

COMPARISON OF THREE KETAMINE DRUG COMBINATIONS FOR SHORT TERM ANAESTHESIA IN WEST AFRICAN DWARF GOATS

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ABSTRACT

The anaesthetic qualities of single intravenous (IV) injection of Xylazine/Ketamine (XK) at a dose of 0.05/25mg/kg, acepromazine/ketamine (AK) at a dose of 0.05/25mg/kg and diazepam/ketamine (DK) at a dose of 0.5/25mg/kg were evaluated and compared in five non-fasted West African Dwarf (WAD) goats. The mean heart rate (HR), respiratory rate (RR) and rectal temperature (RT) were measured in the anaesthetized goats placed in lateral position. Surgical anaesthetic time, recumbency time, standing time and time to feeding were also calculated. The anaesthetized goats were observed for the presence or absence of the side effects of the drugs administered. The mean HR in the XK group was significantly ($P < 0.05$) lower throughout the study period compared to AK and DK groups. The surgical anaesthetic time (65 ± 6.4 min) was significantly ($P < 0.05$) longest in XK group followed by the DK group (46.0 ± 7.2 min) and AK group (29.2 ± 4.5 min). The time to feeding (2.0 ± 1.1 min) following DK injection was significantly shorter than the value of 9.4 ± 4.6 min for AK group or 12.0 ± 3.4 min for XK group. The recumbency times of 83.0 ± 9.1 min for XK group, 78.6 ± 14.1 min for DK group and 89.6 ± 16.9 min for AK group were not significantly ($P > 0.05$) different. Also the standing time of 6.4 ± 2.0 min for XK, 14.0 ± 7.6 min for DK and 4.0 ± 1.3 min for AK were not significantly ($P > 0.05$) different. The following side-effects were noted: salivation, ruminal tympany, urination, open eyelids and apneustic breathing in all the three groups. It was concluded that the surgical anaesthetic time was longest with XK, shortest with AK and intermediate with DK. The three ketamine drug combinations were safe for clinical use in WAD goats in lateral position since no significant cardiopulmonary embarrassment was noted. However, XK combination appears to be the ideal drug combination and should be used for general anaesthesia in WAD Goats.

Key words: anaesthesia, ketamine, xylazine, intravenous, WAD goats

INTRODUCTION

Goats are widely kept in farms and households in tropical countries including Nigeria. They are kept for the production of meat, milk, skin and fibre (Devendra and Burns, 1983). In Nigeria 5,621 million goats are kept. This is more compared to smaller populations of sheep (857 million) and cattle (347 million) (Janke, 1982).

In view of the large number of goats being raised in Nigeria, there is a high probability for goat keepers to seek veterinary services which may necessitate the use of anaesthetics. For instance, surgical procedures commonly carried out in goat practice include: rumenotomy, relief of intestinal obstruction, caesarean operation, mastectomy and fracture fixation (Gray and McDonell, 1986).

Unlike in cattle, standing surgical operation under sedation plus local analgesia is not practicable in sheep and goats due to their small size (Adetunji and Ogunyemi, 1998). These

animals must therefore be placed in the recumbent position for major surgeries. Thus, for humane reasons and for optimal technical efficiency, the use of a general anaesthetic for the small ruminant appears rational (Adetunji and Ogunyemi, 1998). However since clinical procedures in these species are oftentimes carried out under field conditions, the use of an anaesthetic technique involving the use of only needles and syringes would seem ideal.

The use of ketamine as an injectable anaesthetic is highly favored since it is easy to administer and has a wide safety margin (Thurmon, 1986). It is also cheap and readily available (Personal observation). Its use as sole anaesthetic is however considered unsatisfactory for surgery (Green *et al.*, 1981). This is because of its tendency to produce excitement during induction and recovery. It also increases muscle tone and causes

profuse salivation (Thurmon, 1986). To counteract these side effects, ketamine is administered concurrently with sedatives such as xylazine, acepromazine and diazepam (Gray and McDonell, 1986., Hall and Clarke, 1991).

Currently the xylazine/ketamine (AK) drug combination is widely used in small ruminants (Green *et al.*, 1981., Muir, 1985., Taylor, 1991., Adetunji and Ogunyemi, 1998., Eze *et al.*, 2004) because it produces safe and dependable anaesthesia. There have been reports on the use of acepromazine/ketamine (Gray and McDonell, 1986., Short, 1987) and diazepam/ketamine (Gray and McDonell, 1986., Riebold *et al.*, 1995., Riebold, 1996) in this species in the temperate regions. However no report exists on the use of diazepam/ketamine (DK) and acepromazine/ketamine (AK) in West African Dwarf (WAD) goats. This work was thus designed to evaluate the anaesthetic and physiological effects of DK and AK in WAD goats. These drug effects plus their associated side effects were then compared with those of XK. Information thus obtained would enable the selection of the best ketamine drug combination for short term anaesthesia in WAD goats.

