LINEAR VERSUS EPIDURAL LIGNOCAINE ANESTHESIA FOR CASTRATION IN GOATS

***DR. NJOKU UCHECHUKWU NJOKU,**
Department of Veterinary Surgery and Theriogenology,
Michael Okpara University of Agriculture, Umudike,
Abia State, Nigeria.
njucan@yahoo.co.uk

DR. ROCK ODIMMA UKAHA,
Department of Veterinary Surgery and Theriogenology,
Michael Okpara University of Agriculture, Umudike,
Abia State, Nigeria.
ukarock1@yahoo.com

DR. EBERE OBIAGERI ODIRICHUKWU,
Department of Veterinary Surgery and Theriogenology,
Michael Okpara University of Agriculture, Umudike,
Abia State, Nigeria.
ebyfelix33@gmail.com

DR. KELECHI THERESA JEREMIAH,
Department of Veterinary Surgery and Theriogenology,
Michael Okpara University of Agriculture, Umudike,
Abia State, Nigeria.
jeremiahkelechi@gmail.com

DR. UZUEGBU, OLUCHI MARGARET
Veterinary Teaching Hospital
Michael Okpara University of Agriculture, Umudike,
Nigeria.
uzuolii@yahoo.com

*Corresponding author.

Abstract: Twelve West African Dwarf bucks were used in the study to evaluate and compare the changes in the physiological parameters, stress response and indices of anaesthesia following linear infiltration of lignocaine and epidural administration of lignocaine. The animals were assigned to three groups of four animals per group. Bucks in groups A and B were administered lignocaine either by linear infiltration along the line of incision for castration, or by epidural injection respectively. The goats were castrated following the anaesthesia. Goats in group C served as the negative control for the experiment. Animals in groups A and B were administered lignocaine at the dose of 4mg/kg. The heart rate, respiratory rate, rectal temperature, blood glucose, onset of analgesia, duration of analgesia, onset of recumbency and duration of recumbency were recorded and analyzed for statistical significance. Following the induction of anaesthesia, the heart and respiratory rates were observed to be significantly ($p < 0.05$) lower in groups A and B than group C The blood glucose however was significantly ($p < 0.05$) higher in group A than in group B and C. There was no significant ($p \geq 0.05$) difference in the rectal temperature among the groups. The duration of analgesia and recumbency were significantly ($p < 0.05$) lower in group A than in group B. There was no significant ($p \geq 0.05$) difference in the onsets of analgesia and recumbency between the treatment groups. The result of this study is useful in the determination of the anaesthetic procedure to employ in goats. Where long procedures are desired, epidural anaesthesia tends to be preferred because it provides a longer analgesia than the infiltrative method. However, this method is associated with significant changes in the physiological parameters, which may pose severe risks to the patient.

Index Term- **Goat, Epidural, Infiltration, West Africal Dwarf Goat, Stress, Physiological parameters, Glucose**

I. INTRODUCTION

Surgical manipulations in ruminants are often carried out under local (Oguntoye and Adetunji, 2009; Udegbunam et al, 2013) or general anaesthesia (Doherty et al, 2007; Dzikiti, 2013). This is because ruminants have low pain threshold (Gray and McDonell, 1986), which necessitates analgesic interventions during painful manipulations.

General anaesthesia in goats is associated with some anaesthetic risks, notably potentially fatal pulmonary aspiration arising from passive regurgitation and increased salivation (Hall *et al*, 2001). Other complications associated with general anaesthesia in these species include ruminal tympany and marked cardiopulmonary depression (Taylor, 1991). As a result, local analgesia is preferred to general anaesthesia in goats.

Local analgesia has been achieved with the epidural or intradural administration of analgesic agents such as local analgesic agents, α_2-adrenoceptor agonists, N-methyl, D-aspertate (NMDA) receptor antagonists, potent opioid agonists, or non-steroidal anti-inflammatory agents (Bishop, 2005). Among these classes of agents the use of local analgesics for epidural analgesia is very popular (Vesal and Oloumi, 1998; Lucky *et al*, 2007; Oguntoye and Adetunji, 2009; Rostami and Vesal, 2012; Udegbunam *et al*, 2013).

