base and electrolyte status of animals have been reported [8, 10]. Specifically, in goats, post tibia fracture reduction, marked reduction in blood glucose, osmolality, anion gap, chloride, sodium and potassium concentrations were recorded while blood urea, base excess, potency of hydrogen (pH), partial carbon dioxide ($PaCO_2$), total carbon dioxide (TCO_2) and bicarbonate levels increased [8]. In the flow/catabolic phase post injury, increase in anti-diuretic hormone (ADH) and aldosterone secretion leads to retention of salt and water with loss of potassium [11]. The salt and water retention which occur after injury is the body's way of preserving the extracellular fluid (E.C.F) and circulating volume [12]. These changes may alter the fluid and electrolyte status thereby necessitating intravenous fluid administration. In this phase of tissue response sick patients may be easily overloaded with extensive salt and water by administering excess water or hypotonic fluid [11]. It is thus important to administer crystalloids not only in correct volume but also in the appropriate concentrations [11].

Literature search showed paucity of data on serum biochemical and electrolyte changes of West African dwarf goats in the peri rumenotomy period. Also, no research has studied the effects of intravenous infusion of crystalloid solutions on the aforementioned parameters of WAD goats post rumenotomy. This study therefore investigated the serum biochemical changes associated with rumenotomy in goats. Furthermore, effects of intravenous infusion of normal saline and dextrose saline on these changes and erythrocyte osmotic fragility of goats were assessed.

MATERIALS AND METHODS

Methods

Animals and grouping: A total of fifteen adult goats (mean weight 6.5 ± 0.2 kg) were purchased from markets within the University town and used for this experiment. Animals were given Pestes des Petite ruminant vaccine and allowed to acclimatize for 14 days. After acclimatization, goats were

randomly assigned to four experimental groups namely Group 1: Rumenotomy + Normal saline, Group 2: Rumenotomy + 5% Dextrose saline and Group 3: Rumenotomy alone. The protocols used for this research were performed in conformity with the National Institutes of Health revised guidelines for laboratory animals' care and use and approved by the Animal Ethics Committee, University of Nigeria, Nsukka (approval no. UNAEC/19/7211).

Determination of baseline values: Before surgery, bloods for haematology were collected from the external jugular vein into EDTA anticoagulant plastic vacutainers while bloods for erythrocyte sedimentation rate were collected into heparinzed plastic vacutainers. Samples collected without EDTA were allowed to clot and serum harvested from these samples were used to determine serum total plasma protein, urea nitrogen, sodium, chloride, bicarbonate, potassium and calcium.

Presurgical protocols, anaesthesia and surgery: Surgical site was shaved and swabbed with 5% chlorhexidine gluconate. This was followed by draping the site for surgery. Goats were premedicated with xylazine at the dose of 0.05mg/kg, intramuscularly. Flank analgesia was induced by performing an inverted "L" block using Lignocaine Hcl (10mg/kg).

Intravenous (IV) fluid administration was instituted just before the skin incisions and continued intra-operatively and post operatively. Goats in groups 1 and 2 received a total of 300mls of normal saline and 5% dextrose saline respectively. Goats in group 3 serving as the control did not receive any IV fluid.

A 7cm incision was made on the left flank traversing the skin, subcutaneous tissue, abdominal muscles, fascia and the peritoneum. The rumen was exteriorized and anchored on the walls of the stomach to avoid spillage of ruminal content. The rumen was incised with a scapel blade after which it was sutured with 2.0 chromic catgut using Lambert's suture pattern. The peritoneum was sutured with 2.0 chromic catgut using simple continuous suture pattern. The muscle was sutured with 2.0 chromic catgut using simple continuous suture pattern. The skin was sutured by horizontal mattress suture pattern with silk suture material size 2.0.

Postoperative protocols: Oxytetracycline (20%) was given post operatively at the dose of 10mg/kg body weight at 3 days interval, on day 0, 3 and 6. On day 1 and 2 post surgery, 150ml of appropriate fluid was given to appropriate groups. On day 3 post surgery, 100ml of the appropriate fluid was given to the respective groups.

Data collection: Post-surgery, blood was collected from the external jugular vein on days 1, 2 and 3 and was used to carry out osmotic fragility test. Blood was equally collected from the external vain on days 1, 3 and 7 respectively. Blood collected was used to carry out the following tests.

Assessment of serum biochemical parameters: Serum protein, urea nitrogen, chloride, sodium, potassium, calcium and bicarbonate levels were assayed. The assays were carried out using commercial kits (Randox®) adhering strictly to manufacturer's instructions.

Assessment of blood glucose: This was done using Accu-check® blood glucose kit which comprised of a glucometer and test strips. Drops of blood were placed on the strip and the values obtained were recorded in mg/dL.

Body weight: The body weights of goats were determined using a manual weighing balance. Values obtained were recorded in Kilogram.

Red cell osmotic fragility: This was determined by the method described by Ochei and Kolhatkar [13]. The degree of haemolysis (%)

at each level of dilution was calculated. The haemolytic end points (% haemolysis) obtained for each blood sample of an animal was plotted on a coordinate graph against saline concentrations. From the EOF curve (fragiligram), saline concentrations at 10% intervals of haemolytic endpoints (`I0-90%) were obtained

Statistical Analysis: Data collected was subjected to one way analysis of variance (ANOVA) using SPSS. The least significant difference was used to separate the means at post hoc. Probability values of less than 0.05 were considered significant.

RESULTS

Total plasma protein concentrations: The mean total plasma protein (TPP) concentrations of all the groups on post rumenotomy days 1 and 3 were not significantly (P>0.05) different as shown in figure 1. However, on post rumenotomy day 7 the total plasma protein of group 3 was significantly (P<0.05) higher than that of group1 and the total plasma protein of group 1 was significantly (P<0.05) higher than that of group 2.

