

# Electrocardiographic Evaluation of Balanced General Anaesthesia in Adult Domestic Cats (*Felis catus*)

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[Received: 29.07.2019; Accepted: 21.01.2022]

{DOI 10.29005/IJCP.2022.14.1.22-24}

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## ABSTRACT

The study was aimed to evaluate the electrocardiographic changes in cats after administration of an anaesthetic combination using dexmedetomidine, butorphanol, midazolam and ketamine. The study was conducted in 12 healthy adult female cats aged from 9-18 months presented for ovariohysterectomy to Veterinary Hospital of Kerala Veterinary and Animal Sciences University. Electrocardiographic examination of the cats were conducted before administration of anaesthesia and after recovery from surgical plane of anaesthesia. ECG was recorded in right lateral recumbency with sensitivity of 1mV=20 mm and 1 sec= 25mm using lead II. On analysing the ECG, it was found that there was a decrease in heart rate, increased P wave duration, increased in R and T wave amplitude, increased P-R and Q-T intervals; though values for all parameters were within the clinically acceptable range. Hence it was concluded that this anaesthetic protocol could be used in adult cats without causing marked interference in the cardiovascular function.

**Key words:** Butorphanol, cats, dexmedetomidine, ketamine, midazolam

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## INTRODUCTION

Electrocardiography (ECG) has been increasingly used as preoperative patient evaluation and as complementary monitoring modality in veterinary anaesthesia. (Tilley, 1992). Alterations in the cardiac function caused by preanaesthetic and anaesthetics drugs are critical in patients with pre-existing cardiac disease. ECG is important for the designing of the appropriate preanaesthetic and/or anaesthetic protocol in such cases. In addition, cardiac monitoring during surgery offers timely information about the alterations that may arise during the surgical procedure, such as arrhythmias, ischemia and electrolytic disturbances, which may affect cardiac function (Edwards, 1987).

Ketamine is the popularly used anaesthetic agent in cats, though it causes myocardial hypoxia. Butorphanol when administered causes mild sedation, decrease in arterial blood pressure, heart rate and arterial oxygen tension in dogs (Trim, 1986). Midazolam, a rapid but short acting drug with good muscle relaxant property, can reduce the dosage of ketamine needed for induction of anaesthesia and also attenuate ketamine induced hypertension and tachycardia (Ilkiw *et al.*, 1996). On the other hand dexmedetomidine causes dose dependent decrease in the heart rate and cardiac output and increases the total vascular resistance in cats (Granholm *et al.*, 2006). Evaluation of electrocardiographic changes associated with balanced general

anaesthesia in 12 adult cats using a combination of dexmedetomidine, butorphanol, midazolam and ketamine has been recorded.

## MATERIALS AND METHOD

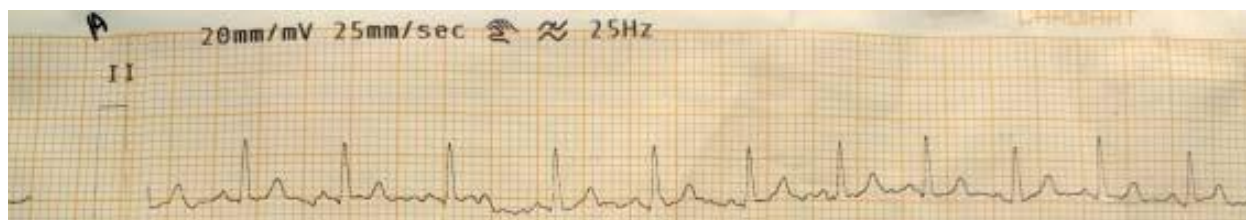
Study was conducted in 12 adult female cats, aged 9-18 months, of mixed breeds subjected to neutering (spaying or ovariohysterectomy), in Veterinary Hospital of Kerala Veterinary and Animal Sciences University. The cats were apparently healthy based on history and physical examination. Electrocardiography (ECG) was performed before administration of the anaesthesia and at the time of recovery from surgical plane of anaesthesia using dedicated ECG machine. Animals were positioned on right lateral recumbency, on an appropriate table, with limbs perpendicularly positioned to the trunk. Electrodes were attached above the elbow joints of both the forelimbs and above stifle joints of both the hind limbs. Paper speed (X-axis) used for all recordings was 25 mm/s, with two sensitivity (Y-axis) (1mV=2cm). A combination of inj. dexmedetomidine, inj. ketamine hydrochloride, inj. midazolam and inj. butorphanol at the dose rates of 10µg/kg, 10mg/kg, 0.2 mg/kg and 0.2 mg/kg body weight, respectively, were used to induce balanced general anaesthesia. All the cats were controlled in right lateral recumbency and the calculated volume of the drugs were mixed in a single syringe and given intramuscularly. The ECG was recorded before administration of the anaesthesia and during

recovery from surgical plane of anaesthesia in the bipolar lead II (L II) and the evaluated parameters were heart rate, cardiac rhythm, duration in milliseconds (ms) and amplitude in millivolts (mV) of the P wave, duration (ms) of the P, PR, QT interval and of QRS complex, amplitude (mV) of the R and T wave, characteristics of the T wave and elevation and/or depression of ST segment.

