



LAND MARKS AND QUANTITY OF 2% LIDOCAINE FOR THORACOLUMBAR PARAVERTEBRAL NERVE BLOCK IN WEST AFRICAN DWARF GOATS (CAPRA HIRCUS)

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INTRODUCTION

The West African Dwarf goat is one of the commonest indigenous goat breeds across the countries of West and Central Africa (ILCA, 1987). Goats contribute about 30% of Africa's ruminant livestock population and its percentage meat and milk production are about 17% and 12% respectively (Wilson 1991). They, play significant roles in the social and economic wellbeing of Nigerians in various ways. Economically the animals serve as source of income earning to major ruminants' dealers- sellers of live animals and butchers/meat sellers; generates employments and creates markets for larger number of people who explore the animals' product and by-products for economic gains. Goat meat constitutes the foremost animal product that is highly explored by the Nigerian households, particularly for direct consumption (Lawal-Adebowale, 2012). Local anaesthetics provide a reversible regional loss of sensation and techniques used include topical anaesthesia, infiltrative anaesthesia, ring blocks, and regional nerve blocks. Local anesthetics inhibit the generation and propagation of nerve impulses via blockage of voltage-gated sodium channels in the nerve membrane (Strichartz 1988). They inhibit nerve transmission by inhibiting the depolarization of the nerve membrane by interfering with both Na⁺ and K⁺ currents. Many surgical procedures can be carried out satisfactorily under local anaesthesia, sedation and restraint in ruminants (cattle, sheep and goats) such as Caesarean section and rumenotomy. Lidocaine according to Waterman and Livingston, (1978) is one of the commonly used local anaesthetic solution and is well tolerated in most species. Regional anaesthesia is achieved when specific nerves to a particular area concerned are blocked. Such as specific nerve blocks to the limbs, Thoracolumbar paravertebral

nerve blocks, and cornual block for dehorning (Edmondson 2008). Regional anaesthesia is the anaesthesia of choice in ruminants since general anaesthesia has certain limitations, due to their anatomical and physiological peculiarities (Shokry 1982; Hossain 1984; Hashim and Hossain 1989).

Thoracolumbar paravertebral nerve block (TLPVB) refers to the perineural infiltration of local anaesthetics on the spinal nerves as they emerge from the intervertebral foramina. Methods of achieving TLPVB have been described, which include the proximal and distal thoracolumbar paravertebral nerve blocks (Edmondson, 2008). Its advantage is that it enhances pain relief and muscle relaxation of a very wide area covered by the segmental nerves desensitized (Edmondson, 2008). Also, thoracolumbar paravertebral nerve block results in effective analgesia in all the muscle layers of the abdominal wall including the peritoneum and reduces intra-abdominal pressure. The thoracolumbar paravertebral nerve block in goat is not always successful and unreliable because of variations in the course of the dorsal and ventral branches of the spinal nerves (Roe,1986). But it can easily be carried out with the knowledge of the topographic anatomy of the courses of T₁₃, L₁, L₂, L₃ and L₄ nerves (Lee,2006). In goats, the segmental nerves T₁₃, L₁ and L₂, are required to be desensitized for surgeries in the flank (Hall and Clark, 1989). Most of the small ruminants reared within Benue state and its environs are West African Dwarf goats. These animals are presented with lots of dystocia cases, that general anaesthesia cannot be used, since ruminants are not good candidates for general anaesthesia. Other alternative methods of achieving anaesthesia of the flank, like tissue infiltration and inverted L block which may not produce analgesia of all muscle layers including

peritoneum especially in fat animals (Sloss and Dufty, 1977). There is paucity of information and data on the anatomical landmarks and quantity of anaesthesia for performing thoracolumbar paravertebral nerve blocks in our local breeds of goats. In addition, the proximal and distal paravertebral nerve block approaches for cattle postulated by Farquharson (1940) and Cakala (1961) are used in caprine and ovine species by extrapolation. This study therefore aimed at establishing the reference anatomical landmarks of spinal nerves T₁₃, L₁, L₂, L₃ and L₄ and the quantity of local anaesthetic agent (2%Lidocaine) required for Proximal and distal Paravertebral nerve blocks at the Para lumbar fossa in West African dwarf goats.

MATERIALS AND METHODS

Ethical considerations

This study involved the use of animals and ethical approval was granted by the Federal University of Agriculture Makurdi Committee on Animal Use and Care with reference number 2016/002.