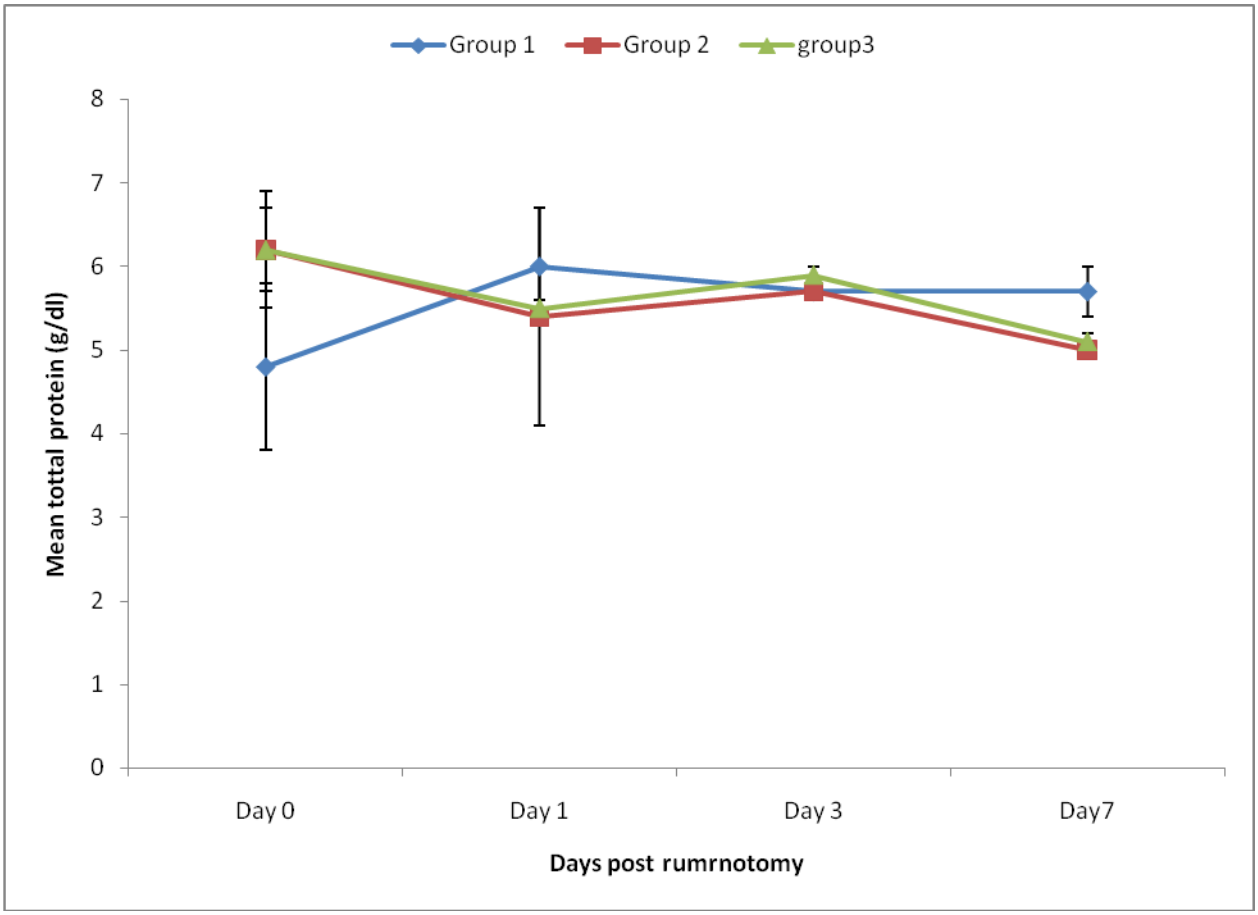

Fig 1: Changes in mean total plasma protein level of goats that were given normal saline and dextrose saline infusion post rumenotomy

Blood urea nitrogen concentrations: Figure 2 shows the mean blood urea nitrogen (BUN) on post rumenotomy day 1 of groups 1 and 3 were significantly (P<0.05) higher than the BUN of group 2. On post rumenotomy day 3 the mean blood urea nitrogen concentration of group 1 was significantly (P<0.05) higher than that of group 3 and 2 while that of group 3 was significantly (P<0.05) higher than that of group 2. On post rumenotomy day 7, BUN concentration of groups 1 and 3 were significantly (P<0.05) higher than that of group 2.

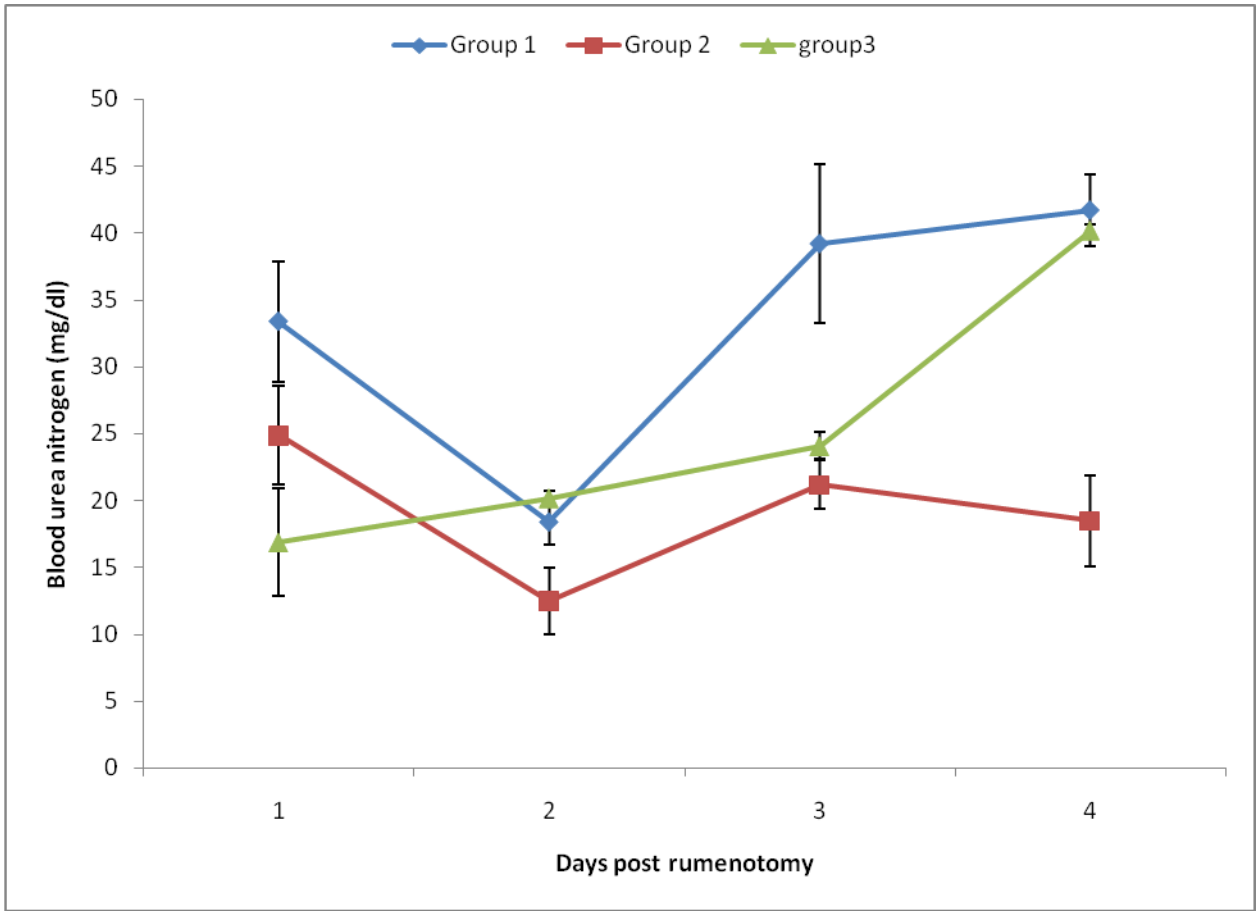

Fig 2: Changes in mean blood urea nitrogen level of goats that were given normal saline and dextrose saline infusion post rumenotomy

Body weights of goats: The mean body weight of groups 1 and 2 were not significantly (P>0.05) different throughout the study. However, mean body weight of group 3 (control) were significantly (P<0.05) lower than those of groups 1 and 2 throughout the study as seen in figure 3.

