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Anaesthetic effects of different doses of dexmedetomidine and ketamine in bovines

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Abstract
Twelve clinical cases of bovines of either sex, weighing 30 to 150 kg and of different age group requiring surgical intervention for various conditions were considered for the study. The bovines were randomly divided into two groups comprising of six calves in each group. The bovines of group I injected with dexmedetomidine @ 5 µg/kg and ketamine @ 2 mg/kg body weight intramuscularly; bovines of group II were injected with dexmedetomidine @ 7.5 µg/kg and ketamine @ 2 mg/kg bodyweight intramuscularly. Induction was recorded at 4.83±0.36 minutes, duration of anaesthesia was up to 36.00±1.13 minutes and recovery time was at 50.00±2.73 minutes in the animals of group I, and were 3.37±0.04 minutes, 51.33±2.18 minutes and 64.50±3.58 minutes respectively for group- II. Smooth induction and recovery were recorded in both the groups. Induction and recovery were smooth in both the groups with good anaesthesia along with muscle relaxation. Animals of both the groups exhibited signs of anaesthesia with relaxation of muscle, protrusion of tongue, on set of salivation, absence of palpebral, pedal reflex and pinprick response. Urination was recorded at the time of recovery. Based on the findings of the present study, a combination of dexmedetomidine @ 7.5 µg/kg along with ketamine @ 2 mg/kg body weight intramuscularly produced balanced anaesthesia permitting surgical procedure. therefore, this combination could be suggested for clinical use.

Keywords: Bovines**,** dexmedetomidine, ketamine, surgical parameters, anaesthetic effects

Introduction
Bovines are well domesticated animal, easily scared and generally are not aggressive. Dealing with dairy cattle is generally quite easy as they are handled from birth and milked twice daily. Beef cattle, on the other hand, are usually seldom handled and most of the time for medical treatment. Some routine procedures in bovine raised under extensive pasture management conditions, such as castration, repair of umbilical hernia, caesarean section, need to be performed with animal sedation and regional or local analgesia. Combinations of pre-anaesthetic or anaesthetic supporting drugs are generally required to improve the quality of general anaesthesia or stand alone as efficacious sedatives. Dexmedetomidine, a newer alpha2-agonist, shows the highest affinity for alpha2-adrenergic receptors compared to other drugs such as xylazine and medetomidine and has gained interest in veterinary anaesthesiology over medetomidine. Ketamine is a dissociative anaesthetic agent that can be used in a wide variety of species, by different routes and in combination with other agents. The drug is described as unique because of its hypnotic, analgesic and amnesic effect. In the recent years emphasis has been given for the use of injectable anaesthetic agents which produces adequate sedation with wide margin of safety, smooth induction and recovery. It is economic and easy to carry out under field condition and without sophisticated instruments.

Materials and Methods
Twelve clinical cases of bovine calves, presented to the Department of Surgery and Radiology, teaching veterinary clinical complex, College of Veterinary Science, AAU, Khanapara and Lakhimpur veterinary college, AAU, Lakhimpur, requiring surgical intervention for various conditions were considered for the study. The bovine calves of different age groups of either sex, weighing 30-150 kg were randomly divided into two groups consisting of six calves in each group. They were kept off fed for 12-18 hours prior to the study. Clinical, physiological, haematological and biochemical parameters were studied in all the bovine calves of each group which received an aesthesia as follows:

