Physiological and Electrocardiographic Findings in Ketamine and Medetomidine Anesthesia in One Humped Camel

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Abstract

Electrocardiogram is a good tool for monitoring the physiological status of animals and human during anesthesia. This investigation was directed to record the physiological and electrocardiographic findings of anesthetized one humped camels by different doses of ketamine and medetomidine. Twenty clinically apparently healthy male one humped camels ageing 3 – 4 years weighting 280 – 300 Kg were allocated into four groups (five animal of each), group (I) control unanesthetized camels and groups (II, III), receiving Ketamine only by I/V route at dose of 1mg/Kg and 2mg/kg body weight respectively. While, group (IV) was injected with Medetomidine in a dose of 30 µgm/kg followed by 1 mg/kg of ketamine. Core body temperature (BT), respiratory rate (RR), heart rate (HR) and electrocardiogram were determined to represent physiological and clinical finding. The ECG results revealed that, in group II there were tachycardia as shown in lead I, II and III one minute post ketamine injection. After 5 min., decreased P-R interval and QRS complex time while T wave strength was increased specially in lead II. All these findings were persisted after 10 min. in addition to increase the negativity of S waves and strength of P wave’s. While after 15 min., P waves was equal to T waves in amplitude with still increased heart rates. In group III; ketamine injection showed initial bradycardia with irregular rhythm with absent or decreased strength of T waves. After 5 and up to 10 min, showed tachycardia with S-T segment increased in time and QRS complex in its strength. After 15 min., there were irregular heart rate and inverted T waves in lead I, these findings were persisted until the end of experiment. Furthermore, the results revealed that, heart rate (HR) showed a tachycardia in group II and III that started with the beginning of the study and persisted for 30 min. While in group IV, medetomidine injection significantly lower the heart rate inducing bradycardia. Respiratory rate showed significant increases in all anesthetized groups starting from the beginning of experiment and was persisted at high rate for 30 min. before returning to control rate at the end of the study (at 45 min). Moreover, results appeared significant decreases in core body temperature in all anesthetized groups proceeded parallel to the time of experiment. It could
be concluded that, Ketamine anesthesia at a dose of 1 or 2mg/kgm body weight could be alter the electrocardiogram and cardiorespiratory response of one humped camel.

Key words: Electrocardiogram – one humped camels – anesthesia – ketamine- medetomidine.

Introduction

The electrocardiogram is a recording of difference of electrical potential generated by the waves of the depolarization and repolarization traversing atrio-ventricular myocardium. These electrical potential projects to the point on the body surface. The normal electrocardiogram is composed of a P wave, a QRS complex and T wave, the QRS complex is composed of three separate waves the Q wave, the R wave, and the S wave. The P wave is caused by electrical currents generated as the atria depolarize before the contraction, the QRS complex is caused by current generated when the ventricles depolarization, while T wave represent recover from state of depolarization or the repolarization wave of the ventricle.

The refinement of anesthetic regimes is central to improving the welfare of camels whether for research, management or veterinary check. However, anesthetics are frequently administered to camels in the absence of objective data on their suitability from experimental trials.

Ketamine hydrochloride (K) is a relatively short acting (dose-dependent) dissociative anesthetic, which produces anesthesia with moderate analgesia in a number of species. The drug is not readily degraded by heat or cold, is fast acting, does not require that food is withheld prior to administration and has a wide safety margin. Furthermore, unlike barbiturates, the effects of ketamine are not cumulative, hence doses can be repeated frequently. Consequently, ketamine hydrochloride has been widely used in studies of wild mammals, particularly for carnivores, both as a sole anesthetic agent and in combination with other drugs.

Unlike many anesthetics, ketamine usually stimulates cardiovascular function in normal animals, causing increase in heart rate (HR) and mean arterial pressure (MAP).

The use of ketamine as a sole anesthetic has been limited by muscle hyper tonicity, violent recovery and occasional occurrence of convulsions. In an attempt to counteract these undesirable effects, ketamine has been used in combination with various drugs including benzodiazepines, e.g. diazepam, and alpha-2 agonists, as medetomidine.

Medetomidine (M) is one of the newest alpha 2 adrenergic agonist with a higher affinity for α-2 adrenergic receptor than xyalzine. Alpha -2 agonists produce dose dependant sedation, analgesia and muscle relaxation. They can be combined with the other sedatives, tranquilizers and their effects are reversible with specific antagonists. However, alpha -2 agonists profoundly alter cardiovascular function by producing Bradycardia, hypertension followed by hypotension, decreased myocardial contractility, perfusion and dys-arythmias. Previous study tested the hypothesis that anesthesia selection has an influence on the measured ECG parameters. They systematically compared the utility an injectable mixture of ketamine/medetomidine.
This study was directed to define the electrocardiographic and physiological findings of one humped camel under anesthetic effect of ketamine and medetomidine.