Lumbosacral epidural administration of lignocaine has been reported to produce sufficient analgesia for surgical manipulations caudal to the umbilicus (Oguntoye and Adetunji, 2009; Rostami and Vestal, 2012). However, it has been associated with certain anaesthetic risks such as hypotension, ataxia, limb weakness and recumbency in patients (Sadegh *et al*, 2009; Rostami and Vesal, 2012). Conversely, painful manipulations in goats in which analgesia was achieved by the administration of local analgesics by the local infiltration method has been reported to require either further sedation of the animals or some degree of physical restraint to facilitate the manipulations (Hay *et al*, 2003; Keita *et al*, 2010).

Minimal alteration in the physiological parameters and sufficient analgesia are desired for surgical manipulations in animals. Therefore, drug combinations or administration techniques that produce these two effects would highly be appreciated. The aim of this study therefore is to compare the physiological paramaters, anaesthetic indices and stress response of goats that were anaesthetized with epidural lignocaine with those that received local infiltrations of lignocaine.

II. .MATERIALS AND METHOD

This study was conducted with approval and under the supervision of the Animal Handling Research Regulatory Committee of the Department of Veterinary Surgery and Theriogenology, Michael Okpara University of Agriculture, Umudike. Nigeria. Twelve adult male West African Dwarf (WAD) goats weighing 8.25±1.87kg, obtained from local breeders within Abia State, Nigeria, were used for this experiment. Following purchase, they were transported to the Animal Health and Production Unit of the College of Veterinary Medicine, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria, where they were housed and acclimatized to the local conditions for two weeks before the study. They were fed *ad libitum* with giant star grass (*Cynodon alenifuensis*), supplemented with cereal-based concentrates. Water was also provided *ad libitum*.. .Within the period of acclimatization, blood and feacal samples were collected for heamo- and endo- parasite screening. Only goats adjudged to be healthy based on physical and laboratory examinations were included in the study.

The goats were assigned to three groups (groups A, B and C) of four animals per group. Animals in Group A were anaesthetized with lignocaine at the dose of 4mg/kg body weight given by line infiltration along the proposed incision line. Animals in Group B were anaesthetized with epidural lignocaine at the dose of 4mg/kg body weight, while those in group C served as negative control. No anaesthetic protocol or surgery was carried out on animals in group C. The doses of the drugs used were based on previous researches (Hall and Clarke, 1991; Umar and Adetunji, 2000; Adetunji *et al*, 2002; Ajadi *et al*, 2012).

Prior to the administration of sedatives, the animals were kept off feed and water, eighteen and three hours respectively. The heart, pulse, and respiratory rates, rectal temperature and blood glucose were recorded. Atropine sulphate (0.02mg/kg bwt) was administered to the goats; the animals were subsequently sedated with xylazine (0.075mg/kg body weight) intramuscularly. Pin pricks were done on the perineal area, and the time the animal stopped responding to pin pricks was recorded. The goats were allowed to become recumbent, and the time of recumbency was recorded. The animals were then prepared for an aseptic orchiectomy.. Animals in group B were further prepared for epidural injection using standard procedures as described by Hall *et al* (2001). Briefly, the lumbosacral region was clipped and prepared aseptically. The animals were placed on ventral position with the hind limbs drawn forward and held together with the fore limbs to give them an arched position. The points of the wings of the ilium of the ossa coxae were identified and the point of intersection between imaginary lines drawn between the points of the wings of the ilium and that drawn along the spinous processes of the lumbar and sacrum bones was determined. The epidural space lies just cranial to that point. A sterile 18G hypodermic needle was inserted into the epidural space. When the epidural space was reached, the syringe containing the lignocaine was attached and the agent is slowly delivered into the space. Efficacy of the anaesthesia was evaluated by the relaxation the anal orifice, ataxia of the hind limbs and loss of sensitivity to hind quarter stimulations.

The goats were castrated surgically following standard procedures (Tyagi and Singh, 1996). An incision was made parallel to the median raphae down the anterior surface of the scrotum. The testicle was lifted out of the scrotum. A ligature was tied (chromic catgut) around the spermatic cord and the cord was severed distal to the ligature. The testicle was then removed. The second testicle was lifted out of the scrotum through the previous incision and the procedure of removal was repeated as for the first testicle. The goats were allowed to recover from anaesthesia, and the time of assumption of sterna position was also recorded.

