



Research Article

Appraisal of Restraint Positions for Rumen Skin Clamp Fixation, Stay Suture, and Mobile Small Ruminant Surgical Chute Rumenotomy Based on the Haematology of Kano-Brown Goats

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ARTICLE INFO:

Keywords:

Rumen,
Goats,
Restrains,
Rumenotomy,
Surgery

ABSTRACT

Standing position in large ruminants and lateral recumbence in small ruminants have been the age-long standard restraint approaches when carrying out most surgical procedures, without recourse to the associated induced surgical stress. This study fabricated a mobile small ruminant surgical chute for standing restraint position and compares its associated haematological responses with those induced in lateral recumbence position during rumenotomy in Kano-Brown goats (KBGs). Eighteen Kano-Brown goats of both sexes diagnosed of rumen foreign body impaction were allocated to groups A, B and D. Goats in groups A and B underwent rumen skin clamp fixation (RSCF) and stay suture rumenotomy (SSR) techniques respectively, while on lateral recumbency. Goats in group D underwent rumenotomy while on standing restraint in a fabricated mobile small ruminant surgical chute (MSRSC). The six other KBGs diagnosed to be free of the rumen foreign bodies did not undergo any rumenotomy and thus, served as control (Group C). Haematological parameters were assayed pre- and post-rumenotomy at 0, 5, 24, 48, 72 hours and weeks 1, 2 and 3. The mean total white blood cell counts were $11.17 \pm 1.4 \times 10^9/L$, $9.63 \pm 1.44 \times 10^9/L$, and $8.58 \pm 0.96 \times 10^9/L$ for groups A, B, and D respectively, at 0-hour post-rumenotomy. Mean TWBC was lowest at 48 hours in group D, post-rumenotomy even though the difference was not significant ($P > 0.05$). In conclusion, lateral recumbency restraints for Rumen Skin Clamp Fixation and Stay Suture rumenotomy versus standing restraints for Mobile Small Ruminant Surgical Chute Rumenotomy did not significantly impact on Haematology in Kano Brown Goats. This could mean that the fabrication was a success and an alternative to performing surgeries in standing restraints beside the conventional lateral recumbency restraints in ruminants.

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INTRODUCTION

In a livestock farm, choosing the right surgical location and restraining devices improves surgical success. The ideal surgical facility should consider patient and surgical personnel ease of access, patient restraint, footing for standing patients, lighting, access to water and drainage, and protection from environmental conditions such as rain, extreme temperature, wind, dust, and flying insects (National agricultural extension and research liaison services, 2000). Bennett (2014) defines animal restraint as "the act of clutching back or the loss of an animal's freedom." It is the restriction or impediment of an animal's free movement or action by using moral persuasion, physical force, or the administration of chemical agents, primarily for milking, diagnosis, or treatment (Hassan and Nwannenna, 2009; National agricultural extension and research liaison services, 2000). Rumen conditions particularly those caused by ingestion of non-digestible elements such as plastics and polythene that litter our environments, are becoming more common nowadays and can only be treated through rumenotomy (Dehghani and Ghahrdani, 1995). Rumen impaction with foreign bodies has resulted in numerous goat mortalities, with pregnant does being the most afflicted. Rumenotomy procedures have evolved throughout time, however they are associated with a variety of problems such as discomfort, adhesions, and infections from contaminations, as well as an unknown pattern of weakened immunity from surgical stress (Dehghani and Ghahrdani, 1995; Geehan et al., 2006) which often hamper prompt healing. The common rumenotomy techniques are stay suture and rumen skin clamp fixation. Some techniques such as Weingarh's ring rumenotomy and Gabel rumen retractor (rumen board) techniques possess special advantages (Niehaus, 2008) which are most beneficial only when performed in the standing position. An essential and reliable medium for assessing the health status of animals is the blood

(Oduye, 1976). The importance of evaluating haematological indices of domestic farm animals has been well outlined and reports have documented haematological indices of indigenous Nigerian goats (Egbe-Nwiyi et al., 2000; Oduye, 1976). Haematological indices of goats in Nigeria show great variation among the breeds (Tambuwal et al., 2002). Management system, nutrition, age, sex, genetics, stress (such as post-surgery), drugs, disease, geographical location, and transportation have been observed to affect haematological parameters of domestic animals. Factors that influence the production and release of stress hormones such as catecholamines and corticosteroids can, in turn, affect both haematological indices (red and white blood cells) (Mike, 2015).

