Journal of Veterinary and Biomedical Sciences
Vol. 5 (2). PP 51 - 59, December, 2023
***ISSN**: 2659-0743*
DOI: 10.36108/jvbs/3202.50.0260

Comparative Evaluation of Topical and Local infiltration of Lignocaine Hydrochloride in Kano Brown Does

Okafor, R. O. S.*[1] and Obiajulu, G. O.[2]
[1]Department of Veterinary Surgery, University of Abuja, Federal Capital Territory (FCT), Nigeria. Phone: +2348136520153.
[2]Ministry of Agriculture and Food Security, Ekiti State, Nigeria. Email: giftchiamaka5@gmail.com, Phone: +2348133776815.
* Corresponding author: richard.okafor@uniabuja.edu.ng

Accepted November, 2023 and Published December, 2023

ABSTRACT

The aim of this study was to compare the effectiveness of pain elimination and onset of anaesthetic activity by topical lignocaine spray with subcutaneous infiltration of lignocaine hydrochloride (LH) through assessment of the effects on vital parameters and pain responses in Kano Brown does. Fourteen does aged 1-3 years were randomly divided into two equal groups (A and B). The does were shaved at the left flank, group A does were infiltrated with 5 mL of LH while does of group B were administered with LH topically. A needle prick test was then carried out post administration in both groups, clinical and behavioral pain responses were assessed over a 2 hours period. Group A recorded a higher pulse rate (85.14± 6.02 bpm) as compared to group B (82.29 ± 4.68 bpm), respiratory rate was significantly ($p<0.05$) lower in group A (20.00± 1.23cpm) as compared to group B (25.71± 1.47 cpm) and a lower rectal temperature was recorded in group A (38.63± 0.35°c) in comparison to Does of group B (39.11 ± 0.07°C). The locally infiltrated group recorded no sign of pain throughout the needle prick test while variations in pain responses were recorded in topical LH administered group. 71% of the topical spray (TS) does exhibited signs of pain immediately post spray, 57% exhibited pain response at 60 and 180 seconds, and 43% at 300 seconds. When the needle prick was carried out at 600 seconds, 14% of the TS does showed signs of pain at first prick while 29% recorded pain signs on second needle prick. No signs of pain was recorded at 1200 (20 minutes) and 1800 (30 minutes) seconds in the TS does. It was concluded, that subcutaneous infiltration of LH had a faster onset of action, last longer and provides better analgesia/anesthesia than topical lignocaine spray.

***Keywords:** Lignocaine; Local infiltration; Topical administration; pain, Kano Brown Does*

*Corresponding author:
email: richard.okafor@uniabuja.edu.ng
Tel: +234 (0)8136520153

INTRODUCTION

A range of drugs may be administered to achieve unconsciousness, memory loss, pain relief, relaxation of skeletal muscles, and the suppression of reflexes in the autonomic system [1]. Local and regional anaesthetics specifically numb body areas, they do not cause unconsciousness like general anaesthetics, and may therefore allow patients to stay awake throughout surgical procedures [2]. Ruminants can undergo a variety of surgical operations in the field with minimal discomfort and expense through the administration of local anaesthetics. [3]. Local anesthetics are mainly used for loco-regional anesthesia and analgesia and can offer adequate anesthesia for numerous minor surgical procedures [4]. Research and evidence indicated that local anesthetics possess not only antinociceptive properties but also immune-modulating, antimicrobial, and tissue-healing effects [5]. Local anesthetics find their primary applications in four main ways: as topical analgesia for the skin or mucosa, as local infiltration for analgesia of specific tissues, and as regional analgesia techniques [6].

Animals experience irritable stimuli and emotional feelings that they interpret as pain and which warn them of a possible threat to their bodily tissues, this aims to lessen the likelihood of further harm, stop it from reoccurring. [7]. Injecting local anesthetics can cause pain, exacerbate anxiety, and potentially lead to disruptive tissue edema [8]. A key component of animal care is facilitating the alleviation of pain [9]. The primary methods used to assess pain in animals include measuring the physiological and biological parameters, such as heart and respiratory rate, as well as monitoring cortisol levels [10].

