

SERUM BIOCHEMICAL RESPONSES FOLLOWING RUMENOTOMY IN WEST AFRICAN DWARF GOATS: AN INVESTIGATION ON PREMEDICATION WITH XYLAZINE OR DIAZEPAM, AND INDUCTION WITH PROPOFOL

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ABSTRACT

Since the global emphasis on ethical and efficient livestock management continues to grow, there is need to enhance healthcare practices for economically important livestock breeds such as the West African dwarf (WAD) goats. This study investigated the serum biochemical responses of rumenotomized WAD goats subjected to distinct premedication and anaesthesia induction protocols. Twelve 1–2-year-old goats were randomly assigned, after acclimatization, to three groups: Group A (Diazepam premedication, Propofol induction), Group B (Xylazine premedication, Propofol induction), and Group C (No pre-administration, Propofol induction). Rumenotomy was performed on all groups. Serum biochemical parameters, including total protein, albumin, urea, creatinine, sodium, potassium, and calcium, were analyzed at pre-, intra-surgery and various postoperative time points. Results revealed no significant ($p>0.05$) differences in total protein and albumin concentrations among groups, but a significantly ($p<0.05$) lower protein concentration in group B at 72 hours post-rumenotomy. Group B exhibited lower urea levels at intra-surgery, and group A displayed elevated creatinine concentrations post-rumenotomy. Sodium concentrations were consistently lower in Group A, while potassium levels were higher in Groups B and C. Calcium concentrations were significantly lower in Groups A and C, particularly at 48, and 72 hours, post-rumenotomy. These findings underscore the intricate biochemical dynamics influenced by premedication and anaesthesia induction, providing crucial insights for refining veterinary anaesthesia practices and ensuring optimal postoperative outcomes in rumenotomized goats.

Keywords: Diazepam, premedication, propofol, rumenotomy, serum biochemistry, West African dwarf goats

INTRODUCTION

West African Dwarf (WAD) goats, characterized by their small stature and adaptability to diverse environments, are commonly subjected to rumenotomy procedures to address specific gastrointestinal issues (Anoh *et al.*, 2021; Martin *et al.*, 2021). Rumenotomy is a surgical intervention that involves the opening of the rumen to remove foreign bodies,

alleviate impactions, or treat other ruminal disorders (Martin *et al.*, 2021). These goats are particularly prone to ingesting indigestible materials or experiencing blockages in the rumen, making rumenotomy a crucial veterinary procedure to ensure their health and well-being (Underwood *et al.*, 2015; Priyanka & Dey, 2018).

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In the field of veterinary medicine and animal science, understanding the physiological responses of animals to various medical interventions is crucial for ensuring their well-being and successful medical procedures (Domínguez-Oliva *et al.*, 2023). Since rumenotomy is commonly performed in veterinary practice, comprehending the biochemical changes that accompany such interventions is paramount for refining and optimizing veterinary procedures. In the context of rumenotomy for WAD goats, premedication with agents like diazepam or xylazine is often employed to induce sedation and muscle relaxation (Yakubu *et al.*, 2020; Abouelfetouh *et al.*, 2021). Following premedication, the goats are typically anaesthetized using intravenous propofol for a smooth and controlled induction (Ragab *et al.*, 2022). Propofol is renowned for its rapid onset and short duration of action, making it an ideal choice for various veterinary procedures (Sahinovic *et al.*, 2018).

Monitoring serum biochemical responses during and after rumenotomy is essential in assessing the metabolic status of the goats, ensuring proper anaesthesia management, and facilitating effective postoperative care (Domínguez-Oliva *et al.*, 2023). The unique physiological characteristics of WAD goats necessitated a tailored approach to rumenotomy procedures, thus, emphasizing the importance of careful anaesthesia and vigilant monitoring to ensure a successful and safe surgical outcome. However, the specific impact of premedication with diazepam or xylazine, and Propofol induction on serum biochemical parameters in rumenotomized West African Dwarf Goats remains largely unexplored. This study, therefore, explored into the complex dynamics of serum biochemical responses in rumenotomized West African Dwarf (WAD) goats, shedding light on the impact of premedication with either Xylazine or Diazepam, coupled with the subsequent induction using Propofol.