The erythrocyte numbers are most notably affected by catecholamines through their induction of spontaneous reactive splenic contraction in Canidae, Felidae, Camelidae, Cervidae, Bovidae, and Equidae. These animals have large, reactive spleens capable of sequestering up to 25% of their total number of red blood cells (by contraction). This contraction releases red blood cells into the circulation causing increased RBC, Hb and PCV levels (Mike, 2015). Since splenic relaxation takes approximately 45 minutes after initiation of stress stimulus, animals anaesthetized or administered with adrenolytic immobilizing drugs such as prazosin, propranolol or guanethidine prior to the examination and blood sampling suppresses the action of catecholamines and the red blood cells are re-sequestered (Mike, 2015). Therefore, care must be observed when assessing the RBC, Hb and PCV levels in animals that have been immobilized with adrenolytic agents. It could be argued that the anaesthetised state is more "haematologically normal" than the stressed state (Mike, 2015). The effect of stress on white cells is less pronounced, slower and usually lasts much longer than that of the red cells. White blood cell changes are mainly effected by

corticosteroids while neutrophilia, lymphopaenia and eosinopaenia have been associated with stress in most species of animals while monocytosis appears a common finding in dogs (Mike, 2015). As reports for other surgical techniques in goat breeds may not represent the responses to rumenotomy, there are paucity of literature on the haematologic response of Kano-Brown goats to rumenotomy techniques performed in standing and lateral recumbency restraint positions. However, the obvious challenge was that no chute was purposely designed for surgery in small ruminants. This study compared the effects of rumen skin clamp fixation technique (RSCF), stay suture rumenotomy (SSR) in lateral recumbency restraints positions and a standing restraint mobile small ruminant surgical chute rumenotomy (MSRSC) on haematological parameters of Kano-Brown goats. To achieve the objectives of this study, a rotating surgical cage was fabricated with a lot of modifications similar to the work of McDonough (1948), which provided better footing for small ruminants while they are restrained standing, for surgical procedures such as rumenotomy.

MATERIALS AND METHODS

Ethical Clearance

The Ahmadu Bello University Committee on Animal Use and Care (ABUCAUC) granted ethical approval, with approval number ABUCAUC/2018/054.

Grouping of Research Animals

The study comprised eighteen (18) Kano-Brown goats (KBG), nine (9) females and nine (9) males with rumen foreign body impaction (RFBI) on palpation. Using a random number generator, the animals were placed into three groups: A, B, and D, each with three female and three male KBGs. Six more goats, three males, and three females, were assigned to group C as controls but were free of RFBI.

Pre-surgical Evaluation

Physical and haematological examinations were performed on goats in groups A, B, C, and D; the goats were additionally screened

for blood and faecal parasites to ensure that the animals were in stable condition for rumenotomy.

Preoperative Preparation

The goats were fasted for 12 and 6 hours for feed and water, before surgery respectively. All goats in groups A, B, and D were sedated subcutaneously with xylazine hydrochloride (XYL-M2® VMD NV/sa-Hoge Mauw 900-B-2370 Arendok-Belgium) at 0.025 mg/kg. This dose was required to accommodate the standing operation. The animals in groups A and B were positioned in right lateral recumbency, and each goat's left paralumbar fossa was shaved using a sterile razor blade. Each goat in Group D had its paralumbar fossa shaved while restrained in a standing position in the fabricated mobile small ruminant surgical chute. The paralumbar fossa of each goat in group D was similarly shaved while in a standing position restraint in the fabricated mobile small ruminant surgical chute. The shaved paralumbar fossa of each goat was aseptically prepared by scrubbing with 0.2% Chlorhexidine gluconate (Savlon®, Vervaading deur, Johnson and Johnson (Pty) Ltd., London) and smeared with povidone-iodine (Sawke-10%®, Jawa International Limited, Jawa House Compound, Plot 6, Abimbola Estate, Isolo, Lagos, Nigeria) prior to local anaesthesia and surgery.

