



Research Article

Postoperative Physiologic Responses Following Various Skin-Rumen Incision Patterns for One-Stage Rumen Cannulation in Yankasa-Balami Cross-Bred Rams

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ABSTRACT

Many factors complicate ruminal fistulation and cannulation by conventional methods and various modifications in the processing of ruminal cannulas as well as fistulation techniques had been recorded to minimise complications. Some studies investigated the effects of rumenostomy on physiological parameters, this study assessed changes in vital or physiological parameters following three different incision patterns of one-stage rumenostomy in Yankasa-Balami Ram. Nine healthy rams divided into three groups (A, B and C) were investigated for the effect of stylized (different incision locations on the rumen and skin) rumenostomy incisions on rectal temperature, pulse rate, and respiratory rates. These parameters were recorded before anaesthesia as preliminary values (Pre). Following anaesthesia and rumen cannulation, samples were collected at 0 h, days 1, 2, 3, 4, 5, 6 and similarly at weeks 1, 2, and 3. The Mean \pm SE rectal temperature 37.56 ± 0.42 , 38.80 ± 0.05 , 38.26 ± 0.18 , pulse rate 72.00 ± 1.15 , 75.33 ± 1.76 , 76.00 ± 3.05 and respiratory rate 23.33 ± 2.90 , 22.00 ± 3.05 , 24.33 ± 1.85 were established at Pre for groups A, B and C respectively. All these parameters remain within the control values throughout the study except for group B where significant increase in pulse rate (97.66 ± 0.88) was observed after surgery and subsequently returned to normal at day 1, while that of A and C are 83.00 ± 2.88 and 80.33 ± 2.18 respectively. The significant decrease in respiratory rate (17.00 ± 0.57 , 14.66 ± 0.66 , 15.33 ± 0.88 for A, B and C respectively as well as decrease in temperature (35.00 ± 0.06 , 36.03 ± 0.14 and 36.50 ± 0.28 for group A, B and C respectively) were observed. Normal pulse rate (78.33 ± 2.02 , 77.66 ± 2.18 , 79.33 ± 2.33 for group A, B and C respectively), respiratory rate (20.00 ± 0.57 , 20.33 ± 0.66 , 21.00 ± 1.52 for A, B and C respectively) and temperature (38.03 ± 0.29 , 38.66 ± 0.06 , 38.73 ± 0.06 for A, B and C) were recorded at day 1. Additional incisions in group B resulted in more bleeding, which could have caused additional physiological stress. Overall, the more invasive procedure performed on group B likely resulted in a greater degree of physiological stress compared to the other groups, which may explain the observed differences in heart rate, respiratory rate, and rectal temperature. Results from the analyses show that the proposed scheme is highly effective and can withstand any statistical and brute-force attacks.

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INTRODUCTION

Ruminal fistulation and cannulation are surgical procedures created between the dorsal sac of the rumen and the body surface in the left paralumbar fossa (Azizi et al., 2007; Zemjanis, 1970). Fistulation and cannulation of the rumen are integral part of the bovine and small ruminants (caprine and ovine) nutritional studies. It is recommended as conservative treatment in cases of chronic bloat (Abdel-Fattah, 1999; Abdel Fattah *et al.*, 2008; Anderson and Frederiksen, 1987; Azizi *et al.*, 2007), a useful biological tool for in-sacco studies (Osuji et al., 1993) and the role of transfaunates in Farms. Many factors complicate ruminal fistulation and cannulation by conventional methods; accordingly various modifications in the processing of ruminal cannulas as well as fistulation techniques had been recorded to minimise complications (Abdel-Fattah *et al.*, 2008; Corley III et al., 1999; El-Monzaly, 1975; Komarek and Leffel, 1961; Nocek et al., 2002; Schnautz, 1957; Wayne and James, 1959). There are several types of ruminal cannula and some surgical techniques have been reported (Santra and Karim, 2014). A single or one-stage ruminal fistula technique was quite successful in sheep and stylized incisional patterns was established in ovine species by Saidu et al. (2022b). A two-stage technique have been demonstrated in cattle (Azizi *et al.*, 2007; Dougherty, 1981; Hassanein et al., 1988). The fistulated animals-maintained functioning satisfactorily for about 10 months. It is a very good and practical means of in-sacco degradation studies for feed evaluation research and or ranking of feeds as well as transfaunate donors in farm animals (DePeters and George, 2014).

