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Research Article

Comparative Effects of Duration of Epidural Anaesthesia in West African Dwarf Goats Using Ketamine HCL, Lidocaine HCL and Xylazine HCL

Kisani AI*, Faeren PK and Elsa AT

Department of Veterinary Surgery and Theriogenology, Federal University of Agriculture, Makurdi, Benue state, Nigeria
***Corresponding author:** abohkisani@yahoo.com

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ABSTRACT

The aim of this study was to compare the duration of analgesia produced by epidural injection of ketamine, lidocaine and xylazine in West African dwarf goats. Three healthy West African dwarf goats of varying ages were used for this study. After administration of each drug, the onset of action was recorded and the duration of action of each drug was determine through pin prick method at ten (10) minutes interval to ascertain loss of sensation as well as response to stimuli. Vital parameters (temperature, pulse, respiratory and heart rates) were determined at five (5) minutes interval throughout the duration of the anaesthesia to evaluate changes in these variables due to the actions of these drugs. The results revealed that ketamine at the dose rate (10mg/kg) had the shortest duration of analgesia and is therefore, unsuitable for use in ruminants (WAD). Xylazine has the longest duration of analgesia compare to lidocaine which has a rapid onset but short duration. It is therefore, concluded that xylazine will be suitable for epidural analgesia in healthy, young and unpregnant WAD than ketamine and lidocaine.

Key words: Xylazine, Ketamine, Lidocaine, West African Dwarf goat, Epidural anaesthesia

INTRODUCTION

The administration of agents with analgesic properties via the epidural or spinal routes has been used for many years to provide highly effective localized anaesthesia and analgesia to the animal patients (Otero and Campoy, 2013). It is a central neuraxial block technique, which is commonly utilized in veterinary medicine to allow diagnostic, obstetrical and surgical intervention in the perineal (Elmore, 1980; Skarda, 1996; Pascoe, 1992; Rauser *et al.*, 2004), sacral, lumbar regions and also caudal parts of the thoracic region. Drug selection varies depending on the goal (local anaesthetics for anaesthesia of the area, opoids or alpha-2 for analgesia without motor blockade). Species differences also influence the choice of epidural drug and need for systemic administration of sedation or tranquilizers (Mama, 2013). Drug access to the site of action is largely dependent on the drug's physical and chemical properties and its interaction with the different membranes that cover and protect the nervous tissue (Otero and Campoy, 2013).

Due to its simplicity, safety and efficacy, epidural anaesthesia is one of the most commonly used central neural block technique for control of intraoperative and post-operative pain (Vnuk *et al.*, 2011). Diagnostic, obstetrical and minor surgical procedures in the rear limbs, perineum, pelvis and tail are the main indications for the use of epidural anaesthesia. It provides excellent analgesia and improves postoperative outcome (Brodner *et al.*, 1999). Lumbosacral (L6-S1) epidural anaesthesia is the most common epidural technique used in sheep, goats and calves for all procedures caudal to the umbilicus (Gray and McDonell, 1986; Skarda and Tranquilli, 2007; Dadafarid and Najafpour, 2008). The aim of this study was to compare the duration of analgesia produced by epidural injection of ketamine, lidocaine and xylazine in West African dwarf goats.

MATERIALS AND METHODS

Experimental animals

Three apparently healthy West African dwarf goats (2 bucks and a doe) were bought from the goat market at North Bank Makurdi, Benue state, Nigeria. Their age ranged from 4-1 months and weights range was between 6-10kg. They were housed at the Veterinary Teaching Hospital University of Agriculture, Makurdi and were fed with (dusa) roughly grinded maize grain chaffs, mango leaves and water adlibitum for a period of one and half months for thorough clinical examination and evaluation

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before the commencement of practical. Each animal was subjected to thorough physical examination and vital parameters (temperature, pulse, respiratory and heart rates) were taken to ensure that only healthy animals were used.

Drugs

In this study, three drugs were used namely: lidocaine hydrochloride, ketamine hydrochloride and xylazine hydrochloride.