Anaesthetic protocol

The goats in groups A, B, and D received inverted L-block with 2% lidocaine HCl at a dose of 4 mg/kg (NCL Lidocaine®, Syncom Formulations, NCL Pharm Chem Ind. Ltd., India), as described by Lee (2012).

Surgical Procedure of Rumenotomy

A polythene rumen shroud was used to drape the goats in standing-chute restraint rumenotomy while a conventional four corner draping was employed for goats in the lateral recumbency restrained position (Fig.1). In these later groups (A and B), polythene rumen shroud was only applied when the rumen was fully exteriorised before incisions were made on it. A seven centimetre through and through

an incision as described by Firth et al. (1985) was made on the skin via the left mid-flank into the abdominal cavity of all experimental goats in groups A, B and D. Following the skin incision, the muscles were manually separated along the direction of their fibres with the surgeon's hands following a scalpel stab incision on each muscle layer that was lifted with a rat tooth forceps. After

laparotomy and exteriorization of the rumen of each goat in the treated groups, rumen skin clamp fixation rumenotomy (Fig. 1), stay suture rumenotomy (SSR) and the mobile small ruminant surgical chute rumenotomy (Fig. 2), were performed in groups A, B and D, respectively, as described by (Saidu et al., 2020).



Figure 1: Grossly soiled surgical site with rumen ingesta in a rumen skin clamp fixation technique of a lateral recumbency restraint rumenotomy in Kano-Brown Goats



Figure 2: A surgical guide bar and sliding gate aided head and body restraint in a mobile small ruminant surgical chute for laparotomy incision and rumenotomy in Kano-Brown Goat

Blood Sample Collection for Haematology

To establish preliminary haematological values, 5 ml of blood was obtained from each goat's jugular vein and similarly at 0, 5, 24, 48, and 72 hours, as well as weeks 1, 2, and 3 post-rumenotomy such that 0 hour defines the period immediately post rumenotomy. The blood sample was poured into a container containing ethylene diamine tetra acetic acid for haematology. Routine laboratory procedures were used to determine the haematological parameters and microhaematocrit technique was used to calculate packed cell volume (Coles, 1986). Erythrocyte (red blood cell) count, total leucocyte (WBC) and differential WBC counts, and haemoglobin concentration (Hb) were also evaluated as described by Coles (1986).

DATA ANALYSIS

To establish the $M \pm SE$ of periodic values of the variables for the entire group, the data obtained in the study were subjected to column statistics in Graph Pad Prism Version 4.0, (2005) software. Two Way Repeated Measures ANOVA with Bonferroni posttest was used to compare between the groups and analyses were considered significant at $P < 0.05$.

RESULTS

The Haematological Response of Kano-Brown Goats

The mean haematological values for the groups A, B, C and D KBGs, pre- and post-rumenotomy are presented in Tables 1, 2 and 3. The haematological profiles of Kano-

Brown goats following rumen skin clamp fixation technique (RSCF) and stay suture rumenotomy (SSR) in lateral recumbency restraint positions did not significantly differ ($P > 0.05$) throughout the experimental period. All values of the haematological indices in this experiment were within the reference intervals for the species. The mean haematological parameters at 5, 24, 48 hours and Week 3 post-rumenotomy were higher than the pre-rumenotomy values, even though the differences were not significantly different ($P > 0.05$). The pre-rumenotomy mean TWBC counts for groups A, B, C and D were 9.38 ± 1.83 , 6.08 ± 0.49 , 6.93 ± 1.05 and $8.47 \pm 1.10 \times 10^9/L$, respectively. The mean TWBC values for groups A, B, C and D at 0-hour post-rumenotomy were 11.17 ± 1.4 , 9.63 ± 1.44 , 9.23 ± 1.47 , $8.58 \pm 0.96 \times 10^9/L$, respectively (Table 1). The mean TWBC at 48 hours post-rumenotomy was still higher in group A (13.92 ± 0.94) and B (12.9 ± 1.71) than in the control group C (12.88 ± 1.34) and the MSRSC treated group D (11.58 ± 0.83). The mean lymphocyte counts at 72 hours post-rumenotomy were group A (6.43 ± 0.67), group B (9.02 ± 1.05), group C (6.96 ± 0.97) and group D ($10.54 \pm 0.87 \times 10^9/L$), (Table 2). These values were all not significantly different ($P > 0.05$). Similarly, at week 3, the mean TWBC was 15.87 ± 1.57 , 12.45 ± 1 , 14.75 ± 1.63 and 13.83 ± 1.48 for groups A, B, C and D, respectively, ($P > 0.05$), (Table 3).