The integration of these components in this study sought not only to advance our understanding of the biochemical responses during rumenotomy but also to provide veterinarians and researchers with a foundation for refining protocols and ensuring the welfare of WAD goats undergoing such procedures. Ultimately, this investigation held the promise of fostering improved veterinary practices and enhancing the overall care and management of these small ruminants in clinical settings.

MATERIALS AND METHODS

LOCATION OF THE STUDY

This study was conducted at the College of Veterinary Medicine, University of Agriculture Makurdi.

HOUSING OF ANIMALS

The large animal surgery theatre and the large animal pen was used for the surgery and housing of the animals respectively.

ANIMALS USED FOR THE STUDY

Twelve, 1–2-year-old, West African Dwarf (WAD) goats, obtained from reputable market in Makurdi and its environs, Benue State, Nigeria, were used for the study. After acclimatization for 2 weeks, the goats were randomly assigned into 3 groups (A, B, and C), each comprising of 4 goats. Groundnut hay and bean husks were fed to the goats, and water was provided *ad libitum*.

EXPERIMENTAL DESIGN

Goats in group A were pre-administered with Diazepam (0.2 mg/kg), and anaesthesia induced with Propofol (5 mg/kg); B were pre-administered with xylazine (0.05 mg/kg), and anaesthesia induced with Propofol (5 mg/kg); while in group C, there was no pre-administration with Diazepam/xylazine, but anaesthesia was induced only with Propofol (6 mg/kg). Thereafter, rumenotomy was performed on the goats in all the groups.

SURGICAL PROCEDURE

The goats were fasted for 12 hours for feed and 6 hours for water. The left paralumbar fossa was shaved and the area was prepared aseptically with 0.2% chlorhexidine gluconate (Savlon, Vervaadingdeur, Johnson and Johnson Ltd London),

A laparotomy incision was made on the upper paralumbar fossa of the flank. The rumen was gently exteriorized through the incision and firmly anchored to the skin. A ten-centimetre (10cm) incision was made over a less vascularized portion of the rumen with greater curvature and the rumen was explored and foreign materials mostly plastic bags were brought out in some of the animals. The edges of the rumen incision were cleaned with 0.9% saline solution, and a double-layer Cushing suture pattern was used to invert the rumen edges with chromic catgut size 2/0 (Lifecare, Anhui Kangning Industries Group Co, Ltd Tianchang City, Anhui, China) The skin was closed using size 2 nylon suture (Lifecare, Anhui Kangning industries group Co, Ltd Tianchang City, Anhui, China) using ford interlocking suture pattern

COLLECTION OF BLOOD SAMPLES

Blood sample was collected 30 minutes before the surgery, intra-operative, immediately after the procedure, 24, 48, 72 and 96 hours post-rumentomy, blood (2 mL) was collected from each goat via jugular venipuncture into labelled plain tubes. Thereafter, sera were harvested and used for serum biochemical analyses.

SERUM BIOCHEMICAL ANALYSES

Serum total protein, albumin, urea, creatinine, sodium (Na⁺), potassium (K⁺), and calcium (Ca⁺) concentrations were determined using serum auto-analyzer.

DATA ANALYSES

Data were presented using charts, and expressed as mean \pm standard error of the mean (SEM). One-way ANOVA was used to analyse the data followed by *Tukey's* post-hoc test. Statistical Package for Social Sciences (SPSS IBM 26) was used for the analysis. Values of $p \leq 0.05$ were considered significant.

