SHORT COMMUNICATION

Sokoto Journal of Veterinary Sciences
(P-ISSN 1595-093X/ E-ISSN 2315-6201)
Umar & Irefin /*Sokoto Journal of Veterinary Sciences* (2013) 11(2): 63-66.
http://dx.doi.org/10.4314/sokjvs.v11i2.10

Evaluation of the effects of intravenous anaesthesia using a combination of ketamine - medetomidine in Sahel goats

MA Umar* & KE Irefin

Department of Veterinary Surgery & Theriogenology,
Faculty of Veterinary Medicine
University of Maiduguri

*Correspondence: Tel.: 2348033499693, E-mail: ahmedtjumar@gmail.com

Abstract

The anaesthetic and cardiopulmonary effects of the combination of ketamine-medetomidine for total intravenous anaesthesia were evaluated in six sahel goats. The goats were administered a combination of ketamine (5mg/kg) and medetomidine (0.01mg/kg) intravenously. Baseline measurements of heart rate, respiratory rate and rectal temperature were taken prior to drug administration and repeatedly, at ten minutes interval after induction of anaesthesia until the end of anaesthesia. Heart rate decreased from baseline value of 73.5±5.7 beats/minute and reached its lowest value at 40 minutes (57.1± 4.8 beats/minute). Also respiratory rate decreased significantly from baseline value of 27.7±3.7 breaths/minute reaching its lowest value of 19.0 ± 4.6 breaths/minute at 50 minutes. Onset of anaesthesia was fast (1.2 ± 1.5min) and mean anaesthesia time was 97.1 ± 21.9min. Ketamine - medetomidine intravenous injection produced effective anaesthesia, muscle relaxation and immobilization in sahel goats. Recovery from anaesthesia was without complication.

Keywords: Anaesthesia, Goats, Intravenous, Ketamine, Medetomidine.
Received: 04-01-2013 Accepted: 22-06-2013

Introduction

Current veterinary anaesthesia in large animals concentrates on the use of ketamine, guaifenesin, alpha$_2$ agonists, barbiturates and chloral hydrate (Yamashita *et al*., 2007). Advantages of intravenous anaesthesia include rapid and smooth induction of anaesthesia, little equipment requirements (needles, syringes, catheters), easy administration of drugs and achievement of balanced anaesthesia (Yamashita *et al.*, 2007). Intravenous anaesthesia is indicated mostly for major surgery such as orthopaedic surgeries in animals including limb amputation, management, arthroscopy, obstetrical procedures like ceasarian section and orchidectomy in large animals (Hall *et al.*, 2001; Umar *et al.*, 2006; Kilic, 2008).

Ketamine has analgesic effect which is partly mediated by N-Methyl-D-aspartate antagonistic activity in cats, dogs, rabbits and other small animals (Gaynor, 2002). Medetomidine is an alpha$_2$ agonist which produces sedation, analgesia and muscle relaxation in veterinary practice. Medetomidine is an effective sedative in small animal practice (Sinclair, 2003) and horses (Umar *et al.*, 2006; Yamashita *et al.*, 2007).

Indeed, ketamine and medetomidine combinations have been found to provide excellent immobilization and muscle relaxation in a wide range of species of animals while the ability to reverse the sedative effect of alpha$_2$ adrenoreceptor agonist has proved to be particularly useful (Hall *et al.*, 2001). Kilic (2008) reported on cardio pulmonary, biochemical, and hematological changes after detomidine-midazolam – ketamine anaesthesia in calves and concluded that satisfactory anaesthesia and immobilization was produced for umbilical surgery, although some hypoxemia and respiratory acidosis occurred.

To date however, there is no report on the use of ketamine and medetomidine combination for intravenous anaesthesia in sahel goats. The aim of

this study is to evaluate the effect of ketamine and medetomidine combination on total intravenous anaesthesia in sahel goats. Their effect on the heart rate, respiratory rate and rectal temperature were determined. Onset of effect, duration of anaesthesia, and time to standing position were also determined. However, their effects on haematological parameters have been published (Umar & Wakil, 2013).

