

Evaluation of Ketamine/diazepam Anaesthesia for Performing Surgery in Desert Goats under Field Condition

Ghurashi, M.A.H., Seri, H.I., Bakheit, A.H., Ashwag, E.A.M., Abakar, J.A.

Faculty of Veterinary Science, University of Nyala, Sudan.

Abstract: The anaesthetic protocol of Diazepam 0.5 mg/kg – Ketamine 4mg/kg was used for performing rumenotomy in caprine. Six desert goats with mean body weight 30 ± 3.3 kg were used in this study. The animals were proved to suffer from presence of foreign body in the rumen. This protocol resulted in surgical anaesthesia for 31.5 ± 4.4 minutes with full recovery time 54.6 ± 7.63 minutes and fair muscle relaxation with non- significant ($P \leq 0.05$) effect on respiration, heart rate and rectal temperature. Reliability of using some reflexes for monitoring of anaesthesia was also studied.

Key words: Ketamine, Diazepam, desert goats, rumenotomy

INTRODUCTION

Ketamine is classified as a dissociative anaesthetic, it can be injected intravenously or intramuscularly (Hall, L.W., K.W. Clarke, 2001). It is composed of two isomers and it produces anaesthetic and analgesic effects and the analgesic effect seems to be greater than the anaesthetic effect (White, P.F., J. Ham, 1980). The effect of ketamine became apparent rapidly after its injection and the drug produces profound analgesia with poor muscle relaxation and muscle tone is often increased (Hall, L.W., K.W. Clarke, 2001). The drug is described as unique drug because it has hypnotic, analgesic and amnesic effect (Tomlinson, A., 1994).

Diazepam is a popular benzodiazepine derivative for use in different animal species (Hall, L.W. and K.W. Clarke, 1992). The drug has a dose dependant effect (Muir, W.W. and D.E. Mason, 1993). The drug was reported to have minimum effect on respiratory system, heart rate and rectal temperature (Bright, R.M., 1986; Hall, L.W., K.W. Clarke, 2001). The drug was reported to cause good muscle relaxation and can be used to cure convulsions (Averill, D.R.Jr., 1970).

The aim of this study is to evaluate the anaesthetic protocol of Ketamine/ diazepam in desert goats in terms of its effect on vital physiological activity and also its efficiency in performing surgical operations.

MATERIALS AND METHODS

Experimental Animals:

Six mature desert goats were used in this study; their mean body weight was 30 ± 3.3 kg. The animals were proved to be suffering from presence of foreign body in the rumen which was detected by external abdominal palpation. Other than the foreign body the general health of the animals was fair.

Site of the Study:

This study was conducted in Nyala town South Darfur state, Sudan; during the period May to July 2008.

The Anaesthetic Protocol:

Ketamine 4mg/kg + Diazepam 0.5 mg/kg was used by intravenous route. Diazepam was injected first and then followed by Ketamine 10 minutes later.

Physiological Parameters:

Respiratory rate, heart rate and rectal temperature were monitored using standard methods (Kelly, W.R., 1984), before injection of the drugs and at ten minutes intervals throughout the period of drugs effect until full recovery was attained.

Correspondence Author: Dr. Hisham Ismail Seri, Faculty of Veterinary Science, University of Nyala, Sudan.
Tel: +249 129356040, Fax: +249 183 575644,
E-mail: hishamser@yahoo.com

Reflexes Monitored:

The different reflexes were monitored subjectively at 10 minutes interval as following: palpebral and pedal reflex (Williams, A.M., J.D. Wyatt, 2007), tongue reflex (Kitzman, V.J., N.H. Blooth, 1982), cough (Radostits, O.M., C.C. Gay, 2007), and swallowing reflex (Rawlings, C.A. and R.J. Kolata, 1983). Throughout the period of anaesthesia the animals were watched closely and remarks were reported immediately.

Statistical Analysis:

Analysis of variance (ANOVA) was used to compare the raw data obtained and the least significant difference was used to determine the significant difference between the means of each parameter.

