



ELECTROCARDIOGRAM OF UNANESTHETIZED HOMING TURKEY (*Meleagris gallopavo*)

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ABSTRACT

In this study, electrocardiographic assessment of turkey (*Meleagris gallopavo*) was undertaken and the reference values and configurations established using apparently healthy unanesthetized turkey. The waveforms of 12 healthy turkeys, presented to Avian, Exotic and Special Species Medicine, Unit of Veterinary College & Research Institute, Orathanadu (Tamilnadu), were analyzed in all the leads at 25 mm sec⁻¹ or 50 mm sec⁻¹ and 20 mm mV⁻¹ or 10 mm mV⁻¹. The heart rate ranged from 210-272 beats min⁻¹ with mean value of 252.5 ± 16.73 min⁻¹. PR interval was higher in females than in male turkeys. QT interval was found to be 0.146 ± 0.008 sec. The ECG values and patterns recorded in clinically healthy turkeys is expected to help in better understanding of ECG changes during diseases and shall serve as a comparison tool in clinical decision making.

Keywords: ECG, lead II, manual restraint, turkey, unanesthetized

INTRODUCTION

The avian cardiovascular system shares many similarities with those of mammals and several other unique and specific details exist in the literature (Krautwald, 2004).). In contrast to the mammals, the pathway of depolarization in turkey (*Meleagris gallopavo*) is from epicardium to endocardium. The mass of avian heart is nearly twice than those of mammals of comparable size. The avian heart is designed to meet the high-performance demands of animal (Krautwald, 2004), as such the stroke volume in avian species is bigger and cardiac output higher than those of mammals. Consequently, the avian heart rate can be as high as 1000 beats min⁻¹ depending upon the species involved (Pees and Krautwald, 2009), thereby allows higher demands for oxygen. Electrocardiogram (ECG) gives information about the cardiac activity and is recognized as a laboratory tool in the assessment of cardiac performance and in diagnosing the cardiovascular diseases (Odom *et al.*, 1991). In mammals, ECG parameters differ significantly among the species of birds. These variations in ECG parameters among species emphasize the need to assess the specific ECG patterns and reference values for each species of exotic birds. Experimental data concerning the ECG of homing turkeys are limited; therefore, the present study was aimed to assess the normal electrocardiographic parameters of this bird which could be used as a reference material for further clinical and experimental studies.

MATERIALS AND METHODS

Twelve apparently healthy turkeys (*Meleagris gallopavo*), six males and six females of 1 to 5 yr age were used in the present study. The birds belonging to the rural household in and around Orathanadu (Tamil Nadu, India) were presented for general health assessment to the Avian, Exotic and Other Exotic Animal Clinics, Veterinary College and Research Institute, Orathanadu (Tamil Nadu, India) during the period June, 2017 to December, 2018. The birds were housed under similar conditions of management. To record ECGs, all the birds were kept in standing position on electrically non-conductive area with manual restraint and ECG (BPL Cardiart GENX3, India) recordings were made as per the method described by Hassanpour and Khadem (2013). The alligator clip electrodes were attached to the skin of birds at the base of right and left wings and the right and left thighs. Good electrical contact was established with electrode gel. ECGs were obtained via standard bipolar limb leads (leads I, II and III). The machines were calibrated to 0.5 or 1 cm mV^{-1} at a paper speed of 25, 50, or 100 mm sec^{-1} . The QRS waveform was described according to the standard nomenclature (Hassanpour and Khadem, 2013). Data processing was performed and expressed as mean $\pm$ standard deviation.

RESULTS AND DISCUSSION

Electrocardiogram being a non-invasive technique is widely used to evaluate cardiac function during infectious and non-infectious ailments. In mammals, ECG parameters vary significantly between the species of birds which emphasize the need to determine specific ECG patterns and reference values for each species of exotic birds. This study was aimed to determine the normal values of ECG parameters in homing turkeys that can be used in cardiac evaluations in a clinical setting. In contrast to the methods adopted in many previous studies, we did not anesthetize the birds under study while recording the ECGs. Obviously, the ECG parameters (waves and intervals) are likely to change in anesthetized birds. Ideally, ECG measurements may be best when animal is conscious but quiet. Sedation and anaesthesia may influence several ECG values of wave intervals as well as cardiac rhythm and heart rate. Therefore, in this study ECG recordings were obtained from conscious animals as done previously by Burntack and Degernes (1993).