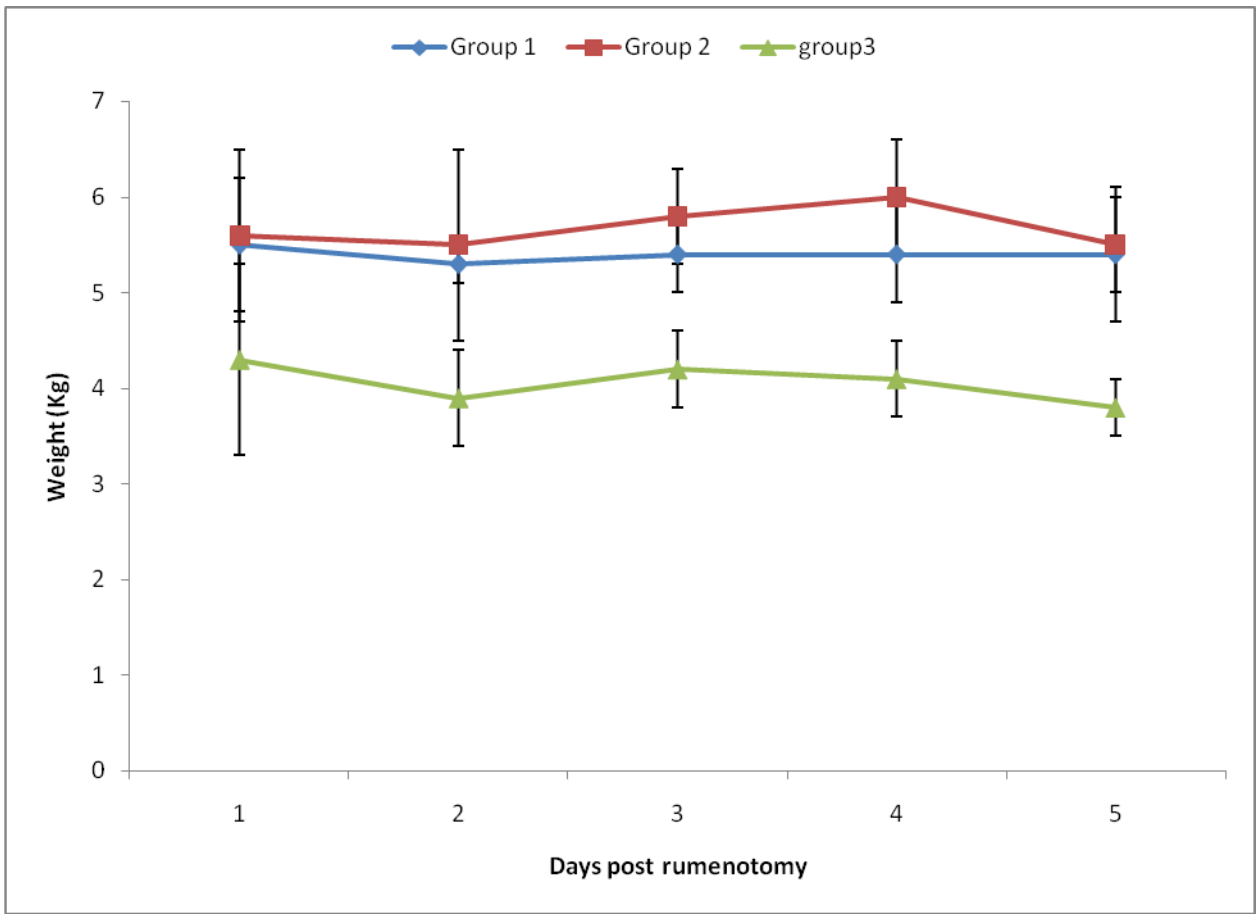

Fig 3: Changes in mean body weights of goats that were given normal saline and dextrose saline infusion post rumenotomy

Glucose concentrations: The mean blood glucose concentration of group 3 was significantly ($P<0.05$) higher on post rumenotomy days 1, 3 and 7. However, blood glucose concentrations of groups 1 and 2 were not significantly ($P>0.05$) difference on post rumenotomy days 1, 3, and 7 (Figure 4).

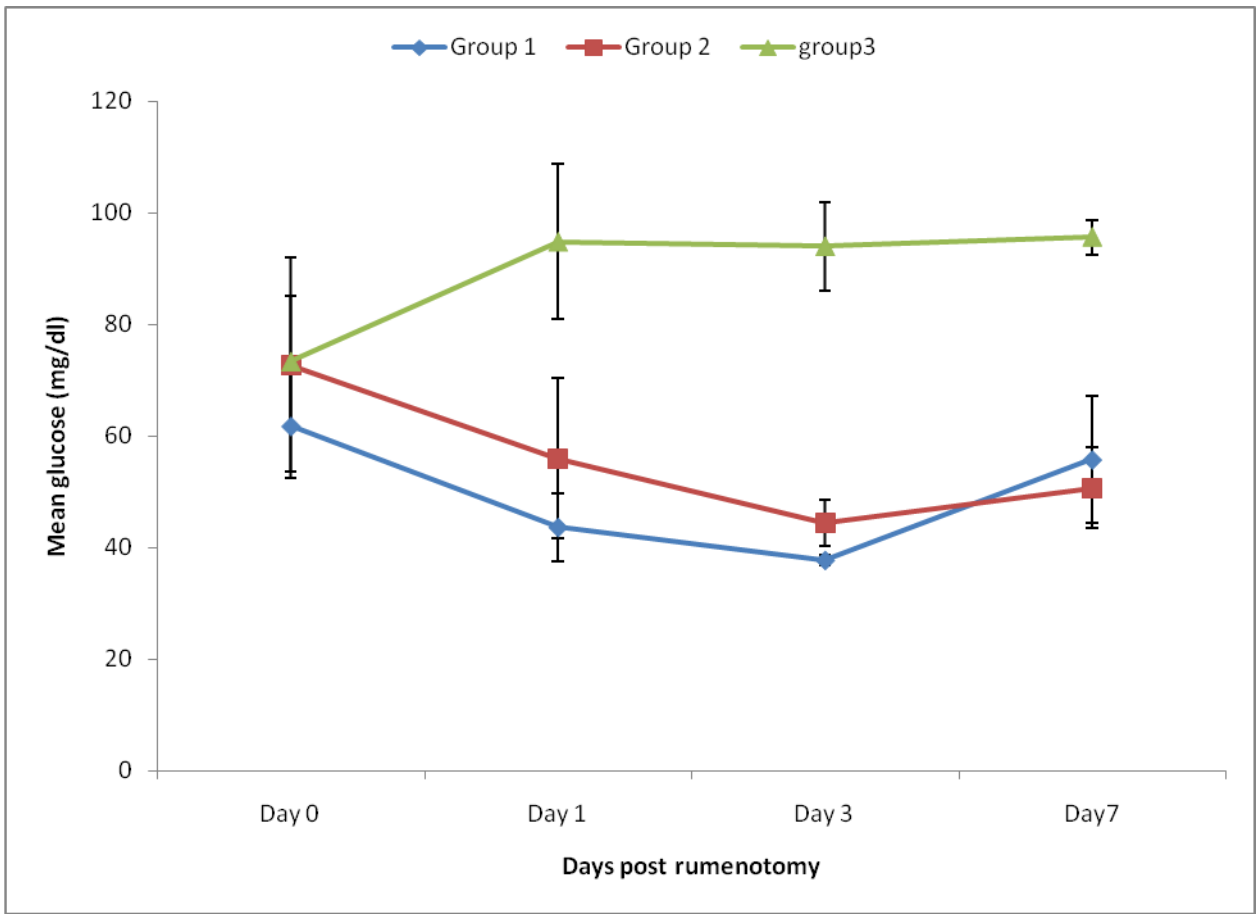

Fig 4: Changes in mean blood glucose level of goats that were given normal saline and dextrose saline infusion post rumenotomy

Serum Chloride concentrations: The chloride assay showed that on post rumenotomy day 1, mean chloride concentration of groups 1, 2, and 3 were not significantly ($P<0.05$) different. However, on post rumenotomy days 3 and 7, chloride concentrations of groups 1 and 2 were significantly ($P<0.05$) higher than that of group 3 (Figure 5).