Table 1: Mean \pm SE haematological values of different treatment groups of the Kano-Brown goats at pre-, 0 and 5 h post rumenotomy

Sampling time	Haematology parameter	Group A (RSCF)	Group B (SSR)	Group C (Control)	Group D (MSRSCR)
pre	PCV (%)	30.17 \pm 1.11	33.50 \pm 2.19	30.33 \pm 2.33	33.17 \pm 2.01
	HGB (g/dL)	10.03 \pm 0.37	11.08 \pm 0.71	10.07 \pm 0.78	10.98 \pm 0.67
	TP (g/dL)	6.63 \pm 0.35	6.52 \pm 0.17	6.68 \pm 0.31	6.88 \pm 0.23
	TWBC X 10 ⁹ /L	9.38 \pm 1.83	6.08 \pm 0.49	6.93 \pm 1.05	8.47 \pm 1.10
	TRBC X 10 ¹² /L	5.37 \pm 0.23	5.43 \pm 0.43	5.42 \pm 0.43	5.63 \pm 0.27
	NEUTRO X 10 ⁹ /L	2.76 \pm 0.37	1.86 \pm 0.38	2.17 \pm 0.32	2.55 \pm 0.11
	LYMPHO X 10 ⁹ /L	6.48 \pm 1.48	3.88 \pm 0.29	4.54 \pm 0.84	5.94 \pm 1.00
	MONO X 10 ⁹ /L	0.14 \pm 0.05	0.10 \pm 0.05	0.10 \pm 0.08	0.00 \pm 0.00
	EOSINO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.03 \pm 0.03	0.00 \pm 0.00
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BAND (%)	0.17 \pm 0.17	0.00 \pm 0.00	1.50 \pm 0.96	0.00 \pm 0.00
0 hr	PCV (%)	30.33 \pm 1.54	31.5 \pm 2.75	30.17 \pm 1.82	35 \pm 2.13
	HGB (g/dL)	9.78 \pm 0.65	10.47 \pm 0.92	10 \pm 0.6	11.63 \pm 0.71
	TP (g/dL)	6.5 \pm 0.26	7.43 \pm 0.38	7.17 \pm 0.28	8 \pm 0.56
	TWBC X 10 ⁹ /L	11.17 \pm 1.4	9.63 \pm 1.44	9.23 \pm 1.47	8.58 \pm 0.96
	TRBC X 10 ¹² /L	5.07 \pm 0.25	5.67 \pm 0.52	5.02 \pm 0.38	5.87 \pm 0.31
	NEUTRO X 10 ⁹ /L	2.91 \pm 0.45	3.37 \pm 0.96	3.02 \pm 0.28	2.42 \pm 0.28
	LYMPHO X 10 ⁹ /L	7.99 \pm 1.11	6.12 \pm 0.7	6.11 \pm 1.28	5.79 \pm 0.78
	MONO X 10 ⁹ /L	0.07 \pm 0.03	0.26 \pm 0.11	0.1 \pm 0.06	0.3 \pm 0.14
	EOSINO X 10 ⁹ /L	0.05 \pm 0.05	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BAND (%)	1.5 \pm 0.72	0.67 \pm 0.42	0.17 \pm 0.17	1 \pm 0.52
5 h	PCV (%)	31 \pm 1.83	30.33 \pm 3.33	28.17 \pm 1.97	32.17 \pm 2.36
	HGB (g/dL)	10.3 \pm 0.62	10.08 \pm 1.12	9.35 \pm 0.65	10.7 \pm 0.78
	TP (g/dL)	6.73 \pm 0.25	7.53 \pm 0.4	6.44 \pm 0.43	7.25 \pm 0.64
	TWBC X 10 ⁹ /L	11.07 \pm 1.13	10.58 \pm 1.62	8.23 \pm 1.3	11.77 \pm 1.49
	TRBC X 10 ¹² /L	5.23 \pm 0.36	5.15 \pm 0.66	5.07 \pm 0.32	5.35 \pm 0.41
	NEUTRO X 10 ⁹ /L	3.33 \pm 0.29	2.55 \pm 0.24	2.62 \pm 0.65	3.73 \pm 0.48
	LYMPHO X 10 ⁹ /L	7.3 \pm 1.06	7.49 \pm 1.5	4.69 \pm 0.99	7.6 \pm 1.09
	MONO X 10 ⁹ /L	0.25 \pm 0.17	0.43 \pm 0.16	0.99 \pm 0.58	0.35 \pm 0.16
	EOSINO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BAND (%)	1.17 \pm 0.98	1.17 \pm 0.65	0.5 \pm 0.5	0.83 \pm 0.4