Group I: Dexmedetomidine 1 @ 5 µg/kg body weight + Ketamine 2 @ 2 mg/kg body weight intramuscularly. Group II: Dexmedetomidine @ 7.5 µg/kg body weight + Ketamine @ 2 mg/kg body weight intramuscularly. Following administration of anaesthetic agents induction time, duration and depth of anaesthesia, induction behaviour, degree of muscle relaxation, quality of analgesia, recovery time and recovery behaviour were studied in all the claves. The time required from the injection of the an aesthetics to animal on sternal recumbency was recorded as induction time. Duration of anaesthesia was recorded as the time from the onset of anaesthesia to the first sign of regaining the movements. The time from induction of anaesthesia to the time of standing was recorded as recovery time. The untoward effects of the an aesthetics like salivation, urination, defecation and recovery behaviour were also recorded. Heart rate, respiration rate, body temperature, tidal volume, minute volume, oxygen saturation (SpO 2) and mean arterial pressure were recorded at 0, 10^{th}, 20^{th}, 30^{th}, 60^{th} and 90^{th} minutes following injection of an aesthetics in all two groups. Heart rate was recorded in beats/minute; respiration rate in breath/minute was recorded by observing the up and down movements of abdomen or thorax per minute. Body temperature was recorded in degree Celsius (°C) by inserting a clinical thermometer per rectum touching the mucous membrane. Two milliliters of venous blood were collected at 0, 10th, 20th, 30th, 60th and 90th minutes following injection of anaesthetic in commercially available sterile 2 ml vacuum blood collection tube (eVac tube) containing K3EDTA 5 and utilised for estimation of haemoglobin, packed cell volume, and total erythrocyte count. Four milliliters of venous blood was collected at 0, 10th, 20th, 30th, 60th and 90th minutes following injection of anaesthetic in commercially available sterile 4 ml vacuum blood collection tube (eVac tube) containing Gel+Clot activator 66 (Serum/pro-coagulation tube). Immediately after collection the blood samples were kept undisturbed in a slanting position for clot formation and serum separation. The blood sample was centrifuged in 3000 rpm/min for 15 minutes and the separated serum was transferred with the help of rubber pipette to the labelled serum vial. The samples were utilised for estimation of Gamma Glutamyl Transferase (GGT) and Glucose by using a spectrophotometer 7.

Results and Discussion

In the group I, maximum reduction of heart rate was recorded at 30 minutes of and in group II at 60 minutes of administration. Bradycardia could be attributed to decrease sympathetic out flow from the Central Nervous System (CNS), direct depression of cardiac pacemaker and conduction tissues. Reduction of heart rate in group II than group I might be attributed to the α2 adrenoceptor agonist induced dose dependent bradycardia. Similar findings were also reported by Aithal *et al.,* 1989 [2] using medetomidine-pethidine for epidural anaesthesia in dogs. Andre *et al.,* 2003 [3]also reported that α2 agonist significantly reduced cardiac activity resulting in bradycardia, Singh *et al.* (2013) [13], recorded bradycardia following use of xylazine, medetomidine and dexmedetomidine in water buffaloes. Highly-significant decreased rectal temperature was recorded from 0 minute to 90 minute was observed in the group I and II. Reduction of rectal temperature administration of dexmedetomidine and ketamine might be due to muscle relaxation and depression of thermoregulatory center of brain. Umar and Irefin, 2013 and Canpolat *et al.,* 2016 [4] also reported reduction of body temperature following medetomidine and ketamine injection in goat. Respiratory rate decreased significantly from 0 minute to 90 minute in the bovine calves' group I and group II following dexmedetomidine-ketamine administration and maximum reduction was recorded at 60 minutes in both the groups. The depression of respiratory rate following administration of dexmedetomidine and ketamine might be due to depression of respiratory center at the medulla of the brain. Similar findings were also reported by Andre *et al.* (2003) [3] following dexmedetomidine-ketamine in cats. Significantly decreased respiration rate was also reported by Santosh *et al.* (2013) [12] in dogs following administration of dexmedetomidine with midazolam-ketamine. Packed cell volume non-significantly decreased from 0 minute to 90 minutes in group I and group II following administration of dexmedetomidine-ketamine and maximum reduction was recorded at 30 minutes. Non-significant reduction might be attributed to decrease sympathetic activity after dexmedetomidine injection leading to spleenic pooling of circulatory erythrocytes or other reservoirs. Similar finding was reported by Kinjavdekar *et al.* (2000) [8] in goats following administration of xylazine and medetomidine. TEC value non-significantly decreased from 0 minute to 90 minutes in group I and group II following administration of dexmedetomidine-ketamine administration. Non-significant reduction of TEC recorded in present study might be due to splenic pooling of erythrocyte from peripheral blood and subsequent hemodilution. Highly-significant increased of GGT level from 0 minute to 60 minutes were observed in bovines of group I and II respectively following intramuscular administration of dexmedetomidine and ketamine and gradually decreased to wards the base level recorded at 90 minutes. Increased GGT were suggestive of transient cholestasis which receded following elimination of the drug byte end of the observation period. Highly-significant rise in blood glucose level was recorded in group I and group II from 0 minute to 60 minutes. The values were gradually decreased at the end of the study period but remained above the base value. Increased level of blood glucose recorded in the present study might be attributed to insulin suppression through direct inhibitory effect of α2 adrenoceptor agonist on the pancreatic β cells and also by stimulation of growth hormone (Dollery, 1991) [6]. This finding was in agreement with Thurmon *et al.* (1982) [14] and observed that there was initial increase in glucose level and decreased at the end of the study in horse after administering intravenous xylazine.