MATERIALS AND METHODS

Animals: Five adult West African Dwarf (WAD) goats were studied. Their body weights ranged from 8 to 10kg (8.4 ± 0.4 kg). They were housed in small pens and fed with giant star grass (*Cynodon alenifuensis*), cassava peelings and wheat bran. Water and salt lick were provided free choice in the pens. During the two weeks acclimatization period, blood and fecal analysis were performed. Deworming was done with albendazole bolus (Salbezole[®], Sam pharmaceutical Ltd. Lagos) at a dose of 5mg/kg orally. The animals were considered to be clinically healthy based on results of physical examination and haematological tests.

Experimental design: Each goat was anaesthetized three times; once each with the three drug combinations. The order of drug administration was randomized and the goats were anaesthetized at one week intervals. All drugs were given intravenously (IV) through the external jugular vein.

Drug combinations: The drugs were combined as follows (i) 0.05mg/kg xylazine (Xylazin[®], Indian immunological Ltd) followed immediately by 25mg/kg ketamine (Ketmine[®], Rotexmedica, Germany) (XK, 0.05/25mg/kg). (ii) 0.5mg/kg diazepam (Valium[®], Roche. Boulevard de Parc) followed immediately by 25mg/kg ketamine (DK, 0.5/25mg/kg). (iii) 0.05mg/kg acepromazine (Calmivet[®], Vetoquinol specialities phamaceutiques veterinaries) followed

immediately by 25mg/kg ketamine (AK, 0.05/25mg/kg).

Experimental procedure: For this study feed and water were not withheld from the goats before the drug trials (Adetunji and Ogunyemi, 1998; Eze *et al.*, 2004). The goats were positioned in sternal recumbency, the jugular areas were shaved and disinfected with 70 percent alcohol. A sterile tuberculin syringe was used to inject the sedatives into the jugular vein followed immediately by bolus injection of ketamine with a 23G hypodermic needle and a 5 ml syringe. The anesthetized goats were then placed on right lateral recumbency on operating tables covered with straw. Their heads were supported on the poll so as to permit free drainage of saliva. All trials were carried out in the absence of any manipulative or surgical procedures. The heart rate, respiratory rate and rectal temperature were taken before IV injection (time 0) and subsequently at every 10 min interval over a time period of 60 min while the animals were recumbent. Heart rate (beats/min) was determined with the aid of a precordial stethoscope, respiratory rate (breaths/min) was counted by visual observation of thoraco-abdominal movements while rectal temperature (°C) was measured with a mercury -in -glass clinical thermometer. For the purpose of this study the calculated anaesthetic indices were defined as described by Adetunji and Ogunyemi (1998). Surgical anaesthetic time: Time interval (in min) between disappearance of flank twitch reflex and its appearance following IV injection of ketamine. Recumbency time: Time interval (in min) between ketamine induced lateral recumbency and assumption of sternal posture by the anaesthetized goats. Standing time: Time interval (in min) between assumption of sternal recumbency and standing posture by the anaesthetized goats. Time to feeding: Time interval (in min) between the assumption of standing posture and the time the animal starts to eat. The anaesthetized goats were observed for the presence or absence of the following: muscle tone, vocalization, phonation, apneustic breathing, regurgitation, salivation, aspiration, ruminal tympany, urination, open eyelids and defaecation (Adetunji and Ogunyemi, 1998., Eze *et al.*, 2004).

Data analysis: Data was expressed as mean \pm standard error of mean (SEM) of the five goats in each group. The anaesthetic indices and physiological effects among the three drug combination were compared using analysis of variance for repeated measures (ANOVA). $P < 0.05$ was accepted as being significant in all comparisons. T-test was employed as post -test.

RESULTS

General observations: All animals lost their righting reflex within one minute of intravenous injection of ketamine. The anaesthetized goats exhibited open eyelids with pupillary dilation. Muscle relaxation was noted in all experimental animals though of less degree in AK group. Grunting was observed early following use of DK and AK drug combinations. Salivation was more profuse in XK group compared to DK and AK groups. Pedal reflex persisted in DK and AK groups but disappeared in XK group.

Physiological variables: The mean heart rate declined slightly following injection of the three drug combinations from 0 to 10 min. The mean HR in XK group was significantly ($P < 0.05$) lower than that in either AK and DK groups (Fig 1). There was no significant ($P > 0.05$) difference in the mean respiratory rates following injection of the three drug combinations (Fig 2). Although there was 0.74°C decrease in the mean RT in general, there was no significant difference in the RT among the three groups (Fig 3).