Research Location

This research was conducted in the large animal clinic of Veterinary Teaching hospital and the gross Anatomy laboratory of the Department of Veterinary Anatomy, Federal University of Agriculture, Makurdi, Benue state.

Experimental animals

A total of thirty (30) West African dwarf goats of either sex, 2-3 years old and

weighing between 11 to 14 kg, were used for the study. The goats were purchased from the International livestock market, North Bank, Makurdi, Benue State. The animals were kept in the small ruminant pens of the Veterinary Teaching Hospital, Federal University of Agriculture Makurdi. The goats were stabilized and acclimatized for 2 weeks, during which routine examination was carried for any sign of ill health. Also, clinical evaluations were conducted on each animal to determine their baseline data. The animals were fed with groundnut hay, bean husks and maize offal, and water was provided *ad libitum*.

Grouping of Animals

The animals were randomly allocated into two groups (1 and 2). Group 1 comprises of 20 goats which were used for proximal paravertebral nerve block while group 2 comprises of 10 goats which were used for distal paravertebral nerve block.

Experimental Design for Paravertebral nerve block Techniques

Proximal approach

The aim of this approach was to block both dorsal and ventral branches of the spinal nerves T₁₃, L₁, L₂, L₃ and L₄ with a single injection at each intervertebral space as the nerve emerges through the intervertebral foramina from the spinal cord. This was done according to the method described by Farquharson (1940) for cattle. The dorsolateral aspect of the caudal half of the left side of each goat starting from the 11th rib to the last lumbar vertebrae was aseptically prepared by shaving the hair coat, swabbing with chlorhexidine gluconate (Saro life care Limited, Nigeria) and finally with 70% alcohol (Harols Pharmaceuticals, Nigeria).

An anaesthetic wheal was made on the skin using 0.5 mL of 2% lidocaine HCl (Kwality Pharmaceuticals Ltd. India), to establish an anaesthetic wheal before a needle was directed downward to a depth of 3 cm until it was positioned at the caudal border of the transverse process five goats each were used for infiltration of 2% lidocaine at (1 cm, 2 cm, 2.5 cm and 3 cm) away from the dorsolateral aspect of the dorsal midline. The land marks (1 cm, 2 cm, 2.5 cm and 3 cm) used were obtained in a previous study after dissection was carried on goat cadaver and morphometry done to establish the land marks based on the orientation and courses of the spinal nerves as they emerge from the spinal cord and as described by Nev, *et al.*, (2017). 2 mL(40mg) of 2% lidocaine was injected into the intervertebral spaces between T₁₃-L₄ using a 21-gauge 1 ½ inch needle. mounted on a 10 ml syringe (El-salmat pharmaceutical co. Nigeria). The drug was infiltrated around the spinal nerves as they emerge from the intervertebral foramina to achieve a proximal block. The time for anaesthesia to take effect was noted and signs include loss of sensation on the affected side and scoliosis towards the anaesthetized side.

Duration of analgesia so as to evaluate the analgesic action of 2 % lidocaine was also determined, as time interval (in minutes) from the onset of loss of response to needle pricks to the return of the response to pain Oijila and Katila (1988). To ascertain and note the time of onset and duration of anaesthesia, the caudolateral aspect of the paralumbar fossa was pricked using a 21-gauge 1 ½ inch hypodermic needle after the

anaesthetic agent was administered. The area of desensitization at the paralumbar fossa was also measured (Plate1).

Distal approach

The aim of this approach was to block the dorsal and ventral branches of each of the spinal nerve separately. The approach was carried out as described by Cakala (1961) for cattle. A distal paravertebral block was performed on 10 WAD goats of which 5 goats were used for infiltration at 1 cm and five goats also for infiltration at 1.5 cm away from the tip of the transverse process, on the dorsal and ventral aspects and with the needle advanced medially from the transverse process. Distal paravertebral nerve block approach was achieved by blocking the dorsal and ventral branches of each spinal nerve separately. The land marks (1 cm and 1.5cm) used were obtained in a previous study after dissection was carried on goat cadaver and morphometry done to establish the land marks based on the orientation and courses of the spinal nerves as they emerge from the spinal cord and as described by Nev *et al.*, (2017). The Para lumbar fossa was prepared, covering an area over the transverse process as in the proximal approach. A 21 gauge 1 ½ inch hypodermic needle mounted on a syringe containing 2% lidocaine Hcl, was placed at the center of the transverse process of L₁. The needle was directed medially, over the transverse process of L₁ and the content infused as the needle advanced to its full length to block the dorsal branch of T₁₃. The needle was withdrawn and inserted ventral to the L₁ transverse process in order to block the ventral branch of T₁₃ nerve. L₁ was blocked in a similar fashion, over L₂ transverse process, while L₂ was also blocked in a similar manner over L₄. 1 mL (20mg) of lidocaine Hcl was injected over the dorsal and 1 mL(20mg)

