



Research Article

Glycaemic response to chromic catgut and polyglycolic acid sutures post-rumenotomy following Diazepam-Lidocaine-Bupivacaine Anaesthesia in Sahel Goats

Abubakar Mshelia Saidu*, Paul Bitrus Bokko and Abdullahi Mohammed

Department of Veterinary Surgery and Radiology, University of Maiduguri, Maiduguri, Borno State, Nigeria

*Corresponding author: abubakarsm51@gmail.com, doi.org/10.55639/607.4959

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ABSTRACT

Glycaemic indices could serve as a biomarker of surgical stress; however, this is unclear in the goat. The experiment evaluated periodic levels of blood glucose as stress biomarker following rumenotomy with assorted sutures and local anaesthetics in prevailing Sahel region conditions among Sahel Goats. Blood samples 5mls each were collected from jugular veins of 15 goats that were randomly allocated into groups A, B and C to establish base line data before commencement of treatments. Blood was also collected at five minutes post anaesthetic induction (PAI) with diazepam-lidocaine and diazepam-bupivacaine for groups A and B respectively. Rumen Skin Clamp Fixation Technique of rumenotomy was employed followed by further blood sampling immediately post surgery at 0 hour and subsequently at 5, 8, 24, 48 and 72 hours postoperatively. Glucose assay was conducted immediately at the time of each blood sample collection. The periodic blood glucose profile for goats in group A were significantly high ($P < 0.05$) at PAI, (94.60 ± 19.55 mg/dl) and zero hour, (101.4 ± 21.35 mg/dl) post-surgery when compared to respective baseline value (57.20 ± 4.15 mg/dl) and similarly for group B at PAI (107.4 ± 28.40 mg/dl) and zero hour (119.8 ± 34.48 mg/dl) hours compared to its baseline value (64.80 ± 4.09). These values declined continuously through 5, 8-, 24-, 48- and 72-hours post-surgery for both groups. The significant rise in blood glucose level in both approaches 5 minutes PAI and immediately after surgery that averagely lasted 40 minutes were only transitory and cannot be used as reliable biomarker of stress because the pattern does not appear to be in consonance with stress profile post-surgery.

Corresponding author: Abubakar Mshelia Saidu Email: abubakarsm51@gmail.com

Department of Veterinary Surgery and Radiology, University of Maiduguri, Borno State, Nigeria

INTRODUCTION

Rumenotomy is a procedure for treating varieties of rumen disorders such as the ingestion of indigestible foreign materials mostly plastics or polythene (Ramaswamy and Sharma, 2011). Rumen Skin Suturing Fixation (RSSF), Stay Suture Rumenotomy (SSR), Rumen Skin Clamp Fixation Method (RSCF), Weingarth's Ring Rumenotomy (WRR) and Mobile small ruminant surgical chute rumenotomy (MSRSC) are some rumenotomy techniques (Dehghani and Ghadrani, 1995; Saidu *et al.*, 2020). In large ruminants, the procedure is performed with the animal standing, whereas in small ruminants, the animal is in recumbent or standing restraints (Geehan *et al.*, 2006; Saidu *et al.*, 2022). Anaesthetics can modify the physiologic states of the body by acting on the nervous system, hence the endocrine or neuroendocrine function (Deborah *et al.*, 2004; Desborough, 2000; Lisowska, 2012; Lisowska *et al.*, 2007). Diazepam is the best drug of choice in goats with cardiovascular compromise or pulmonary disease, but the drug has shown to cause a decrease in blood glucose levels when given intravenously at a dose rate of 0.2 mg/kg (Caulkett, 2003). Local anaesthetics are weak bases and diffuse through membranes as a lipid-soluble unionized moiety (Widman, 1975). Lidocaine is the most widely used general-purpose local anesthetic in veterinary practice and possesses a reasonably rapid onset of action (3-5 minutes) with good spreading properties but a short duration of action ranging from 60–75 minutes (Lee, 2012; Melches *et al.*, 2013). Bupivacaine is an amide with a slow onset (5–10 minutes) after induction but long acting properties of up to eight hours when combined with epinephrine, making it appropriate for procedures that last 2-2.5 hours and long-acting post-operative analgesia (Lee, 2012).