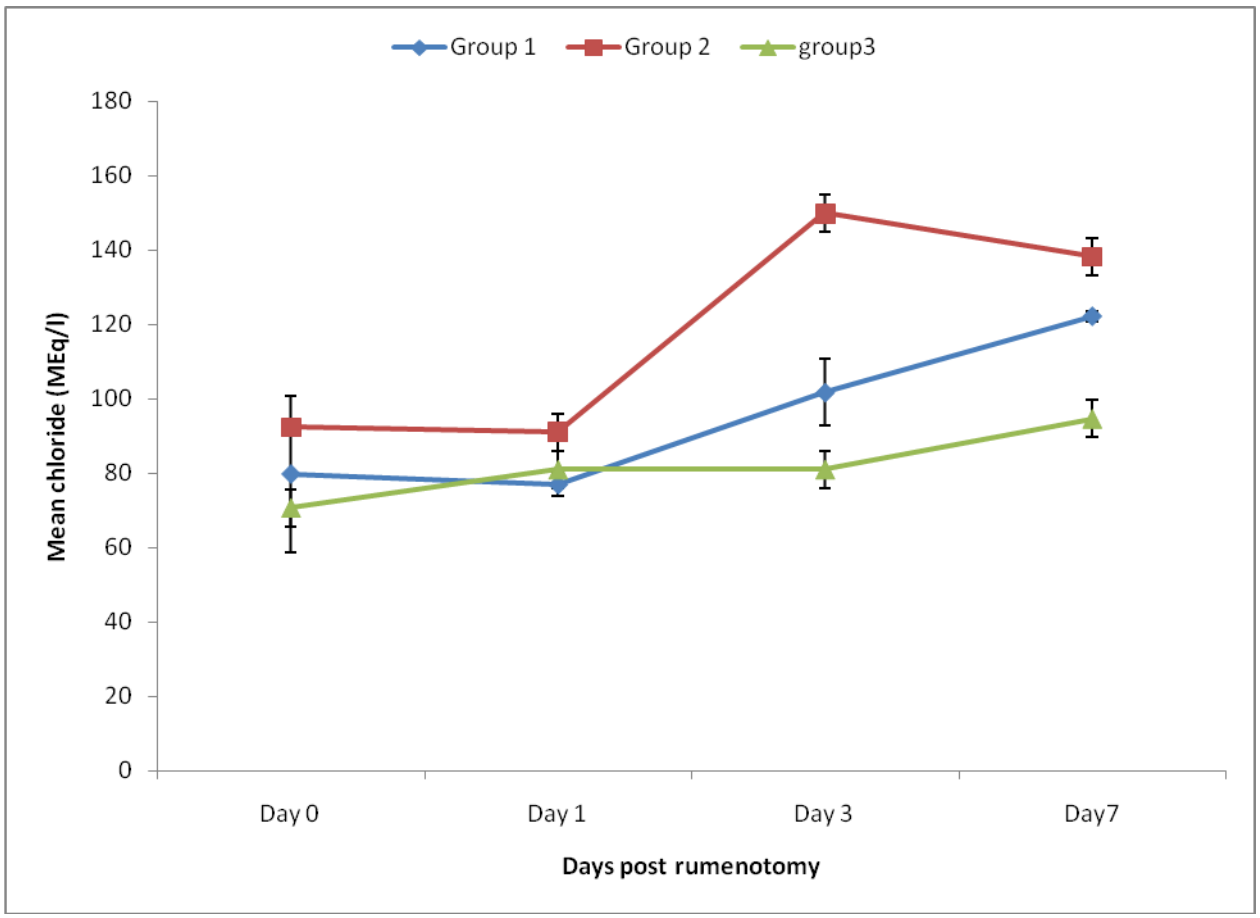

Fig 5: Changes in mean chloride level of goats that were given normal saline and dextrose saline infusion post rumenotomy

Serum sodium concentrations: The mean sodium concentrations of groups 1 and 2 were significantly (P<0.05) higher than that of group 3 on post rumenotomy day 1 as seen in figure 6. On post rumenotomy day 3, sodium concentration of group 2 was significantly (P<0.05) higher than that of group 1 while sodium concentration of group 1 was significantly (P<0.05) higher than that of group 3. However, on day 7 post rumenotomy, sodium concentrations of groups 1 and 2 were significantly (P<0.05) higher than that of group 3.

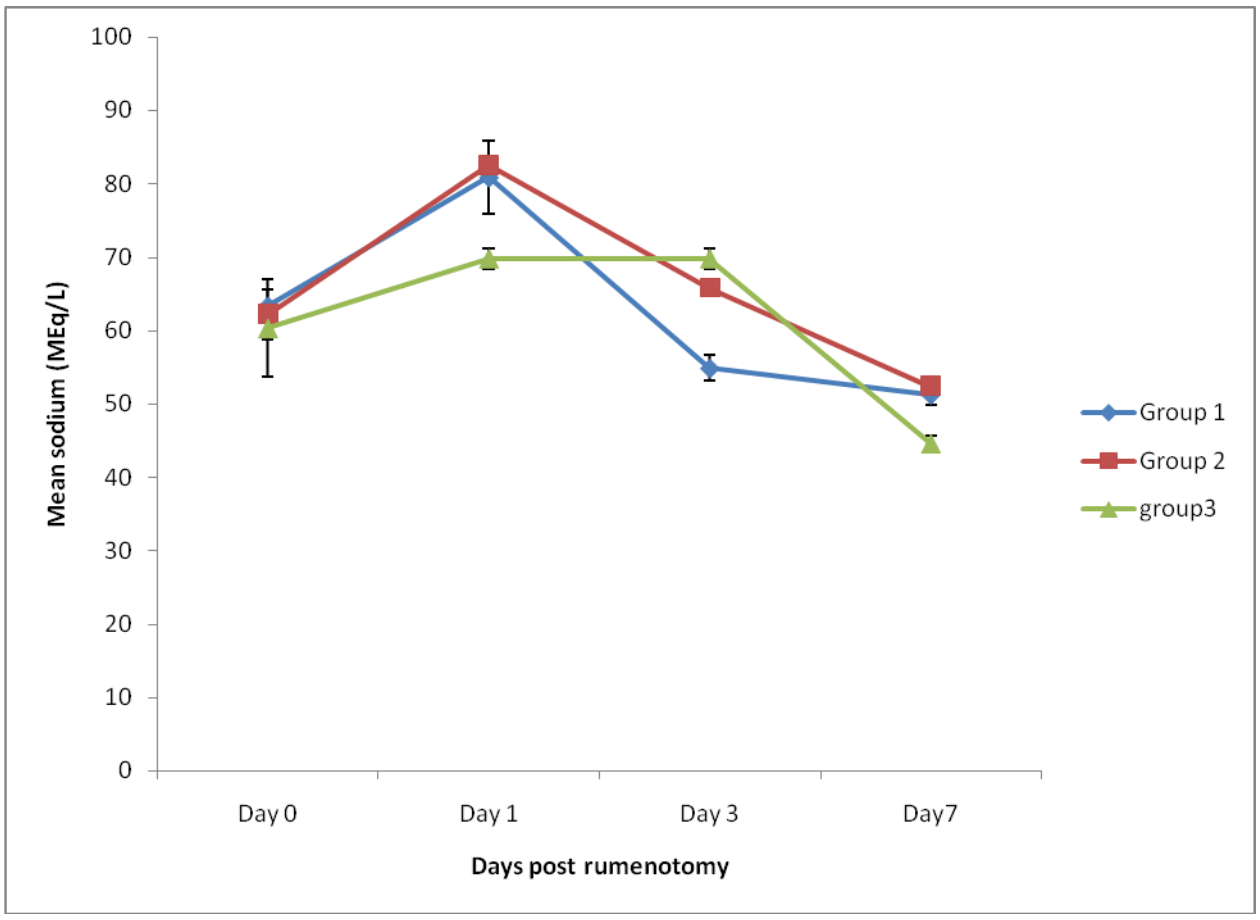

Fig 6: Changes in mean sodium level of goats that were given normal saline and dextrose saline infusion post rumenotomy