Values in rows are not significantly different ($p > 0.05$)

Table 2: Mean \pm SE haematological values of different treatment groups of the Kano-Brown goats at 24, 48 and 72 post-rumenotomy

Sampling time	Haematology parameter	Group A (RSCF)	Group B (SSR)	Group C (Control)	Group D (MSRSCR)
24 h	PCV (%)	32.17 \pm 0.95	30 \pm 2.1	28.67 \pm 1.38	30 \pm 2.45
	HGB (g/dL)	10.68 \pm 0.31	9.9 \pm 0.68	9.53 \pm 0.47	9.97 \pm 0.82
	TP (g/dL)	6.63 \pm 0.2	7.27 \pm 0.62	6.4 \pm 0.47	6.42 \pm 0.5
	TWBC X 10 ⁹ /L	11.45 \pm 0.94	12.88 \pm 1.01	11.8 \pm 1.14	13.07 \pm 1.65
	TRBC X 10 ¹² /L	5.57 \pm 0.17	5.03 \pm 0.41	9.53 \pm 4.7	9.42 \pm 4.72
	NEUTRO X 10 ⁹ /L	3.98 \pm 0.52	3.84 \pm 0.28	4.45 \pm 0.52	4.78 \pm 0.26
	LYMPHO X 10 ⁹ /L	7.21 \pm 0.72	8.79 \pm 0.88	6.51 \pm 1.4	7.28 \pm 1.63
	MONO X 10 ⁹ /L	0.14 \pm 0.07	0.15 \pm 0.06	0.25 \pm 0.09	0.12 \pm 0.06
	EOSINO X 10 ⁹ /L	0.07 \pm 0.05	0.00 \pm 0.00	0.00 \pm 0.00	0.02 \pm 0.02
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.02 \pm 0.02	0.00 \pm 0.00
	BAND (%)	0.67 \pm 0.67	1 \pm 0.82	0.17 \pm 0.17	2.17 \pm 1.19
48 h	PCV (%)	29.5 \pm 0.92	30.17 \pm 1.08	27.33 \pm 1.71	27.67 \pm 2.43
	HGB (g/dL)	9.87 \pm 0.3	9.97 \pm 0.35	9.1 \pm 0.57	9.2 \pm 0.81
	TP (g/dL)	7.05 \pm 0.27	6.95 \pm 0.66	6 \pm 0.36	6.33 \pm 0.42
	TWBC X 10 ⁹ /L	12.9 \pm 1.71	13.92 \pm 0.94	12.88 \pm 1.34	11.58 \pm 0.83
	TRBC X 10 ¹² /L	4.93 \pm 0.24	5.1 \pm 0.18	4.8 \pm 0.33	4.75 \pm 0.52
	NEUTRO X 10 ⁹ /L	4.32 \pm 0.63	4.18 \pm 0.48	4.47 \pm 0.7	2.89 \pm 0.27
	LYMPHO X 10 ⁹ /L	8.35 \pm 1.28	9.35 \pm 0.62	6.93 \pm 1.53	8.53 \pm 0.83
	MONO X 10 ⁹ /L	0.22 \pm 0.14	0.2 \pm 0.12	0.22 \pm 0.16	0.08 \pm 0.06
	EOSINO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BAND (%)	0.00 \pm 0.00	0.83 \pm 0.4	1.2 \pm 1.2	0.83 \pm 0.83
72 h	PCV (%)	29.83 \pm 0.98	27 \pm 1.71	28.67 \pm 2.47	28.83 \pm 2.39
	HGB (g/dL)	9.91 \pm 0.3	9.02 \pm 0.62	7.87 \pm 1.18	9.57 \pm 0.8
	TP (g/dL)	7.18 \pm 0.46	7.08 \pm 0.41	6.48 \pm 0.35	6.73 \pm 0.47
	TWBC X 10 ⁹ /L	9.97 \pm 0.92	13.17 \pm 1.11	10.75 \pm 1.26	16.42 \pm 1.22
	TRBC X 10 ¹² /L	4.87 \pm 0.22	4.53 \pm 0.39	4.68 \pm 0.39	4.77 \pm 0.45
	NEUTRO X 10 ⁹ /L	3.16 \pm 0.19	3.64 \pm 0.36	3.17 \pm 0.49	5.27 \pm 0.51
	LYMPHO X 10 ⁹ /L	6.43 \pm 0.67	9.02 \pm 1.05	6.96 \pm 0.97	10.54 \pm 0.87
	MONO X 10 ⁹ /L	0.22 \pm 0.13	0.24 \pm 0.09	0.37 \pm 0.21	0.16 \pm 0.08
	EOSINO X 10 ⁹ /L	0.03 \pm 0.03	0.00 \pm 0.00	0.00 \pm 0.00	0.03 \pm 0.03
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BAND (%)	1 \pm 0.68	0.67 \pm 0.42	0.5 \pm 0.34	0.5 \pm 0.34