Postoperatively, the goats were managed postoperatively, and any complications were treated. The wounds were dressed daily. Piroxican (0.3mg/kg), procaine penicillin (20,000 IU/kg) and streptomycin (15mg/kg) were administered daily for four days.

Physiological and biochemical parameters monitored

The heart, pulse and respiratory rates were measured 5 minutes before sedation (Pre), immediately after lignocaine administration, at 10, 30, 120, 240, and 480 minutes from the time of lignocaine administration. Blood glucose was measured 5 minutes before sedation, immediately after lignocaine administration, 30, 120, 240 and 480 minutes after lignocaine administration.

Indices of anaesthesia measured

Onset of analgesia: This was measured as the time interval between the time of administration of the sedative and the time of loss of sensation to needle prick on the perineal area.

Onset of recumbency: Was measured as the latency between the administration of xylazine and the disappearance of skin twitch at pin pricks.

Duration of analgesia: this was measured as the time interval between the time of loss of sensation to needle prick and the return of sensibility to pain from needle pricks.

Duration of recumbency: this was measured as the time interval between the assumption of sternal position following drug administration and the time of assumption of standing position after surgery.

Data obtained from the experiment were subjected to analysis of variance (ANOVA) and post hoc least significant difference (LSD) using Statistical Package for Social Sciences (SPSS) Version 20. Values of $p < 0.05$ were considered significant.

III. RESULTS

Physiological parameters

Mean Heart Rates

Results from the experiment (Fig 1) showed that from the time of induction of anaesthesia (0 mins) to 120 minutes post induction (120 mins), the heart rates of goats in groups A and B were significantly ($p < 0.05$) lower than those of animals in group C. There was no significant ($p > 0.05$) difference in the heart rates of animals in groups A and B within that period, except at 120 mins, where animals in group A showed a significantly ($p < 0.05$) higher heart rates than those in group B.

Mean Respiratory Rate

From 0 min to 120 mins, the mean respiratory rate of animals in group B was significantly ($p < 0.05$) lower than that of the control group (Fig. 2). The respiratory rate of animals in group B was significantly ($p < 0.05$) lower than that of animals in group A from 0 mins to 30 mins. There was, however, a progressive reduction in mean respiratory rate of animals in group A from 0 mins to 120 mins, but this change was not statistically significant ($p > 0.05$).

Mean rectal temperature

The rectal temperature showed no significant change from the baseline values in both groups (Fig. 3). Also, there was no significant difference in the rectal temperature between the groups.

Mean blood glucose

The mean blood glucose of goats in groups A was significantly ($p < 0.05$) higher than those of goats C, from 0 mins to 120 mins (Fig. 4). There was however no significant ($p \geq 0.05$) difference in the blood glucose of animals in the treatment groups.

Indices of anaesthesia measured

The results of the onset of analgesia, onset of recumbency, duration of analgesia and duration of recumbency are shown in Table 1.

IV. DISCUSSION

Castration is one of the frequent management practices in large animal husbandry. The indications include prevention of breeding and enhancing the growth rate of the goats (Venogopalan, 2000; O'Connor, 2005). The procedure has been reported to elicit varying degrees of pain in animals (Udegbunam *et al*, 2013). Tissue damage leads to the release of endogenous chemical neurotransmitters. Pain in animals is associated with changes in physiological and biochemical parameters, as a result of changes in plasma levels of catecholamines (Molony and Kent, 1997; Omamegbe and Ukweni, 2010).

Painful stimulations have been associated with increased heart and respiratory rates as a result of increased activities of the sympathetic nervous system (Molony and Kent, 1997; Omamegbe and Ukweni, 2010; Udegbunam *et al*, 2013). In this study, the heart and respiratory rates observed in both groups were reduced significantly ($p < 0.05$) when compared with the baseline values. This may have occurred as a physiological effect of the sedative used. Premedication with xylazine produces a reduced heart and respiratory rates in animals (Hall *et al*, 2001; Bishop, 2005). Premedication with a sedative is recommended when local anaesthetics alone are to be used for painful procedures (Oguntoye and Adetunji, 2009). The significantly ($p < 0.05$) lower respiratory rates of animals in group 2 may have been as a result of the epidural injection of lignocaine. A study by Rauser et al, (2004) showed a similar trend in unpremedicated dogs.