of lidocaine in the ventral aspect of the transverse processes of T₁₃ - L₄ using a 10 ml syringe and 21- gauge 1½ inch needle. The area of desensitization at the paralumbar fossa was also measured (Plate1). Similarly, duration of analgesia to evaluate the analgesic action of Lidocaine Hcl as described by Oijala and Katila (1988) was also determined as time interval (in minutes) from the onset of loss of response. The caudolateral aspect of the abdominal wall was pricked using a sterile 21-gauge hypodermic needle after the anaesthetic agent was injected to ascertain the anaesthetized area and note the time of the onset and duration of anaesthesia.

Vital Parameters

The parameters observed during the nerve blocks were; rectal temperature, pulse and respiratory rates. Rectal temperature (in degrees Celsius) was measured by using a mercury-in-glass clinical thermometer. Respiratory rate was obtained by counting the movements of the flank at the paralumbar fossa per unit time and was presented as number of cycles per minute (Saddiqi *et al.*, 2011). Pulse rate was obtained by counting the pulsations felt on the femoral artery per unit time and was presented as number of beats per minute (Habibu *et al.*, 2017; Yaqub *et al.*, 2021). These parameters were taken before and after administration of anaesthesia.

Data Analysis

Data generated in this study was tabulated. Students-t- test was used to test the mean difference obtained in the application of anatomical land marks, temperature, pulse

and respiratory rates obtained before and after administration of 2% lidocaine. Graph pad prism software version 5.0(San Diego, California, USA) was used for the analysis. $P \leq 0.05$ was considered to be statistically significant.

RESULTS



Plate 1: A - Showing area of desensitization of the paralumbar fossa and part of the trunk. B - Animal exhibiting lateral recumbency, when lidocaine was administered through the distal paravertebral nerve block.



Plate 2: Goat exhibiting ataxia during distal paravertebral nerve block.