RESULTS

TOTAL PROTEIN AND ALBUMIN LEVELS

There was no statistical ($p > 0.05$) difference in the total protein concentration of all groups of goats, pre-surgery, up to 48 hours and 96 hours post-rumenotomy. At 72 hours post-rumenotomy, the total protein concentration was significantly ($p > 0.05$) lower in group B (5.50 ± 0.12 g/dL) than in groups A (5.95 ± 0.22 g/dL) and C (5.90 ± 0.24 g/dL) (Figure I). No statistical ($p > 0.05$) differences existed for the albumin concentrations of all groups of goats, pre-surgery and up to 96 hours post-rumenotomy (Figure II).

UREA AND CREATININE CONCENTRATIONS

There was statistically ($p < 0.05$) higher urea concentration at intra-surgery in group A (36.28 ± 1.44 mg/dL) compared to groups B (33.63 ± 1.32 mg/dL) and C (31.43 ± 1.55 mg/dL) (Figure III). The creatinine concentration was statistically ($p < 0.05$) higher at immediate, 24, 48, and 72 hours, post-rumenotomy in group A (1.30 ± 0.08 ; 1.25 ± 0.06 ; 1.25 ± 0.10 ; 0.95 ± 0.05 mg/dL) than in groups B (1.23 ± 0.05 ; 1.15 ± 0.09 ; 1.13 ± 0.03 ; 0.83 ± 0.02 mg/dL) and C (1.10 ± 0.09 ; 1.10 ± 0.13 ; 1.10 ± 0.09 ; 0.80 ± 0.09 mg/dL) (Figure IV).

SODIUM, POTASSIUM AND CALCIUM CONCENTRATIONS

The sodium concentration was significantly ($p < 0.05$) lower at intra-surgery, immediate and 24 hours, post-surgery in group A (97.40 ± 1.61 ; 101.08 ± 4.98 ; 104.23 ± 4.78 mg/dL) compared to groups B (113.75 ± 5.93 ; 110.90 ± 3.29 ; 118.70 ± 6.09 mg/dL) and C (112.63 ± 7.21 ; 111.53 ± 8.12 ; 115.85 ± 3.95 mg/dL) (Figure V).

At intra-surgery, immediate, and 24 hours post-surgery, there was statistically ($p < 0.05$) higher potassium concentration in groups B (3.83 ± 0.28 ; 3.78 ± 0.67 ; 3.20 ± 0.27 mg/dL) and C (3.93 ± 0.80 ; 3.88 ± 0.23 ; 3.43 ± 0.30 mg/dL) than in group A (2.65 ± 0.29 ; 2.95 ± 0.09 ; 2.95 ± 0.06 mg/dL) (Figure VI).

Calcium concentrations were statistically ($p < 0.05$) lower in groups A (8.33 ± 0.09 ; 8.40 ± 0.08 mg/dL) and C (8.48 ± 0.13 ; 8.65 ± 0.27 mg/dL) than in group B (8.90 ± 0.15 ; 9.18 ± 0.29 mg/dL) at intra- and immediate post-rumenotomy (Figure VII).

There was statistically ($p < 0.05$) lower calcium concentration at 48, and 72 hours, post-rumenotomy, in group A (8.30 ± 0.12 ; 8.10 ± 0.28 mg/dL) compared to groups B (8.88 ± 0.11 ; 8.63 ± 0.08 mg/dL) and C (9.03 ± 0.18 ; 8.65 ± 0.19 mg/dL) (Figure VII).