Changes in rectal temperature were not significant ($p \geq 0.05$) in both groups. There was also no significant ($p \geq 0.05$) difference in the rectal temperature between both groups. Hypothermia is a common feature in prolonged anaesthesia (Vesal and Oloumi, 1998). It has also been associated strongly with xylazine. Xylazine has been reported to depresss thermoregulation in cats (Doherty, 1988). The low dose of xylazine used and the short duration of sedation may not have been adequate to produce the classical hypothermia, thus our result.

Damage to superficial nerve endings, as a result of tissue trauma, leads to acute pain. (Singh, 2003). The resulting inflammation causes the release of pain mediators such as cytokines, prostaglandins, serotonine and leukotrienes. These mediators stimulate the autonomic and central nervous systems, leading to the release of epinephrine, nor-epinephrine, cortisol, glucagon, among others (Singh, 2003). The cortisol released leads to a delay in the metabolism and utilization of glucose, while the increased plasma epinephrine causes gluconeogenesis, hepatic gluconeogenesis, lypolysis and insulin resistance, preventing the uptake of glucose Singh, 2003; Udegbunam *et al*, 2012).. These activities culminate in an elevated concentration of glucose in plasma. The hyperglycemic state induced by epinephrine and cortisol enables the provision of the energy needed by tissues such as the central nervous system, wound and red cells for survival (Cousin and Mather, 1984). However, continued hypermetabolism may cause exhaustion of glucose, fat and protein leading to weight loss, fatigue, decreased immunity, delayed ambulation and delayed wound healing (Pediani, 2001; Velickovic *et al*., 2002). The significantly ($p < 0.05$) elevated blood glucose level observed in group 1 animals may indicate that the linear infiltration of lignocaine may not have sufficiently blocked the nerve endings at the site of trauma, unlike the group 2 animals where sufficient analgesia was produced by epidural anaesthesia.

The higher duration of recumbency observed with the epidural administration of lignocaine is attributed to the rear limb paralysis which is a normal sequel of epidural anaesthesia (Oguntoye and Adetunji, 2009). Epidural lignocaine causes a motor nerve blockade at the spinal cord level, which leads to hindquarter paralysis (Azari et al, 2014). The same trend was observed for the duration

V. Conclusion

The result of the present study shows that the alteration in physiological parameters is minimal in goats castrated under linear infiltration of lignicaine than those orchidectomized under epidural lignocaine. However, the stress response to castration is more in the former than in the later. It is therefore concluded that linear infiltration of lignocaine should be employed in castrations and other short duration procedures, while epidural lignocaine anaesthesia should be reserved for long invasive procedures in goats. Further research, is however recommended to study the response of these two anaesthetic protocols on other stress indicators.

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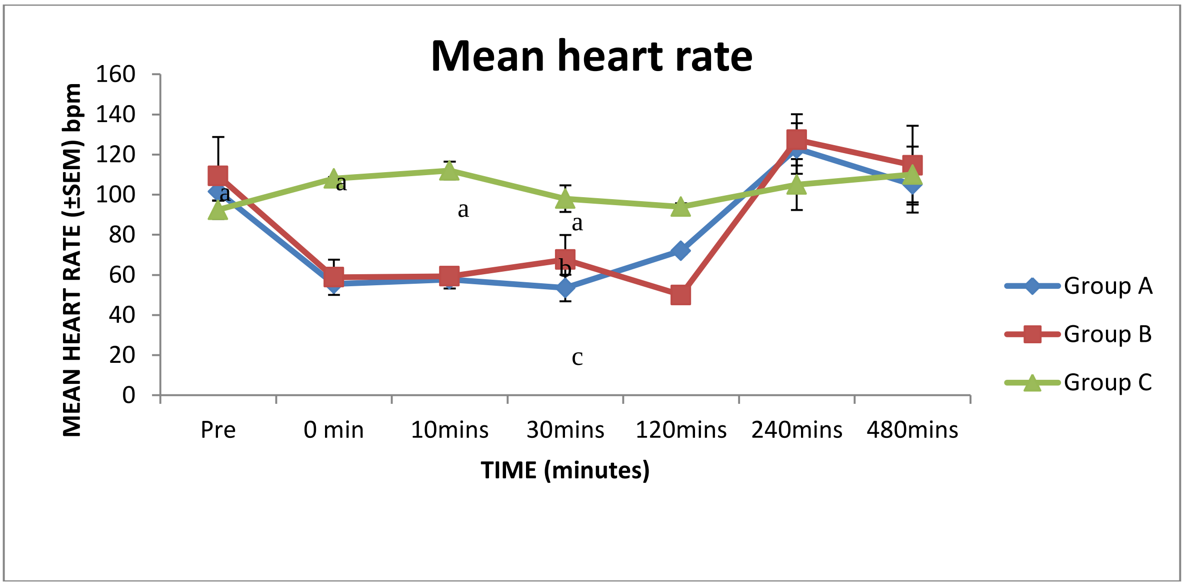