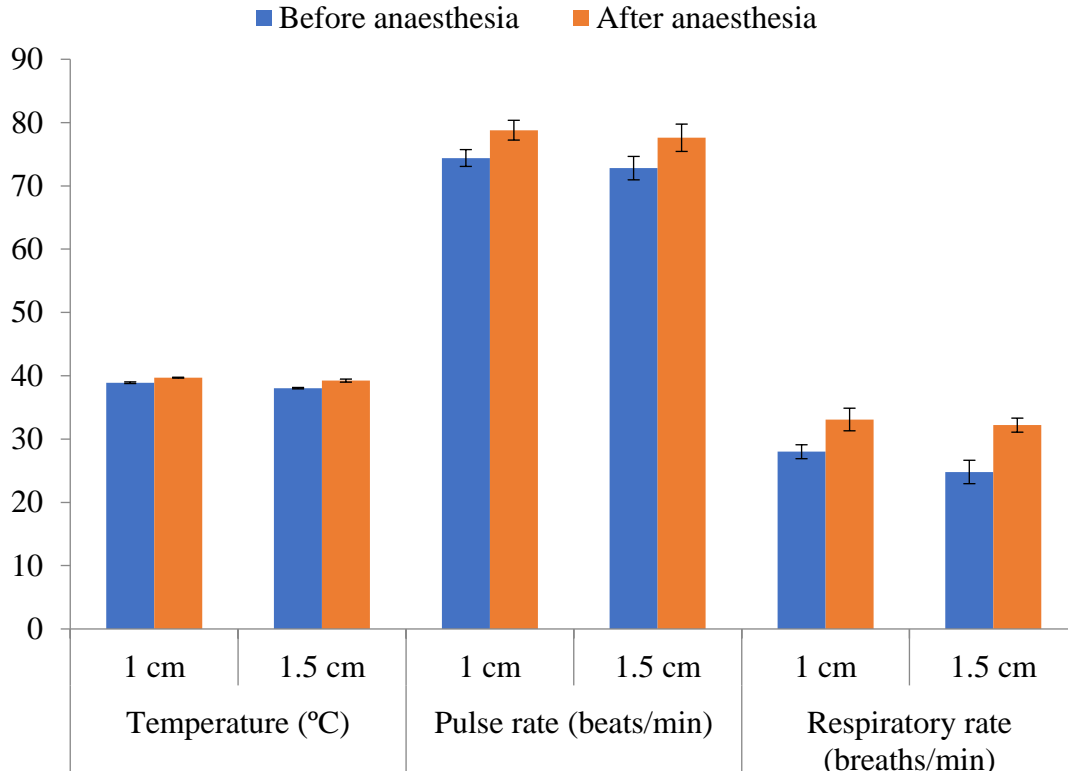


Figure 1: Vital parameters for distal paravertebral nerve block at 1 and 1.5 cm from the tip of transverse process.

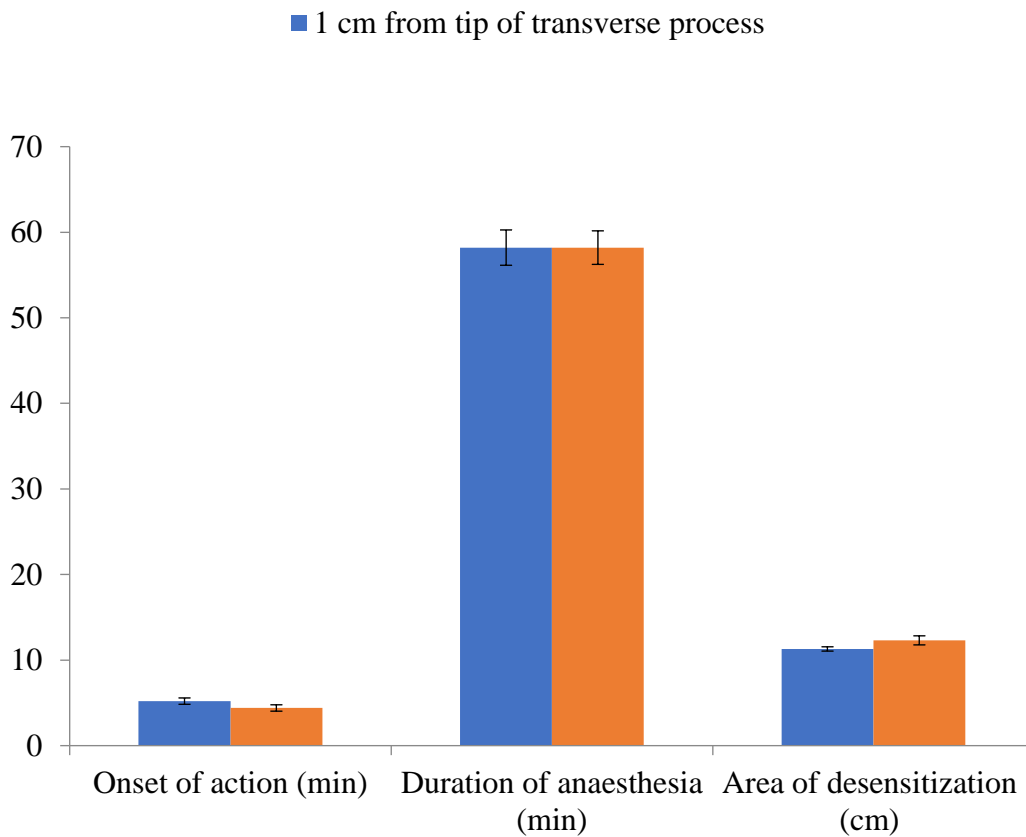


Figure 2: Onset and duration of anaesthesia, and area of desensitization for distal paravertebral nerve block at 1 and 1.5 cm from tip of transverse process.