Serum potassium concentrations: Figure 7 shows that the mean potassium concentration of all the groups were not significantly (P >0.05) different from each other on post rumenotomy days 1 and 3. However, lower potassium concentrations were obtained in groups 1 and 2 compared to potassium level of group 3, which was higher. On post rumenotomy day 7 the mean potassium concentration of group 1 was significantly (P<0.05) higher than those of groups 2 and 3.

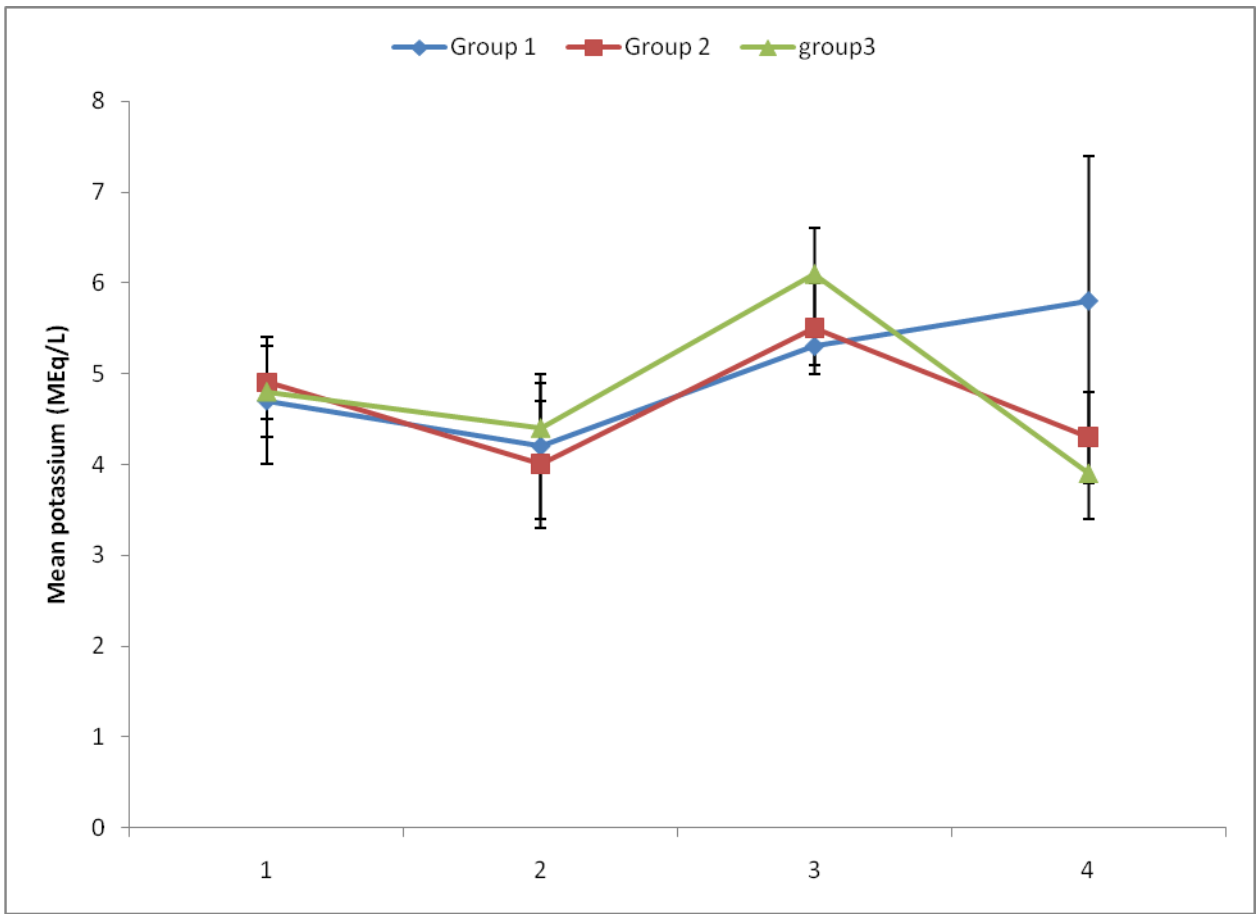

Fig 7: Changes in mean potassium level of goats that were given normal saline and dextrose saline infusion post rumenotomy

Serum calcium concentrations: The mean calcium concentration of group 1 was significantly (P< 0.05) higher than those of groups 2 and 3 on post rumenotorny day 1. On post rumenotorny day 3 the calcium concentration of group 3 was significantly (P<0.05) higher than those of groups 1 and 2 while there was no significant difference in calcium concentrations of groups 1 and 2. On post rumenotorny day 7, calcium concentration of group 2 was significantly (P< 0.05) higher than that of group 1 while calcium concentration of group 1 was significantly (P< 0.05) higher than that of group 3 (Figure 8).