Lidocaine is considered the "most versatile and commonly used local anesthetic and it is known for its rapid onset of action and intermediate duration, making it suitable for a wide range of procedures and applications [11]. The use of topical anesthesia is increasingly becoming a standard practice in clinical settings, it provides effective pain relief without the need for injections and minimizing the associated complications. [12].

There are speculations or arguments on the effectiveness of the systemic administration of lignocaine over the topical application, in terms of duration of action as well as onset of action. It is imperative then to conduct a comparative study between the analgesia/anesthesia achieved with lignocaine topical spray and that of subcutaneous infiltration.

MATERIALS AND METHODS

Ethical approval for this study was obtained from the Department of Veterinary Surgery Ethics Committee on Animal Use**.** The study was carried out at the Nigerian Army Farms and Ranches Limited, Airport Road, Giri, F.C.T, Abuja, Nigeria. Fourteen (14) apparently healthy Kano brown does, aged between 1 to 3 years, were randomly selected and tagged for identification. They were examined for presence of ticks, mites, and any other ecto-parasites. The does were dewormed and were free from any dermatological lesions. They were randomly divided into two groups of seven does each, placed in previously cleaned, and disinfected pens and administered with antibiotics a week to the time of the experiment. A day prior to the experiment, the animals were properly restrained and shaved at the left flank (boundary of the last rib, distal to the transverse process of the vertebrae, proximal to the linea alba, and cranial to the paralumbar fossa). A 5cm by 5 cm mark was made using a ruler and a marker, taking care not to exceed the stipulated site (Plate 1). The site was washed with soap and water and disinfected with a gauze soaked in chlorhexidine (Plate 2)

Anaesthesia

Experimental does were properly restrained and were placed on right lateral recumbency. An inverted 'L' local infiltration of lignocaine hydrochloride (Lidocaine injection BP, Akason^{R} Mumbai, India) was administered in

group A does (Plate 3). Group B does were liberally sprayed with a lignocaine spray (lidocaine[R], Aspen, Sodertalje, Sweden) topically (Plate 4).

Physiological Parameters

The rectal temperature, pulse, and respiratory rate were monitored and recorded with digital thermometer, digital pulse pressure and manual counting of inspiration and expansion of the chest wall respectively pre and post experiment.

Needle Prick Test The Subcutaneous Infiltration (SI) does were subjected to a needle prick test at the experimental site immediately the infiltration was conducted (0 seconds) and at 60,180, 300, 600, 1200, 1800 and 7200 seconds and the does reactions recorded. Both groups were tested at the same time intervals for onset of anesthesia using a sterilized needle (Plate 5). A response to pain as the test is done indicates that anesthesia has not been achieved whilst no response indicates effective anesthesia. The does were monitored intently, and the slightest reaction to pain was recorded. The duration and onset of action of lignocaine was measured using a stopwatch. Pain was assessed using behavioral responses such as bleating, head raising and muscle twitching. The does were pricked at the same site for both groups to maintain a level of consistency.