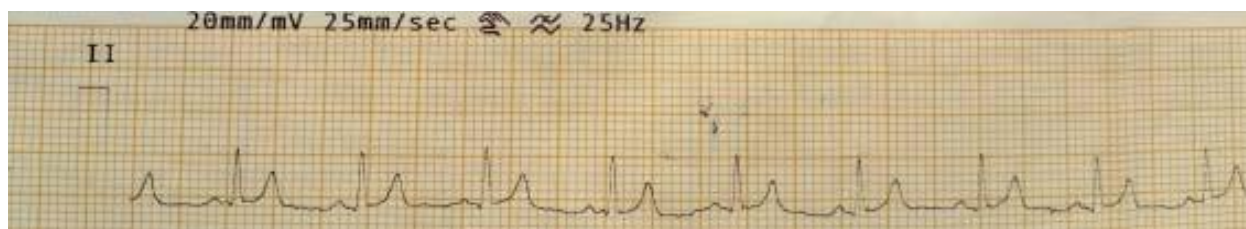
normal. After recovery from surgical plane of anaesthesia, significant ( $P < 0.05$ ) decrease in heart rate with regular rhythm, increase in duration of P wave, increase in R and T wave amplitude and nonsignificant ( $P > 0.05$ ) increase in P, R wave amplitude were noticed. The duration of P-R interval was significantly (increased with a nonsignificant increase in Q-T interval and elevation of S-T segment (Table 1).

## RESULTS

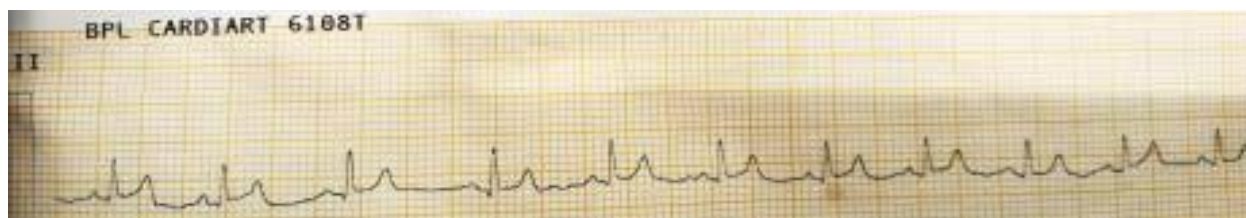
Electrocardiography before surgery was



**Fig. 1:** Normal ECG (before administration of anaesthesia)



**Fig. 2:** ECG, during recovery from surgical plane of anaesthesia (Regular rhythm, Increased P-R interval (bradycardia), peaking of T wave)



**Fig. 3:** ECG, during recovery from surgical plane of anaesthesia (Elevation of S-T segment, increased amplitude of R wave)

**Table 1:** Mean  $\pm$ SE values of different parameters of electrocardiography before administration of anaesthesia and during recovery from surgical plane of anaesthesia (n=12)

Parameters	Before administration of anaesthesia	During recovery from surgical plane of anaesthesia
Heart rate (bpm)	146 $\pm$ 2.62 <sup>a</sup>	105.25 $\pm$ 4.03 <sup>b</sup>
P wave duration (s)	0.043 $\pm$ 0.001 <sup>a</sup>	0.047 $\pm$ 0.002 <sup>b</sup>
P wave amplitude (mV)	0.061 $\pm$ 0.006	0.067 $\pm$ 0.007
R wave amplitude (mV)	0.363 $\pm$ 0.03 <sup>a</sup>	0.0438 $\pm$ 0.024 <sup>b</sup>
QRS wave duration (s)	0.039 $\pm$ 0.02	0.042 $\pm$ 0.001
T wave duration (s)	0.1 $\pm$ 0.046	0.072 $\pm$ 0.006
T wave amplitude (mV)	0.088 $\pm$ 0.007 <sup>a</sup>	0.158 $\pm$ 0.012 <sup>b</sup>
PR interval (s)	0.097 $\pm$ 0.002 <sup>a</sup>	0.0112 $\pm$ 0.004 <sup>b</sup>
QT interval (s)	0.183 $\pm$ 0.002 <sup>a</sup>	0.217 $\pm$ 0.002 <sup>b</sup>

Mean  $\pm$ SE values with different superscript differ significantly ( $P < 0.05$ )

## DISCUSSION

The decrease in heart rate was significant on recovery from surgical plane of anaesthesia ( $P < 0.05$ ) and this may be attributed to the effect of administration of dexmedetomidine which produced marked bradycardia, and increased vascular resistance. It is in agreement with the findings of Selmi *et al.* (2003) and Granholm *et al.* (2006). The significantly ( $P < 0.05$ ) increased P wave duration and non-significant increase in QRS wave duration were suggestive of prolonged atrial and ventricular depolarization which was in accordance with the findings of Moezzi *et al.* (2014).

The significant increase in R amplitude in post anaesthetic observation was indicative of higher systolic pressure, which may be due to administration of dexmedetomidine and midazolam. Similar observations were made by Rafee *et al.* (2016). The elevation of S-T segment was indicative of hypoxia. This was in accordance with the findings made by Periera *et al.* (1992) and Reilly *et al.* (2014). Significant increase in duration of P-R interval was suggestive of the first degree AV block on account of the effect of dexmedetomidine (Rafee *et al.*, 2016).

## CONCLUSION

All the cats were subjected to general anaesthesia using a balanced anaesthetic combination of four drugs at lower doses of each individual drug which produced adequate state of surgical plane of anaesthesia with smooth induction and recovery and least cardiovascular effects.

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