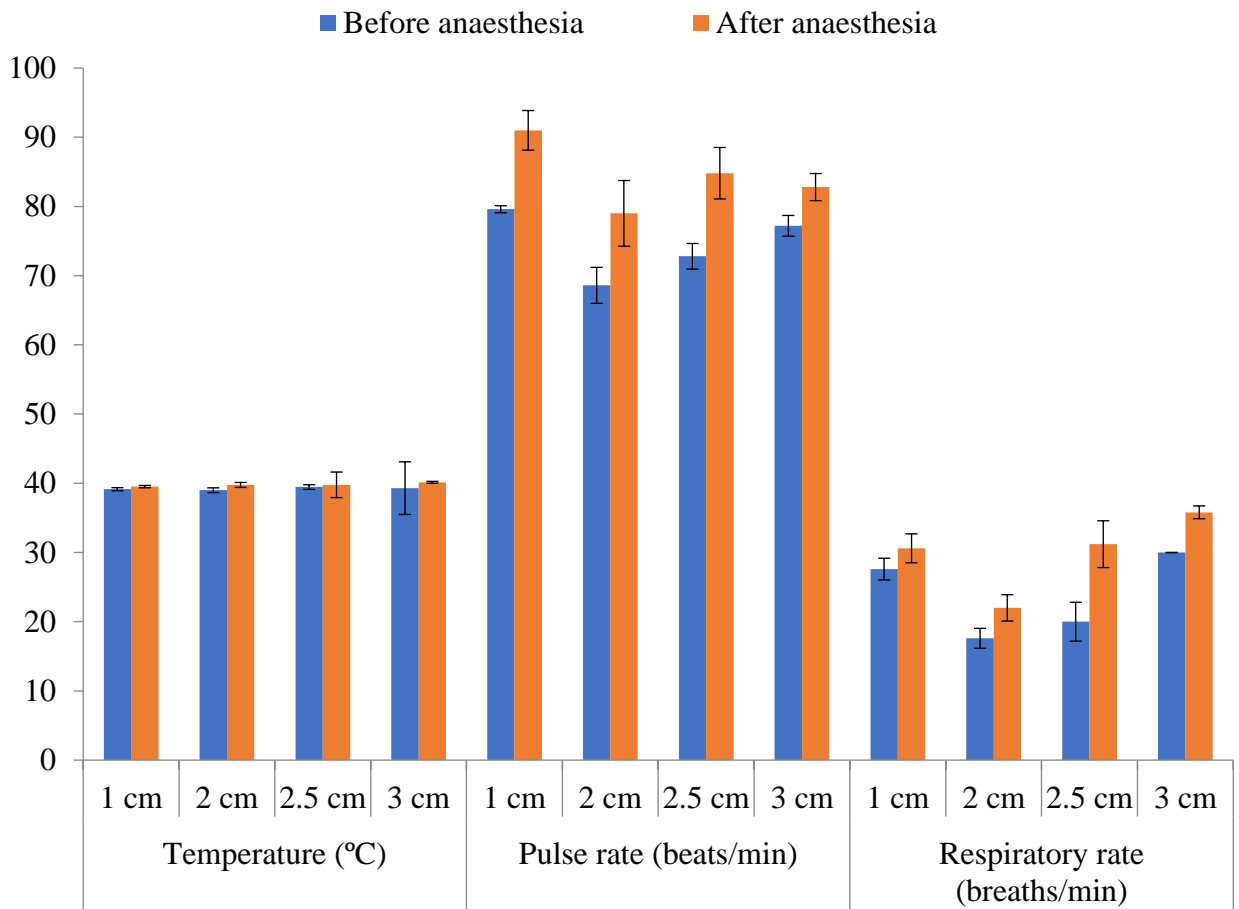


Figure 3: Vital parameters for proximal paravertebral nerve block at 1, 2, 2.5 and 3 cm from dorsal midline.