Values in rows are not significantly different ($P > 0.05$)

Table 3: Mean \pm SE haematological values different treatment groups of the Kano-Brown goats at weeks 1, 2 and 3 post-rumenotomy

Sampling time	Haematology parameter	Group A (RSCF)	Group B (SSR)	Group C (Control)	Group D (MSRSCR)
week 1	PCV (%)	27.67 \pm 1.43	29.5 \pm 2.13	29.17 \pm 2.02	29.33 \pm 1.63
	HGB (g/dL)	9.22 \pm 0.47	9.82 \pm 0.71	9.68 \pm 0.67	9.75 \pm 0.54
	TP (g/dL)	7.85 \pm 0.37	7 \pm 0.28	5 \pm 0.48	6.73 \pm 0.35
	TWBC X 10 ⁹ /L	6.98 \pm 0.71	10.53 \pm 0.71	10.92 \pm 0.69	9.97 \pm 0.63
	TRBC X 10 ¹² /L	4.72 \pm 0.22	5.2 \pm 0.35	4.98 \pm 0.35	4.85 \pm 0.24
	NEUTRO X 10 ⁹ /L	2.14 \pm 0.22	3.68 \pm 0.53	3.29 \pm 0.52	2.97 \pm 0.41
	LYMPHO X 10 ⁹ /L	4.63 \pm 0.82	6.76 \pm 0.77	7.02 \pm 0.79	5.55 \pm 1.29
	MONO X 10 ⁹ /L	0.11 \pm 0.04	0.06 \pm 0.04	0.48 \pm 0.18	1.22 \pm 0.91
	EOSINO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BAND (%)	1.33 \pm 0.61	0.33 \pm 0.21	0.00 \pm 0.00	2.5 \pm 1.15
week 2	PCV (%)	28.83 \pm 0.87	29.17 \pm 1.45	29.17 \pm 2.23	27.33 \pm 1.52
	HGB (g/dL)	9.57 \pm 0.29	9.63 \pm 0.44	9.7 \pm 0.74	9.1 \pm 0.51
	TP (g/dL)	7.4 \pm 0.31	6.25 \pm 0.48	6.1 \pm 0.32	7.9 \pm 0.59
	TWBC X 10 ⁹ /L	7.87 \pm 0.59	9.65 \pm 1.42	11.35 \pm 0.76	10.75 \pm 1.61
	TRBC X 10 ¹² /L	4.95 \pm 0.21	5.35 \pm 0.31	4.9 \pm 0.41	4.7 \pm 0.35
	NEUTRO X 10 ⁹ /L	2.73 \pm 0.36	3.17 \pm 0.42	3.03 \pm 0.3	3.21 \pm 0.36
	LYMPHO X 10 ⁹ /L	5.0 \pm 0.32	6.31 \pm 1.09	7.96 \pm 0.67	7.45 \pm 1.38
	MONO X 10 ⁹ /L	0.05 \pm 0.03	0.13 \pm 0.1	0.35 \pm 0.15	0.07 \pm 0.02
	EOSINO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BAND (%)	1.33 \pm 0.8	0.5 \pm 0.34	0.17 \pm 0.17	0.33 \pm 0.33
week 3	PCV (%)	27.17 \pm 1.01	28.67 \pm 1.98	26.67 \pm 1.78	29 \pm 1.75
	HGB (g/dL)	9.03 \pm 0.33	9.52 \pm 0.66	8.87 \pm 0.6	9.63 \pm 0.58
	TP (g/dL)	6 \pm 0.76	6.17 \pm 0.41	5.97 \pm 0.42	6.27 \pm 0.27
	TWBC X 10 ⁹ /L	15.87 \pm 1.57	12.45 \pm 1	14.75 \pm 1.63	13.83 \pm 1.48
	TRBC X 10 ¹² /L	4.63 \pm 0.22	4.8 \pm 0.32	4.83 \pm 0.42	4.83 \pm 0.33
	NEUTRO X 10 ⁹ /L	4.38 \pm 0.46	2.67 \pm 0.41	3.95 \pm 0.48	3.88 \pm 0.63
	LYMPHO X 10 ⁹ /L	9.79 \pm 2.26	9.45 \pm 1.12	10.61 \pm 1.32	9.67 \pm 1.78
	MONO X 10 ⁹ /L	0.27 \pm 0.19	0.16 \pm 0.07	0.1 \pm 0.05	0.07 \pm 0.04
	EOSINO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BASO X 10 ⁹ /L	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00
	BAND (%)	0.33 \pm 0.33	1.67 \pm 0.92	0.83 \pm 0.65	1.5 \pm 0.56