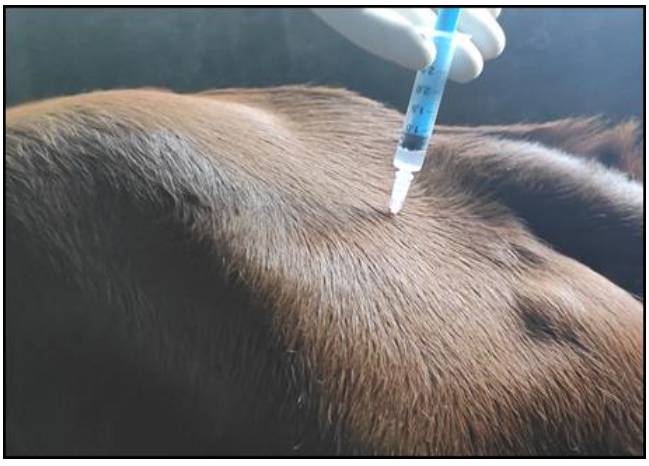

Fig 1: Intramuscular injection of anaesthetic agents

Fig 2: Recording heart rate

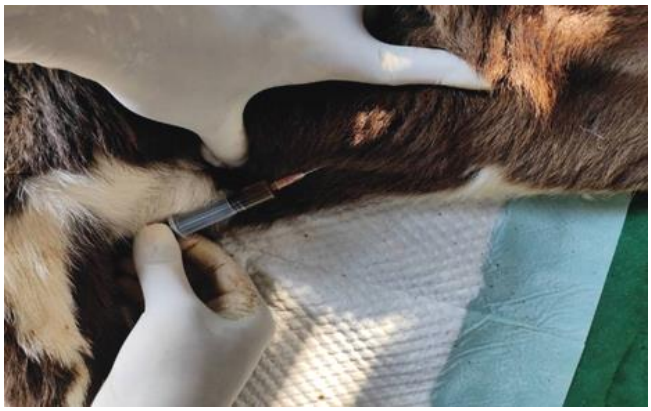

Fig 3: Collection of venous blood from jugular vein

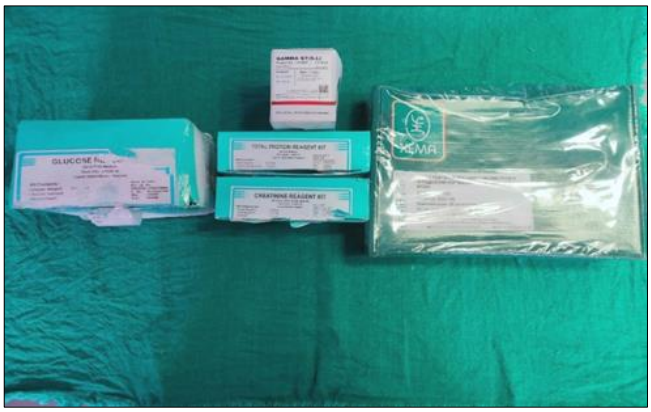

Fig 4: Biochemical kits used during the study

Conclusion

Dexmedetomidine @ 7.5 µg/kg and ketamine @ 2 mg/kg produced shorter induction time with excellent quality of induction. Dexmedetomidine @ 5 µg/kg and ketamine @ 2 mg/kg produced good degree of muscle relaxation. However, dexmedetomidine @ 7.5 µg/kg and ketamine @ 2 mg/kg produced excellent degree of muscle relaxation. Dexmedetomidine @ 5 µg/kg and ketamine @ 2 mg/kg produced good quality of anaesthesia permitting minor surgical procedures. However, dexmedetomidine @ 7.5 µg/kg and ketamine @ 2 mg/kg produced excellent quality of anaesthesia and analgesia permitting surgical procedures of longer duration. Recovery time was longer and recovery behaviour was excellent in animals received dexmedetomidine @ 7.5 µg/kg and ketamine @ 2 mg/kg. No adverse effects were observed in clinico-physiological, hematological and biochemical parameters in both the groups. Dexmedetomidine @ 7.5 µg/kg and ketamine @ 2 mg/kg anaesthetic combinations showed excellent results. So, may be recommended for clinical use in bovines.

Conflict of interest: None

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