Fig 1: Alphabets "a, b, c" indicate significant (p < 0.05) difference in heart rates among the groups.

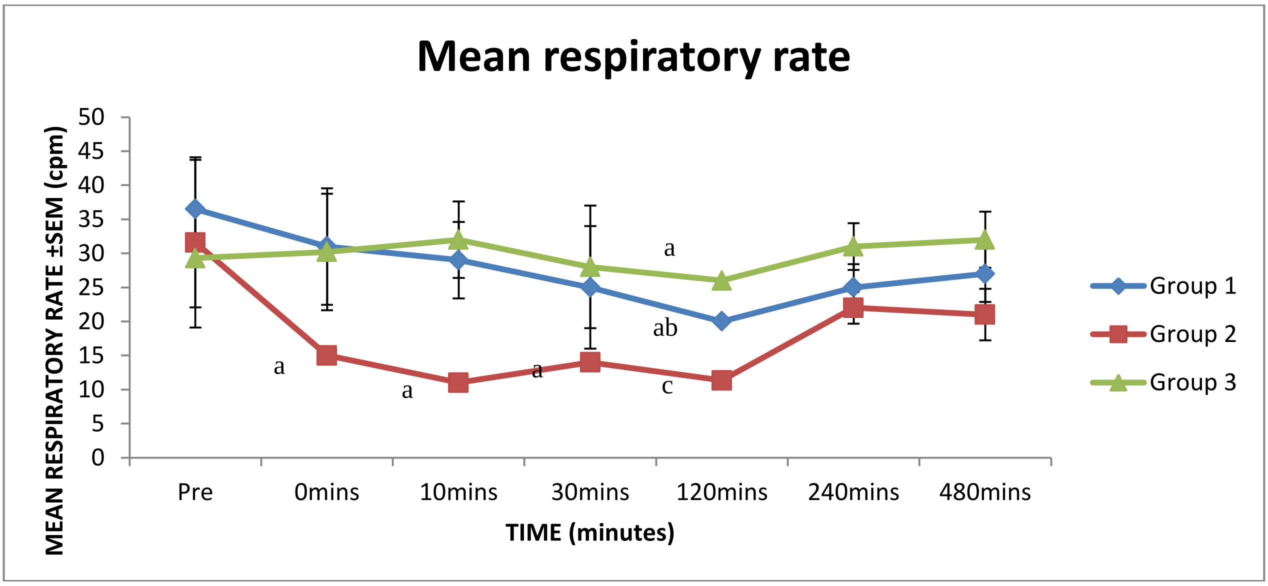

Fig 2: Mean respiratory rates of animals. "a, b, c" indicate significant difference in respiratory rates among the groups.