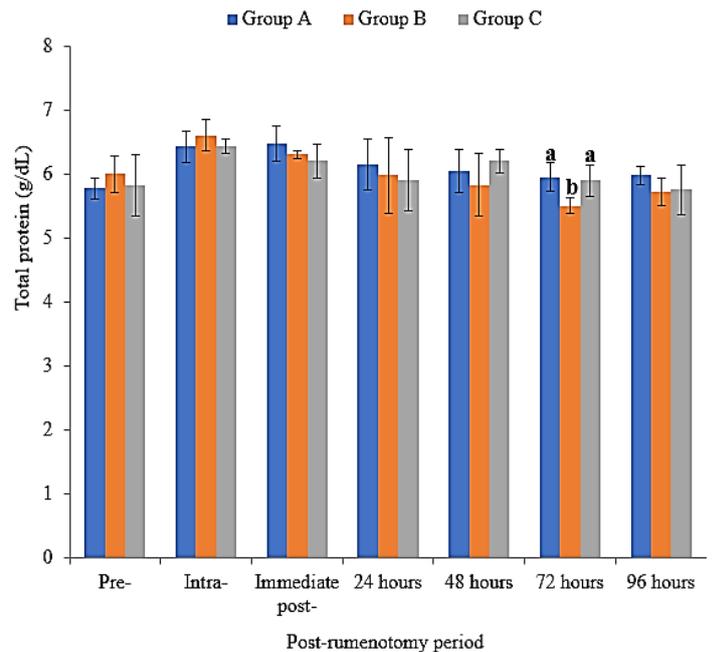


Figure I: Total protein levels of rumenotomized West African dwarf goats pre-administered with xylazine or diazepam, and anaesthetized with propofol. Values with different superscript letters in the same time differ significantly at $p < 0.05$

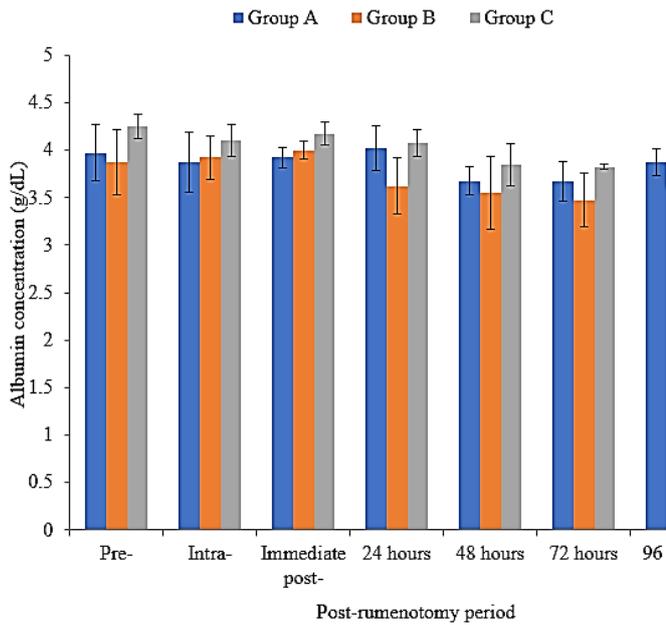


Figure II: Albumin levels of rumenotomized West African dwarf goats pre-administered with xylazine or diazepam, and anaesthetized with propofol

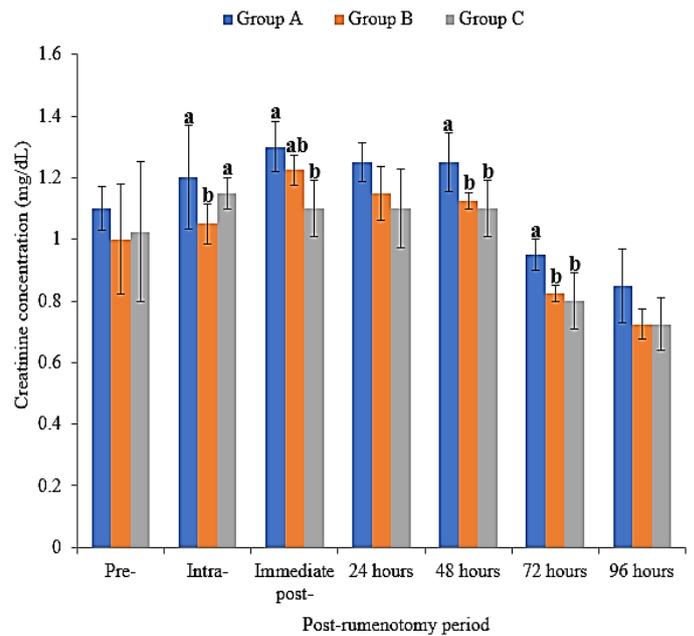


Figure IV: Creatinine concentrations of rumenotomized West African dwarf goats pre-administered with xylazine or diazepam, and anaesthetized with propofol. Values with different superscript letters in the same time differ significantly at p<0.05