Materials and methods

Animals

Twenty male one humped camel (Camelus dromedaries) aged between 3-4 year and weighting 280 -300 kg were used in this investigation. The experiment on the animal was approved by the animal welfare committee of the Faculty of agricultural and Vet. medicine, AL_Qassim University. Animals were housed in Qassim veterinary hospital, department of veterinary medicine, Faculty of agricultural and Vet. medicine, AL_Qassim University, AL-Qassim, King Saudi Arabia. They were fed twice a day with fresh water provided ad-libitum. Following a general check up (status of dehydration, body temperature, color and nature of conjunctive, physical appearance of urine, defecation and the quality of faces), camels were fasted for 12 hr but permitted to drink water and then they were used in study.

They were divided into four groups (I, II, III, IV) randomly. Group (I) control un-anesthetized camels and groups (II, III), receiving Ketamine only by I/V route at dose of 1mg/Kg and 2mg/kg body weight respectively. While group (IV) was injected with Medetomidine in a dose of 30 µgm/kg followed by 1 mg/kg of ketamine.

Drugs

Ketamine Hcl injectable solution was supplied by (ketsmidor, Richtepharmaco KG, wells, Austria).

Domitor® (medetomidine hydrochloride) is a synthetic alpha 2 adrenoreceptor agonist their chemical name is [1-(2,3di methyl phenyl) ethyl] -1 H- imidazole mono hydrochloride. Its molecular weight is (236.7 K Dalton). Medetomidine was available as a 1 mg/ml solution supplied by (Domitor, Orion Corporation, Espoo, Finland).

Physiological findings

Physiological monitoring took place at (0,5,10,30 and 45 min) after each interval, respiratory rate (breath/min) was measured by direct observation of thoracic abdominal movement, heart rate (beat/min) by stethoscope and core body temperature by standardized digital medical thermometer.

Electrocardiogram (ECG)

It was recorded for each animal in all groups. Normal (ECG) was recorded which represented by group I and in the experiment in other groups (II, III, IV). Bipolar standard limb leads that measure the potential difference between two limbs. Lead I who measure the potential difference between right forelimb – Ve pole and left forelimb + Ve pole. Lead II which measure the potential difference between right forelimb – Ve pole and left hind limb + Ve pole. Lead III which measure the potential difference between left forelimb – Ve pole and left hind limb + Ve pole. Using a Electrocardiogram, the previously described leads were applied on each camel.
before and after injection of Ketamine and medetomidine and the ECG waves were recorded at previously mentioned interval.

**Statistical analysis:** All data were subjected to two way analysis of variance (ANOVA) to detect differences between means at different intervals and according to the statistical analysis system.¹⁴

**Results**

**Electrocardiogram results (ECG)**

Effects of ketamine and medetomidine on the electrical activity and conduction rate of the heart were recorded by ECG waves as P, QRS and T waves. The result revealed that, in control group (Group I) showed negative T wave in lead I and II (figure 1). In group II, ketamine injection by a dose of 1 mg/kg B.W induced tachycardia as shown in lead I, II and III inducing decreases in P-R interval, increases in strength of cardiac muscle contraction, QRS complex decreases in its time and increase strength of waves were observed at 5 min. and persisted for 10 min. In addition to, increase the negativity of S waves and strength of P waves. After 15 and up to 30 minutes, P waves was as the strength of T waves with a persisted tachycardia.

In G III, the effect of ketamine at a dose of 2 mg/kg B.W showed initial bradycardia with irregular rhythm with absent or decrease strength of T waves at 5 min. After 10 min. S-T segment increased in time and QRS complex increased its strength. After 15 min, there were irregular heart rate and inverted T waves in lead I, the same findings were observed at 30 min. post injection.

In G IV, the effect of 30 µgm/kg B.W. medetomidine, followed by ketamine 1mg /Kg B.W there is normal recorded ECG by lead I,II and III represented P wave, QRS wave and T wave, Normal inverted T wave was recorded in lead I and II. Normal strength of cardiac muscle contractility which represented by QRS wave. Five minutes post injection there were increases P-R interval and normal QRS waves, while T wave still inverted. After 10 minutes, heart rate still as in five minutes profile, also QRS wave persisted as its (Fig. 2). After 15 minutes slight decreased heart rate, interval still prolonged while, T wave still inverted.
as before (fig. 3). After 30 minutes the same result as in 15 minutes. After 45 minutes slight bradycardia, T weave still inverted.

Physiological findings

Heart rate as presented in (Fig.4) was showed significant (P<0.05) tachycardia in groups II and III that started with the beginning of study and persisted for 30 min. of the experiment. However, in group IV medetomidine injection maintained heart rate at control rates.