Surgical injury evokes surgical stress characterized by metabolic, hormonal, inflammatory, and immunological responses (Deborah *et al.*, 2004; Desborough, 2000; Murata and Shimada, 2004). These together

are potent stressors to the body and coupled with operative trauma during surgery, severely impact on the stress response (Alberto *et al.*, 2011). Chromic catgut is a surgical gut treated with chromic salt naturally obtained from sheep or bovine small intestines and is a primarily collagen-type connective tissue. Plain catgut is absorbed by proteolytic enzymatic degradation, losing 60% of its tensile strength within one week of wound closure, and no tensile strength remains after two weeks. The rapid degradation of chromic catgut is slowed when it is treated with chromic salt (Kudur *et al.*, 2009). Polyglycolic acid (PGA) is a synthetic absorbable multifilament suture that can be coated or uncoated (Lober and Fenske, 1986; Watts, 1975). It has excellent knot security and good tensile strength, which are degraded through hydrolysis while maintaining 65% of their initial tensile strength after two weeks when buried in the body (Kudur *et al.*, 2009). In pain management studies, the development of a novel complete intravenous anaesthetic protocol employing constant rate infusion in goats revealed substantial effects of treatment protocols on blood glucose (Asif *et al.*, 2022). Anxiety and pain impact the activation of the hypothalamic-pituitary-adrenal axis (HPA), which leads to cortisol production, a key mediator of the stress response (Deborah *et al.*, 2004; Desborough, 2000), which in turn promotes glycogenolysis and gluconeogenesis, resulting in hyperglycemia. According to a study by Moldal *et al.* (2018), glycemic reactions after ovariectomy and ovariectomy generated a mild surgical stress response in female dogs. The glucose response to surgical injury is one of the indicators of the stress response and elucidates the prospective direction of stressors (Desborough, 2000). These may aid in the selection of anaesthetic agents, sutures, and other corrective strategies that will provoke lesser stress and most favorable reparative pathways because there is a practical need for a pragmatic combination of surgical sutures

and local anaesthetic that would manifest a lessened post-surgical stress response and allow uncomplicated healing.

MATERIALS AND METHODS

Study Area

This study was conducted in Maiduguri, Borno state in the northeastern region of Nigeria. Maiduguri is located within latitude 11.15°N and longitude 30.05°E the Sudano-Savanna zone (Udo, 1978).

Experimental Animals

The study utilized fifteen apparently healthy Sahel goats aged 12-24 months and weighed 13-21 kgbw. The animals were obtained from the Maiduguri cattle market in Borno state, Nigeria, and were housed at the Department of Veterinary Surgery and Radiology, pens.

Experimental Design

The goats were fed groundnut husk, concentrates, and water daily. The animals were allowed for two months to acclimate before the experiment began, and extra care was taken to ensure their well-being. Using a random number generator (RNG®), the goats were randomly allocated into 3 groups of 5 goats A, B as experimental groups and C as a control.

Preoperative Preparation

The goats were fasted for 12 and 6 hours for feed and water respectively. Blood samples 5mL each were collected from jugular venipuncture from all 15 goats to establish preliminary data (Pre) before commencement of treatments. The animals were placed on right lateral recumbency and the left paralumbar fossa was clipped and aseptically prepared with 4% chlorhexidine gluconate (Savlon®, Vervaading deur, Johnson and Johnson (pty) Ltd, London). An inverted L-block with 2% lidocaine HCl 4mg/kg (Lidocaine®, Kwality Pharmaceuticals (P) Ltd. Nag Kalan, Majitha Road, Amritsar, India)

RESULTS

The respective baseline values for group A (57.20±4.15 mg/dl) and B (64.80±4.09) compared to the control values group C sampled at the beginning of the experiment 63.80±8.93 mg/dl, and at the last sampling (72 hours) of the experiment (64.60±5.37 mg/dl)

was done for group A and group B had inverted L-block with 0.5% bupivacaine 1.5mg/kg (Marcaïne®, Astrazeneca PLC, Ingi Itere Lisansi ile, Istanbul, Turkey) post 0.2mg/kg IV diazepam (SJG®, Fazul Ellahie, Pvt Ltd, Karachi, Pakistan), sedation.

Five minutes after induction, 5mL of blood samples were drawn from the opposite jugular vein into a plain vacutainer tube and kept at room temperature for 2 hours before centrifugation at 4000xg for 3 minutes in an electronic centrifuge (Centrifuge 800B®, Union Laboratories, England).

Surgery

Rumen Skin Clamp Fixation Technique a fast, all-purpose rumenotomy that produces a clean wound after rumen closure was employed as described by (Dehghani and Ghadrani, 1995) followed by further blood sampling immediately post surgery at 0 hour and subsequently at 5, 8, 24, 48 and 72 hours.

Glucose Assay

The glucose assay was conducted immediately at the time of blood sample collection using an ACCU-CHEK Active blood glucose monitoring system meter (ACCU-CHEK® Active, Roche Diagnostics GmbH, Sandhofer Strasse 116, Mannheim, Germany) and ACCU-CHEK Active test strips (ACCU-CHEK® Active, Roche Diagnostics GmbH, Sandhofer Strasse 116, Mannheim, Germany).

Data Analysis

The data obtained in this study were analyzed within groups using One Way Repeated Measures ANOVA with a Dunnett's Multiple Comparison Post Test and between groups with Two Way Repeated Measures ANOVA with Bonferroni posttest. Column statistics was used to determine M±SD of the groups. Graphpad Prism Version 4.0, (2003) software was used for the data analysis. Analyses were considered as significant at P < 0.05.

were not significantly different P>0.05 (Table 1). The blood glucose values for both groups A and B are not significantly different (P>0.05) at post-surgery periods compare values at post anaesthetic induction and immediately 0-hour post-surgery.

