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Evaluation of comparative efficacy of xylazine-ketamine-guaifenesin and ketamine-guaifenesin anaesthesia for surgical management of urogenital affections in cattle

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Abstract

The study was conducted to evaluate comparison between two different anaesthetic combinations using Xylazine-Ketamine-Guaifenesin and Ketamine-Guaifenesin anaesthesia for surgical management of urogenital affections in cattle. The anaesthetic parameters included quality of induction of anaesthesia, quality of muscle relaxation, analgesia, duration of anaesthesia and quality of recovery of anaesthesia. The overall quality of induction of anaesthesia in Group I was better than Group II animals. Four animals (66.66%) in group I showed excellent muscle relaxation, two (33.33%) good degree of muscle relaxation, however 50% animals showed good and rest of 50% showed moderate muscle relaxation from Group II animals. The surgical anaesthesia time in Group I approximately 66.50 min and 50.66 min in Group II. There was significant lower onset of analgesia in between the groups however; loss of analgesia was significantly earlier in Group II as compared to Group I. The duration for total intravenous anaesthesia recorded in Group I was 54.66±2.44 min which was more as compared to Group II (44.83±2.16 min). The recovery from anaesthesia was smooth but prolonged in all the animals from group I and in Group II (66.66%) four animals showed smooth and fast recovery while two animals (33.33%) showed smooth but prolonged recovery.

Keywords: Xylazine, ketamine, diazepam, guaifenesin, cattle

Introduction

Surgical affections of male urogenital system are very common and life threatening conditions in bovines which pose anesthetic and surgical challenges that have contributed to the poor prognosis generally associated with abnormal location of testicle, orchitis, scrotal hernia, unilateral cryptorchidism, hydrocoele, urolithiasis and rupture of bladder. Many surgical procedures in ruminants can be performed humanely and safely using local or regional anesthesia and physical restraint. However, sedation and general anesthesia are necessary in order to perform some procedures. Although, anesthesia associated risks are greater in ruminants than monogastrics, the former can be anesthetized relatively safely in a field setting if the risks are understood and adequate planning and precautions are in place. For deciding, an anaesthetic preparation for a patient, health status must be assessed and considered along with other extrinsic factors such as anaesthetic procedure, availability of equipment and supplies, and the academic and technical training and abilities of participating personnel.

Ruminants usually allow physical restraint well and with local or regional anaesthesia it is often sufficient to complete many surgical and diagnostic procedures and complex surgical procedures like femoral fracture plating and pinning, penile surgery, umbilical hernia repair, caesarean section, and celiotomy requires general anaesthesia. Therefore, total intravenous anaesthesia can make many procedures more pleasant for both practitioner and to the animals.

Guaifenesin is a centrally acting muscle relaxant with mild to moderate sedative activity. At clinically used doses it produces minimal cardiorespiratory effects. Guaifenesin is used in combination with ketamine and in some cases xylazine to produce anesthetic induction in food animal patients. Guaifenesin-ketamine-xylazine and guaifenesin-ketamine combinations are also used in the intravenous maintenance of anesthesia in food animal patients^[1]. Induction of general anesthesia in cattle, sheep and goats is easily produced in sedated or calm animals by intravenous administration of combinations of muscle relaxants and dissociative anesthetics.

Urolithiasis in ruminants, especially in cattle, is of considerable economic importance as losses inflicted due to this are noticeably very high. Overall, abnormal location of testicles was the most common abnormality (4.08%) followed by abnormal prepuce and penis (2.33%), orchitis (1.94%), enlarged vesicular gland (0.91%), scrotal hernia (0.87%), unilateral cryptorchidism (0.81%), testicular hypoplasia (0.81%) and hydrocoele (0.78%). The presented research study was proposed to evaluate and compare two different anaesthetic protocols in bovine for surgical management of urogenital affections and to assess the acceptable anaesthetic protocol for the surgical interventions of male urogenital affections of cattle viz; cryptorchid, urethrotomy, tube cystostomy and cystorrhaphy under field conditions.