Respiratory rate showed increases in all groups starting from the beginning of study however it significantly persisted at high rate for 15 to 30 min. in group III before returning again to the control rate at the end of experiment (at 45 min). (Fig. 5).

Core body temperature was showed significant decreases in groups II, III and IV that proceeded parallel with the time of experiment. (Fig.6).

Discussion

Recently, anesthesia in camel has gained an interest in veterinary clinic because, it represent solve of camel problems, surgical treatment and provide a good line of treatment of many problems in camels. The results of electrocardiogram (ECG) reported a negative T weave in 4 of 5 camel in group I as depicted in figure (1) in lead I, II and III, this data was in consistent with the previous results of Fresh et al., 27 in their study in Illama; they found that T weave was commonly –ve in healthy normal cameldia. Furthermore, ketamine and medetomidine injection in camel as anesthetic and sedation drugs can changes the electrical activity in the cardiac muscle (heart) in one humped camel. These changes as shown in lead I,II and III in group II (ketamine 1mg /kg BW ) that revealed increases in heart rate (tachycardia) 5 min. post injection of the drug with decreases P-R interval and increases in the strength of cardiac muscle contraction with decreased the time of QRS complex. Moreover, there was an increased in the strength of T waves especially in lead II. These results could be attributed to the pharmaco dynamic effects of ketamine on electro-cardio graphic ECG signal. Where, it was hypothesized that ketamine administration would strongly perturb cardiac signal dynamics because ketamine antagonizes the N-methyl-D-aspartate (NMDA) receptor, blocks the serotonin transporter, and increases serotonin type-3 (5-HT) receptor-mediated Ca\(^{2+}\) currents by a mechanism not dependent on inhibition of the serotonin transporter. 16,17,18 Areas of the brain stem such as the nucleus tractus solitaries involved in heart rate regulation are rich in 5-HT as well as excitatory amino acid receptors1. Profound effects on the reflex regulation of heart rate are seen following pharmacologic manipulation of NMDA and 5-HT receptor activities. 19,23 Furthermore, this transient excitation reported in group II and III could be resulted from sympatho-neuronal and sympathe-adrenal activity that presumably brought about by central mechanism of action of ketamine. 28
The results of electrocardiogram (ECG) in group III revealed that, the effect of ketamine 2 mg/kg B.W., after 2 min. post injection induced initial bradycardia with irregular rhythm with absent or decrease strength of T waves, after 5 min. the same findings previously mention in group II still present with tachycardia. This effect could be returned to the duplication of the ketamine dose that may be inducing more CNS depression or brain stem cardiopulmonary centers depression.
In group IV the effect of medetomidine by a dose of 30 µg/kg B.W. followed by ketamine 1mg/Kg B.W. showed normal recorded ECG by lead I, II and III represented P wave, QRS wave and T wave (figure 2 &3). Normal inverted T wave was recorded in lead I and II. These may be due to combination between medetomidine and ketamine where medetomidine prevent the undesirable effects of ketamine. Physiological finding as heart rate (beat/min.), respiratory rate (min.) and rectal body temperature were showed significant changes during anesthesia with ketamine in one humped camel as previously reported by. In the current study, heart rate was significantly increased in group II and III after (K) injection and this increase persisted for 30 min. post injection before returning again to basal rate (Fig.4). These results agreed with the previous results of in lambs. These data could be explained by the central stimulatory and enhancement effects of ketamine. Moreover, the transient tachycardia recorded in groups II and III in this study could be related to the direct stimulatory effect of (K) on the heart before entering the deep anesthesia. On the other hand, heart rate was also dramatically decreased by (M) injection in group IV as presented in figure (4), this result similar to the previous results of in cynomolgus monkey; in lamb and in dogs. These changes resulted from depressant effects of (M) on cardiorespiratory centers in nervous system as approved by.

Respiratory rate showed significant increases in all groups starting from the beginning of study and persisted at high rate for 15 min. before returning again to the pre-injection rate at the end of study (at 45 min). This result was in contrast with the finding of ketamine in higher dose in human and cat but in camel the ketamine not cause significant respiratory depression at usual dose. So, controversy results about the effects of ketamine and medetomidine on respiratory rate in animals could be approved and could be explain this effects.

Core body temperature showed slight significant decreases in group II and III after injection. Body temperature is known to be decreased following the administration of general anesthetics like barbiturates may be due to reduction of muscular activity of the animal during anesthesia or depression of thermoregulatory center in the hypothalamus.

It could be concluded that, ketamine anesthesia in camel in a dose of 1mg/kg or 2mg/kg were alter the electro-cardiac and physiological findings and these alterations could be minimized by premedication with medetomidine. So medetomidine premedication could be recommended before ketamine anesthesia in camel.

References


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