Calculated indices: The surgical anaesthetic time (65 ± 6.4 min) was significantly ($P < 0.05$) longest in XK group followed by DK group (46.0 ± 7.2 min) and AK group (29.2 ± 4.5 min). The time to feeding (2.0 ± 1.1 min) following DK injection was significantly ($P < 0.05$) shorter than the value of 9.4 ± 4.6 min for AK group or 12.0 ± 3.4 min for XK group (Fig 4). The recumbency times of 83.0 ± 9.1 min for XK group, 78.6 ± 14.1 min for DK group and 89.6 ± 16.9 min for AK group were not significantly ($P > 0.05$) different. Also the standing time of 6.4 ± 2.0 min for XK, 14.0 ± 7.6 min for DK and 4.0 ± 1.3 minutes for AK were also not significantly ($P > 0.05$) different.

Side effects: The incidence of salivation, ruminal tympany, grunting, aspiration and open eyelids observed in all three groups were similar (Table 1). Urination was observed in the three groups but its incidence was higher in AK (5) compared to XK (2) and DK (1). Defaecation was observed in two animals in AK group. Apneustic breathing was observed in all animals in XK group and in one animal in AK. Regurgitation occurred in two animals in AK group.

Table 1: Side effects of intravenous injection of xylazine/ketamine (XK), diazepam/ketamine (DK) and acepromazine/ketamine (AK) in West-African Dwarf goats.

Side effects	XK (N=5)	DK (N=5)	AK (N=5)
Salivation	5	4	5
Ruminal tympany	5	5	5
Urination	2	1	5
Regurgitation	0	0	2
Grunting	3	3	2
Apneustic breathing	5	0	1
Aspiration	0	0	0
Defaecation	0	0	2
Open eyelids	5	5	5

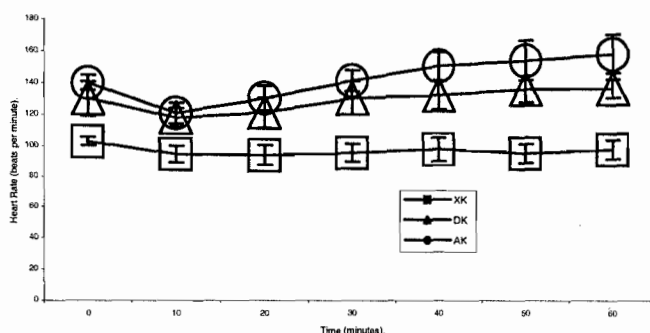


Figure 1: Heart rates following intravenous (IV) injection of Xylazine/ketamine (XK), diazepam/ketamine (DK) and acepromazine/ketamine (AK).

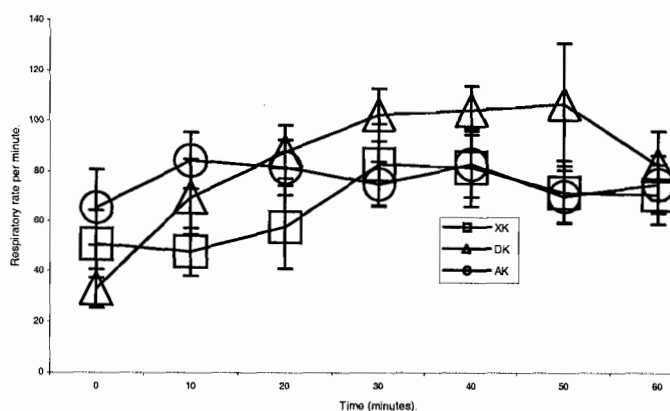


Figure 2: Respiratory rates following intravenous (IV) injection of xylazine/ketamine (XK), diazepam/ketamine (DK) and acepromazine/ketamine (AK).

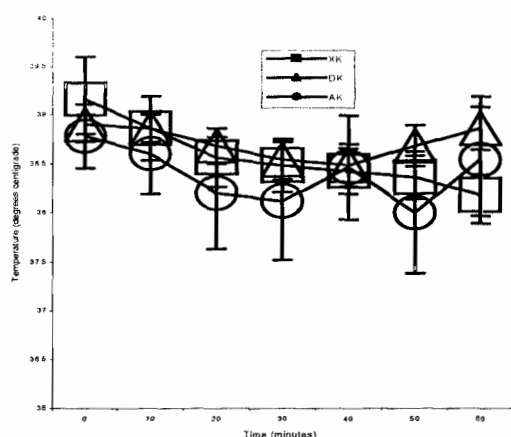


Figure 3: Temperatures following intravenous (IV) injection of Xylazine/ketamine (XK), diazepam/ketamine (DK) and acepromazine/ketamine (AK).