Materials and Methods

The research was conducted in cattle referred to Department of Surgery and Radiology and Teaching Veterinary Clinical Complex, College of Veterinary Animal Sciences, Udgir. Total twelve cattle having urogenital affections with 0.5 to 3.5 years old age group weighing 113 to 328 kg body weight were randomly divided into two equal groups. All the animals were fasted for 24 hours and water was withheld for 12 hours prior to induction of anaesthesia. The induction of anaesthesia in Group I was carried out with solution of triple drip containing 50 mg/mL guaifenesin, 1.00 mg/mL ketamine and 0.10 mg/mL xylazine @ 1.00 mL/kg body weight and in Group II double drip solution was administered @ 1.50 /kg containing guaifenesin 50 mg/mL and ketamine 1.00 mg/mL. A mixture of guaifenesin @ (50 mg/mL), ketamine (1.00 mg/mL) and xylazine (0.05 mg/mL) infused @ 2.0 mL/kg/hr following induction for maintenance of anaesthesia [8]. The

anaesthetic parameters included quality of induction of anaesthesia, quality of muscle relaxation, analgesia, duration of anaesthesia and quality of recovery of anaesthesia.

Results and Discussion

The dosages adopted in this research study have been well documented as per the literature [1, 14], the following anaesthetic parameters were studied.

Quality of induction of anaesthesia

The quality of induction of TIVA was assessed by observing different characteristics such as nociception, gag reflex (Plate 1), pin prick reflexes, relaxation of limb and jaw reflex and graded as A, B, C and D as per Table 1.



Plate 1: Anaesthetized animal showing loss of gag reflex

Table 1: Grading of quality of total intravenous Anaesthesia

Grade	Parameters studied
A	Excellent
	Loss of gag reflex, Unresponsive to all reflex and Regular respiratory movements
B	Good
	Generally unresponsive to needle prick, Little response to palpebral reflexes, Palpebral reflexes relaxed and moved freely
C	Moderate
	A period of slight apnoea followed by minute convulsions, Variation in heart beats and or respiration Limb movements.
D	Poor
	A period of full apnoea followed by severe convulsions, Irregular heartbeats, respiration Struggling.

The quality of total intravenous anaesthesia was judged by observing characteristic signs like pedal reflexes; gag reflexes, nociception stimuli by needle prick, apnoea, arrhythmia, convulsions and head/limb movements. The overall quality of induction of anaesthesia in Group I was good in three (50%) and moderate in 50% male cattle. The overall quality of induction of anaesthesia in Group I was better than Group II animals. The improved cardiopulmonary effect in calves was observed during induction with guaifenesin-ketamine-xylazine as compared to ketamine [10]. The quality of induction with GKX was 0.57±0.18 mL/kg and 2.70±0.40 mL/kg/h to induce and maintain anesthesia, respectively in calves [5]. The induction of anaesthesia in ruminants @ 1.00 to 1.50 mL/kg with triple drip of GKX was

adequate, similarly, in Group I animals the dose rate of 1.00 mL/kg was sufficient for induction of anaesthesia whereas, the dose rate for induction with double drip GK generally required 1.5 to 2.00 mL/kg [2]. The similar dose of double drip @ 1.5 mL/kg was adequate for induction of anaesthesia of Group II animals. Xylazine causes the more sedation in cattle at low doses as compared to other species [3]. However, xylazine could also result into the recumbency and light plane of general anaesthesia in cattle [4].

Quality of muscle relaxation

The quality of muscle relaxation was judged as per subjective assessment of the surgeon. The quality of anaesthesia and muscle relaxation was graded as shown in Table 2.

