

A preliminary study on normal electrocardiographic parameters of ostriches (*Struthio camelus*)

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ABSTRACT

Electrocardiograms were taken from 100 normal healthy male and female ostriches which were 1 to 15 months old using a base apex lead. The heart rate of those less than 3 months old ranged from 107 to 250 beats per minute with a mean of 171.47 ± 9.03 and that of ostriches of more than 3 months old ranged from 43 to 167 with a mean of 90.52 ± 2.64 beats/minute. The P-waves were positive in all cases except in 1 ostrich which it was isoelectric. The QRS complexes were mainly negative and either monophasic (QS) or biphasic (rS or RS). The T-wave showed more variation than other waves. The durations of P, P-R, QRS, Q-T and T-waves of chicks and of those more than 3 months of age (4–15-month-old) were 0.04 ± 0.00 , 0.06 ± 0.00 ; 0.14 ± 0.04 , 0.16 ± 0.00 ; 0.04 ± 0.00 , 0.06 ± 0.00 ; 0.18 ± 0.00 , 0.27 ± 0.00 and 0.06 ± 0.00 , 0.09 ± 0.01 s, respectively, and amplitudes of the main direction of P-, QRS and T-waves of 2 groups were 0.29 ± 0.02 , 0.26 ± 0.01 ; 1.87 ± 0.17 , 2.21 ± 0.08 ; and 0.34 ± 0.06 , 0.37 ± 0.02 mV, respectively. Ten cases showed cardiac dysrhythmias of which 9 showed sinus arrhythmia and 1 showed premature atrial contractions (PAC). This study showed that the base apex lead can be a suitable monitoring lead for electrocardiographic examination of ostriches.

Key words: bird, dysrhythmia, electrocardiogram, heart, ostrich.

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INTRODUCTION

Anatomy of the heart and some congenital and acquired cardiac disorders of ostriches have been reported in the literature and cases of sudden death have been observed by field practitioners^{1,7,11,13}. Many diagnostic aids have been used for the diagnosis of various cardiac diseases of birds and domestic mammals. One of these aids, which is used routinely, is the electrocardiogram (ECG). The ECG remains an indispensable technique and is relatively simple for monitoring cardiac functions. Awareness of normal ECG parameters is important in defining abnormality in the shape of the wave forms or cardiac rhythms. There are only a few reports in the literature on the use of ECGs in ostriches, mainly in ostriches under anaesthesia^{2,4,6}.

Recent interest in ostrich farming in several countries, including Iran, has

resulted in referral of clinical cases to veterinary practitioners who need to have the knowledge of normal physiological parameters. A review of the literature has indicated that such data are lacking. However, a few published papers have reported ECG parameters in ostriches under general anaesthesia but have only recorded the heart rate and rhythm^{2,4,6} without providing comprehensive ECG parameters. The objective of this present study was to obtain ECGs from a large number of ostriches (blue neck) from a farm near Tehran in order to generate some data on the ECG parameters of the base apex lead of healthy ostriches.

MATERIALS AND METHODS

The birds studied were from a farm in Tehran Province. A hundred ostriches of both sexes and different ages were used. At the time of ECG recording, the adult males and females were used for breeding so it was not possible to obtain ECG from this group. Initially, it was intended to record ECGs on both bipolar and unipolar limb leads but after a 2-day trial it was found that attaching electrodes to the wing and the legs, the points routinely used for

other birds^{5,8,10,14}, was very stressful to ostriches. As an alternative, a base apex lead was used which has been employed routinely in large animals⁹ and also in an 18-month-old ostrich⁶. The ECG was thus recorded on a bipolar base apex using the electrodes of the limb lead I. No preparation was carried out for electrodes attachment apart from the use of ECG jelly. The ECG was obtained when birds were thought to be in a quiet state, restrained either in a standing or sitting position. The positive electrode of lead I (left arm) was attached to the skin half-way between the anterior and the posterior poles of the sternum, where the apex of the heart is located. The negative electrode (right arm) was attached to the base of the left side of the neck. The earth electrode was attached to the skin of the upper part of the left leg. All ECGs were recorded on a single-channel machine (Fukuda 501B, Cardisun, Japan) with the paper speed of both 25 and 50 mm/s and calibration of 5 mm or 10 mm equal to 1 mV. One hundred traces of ECGs were recorded and evaluated according to the criteria given for domestic animals⁹.