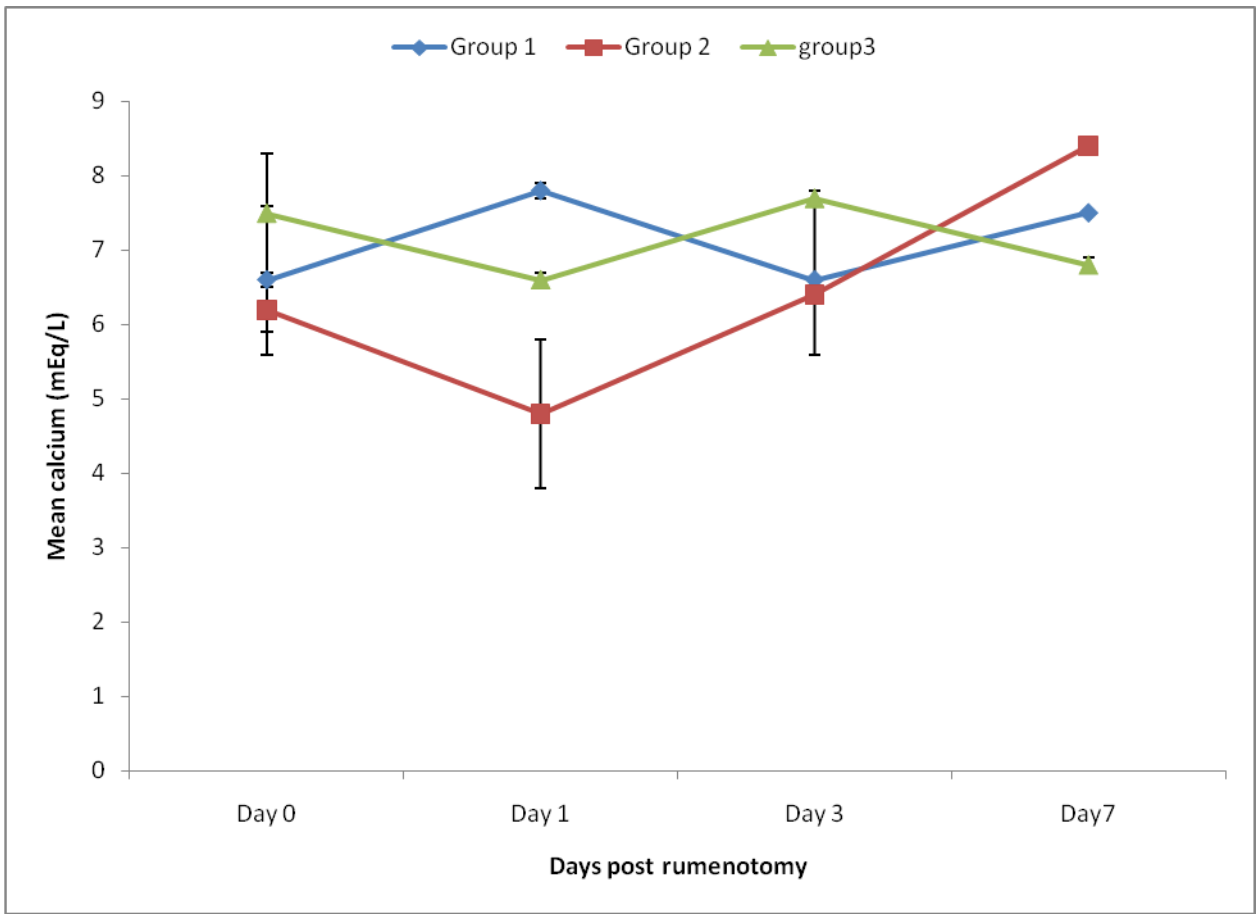

Fig 8: Changes in mean calcium level of goats that were given normal saline and dextrose saline infusion post rumenotomy

Serum bicarbonate concentrations: The mean bicarbonate concentration of the three groups were not significantly (P>0.05) different throughout the study (Figure 9). Although, group 3 had the highest bicarbonate level followed by group 2 and then group 1 had the least bicarbonate level.

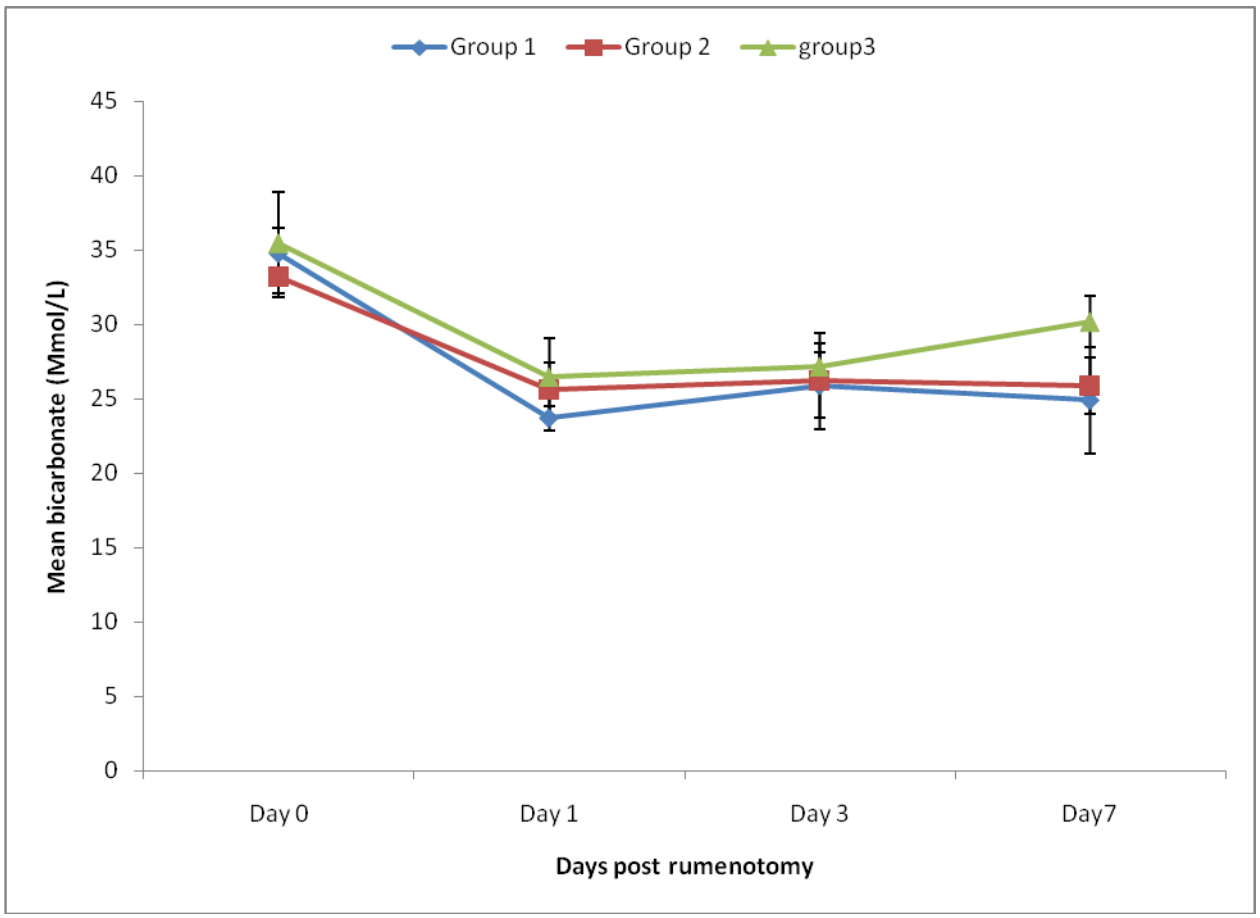

Fig 9: Changes in mean bicarbonate level of goats that were given normal saline and dextrose saline infusion post rumenotomy

Erythrocytes osmotic Fragility: The percentage (%) erythrocyte haemolytic effect of normal saline and dextrose saline were not significantly (P> 0.05) different on post rumenotomy day 1. However, the % erythrocyte haemolytic effect of normal saline was significantly (P<0.05) more than the erythrocyte haemolytic effect of dextrose saline on post rumenotomy days 2 and 3 (Figure 10).