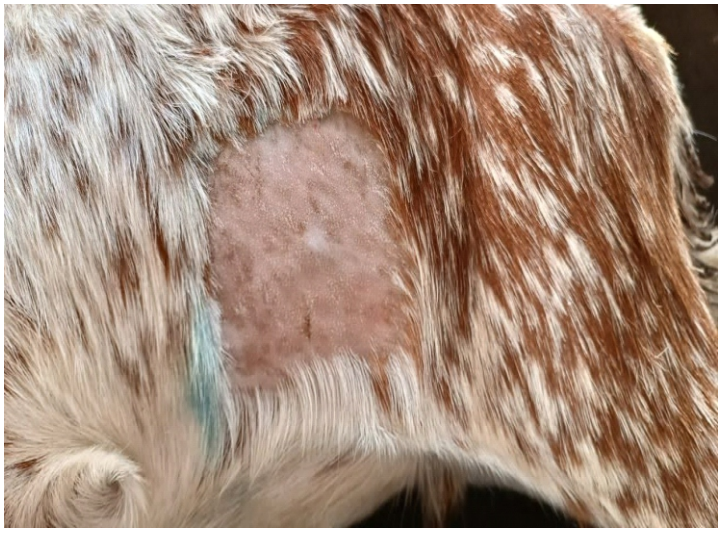

Plate 1: 5cm by 5cm shaved site on the left flank

Plate 2: Aseptic cleaning of shaved site with chlorhexidine

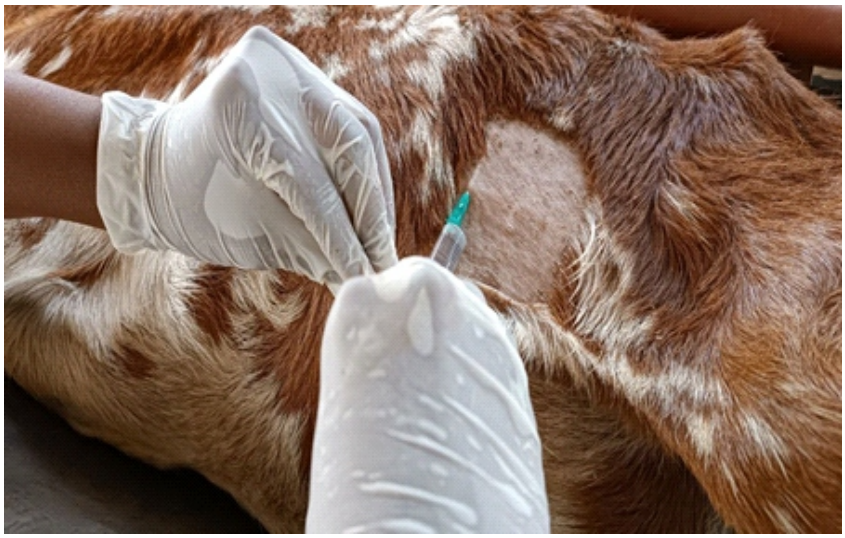

Plate 3: Inverted L infiltration of Lignocaine

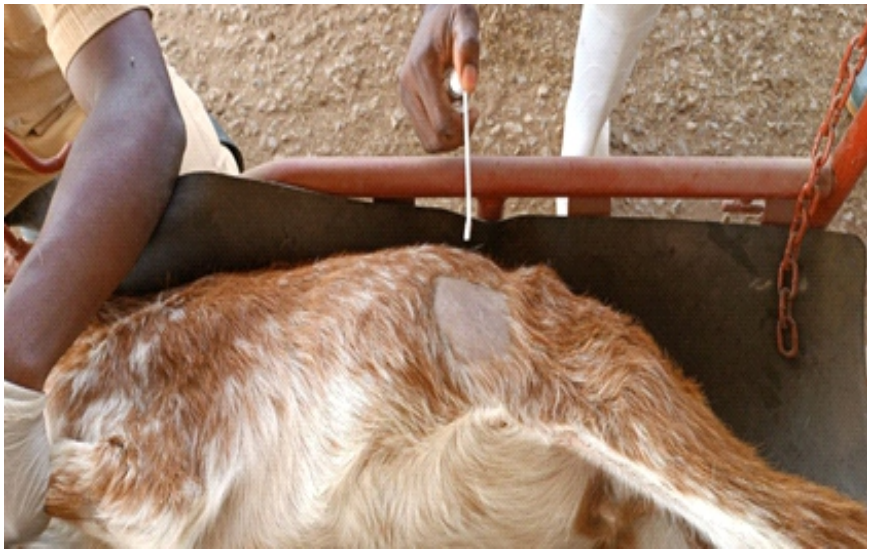

Plate 4: Topical application of lignocaine spray

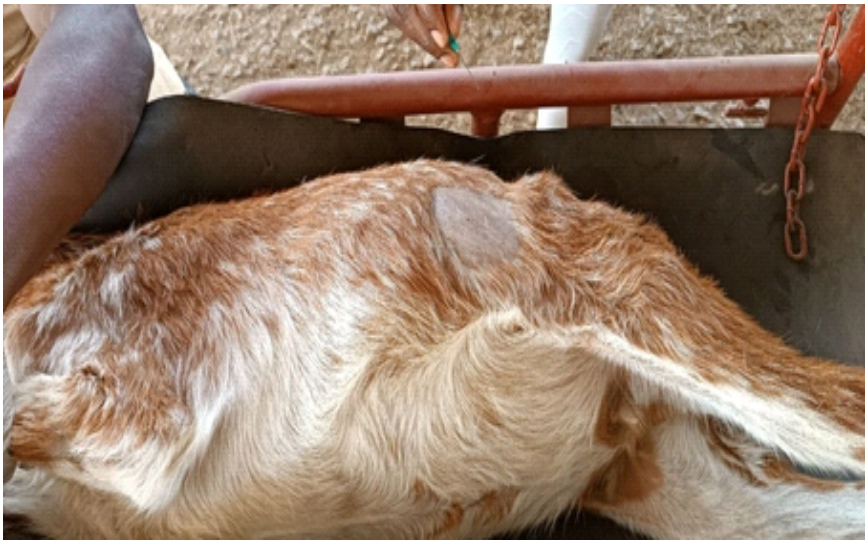

Plate 4: Needle prick

Data Analysis

Data obtained were expressed as mean ± standard error of mean (Mean ± SEM). They were analysed using students T test with GraphPad version 9.0 for windows (GraphPad software, San Diego, California, USA) to compare the level of significance between the subcutaneous infiltration of lignocaine and the topical spray administration. Values of $P< 0.05$ was considered significant. Non parametric values were presented in tables.

RESULTS

PHYSIOLOGICAL PARAMETERS

A higher pulse value was recorded when lignocaine was subcutaneously infiltrated (85.14 ± 6.029 bpm) while a lower pulse value was recorded when lignocaine was administered topically (82.29 ± 4.689 bpm). Higher temperature values were recorded when lignocaine was administered topically (39.11± 0.079^0C) while lower temperature values were recorded when lignocaine was subcutaneously infiltrated (38.63 ± 0.351^0C). Respiratory values were higher when lignocaine was administered topically (25.71 ± 1.475) while lower respiratory values were recorded using subcutaneous infiltration (20.00 ± 1.234). Although there was a significant difference in the respiratory values ($p<0.0117$), all other physiological parameters were within reference range. (Table 1)