Table 1: Mean blood glucose (mg/dl) at pre- and post-anaesthetic induction (PAI) and following Diazepam-lidocaine with chromic catgut and Diazepam-bupivacaine with PGA rumenotomy in Sahel Goats

M±SD of Blood Glucose Values (mg/dl) at Various Periods Post-Surgery								
Group	Pre	PAI (5mins)	0hr	5hrs	8hrs	24hrs	48hrs	72hrs
A	57.20±4.15 ^a	94.60±19.55 ^b	101.4±21.35 ^c	72.80±8.23 ^a	71.00±7.681 ^a	68.00±4.528 ^a	62.60±4.22 ^a	63.20±5.59 ^a
B	64.80±4.09 ^a	107.4±28.40 ^b	119.8±34.48 ^b	84.60±25.24 ^a	73.60±5.51 ^a	74.60±6.91 ^a	63.60±6.54 ^a	62.80±5.76 ^a
C	63.80±8.93 ^a	-	-	-	-	-	-	64.60±5.37 ^a

Values with different superscripts within a row are significantly different (P<0.05).

Goats in group A and B had Diazepam-lidocaine with chromic catgut sutures and Diazepam-bupivacaine with PGA sutures respectively for anaesthesia and rumen and abdominal muscle closure.

The periodic blood glucose profile for goats in group A were significantly high ($P < 0.05$) at PAI, (94.60 ± 19.55 mg/dl) and zero hour, (101.4 ± 21.35 mg/dl) post-surgery when compared to its baseline value (57.20 ± 4.15 mg/dl). These values declined continuously through 5-, 8-, 24-, 48- and 72-hours post-surgery. There was significant rise ($P < 0.05$) in the blood glucose levels of group B at PAI (107.4 ± 28.40 mg/dl) and 0-hour (119.8 ± 34.48 mg/dl) hours compared to its baseline value (64.80 ± 4.09). The decline in the values from the fifth hour up to 72 hours post-surgery were also observed in group B and were not significantly different ($P > 0.05$).

DISCUSSION

Premedication, anaesthesia, and surgery for the purposes of examinations, diagnosis, and treatment of conditions such as foreign masses in the rumen, dystocia, and hysterectomy can expose these patients to a pattern and/or controlled stress; this surgical trauma impacts the body's stress response pathways. The RSCF approach was used in this study because it is quick and generates clean wounds with fewer postoperative problems (Dehghani and Ghadrani, 1995). The average blood glucose level for goats is within a range of 3.6 mmol/L (64.8 mg/ml) (Gana *et al.*, 2014). This study recorded a significant increase in the blood glucose levels 5 minutes post induction (PAI) of intravenous diazepam with lidocaine and immediately after surgery at 0hr as 94.60 ± 19.55 mg/dl, 101.4 ± 21.35 mg/dl respectively for group A, while for group B that was treated with diazepam and bupivacaine, the values were 107.4 ± 28.40 mg/dl, and 119 ± 34.48 mg/dl at PAI and 0 hour respectively. The significant increase in the levels of blood glucose in both groups A and B are contradictory to the report of Gana, *et al.*, 2014 that reported a significant decrease in blood glucose levels post diazepam induction in goats. This may be attributed to the animal breed, assay technique or largely the combination of the diazepam with these amides. According to (Njoku, 2015) and (Kisani *et al.*, 2018), the high glucose level could be attributed to surgical stress during

rumenotomy. Sengar *et al.* (2020) on the other hand, observed a significant increase in blood glucose levels following midazolampropofol-ketamine to atropinized goats which agree with the diazepam used in this experiment. Although reports on the effects of these amides alone on glucose levels of goats are not well established, the decrease in the blood glucose levels at 5 hours upto 72 hours post-surgery for both experimental groups may be attributed to the local anaesthetics dampening or inhibiting cortisol and aldosterone production. The result of metabolic inhibition of cortisol was a decline in glycaemic response (Desborough, 2000; Manorama, 2003). Impliedly, glucose may not be a suitable marker of stress in the goat since only transitory hyperglycaemic response occurred post anaesthesia and has not followed the patterning of stress profile post-surgery.

CONCLUSION

Glycaemic response to chromic catgut and polyglycolic acid sutures rumenotomy following Diazepam-Lidocaine-Bupivacaine Anaesthesia in Sahel Goats revealed significant increase in the blood glucose levels of both approaches at 5 minutes PAI and immediately after surgery. These glycaemic states were only transitory and cannot be used as reliable biomarker of stress since the pattern is not in consonance with stress profile. Further studies to establish the blood glucose responses of Sahel goats to these anaesthetic agents separately are required.

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