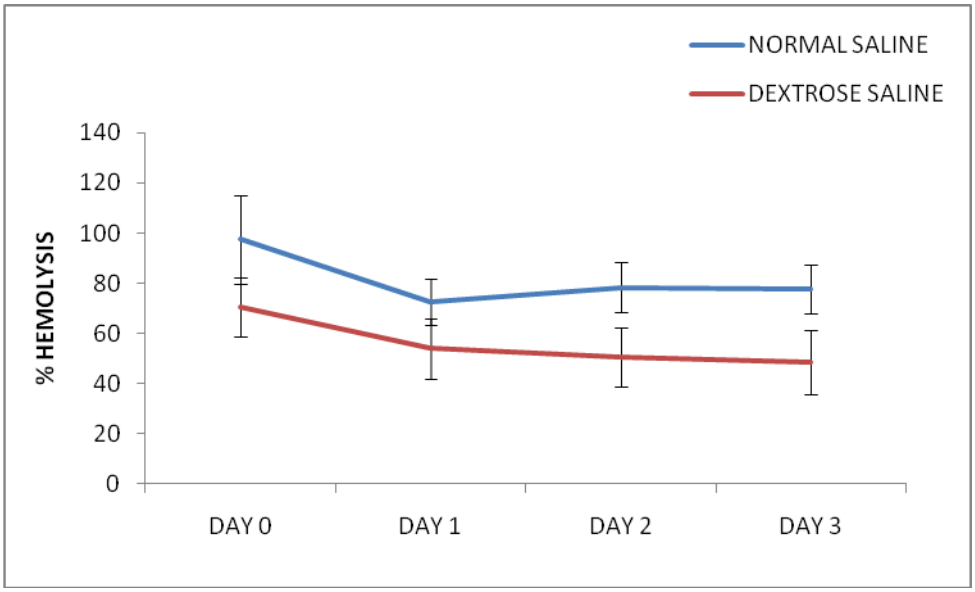

Fig 10: Changes in the mean percentage erythrocytes fragility of goats that received normal saline and dextrose saline infusion post rumenotomy

DISCUSSION

The biochemical assay showed that on day 1 post rumenotomy, total plasma protein (TPP) of group 1 increased while TPP of group 2 and 3 decreased. Significant drop in the concentration of TPP in West African dwarf bucks after bilateral orchidectomy [14] and first week after burdizzo castration [7] had been earlier reported. It has been suggested that protein catabolism post-surgery is stimulated by increased cortisol concentration. Predominantly, skeletal muscle is broken down, but some visceral muscle protein is also catabolized to release the constituent amino acid [12].

Furthermore, earlier report that the amino acid may be further catabolized for energy or are used in the liver to form new protein, particularly acute phase proteins [12]. In addition, physiological response with increased mobilization of fluid and albumin into the intestine and interstitial space result in decrease in TPP post trauma/surgery [11, 15, 16]. Therefore, the decrease in TPP concentration recorded in group 3 (control) on day 1 post surgery might be either due to increased protein catabolism or a consequence of increased mobilization of fluid and albumin into the interstitial space. In group 2, the reason for the decrease in TPP has not been previously postulated. However, it might be that the infusion of dextrose saline increased the extracellular fluid volume thus lowering the serum TPP concentration. Furthermore, the increase in TPP concentration of group 1 on day1 post rumenotomy suggests a reduction in the ECF volume of goats in this group.

The blood urea nitrogen (BUN) of group 3 (control) was significantly higher than that of other groups on day 1 post rumenotomy. Similarly, Olaifa and Opara [7] reported a significant increase in BUN level in West Africa dwarf bucks post castration by burdizzo method. Also, another study reported an increase in blood urea nitrogen in goats [17]. Severe blood loss and decrease in

glomerular filtration rate (GFR) in the immediate post-operative period leads to increase in BUN concentration in the immediate post-surgical period had also been documented [11]. The lower the blood urea nitrogen level in group 2 may suggest that the dextrose saline infusion was able to avert the high level of BUN level.

Painful procedure may decrease the post-operative performance of animals and thus their body weight gain [18-19]. In a previous study, marked decrease in body weight was reported in a study in rabbits [20]. However, loss in body weight post-surgery as seen in group 3 often occurs due to decreased food consumption as well as post-operative protein catabolism [21]. Also, the liver converts amino acids into other substrates notably glucose, fatty acids and ketone bodies. This results in marked weight loss and muscle wasting in patients after major surgical or traumatic injury [12]. Also, in this study while decrease in body weight was noted on post rumenotomy days 1, 3, 6 and 10 in group 3, groups 1 and 2 which were given fluid had higher body weight. This finding in both normal saline and dextrose saline treated groups showed that fluid administration benefited the goats in both groups.

High post – operative blood glucose level was observed in group 3 on days 1, 3 and 7. Blood glucose concentration has been reported earlier to increase after surgery [22]. Cortisol and catecholamine released post-surgery in response to stress and pain facilitate glucose production as a result of increased hepatic glycogenolysis and gluconeogenesis [23-24]. Also, it has been suggested that increase in blood glucose concentration are related to the intensity of the surgical injury. Therefore, the high blood glucose value obtained in group 3 showed that the animals in this group were more stressed post – surgery. However, in groups 1 and 2, the blood glucose level were lower probably because the fluids administered reduced their stress level.

The serum electrolyte assay showed that chloride and sodium levels of the groups administered with normal saline and dextrose saline (groups 1 and 2) were significantly higher than that of the control group post rumenotomy. The most important neuroendocrine response in the perioperative period is sodium and water conservation with excretion of potassium [25-27]. The principal mediators of this response are anti-diuretic hormione (ADH), aldosterone and rennin-angiotensin II systems [11, 28]. Also, the response to injury and stress in an increase in the size of the pores in the capillary membrane and the transcapillary escape rate of albumin increases [11]. As albumin leaks out of the intravascular compartment into the interstitial space, water and sodium are also drawn into the interstitial space [11]. Therefore, the lower serum sodium and chloride levels obtained in group 3 (control group) goats which were not given intravenous fluid suggests that movement of plasma sodium into the interstitial space occurred in response to surgical stress. On the contrary, higher sodium and chloride level obtained in groups 1 and 2 which were administered with normal saline and dextrose saline respectively suggests that the sodium and chloride contained in this fluid replaced the sodium and chloride lost from the intravascular space. However, it is important to note that sick patients can be easily overloaded with excessive salt and water during the flow period since salt is retained in the immediate period post injury [11]. Therefore, normal saline and dextrose saline are to be administered in the correct volume

in the immediate period post rumenotomy to avoid salt overload

Potassium is the major intracellular cation while in the extracellular fluid, sodium (Na^+) is the principal cation [29]. The high extracellular Na^+ concentration and low K^+ concentration are maintained by the active Na^+-K^+ pump of the cell membrane [29]. In this study, on post rumenotomy day 1 while serum sodium concentration of goats in all the groups increased, on the contrary potassium concentration of the three groups decreased. These results suggest that in response to the increase in concentration of sodium in the extracellular fluid (serum) a compensatory decrease in potassium ion occurred. Also as recorded in the results of this study, on post rumenotomy days 1 and 3, the groups with lower serum potassium levels and higher sodium chloride levels were the normal saline and dextrose saline treated groups. This suggests that infusion of both solutions containing sodium and chloride lead to compensatory excretion of potassium from the extracellular fluid compartment to maintain serum ionic balance.

This study showed that bicarbonate level of group 3 (control) was higher than that of groups 1 and 2 post rumenotomy. Earlier, reported a decrease in bicarbonate level after normal saline infusion in cat had been documented [30]. Chloride is the primary extracellular anion and plays an important role in acid-base regulation [25, 29]. This role is linked to its reciprocal relationship with bicarbonate [29]. Therefore, the lower bicarbonate levels of groups 1 (normal saline) and 2 (dextrose saline) and their higher chloride levels suggests that more bicarbonate was excreted in both groups probably in an attempt to maintain the acid-base status of the goats.