In present study, a normal sinus rhythm was observed in all the turkeys studied (Fig. 1a). ECG values in lead I were isoelectric or too small to evaluate in complex configuration. Hassanpour and Khadem (2013) observed that P-wave was mainly positive in all the measured leads in helmeted guinea fowl (*Numida meleagris*) and green pea fowl (*Pavo muticus*), whereas Hassanpour *et al.* (2010) in golden eagle (*Aquila chrysaetos*) reported that the P-wave was mainly negative in leads III. In our study, P-wave showed positive deflection in lead I and II, but positive, negative and isoelectrical in lead III. The QT-interval, measured from the beginning of Q-wave to the end of T-wave, is a measure of the beginning to the end of ventricular depolarization. Lead II QT interval in our study was found to be 0.146 ± 0.008 sec.

The values for durations and amplitudes of waves at different intervals were recorded and data is presented in Table 1. In QRS complex, prominent 'rS' and 'Rs' were identified in lead II of ECG tracings. Lower heart rate values were observed in females than in male birds. These differences seem to be related to the size and weight of animals. An association between heart rate and body weight (related to the gender) is recognized in chicken and turkey, but not in duck, quail or pigeon. PR interval was higher in females than in males, as it was for the QT interval (Fig. 1b-d).

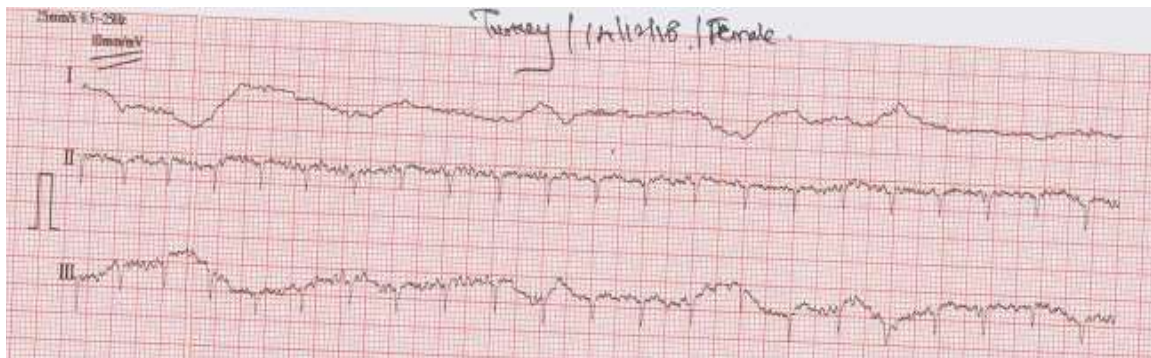


Fig. 1a. Electrocardiography in apparently healthy four years old female turkey (lead II). Paper speed 25 mm sec⁻¹; 1 cm = 1 mV

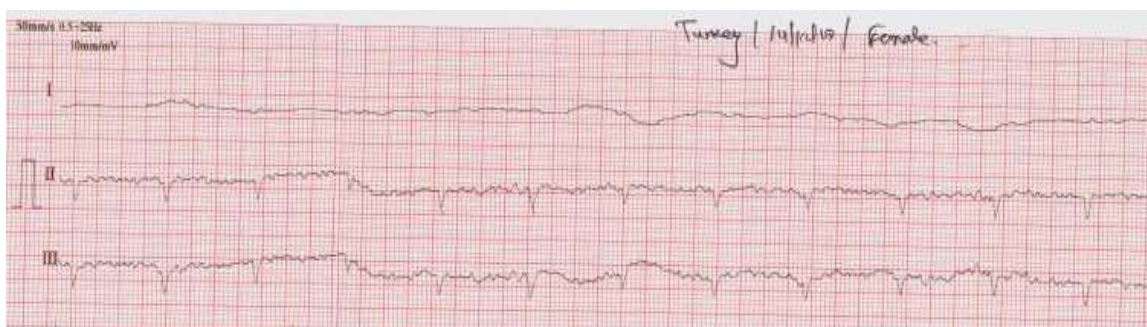


Fig. 1b. Electrocardiography in apparently healthy female turkey (lead II). Paper speed 50 mm sec⁻¹; 1 cm = 1 mV