Values in rows are not significantly different ($P > 0.05$)

DISCUSSION

The absence of significant differences in the mean values of haematological parameters of the different experimental groups, as observed in this study, suggests that the standing rumenotomy technique, using the MSRSC, did not differ in severity of the surgical stress-induced changes it caused in these parameters over and above the existing techniques (RSCF and SSR) carried out in lateral recumbency. Stress is known to induce splenic contraction consequent to the influence of adrenocorticoids (Desborough, 2000; Kerr, 2002; Prasse's, 2011; Thrall et al., 2012). Also, stress causes the release of adrenal corticosteroids known to be associated with lymphopenia and eosinopenia while causing neutrophilia and monocytosis (Hellyer et al., 2007; Kerr, 2002). Thus, any significant differences in the mean leucocyte counts of the different experimental groups would have been attributed to the variable increases in levels of the cortical hormones associated with the standing rumenotomy using MSRSC and RSCF and SSR carried out in lateral recumbency consequent to differences in severity of surgical stress. Alvites et al. (2021) reported that goats can compensate for certain physiological changes. Impliedly, in response to the different surgical techniques used in groups A, B, and D, the goats might have activated compensatory mechanisms to maintain homeostasis, preventing significant alterations in haematological parameters, much so close to the findings of Alvites *et al.* (2021), who observed in their study reviews which summarized the general principles related to the use of small ruminants as animal models for scientific research. A study by So-In and Sunthamala

(2023) on housing systems used for goat management highlighted similar influences on hematology, and stress profiles in goats. Although the surgical technique for rumenotomy differed between groups A and B of the same lateral recumbency restraint position, it is possible that the variation in technique did not have a substantial impact on the measured haematological parameters. If the differences in the techniques were not significant enough to affect the physiological response or recovery, it could explain the absence of significant differences between these groups. Degree of variability within each group, could also have influenced overlapping in values of haematological parameters between the groups. Neave et al. (2018) observed that individual variations in goats' responses, genetics, diet, and general health can contribute to this variability. Therefore, the absence of significant haematological changes in the KBGs between standing position and lateral recumbency for rumenotomy suggest that MSRSC can be used for other surgical procedures in small ruminant at least for convenience of the surgeon and the patient welfare.

CONCLUSION

Lateral recumbency restraints for Rumen Skin Clamp Fixation and Stay Suture rumenotomy versus standing restraints for Mobile Small Ruminant Surgical Chute Rumenotomy did not significantly impact on Haematology in Kano Brown Goats. This could mean that the fabrication was a success and an alternative to performing surgeries in standing restraints beside the conventional lateral recumbency restraints in ruminants.

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