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Evaluation of guaifenesin-ketamine-xylazine and diazepam-ketamine-xylazine triple drip for gelding in equines

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Abstract

The study was aimed to evaluate comparison between two different anaesthetic combinations using guaifenesin and diazepam in xylazine-ketamine induced total intravenous anaesthesia in equine for gelding. The anaesthetic parameters included quality of total intravenous anaesthesia, quality of muscle relaxation and quality of recovery of anaesthesia in Group I and Group II. The anaesthetic parameters were recorded at pre induction (0 min), after induction at 30 minutes, immediately after the complete recovery and 24 hrs after complete recovery of anaesthesia. The study suggested that neither of drug combinations of GKK and DKX produced no any adverse effect on the vital organs of the body and were acceptable for maintenance of anaesthesia in horses for gelding up to 30 minutes duration under field conditions. The quality of anaesthesia was overall excellent to satisfactory in both the groups with loss of gag reflexes. Overall, 90% horses from Group I revealed excellent muscle relaxation whereas, in Group II, 60% horses showed excellent muscle relaxation and 40% showed good degree of muscle relaxation. In Group I the mean duration of anaesthesia was 33.60 ± 1.78 min and mean surgical operating time was 28.50 ± 3.46 min. In Group II, the mean duration of anaesthesia and surgical operating time was 30.40 ± 0.30 min and 23.70 ± 2.00 min, respectively. The quality of recovery in horses of Group I was fast, smooth in 70% and smooth and prolonged recovery in 30% of the horses. Whereas, varied recovery was observed in group II.

Keywords: Anaesthetic parameters, xylazine, ketamine, diazepam, guaifenesin, equines

Introduction

The equines undergo various field surgeries with an injectable anaesthetic regime. The risk of mortality in equine anaesthesia is more than in other commonly anaesthetized domestic species [4, 7]. Horses are large and potentially dangerous creatures, during induction and recovery, when they become excited and ataxic, they can all too easily injure a person. Even when a horse appears well sedated it may still respond aggressively to a stimulus, and hence, normal precautions about where to stand and how to hold the horse should be taken care. The fundamental goals of any anesthetic plan are to place the animal in an unconscious state with immobility, analgesia, neuro-vegetative protection and obviously safety and predictability, with rapid return to physiological parameters and motor activities to baseline values without excitation and sequelae. Prolonged recumbency is unnatural in the horse. The incidence of recovery associated complication is higher in equines than other domestic species. The present study was carried out to compare triple drip by using guaifenesin and diazepam in combination with xylazine-ketamine for gelding in equine under field conditions.

Materials and Methods

The present study was conducted in horses referred to Teaching Veterinary Clinical Complex, NVC, Nagpur and in various field hospitals of the Maharashtra State. Total 20 horses presented for gelding were randomly divided into two equal groups where the anaesthesia was induced with Xylazine @ 1.1 mg/kg body weight and Ketamine @ 2.2 mg/kg body weight in both the groups. Maintenance of anaesthesia during surgical procedure was carried out with triple drip GKK of Guaifensin (25 gm), Ketamine (500 mg) and Xylazine (250 mg), in 500 mL normal saline solution and (DKX) Diazepam (25 mg), Ketamine (500 mg) and Xylazine (250 mg), in 500 mL normal saline solution in group I & II, respectively and was administered @ 2.2 mg/kg/hr in both the groups.

The anaesthetic parameters included quality of muscle relaxation, quality of recovery of anaesthesia and quality of total intravenous anaesthesia. The anaesthetic parameters were recorded pre induction (0 min), after induction at 30 minutes, immediately after the complete recovery and 24 hrs after complete recovery of anaesthesia. Gelding operations were performed in the horses of both groups.

Results and Discussion

The dosages adopted in the present study have been well documented in the literature [6]. Xylazine and Ketamine combination is commonly used for induction and maintenance of anaesthesia in horses [8] whereas, the addition of guaifenesin helps to achieve desirable effects of analgesia, unconsciousness and muscle relaxation associated with

general anaesthesia [9]. Guaifenesin and diazepam are central acting muscle relaxants which augment xylazine induced sedation [11]. Minimising patient mortality and morbidity remains a priority for equine anaesthesia and it is important to identify the causes to reduce the risk associated with general anaesthesia.