Changes in haematological metrics and blood glucose levels in rams following three incisional patterns of one stage rumen cannulation were reported to be predominantly a response to physical, chemical, or mental stress (Saidu et al.,

2022a). However, studies are yet to explore the influence of different incision patterns for rumenostomy on physiological parameters. The main vital signs routinely monitored by veterinarians are body temperature, pulse rate and respiratory rate. Temperature is the degree of heat maintained by the body or the balance between heat produced in the tissues and heat loss to the environment. Usually, rectal temperature measurement is the traditional method of body temperature estimation in clinical Veterinary Practice (Radostits et al., 2006), a prime technique for assessing the health status of a patient (Blood and Studdert, 1999). Accurate determination of temperature is crucial in the diagnoses of febrile conditions (Zhen et al., 2014). The pulse rate is a measurement of the heart rate, or the number of times that the heart beats per minute. As the heart pushes blood through the arteries, the arteries expand and contract with the flow of the blood (Pollock et al., 2017). Although some studies investigated the effects of rumenostomy on physiological parameters, this study assessed changes in vital or physiological parameters following three different incision patterns of one-stage rumenostomy in Yankasa-Balami Ram.

MATERIALS AND METHODS

The Research Station

The research was performed at the Veterinary Surgery Theatre, Department of Veterinary Surgery and Radiology, University of Maiduguri.

Ethical Clearance

Animal Utilization Protocol Approval Letter dated February 26th, 2020, was acquired as a formal Ethical Clearance from the University of Maiduguri Animal Use and Ethics Committee with reference number FVM/UNIMAID/AUEC/2020/002.

Experimental Design

Nine Yankasa-Balami rams were randomly allocated to the treatment in a Complete

Randomized Design: the three groups are A, B and C and each treatment had 3 rams. Treatments for the respective groups were such that group A had Primary and secondary incision on the skin, and primary incision on the rumen were performed while group B underwent Primary and Secondary incisions on both the skin and rumen and group C were subjected to Primary incisions only on the skin and rumen.

Preoperative Preparation

Intravenous combination of Ketamine-Xylazine and a local inverted “L” infiltration directly in the surgical incision area using 2% Lidocaine as local anaesthetic agent was used. The left paralumbar region was shaved and aseptically scrubbed. The surgery was performed with the animals placed on right lateral recumbent position.

Surgical Technique

Three new surgical incisions were developed such that initial incisions either on the skin or rumen was termed primary incision while subsequent incisions on the skin and/or the

rumen were termed secondary incisions (Figures 1, 2 and 3).

The length of incision of the skin and underlying a structure is 7cm and that of the rumen is 3cm. The distance between primary and secondary incision is 4cm (Fig. 1). The rams could eat almost immediately after cannulation (Fig. 4).

Sampling Times

The respiratory rates, heart rates and rectal temperature were recorded Pre- and Post- anaesthesia and after cannulation at 0-hour, day 1, day 2, day 3, day 4, day 5, day 6, week 1, week 2 and week 3.

Data Analysis

GraphPad Prism version 9.0 for Windows, GraphPad Software, San Diego, California USA, www.graphpad.com, was used to calculate the M±SE rectal temperature, respiration, and heart rates for all the groups of rams. Two-way repeated measures ANOVA with Bonferroni post-hoc test was employed to compare the three groups A, B, and C throughout the various sample times. $P < 0.05$ was deemed significant for the analyses.



Figure 1: An improvised polyvinyl chloride plastisol as rumen cannula inserted via a primary rumen incision and measuring a 4cm distance to a point for a 3cm secondary rumen incision.



Figure 2: An improvised polyvinyl chloride plastisol (PVC) rumen cannula exited via secondary rumen incision and a purse string suture thrown around the base of the exited PVC cannula and a sutured or closed primary rumen incision (white arrow) through which the cannular was initially inserted.