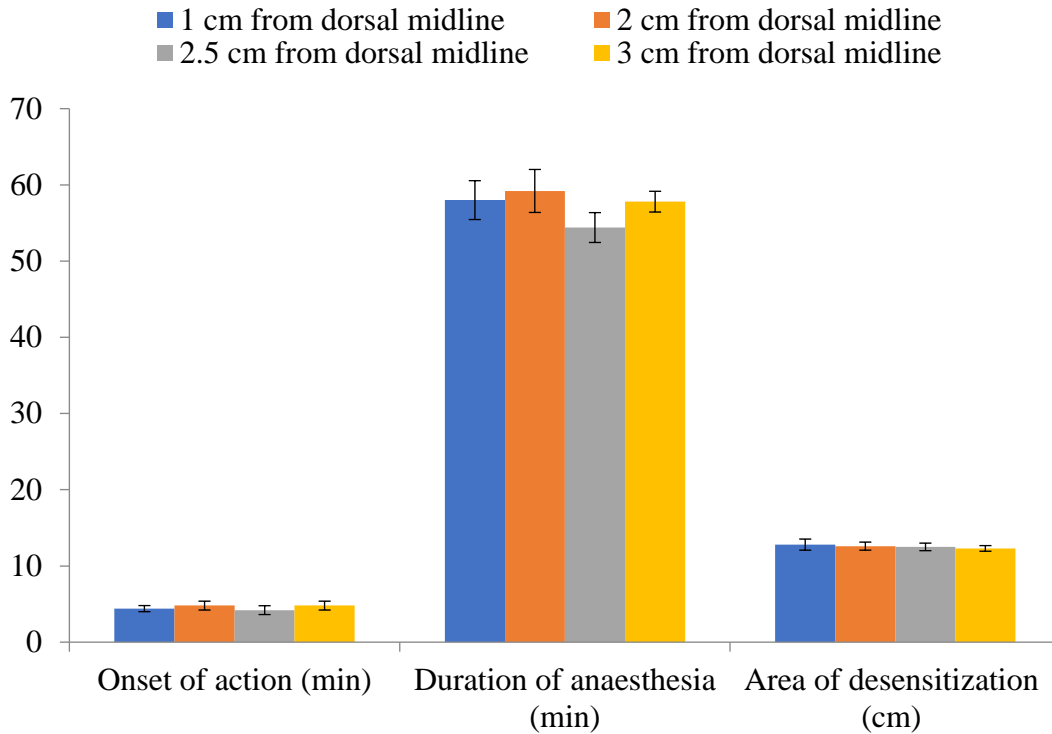


Figure 4: Clinical application of Measured land marks for proximal paravertebral anaesthesia at 1, 2, 2.5 and 3 cm from dorsal midline.

The clinical application of anatomical land marks for distal paravertebral nerve block was recorded in Figure 1. The dimension of the distance for the infiltration of 2% lidocaine was considered for 1 cm away from the tip of the transverse process dorsolateral. The mean rectal temperature at baseline was $38.9 \pm 0.13^{\circ}\text{C}$ which was significantly ($p < 0.05$) lower than the temperature after administration of anaesthetic agent $39.7 \pm 0.07^{\circ}\text{C}$. There was no significance difference in the pulse rate before $74.4 \pm 33\text{b/m}$ and after administration of anaesthesia $78.30 \pm 1.59\text{ b/m}$ ($p > 0.05$). There was a significant ($p > 0.05$) increase in the mean respiratory rate observed from $28.00 \pm 1.10\text{ c/m}$ to $33.0 \pm 1.79\text{ c/m}$. The time for onset of action of anaesthesia was $4.4 \pm 0.40\text{min}$, while the time recorded for duration of anaesthesia was $58.0 \pm 2.55\text{ min}$. See (Figure 2). The mean value for desensitize desensitized area

area around the Para lumbar fossa was $12.8 \pm 0.73\text{ cm}$. The dimension of the distance for the infiltration of 2% lidocaine was considered for 1.5 cm away from the tip of the transverse process dorsolateral (Figure 1). The administration of anaesthetic agent at 1.5 cm for the distal paravertebral approach was observed to have a mean temperature of $38.54 \pm 0.11^{\circ}\text{C}$ before administration of anaesthesia while the temperature obtained post anaesthetic administration was $39.24 \pm 0.24^{\circ}\text{C}$. The difference in the mean rectal temperature was considered to be significant ($p < 0.05$). The mean pulse rate observed before administration of anaesthetic agent was $72.80 \pm 1.25\text{ b/m}$ and the mean obtained after anaesthetic agent was administered was $77.60 \pm 2.16\text{ b/m}$. The difference obtained was considered not significant, ($P > 0.05$).