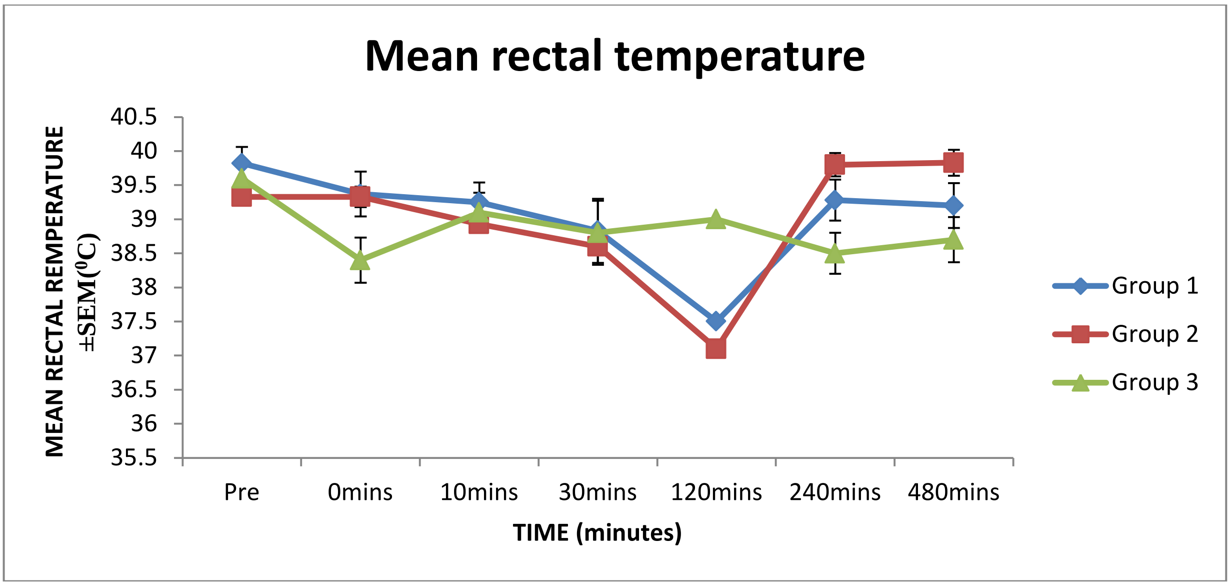

Fig 3: Mean rectal temperature. No significant ($p \geq 0.05$) difference in the rectal temperature.

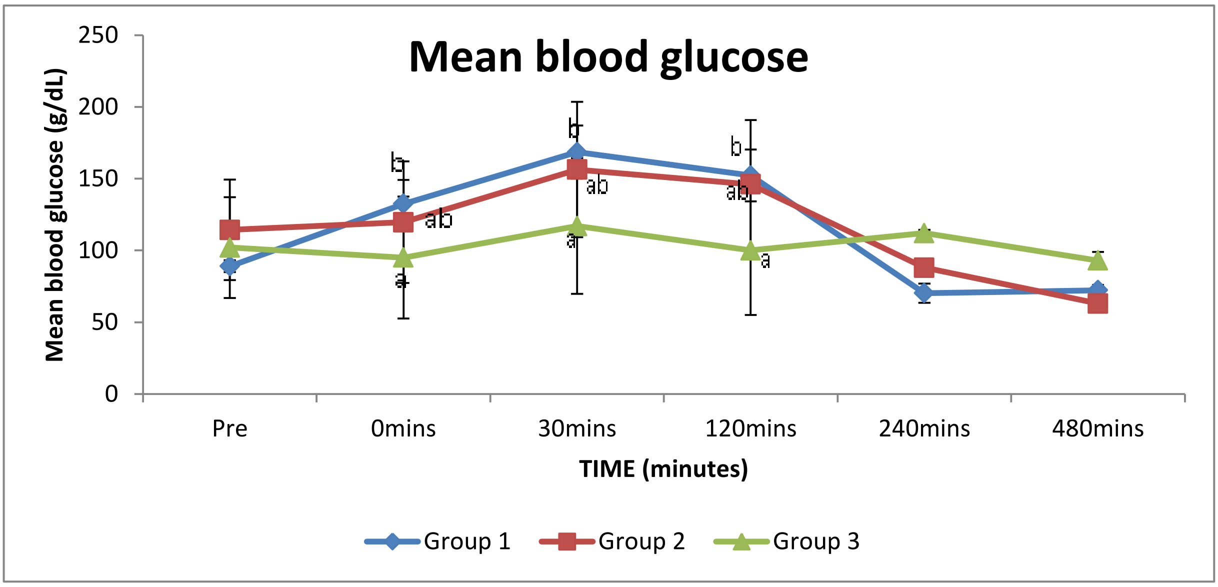

Fig 4: Blood glucose of animals in both groups. "a, b and c" indicate a significant difference in the blood glucose among the groups.

	Onset of recumbency	Onset of analgesia	Duration of analgesia	Duration of recumbancy
Group 1	8.25±2.42	12.75±2.84	43.25±9.57[a]	47.25±10.93[a]
Group 2	7.50±1.96	11.50±3.27	83.25±10.42	86.00±12.48

Table 1: Mean anaesthetic parameters for goats in groups 1 and 2. Superscript indicates a significant ($p < 0.05$) difference for the parameter between the groups.