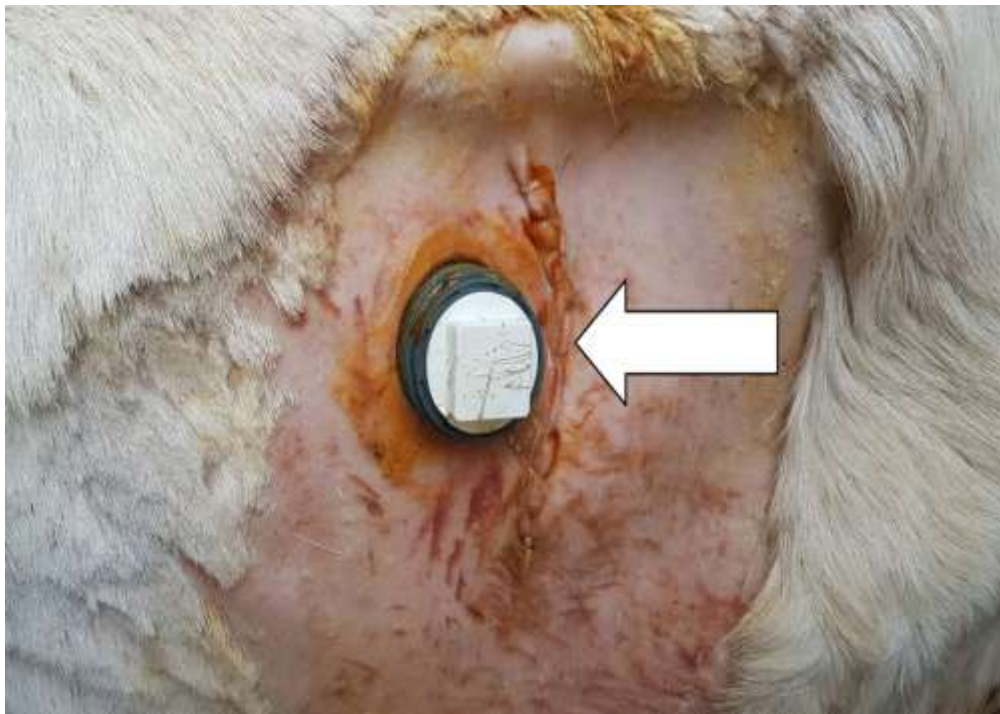


Figure 3: A closed or sutured primary skin incision (white arrow) and an exited rumen cannula via a secondary skin incision (white cap on green cannular)



Figure 4: Yankasa-Balami cross bred rams expressing good postsurgical conditions by feeding after undergoing rumenostomy in a stylized skin and rumen incisions.

RESULTS

The rectal temperature of groups A, B and C at Pre-, were 37.56 ± 0.42 , 38.80 ± 0.05 and $38.26 \pm 0.18^\circ\text{C}$, respectively. Group A (35.00 ± 0.06) had significantly ($P < 0.05$) lower rectal temperature than groups B (36.03 ± 0.14) and C (36.50 ± 0.28), at 0 h. The rectal temperature returned to normal range at day 1, there was no further significant difference ($P > 0.05$) at days 1, 2, 3, 4, 5, 6 and weeks 1, 2 and 3, (Table 1).

The respiratory rates of the Yankasa-Balami rams in groups A, B and C at Pre- were $23.33 \pm$

2.90 , 22.00 ± 3.05 and 24.33 ± 1.85 breaths/min, respectively. At Post Anaesthesia and up to 0 h, the value was significantly lower in group B than A and C. However, the values returned to normal at other sampling periods (Table 2). The heart rates of the animals were 72.00 ± 1.15 , 75.33 ± 1.76 and 76.00 ± 3.05 at Pre for groups A, B and C, respectively. The heart rate was observed to be significantly higher at (97.66 ± 0.88) 0 h in group B than those of groups A (83.00 ± 2.88) and C (80.33 ± 2.18); (Table 3).

Table 1: Effect of rumenostomy (stylized) incisions on rectal temperature ($^\circ\text{C}$) of Yankasa Balami rams

Period	Group A	Group B	Group C
Baseline	37.56 ± 0.42	38.80 ± 0.05	38.26 ± 0.18
Post Anaesthesia	37.56 ± 0.47	38.60 ± 0.10	38.23 ± 0.12
0 hour	35.00 ± 0.06^b	36.03 ± 0.14^a	36.50 ± 0.28^a
Day 1	38.03 ± 0.29	38.66 ± 0.06	38.73 ± 0.06
Day 2	38.33 ± 0.33	38.63 ± 0.08	38.23 ± 0.28
Day 3	38.66 ± 0.43	38.70 ± 0.15	38.03 ± 0.29
Day 4	38.80 ± 0.05	38.76 ± 0.08	38.32 ± 0.23

Day 5	38.80 ± 0.15	38.66 ± 0.06	37.83 ± 0.51
Day 6	38.66 ± 0.12	38.66 ± 0.08	38.10 ± 0.35
Week 1	38.63 ± 0.06	38.70 ± 0.05	38.06 ± 0.06
Week 2	38.80 ± 0.05	38.80 ± 0.15	38.33 ± 0.16
Week 3	38.66 ± 0.18	38.66 ± 0.06	38.50 ± 0.30

Means ± SE values in different columns with different superscripts differ ($p \leq 0.05$) significantly

Table 2: Effects of different (stylized) rumenostomy incision on respiratory rates (breaths/min) of Yankasa Balami rams