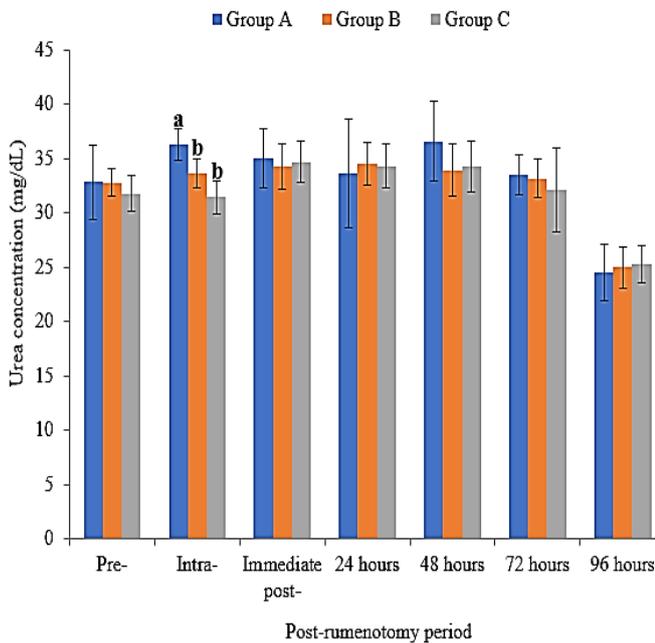


Figure III: Urea concentrations of rumenotomized West African dwarf goats pre-administered with xylazine or diazepam, and anaesthetized with propofol. Values with different superscript letters in the same time differ significantly at p<0.05

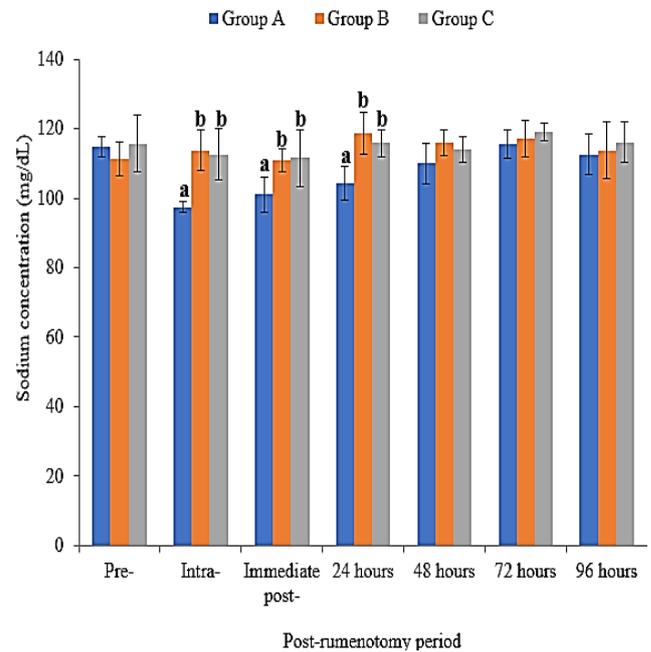


Figure V: Sodium concentrations of rumenotomized West African dwarf goats pre-administered with xylazine or diazepam, and anaesthetized with propofol. Values with different superscript letters in the same time differ significantly at p<0.05