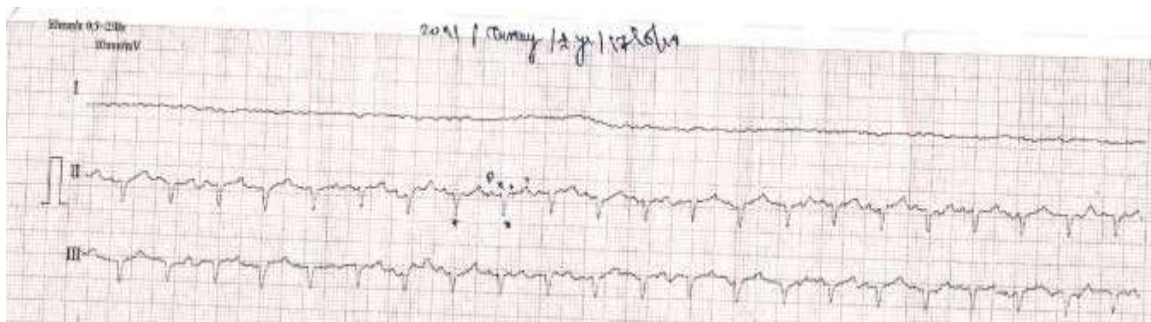


Fig. 1c. Electrocardiography in apparently healthy one year old male turkey (lead II). Paper speed 50 mm sec⁻¹; 1 cm = 1 mV



Fig. 1d. Electrocardiography in apparently healthy female turkey (lead II). Paper speed 25 mm sec⁻¹; 1 cm = 1 mV

Table 1: Electrocardiogram (ECG) variables (durations, amplitudes and heart rate) measured on standard bipolar limb leads from 12 apparently healthy turkeys in standing position

Parameters	Mean $\pm$ SD	Range for total birds (n = 12)	Mean for male (n = 6)	Mean for female (n = 6)
Heart rate (beats min ⁻¹)	252.5 $\pm$ 16.73	210-272	281	245
P duration (sec)	0.026 $\pm$ 0.002	0.022-0.035	0.026	0.037
P Amplitude (mV)	0.137 $\pm$ 0.008	0.080- 0.202	0.121	0.200
PR interval (sec)	0.113 $\pm$ 0.021	0.082-0.150	0.098	0.146
QRS amplitude (mV)	0.512 $\pm$ 0.010	0.451-0.522	0.488	0.500
QRS duration (sec)	0.034 $\pm$ 0.004	0.044-0.048	0.038	0.048
QT interval duration (sec)	0.146 $\pm$ 0.008	0.138-0.172	0.142	0.168
T duration (s)	0.056 $\pm$ 0.013	0.040-0.068	0.052	0.062
T amplitude (mV)	0.136 $\pm$ 0.014	0.140-0.160	0.138	0.152

The PR interval and segment represent the atria depolarization and atrioventricular conduction time. The negative deflection of QRS amplitude in lead II was smaller than conscious golden eagle, although QRS duration was the same (Hassanpour *et al.*, 2010). In most of the species including turkey, the left ventricular muscle mass far exceeds that of the right ventricular mass. It is, therefore, expected that depolarization of left ventricle should control the magnitude and direction of forces of ventricular waves. An increased voltage in QRS complexes may be indicative of heart muscle hypertrophy.

In present study ST segment represented the early phase of ventricular repolarization and was found normally isoelectric. In agreement with previous works on various birds the ST segment appeared elevated over the baseline (Lumeij *et al.*, 1999; Mehmet and Mehmet, 2013). The QT interval represents the total time needed for the ventricles to depolarize and repolarize. The duration of QT intervals in present study was in agreement with the previously reported values in other conscious raptors (Talavera *et al.*, 2008). The mean duration of all ECG intervals was 50 to 75% greater in turkey than in chicken. Similarly, the mean amplitudes for QRS and T waves of ECG of lead II were approximately 2 to 4 times greater than those reported in case of chicken (Martinez *et al.*, 1997; Yogeshpriya *et al.*, 2018). To ensure that any deviations from norms are truly associated with pathology, comparisons should always be made with reference to the data for that particular species. The ECG variables of turkey observed may help such purposes.

Conclusions: In present study baseline values of ECG parameters in conscious turkeys were clearly observed. ECG tracings could be obtained and may be interpreted with regard to rhythm, heart rate, morphologic patterns and magnitude of component deflections. The ECG variables of conscious turkey may help in future cardiovascular research involving birds.

Ethical statement: The present clinical study was carried out in Veterinary Clinical Complex of the Veterinary College and Research Institute, Orathanadu, Tamil Nadu (India) after securing proper clinical approval from the concerned appropriate authorities.

Conflict of interest: The author declares no conflict of interest.

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