Table 2: Grading of quality of muscle relaxation

Grade	Parameters studied
A	Excellent (Complete relaxation)
	No signs of pain, no movement of animal during surgery, complete muscles relaxation during operation suggestive of excellent anaesthesia and muscle relaxation.
B	Good (Adequate Muscle relaxation)
	No signs of pain or discomfort, but a little movement of animal during surgery, satisfactory relaxation of muscles during operation, suggestive that the quality of anaesthesia and muscle relaxation was good
C	Moderate (Partial relaxation)
	Moderate pain sensation indicated by the movement of the animal during surgery, low satisfactory relaxation of muscle during operation.
D	Poor (Rigidity in muscles of head and neck)
	High pain sensation indicated by the movement of animal during surgery, Unsatisfactory relaxation of muscle during operation.

In Group I, four animals (66.66%) showed excellent muscle relaxation, two (33.33%) good degree of muscle relaxation was observed, however 50% animals showed good and rest of 50% showed moderate muscle relaxation from Group II animals. All the animals showed good to moderate muscle relaxation along with profuse salivation (Plate 2).

**Plate 2:** Anaesthetized animal showing profuse salivation

All the animals of Group I and II showed surgical plane of anaesthesia during perioperative procedure. Guaifenesin, a central acting muscle relaxant was used for inducing recumbency in cattle and further addition of ketamine improved induction quality and decreased the volume required for induction and improved muscle relaxation for Group I and II animals, the similar findings were also noted [15].

In Group I, animals the quality of muscle relaxation was excellent to good, similar findings were noted [13] with guaifenesin, chloral hydrate and ketamine combination. Group II animals showed good to moderate muscle relaxation with guaifenesin and ketamine combination, similarly, the moderate muscle relaxation with double drip anaesthesia well before the patient is anaesthetized [2]. Xylazine is cleared more slowly than ketamine therefore, the muscle relaxation was more profound in the Group I animals than Group II animal. In all animals, of Group I and II muscle relaxation was excellent to good might be because of guaifenesin as it was a central acting muscle relaxant, which acts by interrupting impulse transmission in the internuncial neurons of the spinal cord, brain stem and subcortical areas of the brain [7].

Analgesia

The onset and loss of analgesia during the different plane of anaesthesia was judged by pin prick at various body parts.

Mean duration for onset of analgesia for different body parts viz. fetlock, abdomen, base of horn and ribs was 7.00 ± 0.36 min, 7.33 ± 0.42 min, 7.50 ± 0.50 min and 7.83 ± 0.40 min respectively of Group I animals which is highly significant statistically, whereas, 12.00 ± 0.36 min, 12.00 ± 0.36 min, 12.00 ± 0.36 min and 13.00 ± 0.36 min respectively of Group II animals.

The loss of analgesia, at 22.40 ± 1.34 min to abolish the pin pricks sensation from fetlock region. Furthermore, they found the duration of analgesia of 21.47 min from base of tail, abdomen, ribs, periosteum and base of horn with diazepam-ketamine combination in buffalo calves [6]. Mean duration for loss of analgesia for different body parts viz. fetlock, abdomen, base of horn and ribs was 72.16 ± 1.42 min, 72.33 ± 1.40 min, 73.16 ± 1.42 min and 74.33 ± 1.33 min respectively of Group I animals which is highly significant as compared to that Group II, whereas, 62.66 ± 0.76 min, 63.00 ± 0.93 min, 63.50 ± 0.76 min and 63.66 ± 0.76 min respectively of Group II animals.

The loss of analgesia assessed by pin prick at the ribs, base of horn, abdomen and fetlock was 39.72 ± 1.42 min, 43.37 ± 1.80 min, 42.95 ± 1.70 min and 43.95 ± 1.83 min respectively under the maintenance of diazepam-ketamine combination in buffalo calves [6]. In the present study surgical anaesthesia was approximately 66.50 min in Group I and 50.66 min approximately in Group II. There was significant lower onset of analgesia in between the groups however; loss of analgesia was significantly earlier in Group I as compared to Group II. Xylazine, is a potent sedative at lower doses in cattle and posses muscle relaxant and analgesic properties, the receptors for these agents were located pre-synaptically and post-synaptically on the nociceptive neurons in the dorsal horn of the spinal cord. The analgesia was mediated by the antagonistic effects of ketamine on N-methyl-D-aspartate (NMDA) receptors [6].