The respiratory rate before anaesthesia had a mean of 24.80 ± 1.85 c/m while the mean obtained post administration of anaesthesia was 32.20 ± 1.11 b/m but the difference obtained was not significant. The mean for the onset of action of anaesthesia was 4.4 ± 0.57 min while the mean for duration of anaesthesia was 58.2 ± 1.96 min. The mean for desensitization of the Para lumbar fossa was 12.3 ± 0.53 cm. The finding of the clinical application of anatomical land marks for proximal paravertebral nerve block was recorded in Figure 3. The result obtained from the dimensions of infiltration of local anaesthetic 1 cm away from the dorsal midline. The mean rectal temperature at baseline was $39.14 \pm 0.22^\circ\text{C}$ which was not significantly different from the mean rectal temperature after administration of anaesthetic agent $39.52 \pm 0.17^\circ\text{C}$. The pulse rate before administration of anaesthesia was 79.60 ± 0.51 b/m while the value after administration of anaesthesia was 91.00 ± 2.86 b/m ($p > 0.05$), which showed a significance difference. The baseline value of respiratory rate before anaesthesia was 27.60 ± 1.57 c/m while the value after anaesthesia was 30.60 ± 2.09 c/m. There was no significant difference the time for onset of action of anaesthesia was 5.2 ± 0.37 min, while the time recorded for duration of anaesthesia was 58.2 ± 2.06 min. See (Figure 2). The mean value for desensitized area around the Para lumbar fossa was 11.3 ± 0.25 cm. The result obtained from the dimensions of infiltration of local anaesthetic 2 cm away from the dorsal midline. The clinical parameters evaluated before and after administration of anaesthesia were Temperature, pulse and respiratory rate. The mean body temperature before and after administration of 2% lidocaine were $39.14 \pm 0.22^\circ\text{C}$ and $39.52 \pm 0.17^\circ\text{C}$ respectively. The difference in the rectal temperature was not

significant ($p > 0.05$). The mean value of pulse rate before administration of anaesthesia was 79.60 ± 3.51 b/m while after anaesthesia had a mean of 91.0 ± 2.86 b/m after administration of anaesthesia, though the post anaesthesia value was higher than the base line value though not significant. The mean value for respiratory rate before and after administration of anaesthesia was of 27.60 ± 1.57 c/m and (30.60 ± 2.09 c/m). However, the difference was considered not to be significant ($p > 0.05$). The onset of action of the local anaesthetic had a mean of 4.4 ± 0.40 min while the duration of anaesthesia had a mean of 58.0 ± 2.55 min, see Figure 4. The area of the Para lumbar fossa that was desensitized had a mean value of 12.8 ± 0.73 cm. The result obtained from the dimensions of infiltration of local anaesthetic 2.5 cm away from the dorsal midline. The baseline value of for temperature was $39.46 \pm 0.23^\circ\text{C}$ while the temperature when anaesthesia was administered was $39.78 \pm 0.51^\circ\text{C}$. However, the difference was considered not significant ($p > 0.05$). Pulse rate before administration of anaesthesia had a mean value of 72.80 ± 1.85 b/m while the mean after administration of the anaesthesia was 84.80 ± 3.72 b/m. The difference in the pulse rate was considered significant ($p < 0.05$). Respiratory rate recorded before administration of anaesthesia had a mean of 20.00 ± 2.10 c/min while after administration of 2% was 31.20 ± 3.38 c/min and higher as compared to the baseline value. The difference obtained was also significant ($p < 0.05$). The mean onset of action of anaesthesia was 4.2 ± 0.58 min, while the mean for the duration of anaesthesia was 54.4 ± 96 min as recorded in Figure 4. The mean value obtained from the desensitization area of the Para lumbar fossa was

(12.5 ± 0.50 cm). The mean rectal temperature after infiltration of 2% lidocaine for the proximal approach at 3 cm away from the dorsolateral aspect of the midline, had a baseline value of 39.3 ± 3.8°C while 40.14 ± 0.14°C was recorded after administration of anaesthesia. The difference was considered to be significant ($p < 0.05$). The mean for the pulse rate taken before administration of anaesthesia was 77.2 ± 1.50 b/m, while the value obtained after anaesthesia was 82.80 ± 1.96 b/m. The difference was considered not significant ($p > 0.05$). The mean respiratory rate before anaesthesia was 30.00 ± 0.00 b/m, while the mean obtained after anaesthesia was 35.80 ± 0.92 b/m. The difference obtained was considered significant ($p < 0.05$). The mean for the onset of action of anaesthesia was 4.8 ± 0.58 min, while the mean for duration of anaesthesia was 57.8 ± 1.36 min. The mean value obtained for area of desensitization of the para lumbar fossa was (12.3 ± 0.37 cm).