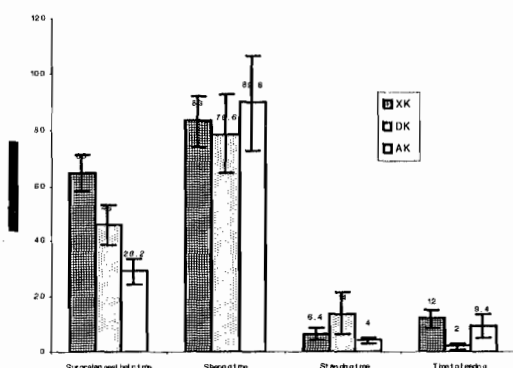


Figure 4: Anaesthetic indices following intravenous (IV) injection of Xylazine/ketamine (XK), diazepam/ketamine (DK) and acepromazine/ketamine (AK).

DISCUSSION

The results of this study show that XK group had the lowest mean HR throughout the study period. XK injection induced the longest period of surgical anaesthesia while AK injection induced the least. Time to feeding was shortest in DK group and longest in XK group. The IV injection of the three drug combinations was associated with side effects such as salivation, ruminal tympany, urination and open eyelids.

The cause of the slight fall in HR at the 10 minute interval relative to base line values is unknown. Throughout the experiment, XK group had the lowest mean HR probably due to the over-riding bradycardiac effect of xylazine in the combination (Eze *et al.*, 2004). Similar studies using XK combination have also reported lowering of HR

following administration of the drug combination (Nowrouzian *et al.*, 1981., Thurmon, 1986., Coulson *et al.*, 1989., Eze *et al.*, 2004). In the other two groups the cardio-stimulatory effect of ketamine appears to be prevalent.

DK group had the shortest time to feeding probably due to the appetite stimulatory effect of diazepam (Van Meit *et al.*, 1989).

It is interesting to note that there were no significant differences in the values of time to standing and recumbency time among the three groups. Hall and Clarke (1991) reported that acepromazine is long acting. This was not noticed in this study probably due to the IV route of administration which favours rapid drug biotransformation (Chung *et al.*, 1983).

Salivation, ruminal tympany, grunting, aspiration and open eye-lids were observed in all three groups. These side effects have also been reported in other studies following use of ketamine drug combinations (Riebold, 1995., Carroll and Hartsfield, 1996., Adetunji and Ogunyemi, 1998., Eze *et al.*, 2004).

Urination was induced by the injection of the three drug combinations. This side effect has been reported in studies using ketamine in combination with xylazine in goats (Nowrouzian *et al.*, 1981., Adetunji and Ogunyemi, 1998., Eze *et al.*, 2004). The reason for urination in AK group is not known.

Apneustic breathing characterized by inspiratory holds was observed in all animals in XK group. This breathing pattern has been reported following sole use of ketamine in sheep (Waterman and Livingston, 1978). Apnoea is also a side-effect of xylazine (Hall and Clarke, 1991). Thus the apneustic breathing observed in the experimental group can be attributed to the ketamine and xylazine components of the drug combinations. It is however surprising that there was no record of apneustic breathing in DK group. Thus the use of diazepam for pre-medication seemed to have reduced the apneustic effect of ketamine.

The cause of defaecation in AK group is not clear. It may be due to muscle relaxation of the anal sphincter. Defaecation during anaesthesia is not desirable since it will break asepsis.

Regurgitation was noted in two animals in AK group. This observation is supported by previous work by Trim (1981) who reported that the risk of regurgitation is high under general anaesthesia in which oesophageal tone is reduced and the sphincter is relaxed. In other works, regurgitation was reported following use of AK drug combination (Riebold *et al.*, 1982., Thurmon *et al.*, 1973). The regurgitation observed in this group was attributed to the acepromazine component of the drug combination. Acepromazine causes relaxation of the pharyngo-oesophageal and gastro-oesophageal sphincters allowing reflux of rumen content (Jones, 1972).

Aspiration was however not observed in this work following regurgitation due to the postural drainage used. This confirms the existing report that postural drainage can be used in non-intubated goats to prevent aspiration (Gray and McDonnell, 1986).

CONCLUSION.

From the results obtained, it is concluded that DK and AK are also safe for use in West African Dwarf goats since their use did not cause any significant cardiopulmonary embarrassment or deleterious effect. However, XK combination appears to be the ideal drug combination and should be used for general anaesthesia in WAD Goats.

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