Table 1: Physiological parameters of Does subjected to subcutaneous and topical lignocaine hydrochloride administration

PARAMETER	SUBCUTANEOUS INFILTRATION (SI)	TOPICAL SPRAY (TS)	REFERENCE RANGE
PULSE RATE (beats/min)	PRE: 87.43 ± 5.948	PRE:82.29 ± 2.740	70 - 90
	EXPT:85.14 ± 6.029	EXPT: 82.29 ± 4.689	
RESPIRATORY RATE (cycles/min)	PRE: 20.57 ± 1.043	PRE: 24.57 ± 1.360	20 - 30
	EXPT:20.00 ± 1.234[a]	EXPT:25.71 ± 1.475[b]	
TEMPERATURE (^{0}C)	PRE: 38.11 ± 0.2314	PRE: 38.36 ± 0.1395	38 - 40
	EXPT: 38.63 ± 0.3517	EXPT:39.11± 0.0799	

Reference range adapted from: Hassan and Hassan (2003).

Key: [ab]superscripts on the same row indicate significant differences at $p<0.05$; ± = SEM; PRE = Pre-experimental values; EXPT = Experimental values; n = 14.

NEEDLE PRICK TEST

The Subcutaneous Infiltration (SI) group recorded no sign of pain throughout the test period while variations in pain responses were recorded in the Topical Spray (TS) Does. Immediately post topical spray, 71% of the TS Does exhibited signs of pain, 57% exhibited pain response at 60 and 180 seconds, and 43% at 300 seconds. When the needle prick was carried out at 600 seconds, 14% of the TS Does showed signs of pain at first prick while 29% recorded pain signs on second needle prick. No signs of pain was recorded at 1200 (20 minutes) and 1800 (30 minutes) seconds in the TS Does (Table 2).