1. Quality of total intravenous anaesthesia

The quality of total intravenous anaesthesia was judged by observing characteristic signs like pedal reflex, gag reflex, nociception stimuli by needle prick, apnoea, arrhythmia, convulsions and head/limb movements. The quality of total intravenous anaesthesia (TIVA) was assessed with different grades as per Table 1.

Table 1: Grading of quality of total intravenous anaesthesia (TIVA)

Grade	Parameters studied
A	Excellent Loss of gag reflex, generally unresponsive to all reflexes and regular respiratory movements.
B	Satisfactory Unresponsive to needle prick but a little response with slight voluntary/involuntary movements
C	Partially satisfactory A period of apnoea followed by minute convulsions, variation in heart rate, respiration and limb movements.
D	Unsatisfactory A period of apnoea followed by severe convulsions, irregular heart rate, respiration and leg movements

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.

In the present study, the quality of anaesthesia was overall excellent to satisfactory in both the groups with loss of gag reflexes (Plate 1). In group I, 60% horses showed excellent and 40% satisfactory level of anaesthesia to proceed for castration. The maintenance of anaesthesia was excellent to good in guaifenesin and propofol combination [12]. In Group II, excellent quality of TIVA was observed in 40% of horses, satisfactory in 50% and partially satisfactory 10%. Four horses (40%) showed satisfactory TIVA however, adequate level of anaesthesia was observed to carry out the castration. One horse (10%) showed partially satisfactory level of TIVA characterized by slight apnoea, lacrimation (c 2) and limb movements hence, additional dose of DKX was given to achieve adequate level of anaesthesia. The mild evidence of little lacrimation during the initial phase indicated light plane of anaesthesia [14].



Plate 1: Loss of gag reflex during anaesthesia



Plate 2: Lacrimation during light level of anaesthesia

When compared between Group I and II, excellent to partially satisfactory grade of quality of total intravenous anaesthesia was observed in Group I.

2. Quality of muscle relaxation

The muscle relaxation was assessed on the basis of movement of horse during manipulation of testicles, cremaster muscle relaxation and head/limb movements during surgical stimuli. The quality total intravenous anaesthesia and muscle relaxation was judged as per subjective assessment by 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 No signs of pain, no movement of the animal during manipulation of testicles, relaxation of the cremaster muscle during pulling of testicle suggestive of excellent quality of TIVA and muscle relaxation.
B	Good No signs of pain or discomfort, but a little involuntary/voluntary movement of animal during pulling of testicle, suggestive of good quality of TIVA and muscle relaxation that was sufficient to carry out castration
C	Moderate Exhibition of moderate pain sensation indicated by voluntary movement of the animal during pulling of testicle and partial relaxation of the cremaster muscle, suggestive that the quality of TIVA and muscle relaxation not enough to carry out castration.
D	Poor Exhibition of high pain sensation indicated by voluntary movements of animal during surgery, unsatisfactory relaxation of muscle during operation and voluntary movement of head and limbs.

Overall, 9 horses (90%) from Group I revealed excellent muscle relaxation as GKX combination contains guaifenesin and is central acting skeletal muscle relaxant; it depresses or blocks nerve impulses transmission at subcortical areas of the brain and brainstem at the level of the spinal cord. The dose utilized in the present study worked well within the clinical range and did not affected diaphragmatic functions [2], present study corroborate with these findings.

Whereas, in Group II, six (60%) horses showed excellent muscle relaxation whereas in four horses (40%) good degree of muscle relaxation was observed. Combination of benzodiazepines with dissociative anaesthetics produced better anaesthesia in terms of duration, muscular relaxation, analgesia and induction and recovery qualities [10]. However, in the present study 60% horses exhibited adequate quality of muscle relaxation. Group I and II exhibited excellent to good quality of muscle relaxation when compared in between the groups. The GKX group found suitable with the concern of quality of muscle relaxation.