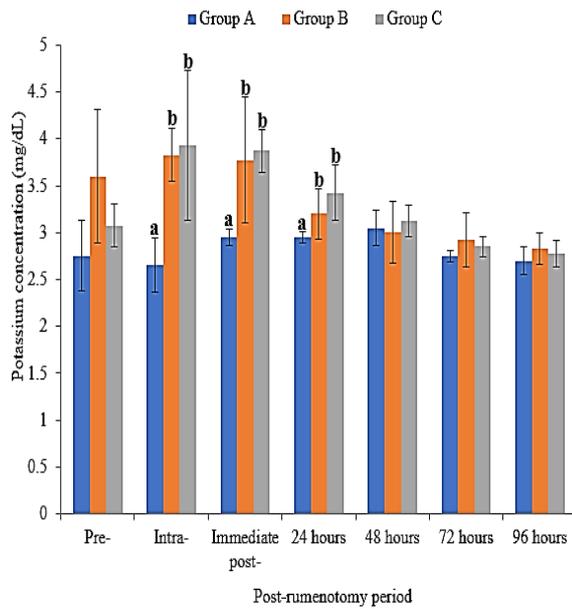


Figure VI: Potassium concentrations of rumenotomized West African dwarf goats pre-administered with xylazine or diazepam, and anaesthetized with propofol. Values with different superscript letters in the same time differ significantly at $p < 0.05$

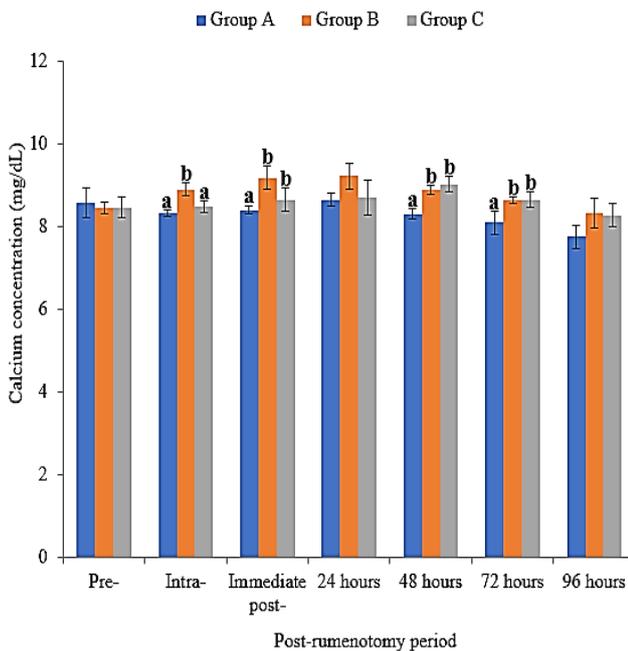


Figure VII: Calcium concentrations of rumenotomized West African dwarf goats pre-administered with xylazine or diazepam, and anaesthetized with propofol. Values with different superscript letters in the same time differ significantly at $p < 0.05$

DISCUSSION

The observed results in the serum biochemical responses of rumenotomized West African Dwarf goats reveal interesting patterns, particularly in the total protein concentrations. The lack of statistical differences in total protein concentrations among all groups pre-surgery, and up to 48, and 96 hours post-rumenotomy suggests a degree of stability in this parameter across the different premedication and anaesthesia induction protocols. This consistency may indicate that the initial stages of the surgical procedure did not significantly impact the overall protein status of the goats, regardless of the specific premedication administered or induction method used. However, the notable decrease in total protein concentration at 72 hours post-rumenotomy in group B compared to groups A and C raises questions about the potential influence of xylazine premedication. Xylazine is known to induce sedation and relaxation, and its impact on gastrointestinal motility may contribute to altered nutrient absorption and utilization (Nunez *et al.*, 2021). Previous studies have reported changes in serum proteins following xylazine administration, suggesting a potential link between xylazine-induced effects on the gastrointestinal tract and the observed decrease in total protein concentration at the specific time point (Ukwueze *et al.*, 2014; Knych *et al.*, 2016; Akter *et al.*, 2023).

In terms of albumin concentrations, no statistical differences were observed among the groups, and this could indicate that the various premedication and induction strategies did not affect albumin levels in the goats. This finding aligns with existing literature that emphasizes the stability of albumin levels in response to short-term stressors (Ergul *et al.*, 2020; Joliat *et al.*, 2022; So-In & Sunthamala, 2023).