Table 2: Needle prick test at different time intervals (s) of Does administered with subcutaneous or topical lignocaine hydrochloride

SUBCUTANEOUS INFILTRATION	0	60	180	300	600	1200	1800
Tag 002	-	-	-	-	-	-	-
Tag 347	-	-	-	-	-	-	-
Tag 109	-	-	-	-	-	-	-
Tag 004	-	-	-	-	-	-	-
Tag BT1	-	-	-	-	-	-	-
Tag BT2	-	-	-	-	-	-	-
Tag 063	-	-	-	-	-	-	-
TOPICAL SPRAY	0	60	180	300	600	1200	1800
Tag NT	+	-	-	-	-	-	-
Tag 434	+	+	+	+	+/-	-	-
Tag 091	+	-	-	-	-	-	-
Tag 001	-	-	-	-	-	-	-
Tag 347(NL)	+	+	+	-	-	-	-
Tag 449	-	+/-	+	+	-/+	-	-
Tag 022	+	+	+	+	+	-	-

Key: + = Reaction to pain at first needle prick; - = No reaction to pain at first;
+/- = reaction to pain on second prick; (n=14)

DISCUSSION

Although Topical Spray (TS) group recorded increased vital parameter values than the Subcutaneous Infiltration (SI) group, the increase became significant only in the respiratory rate. As a result of both local and systemic absorption, local analgesics have an impact on clinical parameters during infiltration [13]. It has been reported that mean pulse rates were substantially greater, respiration rates increased marginally, and rectal temperature was significantly lower during subcutaneous infiltration of lignocaine-induced epidural anaesthesia in ewe [14]. The observed difference in the SI does in this study, may be due to specie differences, even as temperature elevation above 37°C is said to increase the nerve-blocking effects of lignocaine [15].

The topical spray delay of onset of analgesia might be due to the evaporation of the topical spray before penetration of the dermal nerve receptors or probably due to the skin barrier. Does in the SI group achieved better pain amelioration and recorded vital parameters within reference range. Onset of anaesthesia is largely determined by the route of administration and rate of diffusion through the tissue to reach the nerve receptors [16]. When administered topically to mucosal membranes, lidocaine is effective. It can also be utilised in the mouth, tracheobronchial tree, oesophagus, and genitourinary system. However, as compared to infiltration, the beginning of action is typically slower and the analgesia is less. [17]. Topically administered lignocaine must first cross the relatively impermeable stratum corneum, a technological defense barrier, whose impermeability can be attributed to its specific structure, consisting of a cornified proteinaceous envelope surrounding keratin-containing corneocytes interspaced by extracellular lipid lamellae. Since the ability of the agent to penetrate the nerve membrane, which involves a lipoprotein complex, is a key factor in the onset of anaesthesia [18]

The topical xylocaine pump spray used in the present study has the benefit of avoiding the systemic absorption of lidocaine's severe toxic effects in the event of accidental mucous membrane absorption [19]. When administered to intact skin, local anaesthetics often have poor absorption and are ineffective [20]. The topical spray took longer time to achieve anesthesia, with some of the does still reacting to pain even at 20 minutes, this aligns with the studies of Capetillo *et al.*, [21] which suggested that sprays should be administered more than once especially if there is no anesthetic numbness after the first 10 minutes on human model. This should be done with caution, as exposing the does to higher doses of lignocaine can tend towards toxicity [22].

CONCLUSION

This study determined that subcutaneous lignocaine infiltration is more effective as it has faster onset of action as well as longer duration of action when compared to topical lignocaine spray. Subcutaneous infiltration of lignocaine hydrochloride has a better penetrating effect on the skin but has the disadvantage of pain from needle prick. It is recommended that topical lignocaine administration may be employed to eliminate the pain of needle prick on the patients' skin, especially in elective surgeries. It should, however, be applied on the skin 30 minutes prior to the procedure.

AKNOWLEDGEMENT

The contributions of Dr. Jonas Onah and Dr. Zaifada Aisha, of the Department of Veterinary Surgery, University of Abuja, is highly acknowledged. Major Aghanti and Dr. Ezenwaka of the Nigerian Army Farms and Ranches, Abuja, are acknowledged for granting access to the research animals.

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