In this study the erythrocytes osmotic fragility test conducted using normal saline and dextrose saline showed that dextrose saline had less osmotic effect on the erythrocytes. The occurrence of more haemolysis in normal saline treated group suggests that continued normal saline infusion beyond day 1 post rumenotomy affected the integrity of the red cell membrane making the cells more susceptible to hypotonic lysis. This implies that overzealous administration of normal saline in the perioperative period may predispose goats to impaired tissue perfusion with deleterious effects on wound healing, weight gain and recovery.

CONCLUSION

It was noted in this study that fluid infusion averted the post-rumenotomy stress since the groups that received fluid infusion gained more weight and recovered faster. Also, they had higher sodium and chloride levels showing that both fluids were able to replace sodium and chloride as they were lost from the intravascular space. However, results of the erythrocytes osmotic fragility test showed that normal saline had more osmotic effect on the erythrocytes. Therefore, overzealous administration of normal saline to goats in the post rumenotomy period should be avoided.

REFERENCES

1. Dehghani, S.N. and Ghadrdani, A. M. "Bovine rumenotomy: comparison of four surgical techniques," *Can. Vet. J.* 1995; 36; 693-697.
2. Remi-Adewunmi, B.D., Fagbamila, O.I., Ibrahim, N.D.G. and Ogundle J.A. "Evaluation of chronic catgut and polyalycolic acid sutures for closure of rumen incision in savannah brown goats," In:

proceedings of 43rd Annual conference of NVMA, Niger State, Nigeria, pp. 12-15; 2006.
3. Hendrickson, D.A. and Baird, A.N. "Suture materials and needles techniques in: Large animal surgery," John Wiley and Sons 4th ed. Pp. 323; 2013.
4. Sanni, B.D., Gyang, E.O. and Osinowo, O.A. "Polythene-bag-induce rumen impaction in small ruminants. An environmental hazard," In: proceedings of the silver Anniversary Conference of the Nigerian Society for Animal production and the inaugural conference of the west Africa Society for Animal Production Abeokuta, Nigeria, pp. 97-98; 1998.
5. Gyang, E.O. "The digestive system: introduction of large Animal Surgery," Agitab Publishers, Zaria, Nigeria, 1992.
6. Aka, O.L., Obidike, I.R., Eze, A.C. and Igbokwe C.O. "Physiologic evidence of good tolerance of concurrent rumen fistulation and duodenal cannulation in West African dwarf sheep," *Ani. Res. Int.* 2009; 6(2); 1019–1027.
7. Olaifa, A.K. and Opara, N.M. "Haematological and Biochemical parameters of West African Dwarf bucks castrated by burdizzo method," *Vet. Arch.* 2011; 81; 743–750.
8. Uwagie–Ero, A.E., Udegbunam, R.1. and Kadima, K.B. "Haemotological and serum electrolyte Reponses in goats undergoing tibial fracture reduction," *Sokoto Journal of Vet. Sci.* 2016; 14(2); 58-62.
9. Nazifi, S., Dehghari, S. and Barzegar, R.M. "Evaluation of cellular and biochemical parameters of blood and peritoneal fluid following enterectomy in the goat," *Sm. Rum. Res.* 1999; 57; 65–71.
10. Kwak, J.H., Jo, Y.Y., Lee, K.C. Kim, Y.B., Shinn, H.K. and Kim, J.Y. "Acid base alterations during laparoscopic abdominal surgery: A comparison with laparotomy," *Bri. J. Anaest.* 2010; 105(4); 442-447.
11. Lobo, D., Lewington, A.J.P. and Allison, S.P. "Basic concepts fluid electrolyte therapy Bibliomed, Germany, 2013; pp 9 -22.
12. Desborough, P.J. "The stress response to trauma and surgery," *Bri. J. Anaest.* 2000; 85(1); 109-117.
13. Ochei, J. and Kolhatkar, A. "Medical laboratory science Theory and Practice," Tata McGraw-Hill Publishing company Limited, New Delhi: 2007; pp. 322.
14. Oyeyemi, M.O., Olaifa, A.K., Onwuka, S.K., Akinloye, A.K. and Utho, O.A. "The effect of bilateral orchidectomy on some serum enzymes and proteins in West African Dwarf buck," *Afr.J. Biomed. Res.* 2000; 3; 105-108.
15. Petroianu, A. "Cuidados pos-operatovios," In: "clinica cirurgica" sub redactia lui petoianu A., Revinter (Rio de Janeiro); 2001; pp. 17–26.
16. Albeit, L.P., Petroianu, A., Rehata, I.Z. et al. "The effect of surgical procedures on serum albumen concentration," *Chirurgia. 2003;* 103(1); 39–43.
17. Mohammad, B.F., Zghoul, A.L., Raidal, A.K. Abdelsalam, R., Talafah, Q., Omar, A. and Ismail, Z.A. "Cellular and some change in blood and peripheral fluid Constituents in Awassi lambs following elective castration," *Am. J. An. Vet. Sci.* 2008; 3; 23–27.
18. Fitzpatrick, J., Scott, M. and Nolan, A. "Assessment of pain and welfare in sheep. *Sm. Rum. Res.* 2006; 62; 55–61.
19. Luna, S.P.L. "Pain sentience and animal welfare" *Tro. Ani. Heal. Prod.* 2008; 17–21.
20. Leach, M.C., Allweiler, S., Ricardson, C. et al. "Behavioural effects of ovariohystectomy and oral administration of meloxicam in laboratory housed rabbits," *Res. Vet. Sci.* 2009; 87(2); 336-347.
21. Weaver, L.A., Blaze, C.A., Linda, D.E. et al. "A model of clinical evaluation of peri-operative analgesia in rabbits. (Oryctolagus cuniculus)," *J. Am. Ass. Lab. Ani. Sci.* 2010; 49; 845-851.
22. Udegbunam, R.I., Agu, N.N. and Udegbunam, S.O. "Efficacy of piroxicam on acute pain induced by full thickness excision wounds in rats. *Afr. J. Phar. Pharm.* 2012; 6; 1668-1674.
23. Bondy, P.K. "The adrenal cortex," In: Bondy, P.K. and Rosenberg, L.E. (eds). Metabolic

control and disease, 8th edn. WB saudners. Co Philadephia, 1980; pp. 1427 – 1499.

24. Sahir, S and David, J. "Perioperative electrolyte and fluid balance," *Cont. Ed. Anaes. Cri. Care. Pain*. 2005; 5(5); 159.
25. Rassam, S.S. and Counsell, D.J. "Preoperative fluid and electrolyte balance," *Cont. Ed. Anaes. Cri. Care. Pain*. 2005; 5(5); 157-160.
26. Holte, K., Sharrock, N.E. and Kehlet, H. "Pathophysiology and clinical implication of perioperative fluid excess," *Bri. J. Anaest.* 2002; 89(4); 622-632.
27. Singh, M. "Stress response and anaesthesia," *Ind. J. Anaest.* 2003; 47(6); 427- 434.
28. Zaloga, G.P and Hughes, S.S. "Oliguria in patients with normal renal function," *Anaest.* 1992; 72; 598-602.
29. Pettifer, G. "Fluids, Elctrolytes and Acid-Base," Therapy in: Textbook of Small animal Surgery 3rd Edition (Slatter, D) Saunder USA; 2003; pp. 17-43.
30. Natasha, H. "Fluid Therapy in the Emergency feline patient, " Bristol University and Pfizer Animal Health, Editor: Samatha Taylor; 2010; pp. 2.