RESULTS AND DISCUSSION

Results:

Anaesthetic Protocol:

Injection of diazepam resulted in sedation of the animals tested. The sedation occurred is translated by ataxia in 66.6 % (4 out of 6 animals) of the animals which occurred after 11.5 ± 2 sec these animals fell to the ground within 19.75 ± 4.91 seconds. In 33.3 % (2 out of 6 animals) of the animals showed exaggerated sedation which translated by prompt falling of the animals to lateral recumbancy within 16 ± 6 sec. after injection of diazepam.

After falling to the ground the 33.6% (2 out 6 animals of the animals) which adopted lateral recumbancy without taking the sternal recumbancy showed paddling of limbs while the other animals adopted sternal recumbancy do not paddled their limbs

Profuse salivation occurred in the whole group of animals within the first six minutes following injection of diazepam. As shown in table (1), two out of the six animals tested (33.3%), lost palpebral reflex after ten minutes of injection of diazepam. As shown in table (1), 33.3% (two out of six animals) of the tested group lost provoked tongue reflex after ten minutes of injection of diazepam, while the whole group of animals lost spontaneous tongue reflex after ten minutes of injection of diazepam.

Table 1: Showing the effect of diazepam on tested reflexes within 10 minutes following injection of the drug

| Reflex | P.R | P.T.R. | S.T.R. | P.R. | C.R. | S.S.R. | P.S.R. |
|---|------|--------|--------|------|------|--------|--------|
| Percentage of the animals lost the reflex | 33.3 | 33.3 | 100 | 33.3 | 83.3 | 100 | 0 |

P.R= Palpebral reflex, P.T.R= provoked tongue reflex, S.T.R= spontaneous tongue reflex, P.R= pedal reflex C. R.= cough reflex, S.S.R= spontaneous swallowing reflex, P.S.R= provoked swallowing reflex

Two out of six animals (33.3%) of the tested group lost pedal reflex after ten minutes of injection of diazepam as shown in table (1). Five out of the six animals (83.3%) tested lost cough reflex after 10 minutes of injection of diazepam as shown in table (1). All of the animals (100%) lost spontaneous swallowing reflex, while none of the tested animals lost provoked swallowing reflex during ten minutes following injection of diazepam as shown in table (1). Uttered moaning sounds were expressed by 83.3% (5 out of 6 animals) of the animals, at least once during the course of anaesthesia.

Rumenotomy:

The surgical incision was made 6.00 ± 0.17 min following induction of anaesthesia as shown in table (2), four out of the six animals tested (66.6%) showed slight response by contraction of the skin in the flank area while one out of the six animals (16.6%) uttered a loud cry in response to surgical incision of skin and one out of the six animals tested (16.6 %) moved its head and limb in response to surgical incision.

Table 2: Showing the progress of surgical operation and the percentage of the animals which show sensation with the particular stage of surgery

| Parameter | O.S | O.M | O.R | S.R | S.M | S.S |
|--------------------|----------------------------|---------------------------|----------------------------|----------------------------|--------------------------|-------------------------|
| Time of occurrence | 6.00 ± 0.17 (66.6%) | 6.78 ± 1.2 (83.3%) | 10.00 ± 0.3 (16.6%) | 15.00 ± 0.5 (16.6%) | 26.00 ± 4.24 (0%) | 31.00 ± 5.5 (0%) |

O.S= opening of skin, O.M. = opening of muscles, O.R= opening of rumen, S.R= suturing of rumen, S.M. = suturing of muscles S.S= suturing of skin. % = the percentage of the animals show sensation to particular stage of surgery

The muscles were surgically opened within 6.78 ± 1.2 minutes after induction of anaesthesia as shown in table (2). Five out of the six animals (83.3%) reacted positively to the opening of muscles by mild contraction of the muscles in the area while one animal (16.37%) out of the six animals tested reacted by uttering a loud cry.

As shown in table (2), surgical incision of the rumen was made after 10.00±0.3 minutes after induction of anaesthesia. Only one of the animals (16.6%) showed responded to the surgical incision of the rumen by moving of the head. The mean time of suturing rumen was 15.00±0.5 minutes after induction of anaesthesia as shown in table (2), only one animal (16.6%) responded to rumen suture by moaning. The muscles were sutured after 26.00±4.24 minutes of induction of anaesthesia as shown in table (2), the whole group of animals responded negatively.