Materials and methods

Animals

Six sahel goats comprising of five females and one male with a mean (± SD) body weight of 18.8 ± 1.9 (range 16 - 21kg) were used for the study. The goats were assessed to be healthy based on physical examination (heart and respiratory rates within normal) and hematological values that appeared normal and fecal examination showed absence of helminth eggs. Animal Care and Use Committee of University of Maiduguri approved the study.

Drugs

The drugs used for this study were a combination of ketamine hydrochloride injection at 5mg/kg IV (Ketajet 50mg/ml, Rotexmedia, Trittua, Germany) and medetomidine at 0.01mg/kg IV (Dormitor, Meiji, Seika Ltd, Tokyo, Japan).

Experimental procedure

The two drugs at dosages above were combined in a single syringe prior to slow IV injection.

The goats were observed during and after the intravenous injection of the drugs. The onset of the action of the drugs after injection; the time to spontaneous recumbency were noted.

Heart rate, respiratory rate and rectal temperature of the goats were obtained before the drugs were administered (baseline) and every 10minutes after the intravenous injection for the duration of anaesthesia. The heart rate (beats/minute) was assessed using a stethoscope (1 minute full count was done). Respiratory rate (breaths/minute) was assessed by visual observation of the thoraco-abdominal movement (1 minute full count was done). The rectal temperature (^{0}C) was measured using a digital thermometer.

Analgesia was determined using pinprick with hypodermic needle applied at intervals over the skin of rib cage, flank, ventral abdomen and limbs. Positive response by the animal to the needle prick was defined as gross purposeful movement such as moving the head or leg withdrawal. The response was judged as negative when no reactions or movements were observed.

The anaesthetic indices calculated for each goat were: time to onset of anaesthesia, duration of anaesthesia and time to standing.

The calculated indices were defined as:

- Onset of anaesthesia: Is the time interval (in minutes) from the intravenous injection of the drug to the assumption of (lateral) recumbent posture by the goat.
- Duration of anaesthesia: Time interval (in minutes) from ketamine-medetomidine injection induced recumbency to assumption of sternal posture by the goat.
- Time to Standing: Is the time interval (in minutes) from assumption of sternal posture (recumbency) to when the goat is able to stand.

Data analysis

Data obtained are expressed as mean ± SD of 6 goats. Mean heart rate, respiratory rate and rectal temperature measured were each compared to baseline (subsequent readings versus baseline value) using repeated–measures analysis of variance (Graphpad, 2000). Differences were accepted as significant at the probability level of less than 5 percent ($P<0.05$).

Results

The onset of anaesthesia was fast with the combination of ketamine - medetomidine (1.2± 1.5 min). The duration of anaesthesia was 97.1 ± 21.9 min. Time to standing from sternal recumbency was 5.3±3.3min. There was no response to pinprick during anaesthesia in all the goats with onset of analgesia of 5.4 ± 2.0 min that lasted 81.5 ± 6.4 min.

There was no significant decrease in the heart rate in the first 20 minutes. But after 30 minutes, there was a statistically significant decrease in the mean heart rate from the base line of 73.5± 5.7 beats/ minute to 65.0± 4.5 beats per minute, it reached lowest value at 40 minutes (57.1±4.8 beats/minute). Thereafter it began increasing towards base line value. The mean heart rate returned to baseline value at 90 minutes post injection (76.7±7.3 beats/minute) (Table 1).