Procedure

The animals were properly restrained in a standing position with the help of an assistant by placing the animal in between the assistants legs with the forelimb raised. The surgical site (L1-C3) was shaved and scrubbed with soap and water and prepared aseptically with chlorhexidine and 70% isopropyl or ethyl alcohol. The entire surgical site was painted with 20% tincture of iodine which was allowed to dry on the skin after which the patient was taken to the theatre (Kumar, 1997).

After proper preparation and restraint, one finger was used to feel the depression at the intercoccygeal part of the coccygeal vertebra and an 18gauge needle was inserted at the site straight through the skin and then at an angle of 45 degree to the skin surface directed anteriorly and ventrally to the depth of 2-4cm and the anaesthetic was infused (lidocaine 1ml, ketamine 1.2 mls and xylazine0.01 ml). The injection was made slowly and without any resistance to the syringe plunger.

After the drug (lidocaine 2mg/kg, ketamine 10mg/kg and xylazine 0.02mg/kg) was administered, the time of administration was noted as well as the onset of drug action which was determined by performing anal pin prick and non response of the animal indicate onset of drug action. From the onset of drug action the anal pin prick was performed after every 10 minutes to the time the animal started responding indicating the exhaustion of the drug effect. This time was recorded giving the duration of analgesia of the drug. Vital parameters such as temperature, pulse rate, respiratory rate and heart rate were taken before, during and after the duration of action to ascertain changes in value in order to correlate changes with the drug effect.

Statistical analysis

All statistical analyses were performed by use of statistical software, Graph Pad Prism 5.0. Mean and standard error of mean (SEM) values were calculated. To compare post-with pre- anaesthetic values, unpaired *t*-test was applied.

RESULTS

There was no significant difference in the mean ± standard deviation of temperature (°C), respiratory rate (cycle/minute) and heart rate (beat/minute) between the baseline values and those recorded at intervals (20 and 40 minutes) after the injections. No significant difference in respiration rate from baseline values and at the interval is noticed in all animals. But there is a variation at the baseline values of temperature for lidocaine which could be attributed to the tachycardia effect of lidocaine. The variations are observed in pulse rate at 20 minutes for ketamine and xylazine HCL, the same is noticed for the heart rate of the baseline for lidocaine HCL at the 40 minutes for ketamine HCL, which is due to its effect on sympathetic stimulation. However, the overall result of analysis of variance (table 4) shows that there is a significant difference ($P<0.05$) in onset and duration of action for xylazine HCL. This significant variation in the action of xylazine HCL which could be traced to its dose dependent sedation, analgesia, muscle relaxation effect and its rapid onset within 10-15minutes when administered intramuscularly or subcutaneously and its duration of activity is between half an hour and an hour.

DISCUSSION

The duration of analgesia 40.0±0.71 produced by xylazine and 33.0±5.66 by lidocaine in this study is not in accord with the 142.20±13.60 and 75.92±10.33 respectively reported by Sarrafzadeh-Rezaei *et al*. who employed 2% both xylazine and lidocaine at a dose rate of 0.17 mg/kg^{-1} and 0.22 mg/kg^{-1} and with 148.0±23.1 reported by Adetunji[1] using 2% xylazine at a dose rate of 0.5 mg/kg. These discrepancies may relate to the difference in the animal species used by Sarrafzadeh-Rezaei *et al*. and dosages of the drug employed in this and previous similar studies. Also, no significant differences in heart rate and respiratory rate from base value were noticed at different time intervals in the WAD after epidural xylazine. Similar results have been reported following epidural administration of xylazine in horses and donkeys (Sarrafzadeh-Rezaei *et al*, 2007). This can be explained by the expected low plasma concentration of the drug after epidural administration, producing no major systemic effects. Furthermore, in comparison with lidocaine and ketamine, xylazine causes a significant longer duration of analgesia.

Table 1: Changes in vital parameters following epidural injection of lidocaine HCL in WAD

Time (minutes)	Temperature (°C)	Respiratory rate (cycles/min)	Pulse rate (beats/minutes	Heart rate (beats/minutes)
	mean±SD	mean±SD	mean±SD	mean±SD
0	37.7±1.04*	24.0±4.40	62.0±4.80	125.0±3.96*
20	38.0±1.13	24.0±2.94	62.0±4.51	124.0±11.05
40	38.6±1.40	24.0±3.32	62.0±4.73	124.0±10.66

*P<0.05.