The statistically higher urea concentration at intra-surgery in group A, compared to groups B and C suggests a potential influence of Diazepam on nitrogen metabolism. A previous study has reported that Diazepam may affect renal blood flow and glomerular filtration rate, leading to alterations in urea production (Setiawan *et al.*, 2016). The observed increase in urea concentration could be indicative of enhanced protein catabolism and nitrogen excretion, potentially linked to the anxiolytic properties of Diazepam (Gana *et al.*, 2014).

The significant elevation in creatinine concentration at immediate, 24, 48, and 72 hours post-rumenotomy in group A compared to groups B and C raises concerns about the renal effects of Diazepam. Creatinine is a reliable indicator of renal function, and increased levels may signify impaired glomerular filtration (Bagnoux *et al.*, 2018). The prolonged elevation in creatinine levels in group A could be associated with the potential nephrotoxic effects of Diazepam, thus influencing renal blood flow and tubular function (Liao *et al.*, 2021). Previous studies have highlighted the need for

caution when administering Diazepam, as it may lead to renal alterations in various animal models (Kim *et al.*, 2009; Al-Abbasi, 2021).

Moreover, xylazine, known for its sedative and analgesic properties, may have contributed to reduced stress responses during the perioperative period, thus, resulting in lower protein catabolism and nitrogen excretion in group B. In addition, the absence of premedication in group C also suggests that the stress associated with the surgical procedure alone might have been less pronounced, leading to comparatively lower urea and creatinine levels. These findings align with studies emphasizing the role of stress in metabolic alterations and renal function (Cattet *et al.*, 2004; Amin *et al.*, 2021).

The consistently lower sodium concentration in group A at intra-surgery, immediate, and 24 hours post-surgery compared to groups B and C suggests a potential role of Diazepam in sodium homeostasis. Diazepam, as a benzodiazepine derivative, may affect the central nervous system and potentially influence sodium regulation (Deeb *et al.*, 2013; Sanabria *et al.*, 2021). Previous studies have reported alterations in electrolyte balance following benzodiazepine administration, highlighting the need for careful monitoring of these parameters during surgical procedures (Griffin *et al.*, 2013; Siddiqui *et al.*, 2018).

Conversely, the higher potassium concentrations at intra-surgery, immediate, and 24 hours post-surgery in groups B and C compared to group A indicate a potential influence of xylazine or the absence of premedication on potassium dynamics. Xylazine has been associated with hyperkalemia due to its effects on sympathetic activity and potassium redistribution (Pakkanen *et al.*, 2018). The higher potassium levels observed in group C, where no premedication was administered, suggest that the stress associated with the surgical procedure alone may contribute to potassium release from intracellular stores, thus, emphasizing the multifactorial nature of potassium regulation during rumenotomy (Underwood *et al.*, 2015).

The calcium concentrations exhibited interesting patterns, with lower levels in groups A and C compared to group B at intra- and immediate post-rumenotomy. This may be attributed to the potential effects of Diazepam on calcium metabolism, as benzodiazepines have been linked to alterations in bone turnover and calcium absorption (Valsamis *et al.*, 2006; Xing *et al.*, 2014; van de Ven *et al.*, 2018). Moreover, the significantly lower calcium concentration at 48, and 72 hours, post-rumenotomy in group A compared to groups B and C may signify a sustained impact of Diazepam on calcium homeostasis. These findings align with previous research highlighting the role of benzodiazepines in influencing calcium levels (Hiremath *et al.*, 2010), hence, emphasizing the importance of considering

the prolonged effects of premedication in the postoperative period.

CONCLUSION

This study provides a comprehensive evaluation of the serum biochemical responses in rumenotomized WAD goats under different premedication and anaesthesia induction protocols. The observed variations in urea, creatinine, sodium, potassium, and calcium concentrations shed light on the potential impacts of Diazepam and xylazine on metabolic and electrolyte dynamics during and after rumenotomy. These findings contribute to our understanding of the biochemical alterations in goats undergoing such procedures and emphasize the importance of careful consideration when selecting premedication and induction agents in veterinary practice.

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