3. Duration of maintenance of anaesthesia

The duration of maintenance of general anaesthesia is dependent on the duration of surgery and skill of the surgeon. In Group I the mean duration of anaesthesia was 33.60 ± 1.78 min. and the operating mean time was 28.50 ± 3.46 min. In Group II, the mean duration of anaesthesia and surgical operating time was 30.40 ± 0.30 min and 23.70 ± 2.00 min respectively. The duration of anaesthesia significantly increases the risk (Johnston *et al.*, 1995) and the time of anaesthesia should be kept as short as possible and anaesthetic time should never be wasted [8].

Between the groups almost similar and statistically non-significant observations were recorded. The duration of anaesthesia was sufficient to carry out the castration without any neuropathies, myopathies and anaesthetic fatalities. [13] noted 45 to 47 min for surgical castration and anaesthesia lasted for 90 min.

4. Anaesthetic recovery (min)

The anaesthetic recovery in Group I and Group II is depicted in Table 3.

Table 3: Anaesthetic recovery in (min) from Group I and Group II

Group	First Head righting	Lateral recumbency with padelling	Sternal recumbency	On feet
I	9.10 ± 0.37	14.10 ± 0.50	17.50 ± 0.79	19.30 ± 1.03
II	$10.08 \pm 0.66^{**}$	13.09 ± 0.40	18.20 ± 0.38	$24.30 \pm 0.84^{**}$

**Indicates significance at 1% level for comparison between row values of a group

The mean time required for head rightening was 9.10 ± 0.37 min (Plate 2) and 10.08 ± 0.66 min in Group I and II respectively. Highly significant increase in head rightening time (10.80 ± 0.66 min) was noticed in Group II horses after discontinuation TIVA. Further, the time taken by the horses to

rise on feet posture was also highly significant (24.30 ± 0.84 min) Group II between the groups. However, there was no significant change observed in movements in lateral recumbency (Plate 3) and sternal recumbency (Plate 4) timings among the groups.

**Plate 3:** Lateral recumbency during recovery Group I



Plate 4: Sternal recumbency during recovery from Group I

Similar findings were found in the present study as reported by ^[11] that the horses showed first head rightening in 11.00 ± 1.98 and 8.14 ± 1.77 min in DKX and GKS groups, respectively. Sternal recumbency was assumed in 15.42 ± 2.16 min and 13.00 ± 2.44 min and they were on their feet within 19.21 ± 2.51 min 15.64 ± 2.71 min respectively in Group I and Group II after discontinuation of anaesthetic infusion. The propofol and ketamine led to quick recovery from the anaesthesia in the ponies and the mean times to sternal recumbency and standing were 11.10 and 30.00 minutes respectively, by the end of infusion.

The recovery from butorphenol and guaifenesin-ketamine TIVA, the limb/head movement and sternal recumbency were attained in 18.71 ± 1.98 and 26.14 ± 1.62 min, respectively in equine ^[14]. The horse which received the guaifenesin combination TIVA required fewer attempts to stand on feet ^[15].

5. Quality of recovery of anaesthesia

The quality of recovery of anaesthesia was observed for signs like neighing, paddling, delirious, excited, disoriented, hyperaesthesia, seizures, severe pain, profuse sweating, periods of apnoea, stridor, snoring, severely ataxic and perilous recovery. On the basis of these signs the quality of recovery was graded as shown in Table 4.

Table 4: Grading for quality of recovery of anaesthesia

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

The quality of recovery in horses of Group I was fast and smooth in 70% and smooth and prolonged in 30% of the horses. Whereas, varied recovery in II group was observed, smooth and prolonged recovery in 70%, fast and smooth in 20% and struggling and fast recovery (Plate 4) in 10% horses. The faster recovery time in the horses maintained with Isoflurane as compared to Triple Drip of GKX ^[1]. In horses with guaifenesin combination recovery was uniformly smooth and uncomplicated ^[3], uneventful ^[13] and good ^[15]. General risk factors of TIVA include duration of anaesthesia with cumulative effects of hypotension, hypoxaemia and acid-base derangements ^[5].

Conclusion

The study suggested that both the drug combinations of GKX and DKX produced no any adverse effect on the vital organs of the body and were acceptable for maintenance of anaesthesia in horses for gelding up to 30 minutes duration under field conditions.

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