Table 2: Changes in vital parameters following epidural injection of ketamine HCL in WAD

Time (minutes)	Temperature (°C)	Respiratory Rate (cycles/minute)	Pulse Rate (beats/minute)	Heart Rate (beats/minute)
	mean±SD	mean±SD	mean±SD	mean±SD
0	37.7±1.10*	28.0±1.91	68.0±9.80	114.0±4.32
20	38.6±1.17	28.0±1.91	70.0±10.23*	119.0±6.25
40	38.2±1.14	28.0±1.91	69.0±8.98	123.0±8.50*

*P<0.05.

Table 3: Changes in vital parameters following epidural injection of xylazine HCL in WAD

Time (minute)	Temperature (°C)	Respiratory Rate (cycle/minute)	Pulse Rate (beat/minute)	Heart Rate (beat/minute)
	mean±SD	mean±SD	mean±SD	mean±SD
0	38.4±0.33	24.0±2.83	65.0±4.65	125.0±4.80
20	38.5±0.29	24.0±2.08	68.0±4.32*	128.0±4.55
40	38.7±0.47	24.0±2.65	65.0±4.32	126.0±6.19

*P<0.05.

Table 4: Onset and duration of action of the anaesthetics

Time (minute)	Lidocaine HCL (1ml)	Ketamine HCL (1ml)	Xylazine HCL (0.5ml)
Onset of action	6.0±2.12	5.0±0.71	9.0±1.41*
Duration of action	33.0±5.66	28.0±5.00	40.0±0.71*

*P<0.05.

DISCUSSION

The duration of analgesia 40.0±0.71 produced by xylazine and 33.0±5.66 by lidocaine in this study is not in accord with the 142.20±13.60 and 75.92±10.33 respectively reported by Sarrafzadeh-Rezaei *et al*. who employed 2% both xylazine and lidocaine at a dose rate of $0.17mg/kg^{-1}$ and $0.22mg/kg^{-1}$ and with 148.0±23.1 reported by Adetunji[1] using 2% xylazine at a dose rate of 0.5 mg/kg. These discrepancies may relate to the difference in the animal species used by Sarrafzadeh-Rezaei *et al*. and dosages of the drug employed in this and previous similar studies. Also, no significant differences in heart rate and respiratory rate from base value were noticed at different time intervals in the WAD after epidural xylazine. Similar results have been reported following epidural administration of xylazine in horses and donkeys (Sarrafzadeh-Rezaei *et al.*, 2007). This can be explained by the expected low plasma concentration of the drug after epidural administration, producing no major systemic effects. Furthermore, in comparison with lidocaine and ketamine, xylazine causes a significant longer duration of analgesia.

Various studies have shown a decrease in post operative morbidity and mortality when used either with general anaesthesia or alone (Bauer *et al.*, 2012). Neuraxial blocks have been reported to reduce the incidence of venous thrombosis and pulmonary embolism while also minimizing transfusion requirements and respiratory compromise following thoracic and upper abdominal surgery (Bauer *et al.*, 2012).

The result of this study revealed that the epidural administration of lidocaine, ketamine or xylazine is effective for induction of caudal epidural anaesthesia. The spread of anaesthetic solution within the epidural space is known to be influenced by a variety of factors, including age, obesity, pregnancy and body posture. Therefore, aged, obese and pregnant goats were not included in this study in order to obtain valid data for comparison. Although sedation has been recommended for routine use in animals to facilitate epidural administration of anaesthetic agents, the use of sedative drugs was deliberately omitted in this study to avoid its possible confounding effects on the physiological variable being measured.

In conclusion, any of the three drugs can be used for epidural analgesia in WAD. Ketamine at the dose rate used in this study had the shortest duration of analgesia therefore, unsuitable for use in ruminants. Xylazine has the longest duration of analgesia compare to lidocaine which has a rapid onset. In view of this result, xylazine would be preferred for epidural analgesia in healthy young and unpregnant WAD than ketamine and lidocaine.

This study is limited to investigate thoroughly the mechanisms associated with the variations observed in the parameters which suggest that further studies are needed to achieve an optimal satisfactory analgesia without any complications.

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