There was a non-significant decrease in rectal temperature from baseline value of 38.7± 0.9^{0}C to 37.5± 0.4^{0}C after 90 minutes after intravenous injection. Respiratory rate decreased significantly

Table 1: Effects of intravenous injection of ketamine- medetomidine at 5mg/kg and 0.01mg/kg IV, respectively on mean ± SD heart rate, respiratory rate and rectal temperature in six Sahel goats

Time Interval (minutes)	Heart Rate (beats/min)	Respiratory Rate (breaths/min)	Rectal Temperature (^{0}C)
Baseline	73.5±5.1	27.7±3.7	38.7±0.9
10	73.0±8.2	26.3±4.7	38.5±0.7
20	71.3±9.5	27.1±5.9	38.3±0.7
30	65.0±4.5*	21.0±3.3	38.3±0.8
40	57.1±4.8 *	19.5±5.0 *	38.1±0.8
50	58.3±4.7*	19.0±4.6*	38.6±0.7
60	65.5±5.7*	20.0±4.4	37.8±0.6
70	68.7±3.8	23.4±3.9	37.5±0.9
80	65.7±6.8	23.8±2.4	37.8±0.2
90	76.7±7.3	25.0±1.4	37.5±0.4

* Differ significantly (P<0.05) compared with baseline.

from the baseline value of 27.7± 3.7 breaths/minute to that observed at 50 minutes (19.0 ± 4.6 breaths/minute). Thereafter, the value increases towards the baseline value (Table 1).

Discussion

The observed systemic effects of the combination of these drugs on heart rate in this study is a typical reaction as it was similarly reported following total intravenous anaesthesia using detomidine-midazoloam-ketamine in calves (Kilic, 2008) and Gweba *et al.* (2010) also reported heart rate decrease in goats administered xylazine for sedation. Afshar *et al.* (2005) also recorded decreased heart rate, rectal temperature and blood pressure during alpha$_2$ agonist – ketamine anaesthesia in goats. Medetomidine produces decrease in heart rate by activating central and peripheral α_2 adrenoceptors (Sinclair, 2003; Yamashita *et al.* 2007).Respiratory rate decreased significantly towards the middle of this study but increased towards baseline at 90min. This contrasts the report of Kilic (2008) who reported that respiratory rate increased significantly with time following detomidine-midazolam-ketamine anaesthesia in calves undergoing umbilical surgery. The difference in species used and the fact that umbilical surgery was carried out in the previous study might be responsible for the increased respiratory rate reported. Also medetomidine that was used in this study produces more potent effects than other alhpa$_2$ adrenoceptor agonists like detomidine. Afshar *et al.* (2005) reported non-significant change in respiratory rate in goats during xylazine-ketamine anaesthesia. Gweba *et al.* (2010) also reported decreased respiratory rate in goats following xylazine sedation. Rectal temperature decreased in this study, Afshar *et al.* (2005) and Gweba *et al.* (2010) similarly reported that rectal temperature decreased following systemic administration of α_2 adrenoceptor agonist that was attributed to the depression of the hypothalamic thermoregulatory centre. The decrease in rectal temperature was also the result of a reduced basal metabolic rate and depression of thermoregulatory centre (Sinclair, 2003; Afshar *et al.*, 2005).

This study revealed that medetomidine and ketamine combination for total intravenous anaesthesia in goats produced effective general anaesthesia. Onset of anaesthesia was rapid (1.2 ± 1.5 minutes) and the mean anaesthesia time was 97.1±21.9 minutes. This is more than double the anaesthesia time of 45 minutes in calves following detomidine-midazolam-ketamine combination as reported by Kilic (2008). Medetomidine that was used in the present study is a more potent sedative than detomidine and coupled with lack of surgery in this study these prolonged the anaesthesia in the goats. These two are responsible for the prolonged anaesthesia observed in the goats (Umar *et al.*, 2006).

In conclusion, ketamine and medetomidine combination used for total intravenous anaesthesia produced effective anaesthesia in goats. The prompt anaesthesia coupled with manageable and good recoveries with no complications encountered suggests that ketamine and medetomidine combination for total intravenous anaesthesia has

considerable promise as an injectable technique that can be used to produce anaesthesia in goats. However the cardiovascular side effects may preclude the use of the combination in critical and cardiovascular compromised patients.

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