DISCUSSION

A significant increase in physiological parameters (Temperature, pulse and respiratory rate), was observed ($p < 0.05$) when 2% lidocaine was administered at 1cm, 2.5cm and 3cm dorsolateral from the dorsal midline and 1cm and 1.5 cm from the tip of the transverse process. This finding agrees with the report of De Rossi *et al.* (2007) who administered Butorphanol-Lidocaine Hcl in goats and had a significant increase in these vital parameters. The possible increase in these parameters could be due to stress response as a result of the process. Surgical stress occurs, before, during, and after an operative procedure. It arises from psychological stress, tissue injury, and alterations in circulation,

anaesthetic agents, and postoperative complications including sepsis (Carey *et al.*, 1999). Also, when the sympathetic nervous system is stimulated by stress factors, adrenaline is released from the adrenal medulla and the hypothalamic pituitary adrenal axis is stimulated by the hormone cortisol, an increase in these vital parameters could be observed (Diverio *et al.*, 2016). Furthermore, Ugochukwu, (2001) also reported that stress and effect of certain drugs can cause increase in physiological parameters and excitement which can cause the release of -adrenaline causing the increase. The onset and duration of action of the local anesthetic obtained in this study was at variance with the report of Runa *et al.* (2003), they observed the onset of anaesthesia to be 5 minutes after administration of local anaesthetic and duration to be 88 minutes. The possible reason for the difference is because, Lidocaine without adrenaline was used in this study, while they used lidocaine with adrenaline which have vasoconstriction properties and can prolong the duration of anaesthesia. Also, the protein binding characteristics of the local anaesthetic agent influences the duration of action (Gissen *et al.*, 1980). The area of desensitization of the paralumbar fossa indicates the anatomical dermatome covered by the anaesthesia, which is important where surgical operations around the paralumbar fossa is considered. This finding agrees with the report of Hall and Clarke (1989), Who reported that the desensitized area around the Para lumbar fossa was 12.07 ± 3.61 cm in goats. The mean desensitized area around the Para lumbar fossa by the infiltration of 2% lidocaine at 1cm and 1.5 cm away from the tip of the transverse process was marked by the onset of neural

blockage where the goats assumed a sitting posture, ataxia and lateral recumbency. Hind limb ataxia is a normal sequel of blocking the lumbosacral nerve junction which desensitizes the sciatic nerve and results in hind limb paralysis. In achieving paravertebral nerve block, L₃ and L₄ are always not included. But in this study, L₃ and L₄ were blocked and this results in ataxia as these nerve supply motor fibers to the ischial femoral nerves (Hallowell and Potter 2008). This can result in the ataxia observed in the animals. Surgical conditions of the perineum, udder and teat can be successfully carried out using this technique. This finding agrees with the report of Eze *et al.* (2004) in WAD goat under distal paravertebral anaesthesia. The landmarks to achieve TLPVB in WAD goat was established by Nev, *et al.*, (2017) to be 2-3cm away from the spine dorsolateral for the proximal approach and 1-1.5 cm away from the tip or border of the transverse process and needle directed medially. It means that the segmental nerves run its course and the orientation of the nerve is within the range of the dimension of distances given. Successful paravertebral nerve block is dependent on been able to locate the nerve trunk. It was observed in this study that 2-3cm range used for the proximal block produced the best desensitization as compared to 1cm distance used. Our choice of distances for the infiltration of 2% lidocaine was influenced by the report indicating that the concentration of local anaesthetics such as 2% lidocaine is determined by the rate of absorption from the site of injection, rate of tissue absorption and rate of metabolism and excretion of the drug (Hall *et al.*, 2001). In this study desensitizing the spinal nerves in both proximal and distal approaches using equal volume of 2% lidocaine disagrees with the report of Lee, (2006) indicating that

more volume of 2% lidocaine is needed to desensitize the spinal nerves in the distal approach as compared to the proximal approach. In conclusion this study applied the reference anatomical landmarks of the spinal nerves 2-3cm away from the spine dorsolateral for proximal approach and 1-1.5cm for the distance of needle placement medially from the tip of the transverse process dorsal and ventral to achieve desensitization of the flank. Equal volume of 2% lidocaine can be used to desensitize the flank in the proximal and distal approaches.

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