Period	Group A	Group B	Group C
Baseline	23.33 ± 2.90	22.00 ± 3.05	24.33 ± 1.85
Post Anaesthesia	17.00 ± 0.57 ^b	14.66 ± 0.66 ^a	15.33 ± 0.88 ^a
0 hour	16.66 ± 0.66 ^b	14.66 ± 0.66 ^a	15.66 ± 1.20 ^a
Day 1	20.00 ± 0.57	20.33 ± 0.66	21.00 ± 1.52
Day 2	21.33 ± 4.37	23.00 ± 0.57	22.33 ± 1.20
Day 3	27.33 ± 5.36	22.66 ± 0.66	22.00 ± 1.52
Day 4	23.33 ± 2.40	25.00 ± 1.73	22.66 ± 1.45
Day 5	25.00 ± 1.73	24.66 ± 0.33	22.00 ± 1.15
Day 6	25.33 ± 2.40	24.33 ± 1.33	22.66 ± 0.66
Week 1	25.33 ± 1.76	24.33 ± 0.33	24.00 ± 2.33
Week 2	24.33 ± 2.33	25.33 ± 1.76	24.66 ± 0.88
Week 3	23.00 ± 1.00	23.66 ± 0.88	23.66 ± 0.33

Means ± SE values in different columns with different superscripts differ ($p \leq 0.05$) significantly

Table 3: Effects of different (stylized) rumenostomy incisions on heart rates (beats/min) of Yankasa Balami rams

Period	Group A	Group B	Group C
Baseline	72.00 ± 1.15	75.33 ± 1.76	76.00 ± 3.05
Post Anaesthesia	75.33 ± 1.76	77.00 ± 2.88	78.33 ± 2.18
0 hour	83.00 ± 2.88 ^a	97.66 ± 0.88 ^b	80.33 ± 2.18 ^a
Day 1	78.33 ± 2.02	77.66 ± 2.18	79.33 ± 2.33
Day 2	76.33 ± 4.33	76.66 ± 0.88	74.00 ± 2.00
Day 3	74.66 ± 2.02	73.66 ± 0.66	77.33 ± 3.84
Day 4	77.00 ± 1.52	76.33 ± 0.88	72.66 ± 0.33
Day 5	71.66 ± 1.45	75.33 ± 3.93	71.66 ± 0.88
Day 6	77.33 ± 3.84	75.00 ± 1.73	73.66 ± 0.66
Week 1	71.00 ± 1.00	72.66 ± 1.33	71.66 ± 0.88
Week 2	75.33 ± 0.88	74.66 ± 3.84	73.33 ± 0.88
Week 3	73.00 ± 0.57	76.33 ± 0.88	71.66 ± 0.88

Values Means ± SE in the different columns with different superscripts differ ($p \leq 0.05$) significantly

DISCUSSION

The temperature, pulse and respiratory rate remain within the control values throughout the study except for group B where significant increase in pulse rate was observed after surgery and subsequently returned to normal at day 1. The observed increase in heart rate, respiration

rate, and rectal temperature in group B compared to groups A and C might be attributed to group B undergoing a more invasive operation than the other groups. Group B had primary and secondary incisions on both the skin and rumen whereas groups A and C had less incision as provided in the experimental design.

The greater number of incisions in group B most certainly resulted in more tissue injury, which may have resulted in more discomfort and inflammation than in the other groups with few or less incisions. The finding agrees with the report of Stauss (2003) who observed that physiological parameter changes especially heart rate variability is caused by a variety of causes, not just the autonomic nervous system. Specific frequency components of heart rate variability reflect acute autonomic nervous system perturbations but do not always reflect autonomic nervous system activity. Rietmann et al. (2004) as well as (Morton and Griffiths, 1985) have shown that pain and inflammation raises heart rate, respiration rate, and body temperature in animals (Hancock et al., 2005), as the systems of animals try to cope with the stress. This is a plausible link to the higher physiologic changes associated with the animals in group B that received highest number of incisions on the skin and rumen than groups A and C. This finding agrees with the report by Hancock *et al.* (2005) Who observed that physiologic variables may be used to measure reactions to noxious stimuli and have been employed in a number of pain assessment studies. While physiologic variables can provide

useful information, they can be influenced by interactions with humans or inherent cardiopulmonary reflexes, and they may be clearer when used in conjunction with other measurement techniques when assessing pain or stress (Hancock *et al.*, 2005; Santana et al., 2020). Significant decrease in respiratory rate was also reported by Islam et al. (2010) after induction of anaesthesia. This agrees with the finding of Kumar and Sharma (1986) who reported that a Xylazine-Ketamine combination produced a fall in the respiratory rate in goats, a common attributes of the alpha-2 adrenoceptor agonist such as Xylazine and medetomidine. It's also likely that the extra incisions in group B generated greater bleeding, which might have added to the physiological stress. Blood loss can cause a drop in blood pressure, which can set off a reflex response that increases heart rate and breathing rate.

CONCLUSION

Overall, the more invasive Primary and Secondary incisions on both skin and rumen conducted on group B, presumably, caused more physiological stress than the treatments assigned to groups A and C, which might explain the observed disparities in heart rate, respiration rate, and rectal temperature.

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