Isoflurane sparing effect of diazepam and midazolam to xylazine-ketamine induction and isoflurane maintenance in goats

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ABSTRACT

The clinical study was undertaken to assess the isoflurane sparing effect of diazepam and midazolam during isoflurane anaesthesia in goats. The study was conducted in 12 clinical cases of goats randomly divided into two equal groups. In all the animals, xylazine hydrochloride was administered at the dose rate of 0.05 mg per kg body weight intramuscularly. In group I and II, diazepam and midazolam were administered at the dose rate of 0.5 mg per kg body weight i.v. respectively, prior to induction of anaesthesia. Anaesthesia was induced with ketamine hydrochloride at the dose rate of 5 mg per kg body weight i.v. and was maintained with isoflurane employing rebreathing circuit. The end-tidal isoflurane concentration required to maintain surgical plane of anaesthesia was significantly lower in group II (0.82 ± 0.03 per cent) indicating that inclusion of midazolam in the anaesthetic protocol had significant (28 per cent) isoflurane sparing effect.

Key words: Diazepam, Goat, Isoflurane, Midazolam, Sparing effect.

INTRODUCTION

Intravenous anaesthesia in ruminants was associated with prolonged recovery and recumbency. These disadvantages of intravenous anaesthesia can be overcome by injectable induction and inhalant maintenance (Thurmon et al., 1996). At present, xylazine hydrochloride, a sedative analgesic, is routinely employed as premedicant in the anaesthetic protocol of goats. Goats appeared to be more sensitive to xylazine hydrochloride than sheep and cattle (Riebold 1996). Xylazine hydrochloride causes bradycardia, salivation, regurgitation and hypoxaemia and hence supplemental oxygen should be administered during long surgical procedures. Ketamine hydrochloride, a dissociative anaesthetic, is an established induction agent in sheep and goats but high muscle tone and tremor associated with ketamine hydrochloride administration necessitates incorporation of muscle relaxants in the anaesthetic protocol. Better results were obtained when ketamine hydrochloride was combined with xylazine hydrochloride or benzodiazepines (Taylor, 1991). Benzodiazepines being potent muscle relaxant, if included in the anaesthetic protocol could enhance muscle relaxation facilitating oroendotracheal intubation, manipulation of viscera and fractured fragments during complex surgical procedures (Thurmon et al. 1996). Midazolam is an ultra-short acting water soluble benzodiazepine derivative three times more potent and one third less toxic than diazepam. Midazolam can be administered either through intravenous or intramuscular route (Gangle et al., 2001). Hence the present study was undertaken to evaluate isoflurane sparing effect of diazepam and midazolam to xylazine-ketamine induction and isoflurane maintenance in goats.

MATERIALS AND METHODS

The study was conducted in 12 clinical cases of goat presented to large animal surgery out-patient unit, Veterinary College and Research Institute, TANUVAS, Namakkal for orthopaedic surgery. The animals were randomly divided into two groups viz., group I and II, comprising of six animals each. The age in months and body weight in kilograms of the selected animals were recorded. In all the animals, feed and water were withheld for 12 and 6 h, respectively before induction of anaesthesia. The external jugular vein was catheterized using a 20G intravenous cannula and secured in situ using Micropore™ surgical adhesive tape around the neck to facilitate administration of anaesthetic drug and maintenance fluid during anaesthesia.

In all the animals, xylazine hydrochloride was administered as a premedicant at the dose rate of 0.05 mg per kg body weight i.m. and 10 minutes later diazepam and midazolam at the dose rate of 0.5 mg per kg body weight i.v. were administered in group I and II animals, respectively. Ketamine hydrochloride at the dose rate of 5 mg per kg body weight i.v. was administered to induce anaesthesia in all the animals.
animals. After induction of anaesthesia endotracheal intubation was performed using cuffed armoured murphy type endotracheal tube and cuff was inflated to provide secure leak free airway to avoid aspiration of regurgitated ingesta. The endotracheal tube was connected to the Y piece of the breathing circuit through the IRMA® airway adaptor of the multigas monitor and Bird’s spirometer to maintain and monitor anaesthesia. In all the animals, maintenance of anaesthesia was carried out with two per cent isoflurane. Small animal anaesthetic machine with ventilator (Ohmeda Anaesthetic Gas Machine, Modulus II, USA) was used to maintain anaesthesia in all the animals. The fresh gas flow (FGF) was set at three litres per min for the first three min to attain denitrogenation of the anaesthetic circle and to increase the inspired concentration of oxygen. The fresh gas flow was then reduced to two litre per min with variable vaporizer setting to maintain uniform plane of surgical anaesthesia. Lactated Ringer’s fluid was administered at the dose rate of 20 ml per kg body weight per hour during maintenance of anaesthesia. The Schiller Truscope® II multigas monitor was used to measure the inspired and end-tidal concentration of oxygen, carbon dioxide and isoflurane continuously during maintenance of anaesthesia. The average value measured was recorded in all the animals. The isoflurane sparing effect of diazepam and midazolam in group I and II was calculated from the difference in the end-tidal isoflurane concentration. The data obtained were analysed using F-test for variance and T-test for comparison of mean between the groups as described by Snedecor and Cochran (1994) using SPSS® to software package.

RESULTS AND DISCUSSION
The fraction of inspired oxygen in group I and Group II was 84.84 ± 1.22 and 87.99 ± 0.61 respectively and the expired concentration of oxygen in group I and group II was 79.01 ± 1.19 and 82.13 ± 2.50, respectively. The fraction of inspired and end-tidal oxygen concentration in group II was significantly higher compared to group I due to highest fresh gas flow (FGF) employed in group II. The fraction of inspired–isoflurane concentration in group I and group II were 1.43 ± 0.03 and 1.03 ± 0.03, respectively. The fraction of inspired–isoflurane concentration in group I was significantly higher than group II. It might be due to the higher vapourizer setting employed in group I to maintain the depth of anaesthesia during surgery. The end-tidal isoflurane concentration was significantly lower in group II (0.82 ± 0.03) compared to group I (1.13 ± 0.03) indicating that the inclusion of midazolam in the anaesthetic protocol had produced greater isoflurane sparing effect (Dzikiti et al. 2011 and Stegmann and Bester 2012). The fraction of inspired–isoflurane concentration in group II could be attributed to the isoflurane sparing effect provided by midazolam. The minimum alveolar concentration reduction in group II was 28 per cent lower than group I. Statistical comparison revealed that midazolam had a highly significant (p<0.01) isoflurane sparing effect.

CONCLUSION
The end-tidal isoflurane concentration was significantly lower in group II compared to group I. There was a 28 per cent reduction in minimum alveolar concentration of isoflurane in group II than group I. This could be due to the greater isoflurane sparing effect of midazolam. The inclusion of midazolam in the anaesthetic protocol have significant (p<0.01) isoflurane sparing effect than diazepam.