As shown in table (2), the skin was sutured after 31.00±5.5minutes of induction of anaesthesia the whole group of animals responded negatively to suture of skin.

As shown in table (3) the duration of surgical operation was of 31.5±4.4 Minutes, the time required for adopting sternal recumbancy was 40.5±9.46 minutes, and the total recovery was attained at 54.6±7.63 minutes. As shown in table (4) palpebral reflex was found to be positive through the whole period of anaesthesia in all animals, tongue reflex remained positive for the whole period of anaesthesia in 33.3% while in the other animals it disappeared for 25.5±17.5 minutes. Provoked swallowing reflex remained positive for the whole period of anaesthesia in 83.3% of the animals, while in the remaining 16.6% it disappeared for 20 minutes only as shown in table (4). Pedal reflex disappeared for 23.3±12.1 minutes in all animals as shown in table (4). Cough reflex disappeared for 41.6±11.7minutes in all animals tested as shown in table (4).

Table 3: Duration of anaesthesia and recovery

| Parameter | Surgical anaesthesia | Sternal Recumbancy | Full recovery |
|-----------|----------------------|--------------------|---------------|
| Duration | 31.5±4.4 | 40.5±9.46 | 54.6±7.63 |

Table 4: Showing the duration (minutes) of disappearance of different reflexes after injection of the anaesthetic protocol

| Reflex | P.R. | P.T.R. | S.T.R. | P.R. | C.R. | S.S.R. | P.S.R. |
|----------|------|------------|--------|-----------|-----------|--------|--------|
| Duration | 0.00 | 25.5 ±17.5 | 0.00 | 23.3±12.1 | 41.6±11.7 | 100 | 0.00 |

P.R= Palpebral reflex, P.T.R= provoked tongue reflex, S.T.R= spontaneous tongue reflex, P.R= pedal reflex
S.S.R= spontaneous swallowing reflex, P.S.R= provoked swallowing reflex

Respiratory rate, heart rate and rectal were found to be non- significantly affected ($P \geq 0.05$) as shown in table (5).

Table 5: Showing Respiratory rate (R.R) beat/min., Heart rate (H.R) beat/minute and rectal temperature (R.T) degree centigrade during the period of premedication and anaesthesia.

| Parameter | 0 | 10 | 0 (k) | 10 | 20 | 30 | 40 | 50 | 60 |
|-----------|-----------|-------------|-------------|-------------|-------------|------------|-------------|--------------|-------------|
| R.R | 27±5.13a | 25.42±7.9 a | 23.5±13.2 a | 28.4±9.9 a | 24.6±10.6 a | 25.0±6.5 a | 25.0±9.9 a | 27.00±14.0 a | 26.00±7.0 a |
| H.R | 88.0±9.9b | 92.5±10.9 b | 89.8±15.4 b | 69.5±12.7 b | 75.3±11.6 b | 84.3±8.0 b | 85.6±14.2 b | 92.5±12.6 b | 90.5±13.0 b |
| R.T | 38.9±0.6c | 38.5±1.0 c | 38.4±0.98 c | 38.55±1.0 c | 38.1±1.0 c | 38.1±0.9 c | 38.0±1.1 c | 37.7±1.3 c | 38.0±1.0 c |

Values mean ±SD. Different letters in the same raw indicate significant difference ($p \geq 0.05$)

R.R = respiratory rate, measured by cycle /minute

H.R = heart rate, measured beat/ minute

R.T = rectal temperature, measured by centigrade degree

0 (k) = immediately after injection of ketamine

Discussion:

The purpose of anaesthesia is to provide reversible unconsciousness, amnesia, analgesia, and immobility with minimal risk to the patient (Thurman, J.C., W.J. Tranquilli, 1996), in addition to that ideal anaesthesia must satisfy the need for muscular relaxation for technical efficiency of the surgery (Hall, L.W. and K.W. Clarke, 1992) .