Duration of anaesthesia

The mean duration for total intravenous anaesthesia (TIVA) was 54.66 ± 2.44 min and 44.83 ± 2.16 min in Group I and Group II respectively. The duration of anaesthesia, including induction and maintenance up to 2.5 hr with triple drip of 5% guaifenesin, 1 mg/mL ketamine, 0.1 mg/mL xylazine with induction dose of 0.55 mL/kg IV and 2.2 mL/kg IV for maintenance was adequate [4]. In cattle 10-15 min anaesthesia was achieved [8] with Diazepam @ 0.10 mg/kg IV followed immediately by ketamine 4.50 mg/kg by intravenous route.

Guaifenesin was used in combination with ketamine and xylazine to produce anaesthetic induction and maintenance of anaesthesia in cattle. In the present study guaifenesin was used as an adjunct to anaesthesia [4] with xylazine, ketamine and ketamine alone showed the longer duration of anaesthesia

in Group I as compared to Group II and sufficient to carry out the male urogenital affections in cattle viz. urethrotomy, cryptorchid, cystorrhaphy and tube cystostomy.

Quality of recovery from anaesthesia

The quality of recovery from anaesthesia was assessed on the basis of grades as described under (Table 3).

Table 3: Grading for quality of recovery of anaesthesia

Grade	Parameters studied
++++	Smooth and fast recovery
+++	Smooth but prolonged recovery
++	Struggling and fast recovery
+	Struggling but prolonged recovery

In Group I recovery from anaesthesia was smooth but prolonged in (100%) all the animals, in Group II (66.66%) four animals showed smooth and fast recovery while two animals (33.33%) showed smooth but prolonged recovery.

Recovery occurred within 30-45 min in large ruminants with guaifenesin-ketamine-xylazine [8]. The recovery from Group II animals found to be smooth and fast as compared to Group I animals because duration of action of xylazine is longer with guaifenesin and ketamine hence, recovery from the animals of Group I was smooth but prolonged.

The alpha-2 agonist as a part of anaesthetic regimen lead to emergency delirium or make premature attempts to stand similar findings were observed in all the animals from Group I [12]. The recovery was manifested by regain of alar reflexes and regain of corneal and palpebral reflex with opening of eyelids after discontinuation of halothane infusion [11].

In Group I, the average time taken for lateral recumbency was 40.66 ± 1.70 min which was highly significant than the time taken by the animals from the Group II which was 22.00 ± 1.65 min. The average time to attend the sternal recumbency (Plate 3) by Group I animals was 61.50 ± 1.92 min which was highly significant than that in Group II animals (34.33 ± 2.10 min).



Plate 3: Animal in sternal recumbency during recovery

Further, the average time taken by the animals to attend the standing position from Group I was highly significant (80.00 ± 3.19 min) than Group II animals (47.50 ± 2.86 min) similar findings were noted [2] that the post procedure recumbency lengthens as the duration of ruminant triple drip of GKX administration increased.

The recovery within 30-45 min with guaifenesin-ketamine-xylazine which was contradictory to the observations of the

Group I animals as the recovery noted was 80.00 ± 3.19 min in Group I animals [12], whereas, similar findings were observed in Group II animals, the longer time for recovery might be because of addition of xylazine which lead to profound sedation in cattle. Early recovery in Group II might be due to decreased protein binding of drug due to hypoproteinemia in uremic animals and thus more anaesthetic drug was diverted to metabolism from the system soon [9], when an alpha-2 agonist was used as part of the anaesthetic regimen an antagonist can be used to hasten recovery [12].

Conclusion

The result of anaesthetic parameters study suggested that drug combinations of GKX and GK produced no any adverse effect on the vital organs of the body and both group combinations are acceptable for maintenance of anaesthesia in cattle for surgical urogenital affection under field conditions.

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