Although Diazepam is an initial cause of salivation (Hall, L.W., K.W. Clarke, 2001), but the loss of spontaneous swallowing and the loss of spontaneous tongue reflex occurred during this study might be the cause of salivation observed as a result of diazepam injection.

Paddling of limbs shown by two animals of the tested group may be due to panic effect resulted from muscle relaxation which occur suddenly in the two animals, usually the panic effect appear in horses (Muir, W.W., R.A. Sams, 1982), but in these two animals the sudden onset of drug action and their falling to the ground might be the reason which lead to the panic effect translated by paddling movements.

Diazepam is classified as sedative/hypnotic and it is usually exert its effect in that manner (Hall, L.W. and K.W. Clarke, 1992), the drug has a dose dependant effect (Muir, W.W. and D.E. Mason, 1993), sedation occurred during our experiments which translated in form of ataxia or falling of the animal to the ground, is supported by other reports of (Hall, L.W. and K.W. Clarke, 1992; Muir, W.W. and D.E. Mason, 1993).

Although ketamine was reported to be a very good analgesic drug and the onset of drug occur rapidly within 1 minute (Hall, L.W., K.W. Clarke, 2001), it is found that the full analgesic effect of the drug took more than 6 minutes to occur, our finding is partially supported by other findings (Tomlinson, A., 1994), who reported that the onset of the drug may take about 5 minutes to occur.

During performing of anaesthesia it is noticed that the full onset of drug action took about 6 minutes to take place, after the onset of anaesthesia the surgeons carried their job with minimal response by the tested animals to surgical process from opening of the muscles, rumen, and the suture of these tissues also muscle relaxation was found to be fair, the negative response to surgical process may be due to the fact that ketamine was classified as a good analgesic drug (White, P.F., J. Ham, 1980). Although Ketamine was reported to be a poor muscle relaxant (Hall, L.W., K.W. Clarke, 2001), usage of diazepam may be the cause of muscle relaxation observed during surgery performed, since diazepam is reported to be a good muscle relaxant (Hall, L.W., K.W. Clarke, 2001; Taylor, P.M., 1991).

Comparison of the duration of time taken by surgical process 31.5 ± 4.4 minutes to the total recovery time (time of standing and walking) 54.6 ± 7.63 minutes show that more than 50% of the total recovery time was spent by the different tested animal as period of surgical anaesthesia, this finding showed that this protocol has a good anaesthetic and analgesic effect which can be tested under other surgical stresses.

Different reflexes were monitored during the period of premedication or the period of anaesthesia in this study in attempt to measure reliability of these reflexes in monitoring anaesthesia, but although some of these reflexes were used in the literature to monitor anaesthesia: palpebral and pedal reflex (Williams, A.M., J.D. Wyatt, 2007), palpebral, corneal, eyelid reflex (Tammisto, T., U. Aromaa, 1981), movement in response to clamping claw (Doherty, T., M.A. Redua, 2007), or swallowing reflex (Prassinis, N.N., A.D. Galatos, 2005), as a sign of recovery. We found that there was irregularity in the different reflexes when compared with each other and this irregularity can be clearly observed in the percentages of the animals in which a certain reflex appeared or disappeared in the period of disappearance of the different reflexes compared with each or compared with duration of surgical anaesthesia.

Respiratory rate as shown in table (1) revealed non-significant ($P \geq 0.05$) change, this result is supported by other finding (Kul, M., Y. Koc, 2000), who reported non – significant changes in respiratory rate as a result of using Ketamine- diazepam mixture.

During this study Ketamine/ diazepam combination was found to have no significant effect on heart rate and rectal temperature, this finding is supported by previous reports (Davison, K.E., J.M. Hughes, 2007) that showed no significant effect of Ketamine on these two parameters, also diazepam had no significant effect on heart rate (Muir, W.W. and D.E. Mason, 1993).

It is concluded that the protocol of Ketamine/Diazepam is a safe protocol for performing short term surgery in desert goat. Usage of reflexes to monitor anaesthesia is not reliable at least for the protocol tested in this study and this issue in need of further investigation

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