On the basis of their age the ostriches were divided initially into 3 groups, (a) less than 3 months ($n = 19$); (b) 3–9 months ($n = 33$) and (c) 10–15 months ($n = 48$). There were 49 females, 32 males and 19 undetermined (chicks less than 3 months of age). However, after data analysis, no significant differences were found between ECG values of the last 2 groups so the data were pooled.

The statistical method used was Student's *t*-test (SPSS software version 11.5). Differences were considered as significant at $P < 0.05$.

RESULTS

The average heart rate of chicks (less than 3 months old) was 171.47 ± 9.03 with the range of 107 to 250 beats/min, and that of 4–15-month-old ostriches was 90.52 ± 2.64 with the range of 43–167 beats/min. The chicks were in a quiet state at the time of ECG recording, but this cannot definitely be stated for the 2nd group.

The amplitudes and durations of ECG waves are presented in Table 1. Examples

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Table 1: Heart rate, duration and amplitude of electrocardiographic parameters in 2 different age groups of ostriches.

ECG parameters	0–3 months of age (n = 19)			4–15 months of age (n = 81)		
	Mean ± SE	Min	Max	Mean ± SE	Min	Max
Heart rate/min	171.47 ± 9.03 ^a	107	250	90.52 ± 2.64 ^b	43	167
P (s)	0.04 ± 0.00 ^a	0.04	0.04	0.06 ± 0.00 ^b	0.04	0.10
P-R (s)	0.14 ± 0.04	0.08	0.90	0.16 ± 0.00	0.10	0.24
QRS (s)	0.04 ± 0.00 ^a	0.03	0.06	0.06 ± 0.00 ^b	0.04	0.08
Q-T (s)	0.18 ± 0.00 ^a	0.16	0.20	0.27 ± 0.00 ^b	0.16	0.44
T (s)	0.06 ± 0.00	0.04	0.09	0.09 ± 0.01	0.04	0.80
P (mV)	0.29 ± 0.02	0.10	0.50	0.26 ± 0.01	0.08	0.60
R (mV)	0.12 ± 0.01	0.05	0.20	0.23 ± 0.05	0.04	1.30
S (mV)	1.87 ± 0.17	0.80	3.40	2.21 ± 0.08	0.30	4.60
T positive (mV)	0.34 ± 0.06	0.10	0.80	0.37 ± 0.02	0.05	1.00
T negative (mV)	0.20 ± 0.06	0.10	0.40	0.37 ± 0.06	0.10	1.00

Values in the same row followed by a different letter indicate a significant difference ($P < 0.05$, *t*-test).

of the ECGs of the 3 groups are given in Fig. 1.

All the P-waves in this lead were positive but 1 which was isoelectric. The configurations of the QRS complex were either monophasic (QS, 59 %) or biphasic (rS, 39 % or RS, 2 %), and the T-wave was positive (81 %), negative (12 %), biphasic of +/- (5 %) or -/+ (1 %) and 1 was isoelectric. Ninety per cent of the ostriches showed a regular rhythm and 9 % demonstrated sinus arrhythmia and the ECG of 1 case revealed premature atrial contractions (PAC).

DISCUSSION

Evaluation of 100 ECGs revealed the existence of a stable P-wave, slight variability of QRS complexes and the discordant T-wave with the QRS complexes in 81 % of cases. The T-wave in this lead was positive, negative and biphasic.

The QRS complexes were mainly negative in 98 % and equally positive and negative in 2 % of ostriches. In comparison with the ECG of base apex lead of cattle, variability of the P-wave, QRS and T-wave is the same. In fact the base apex lead demonstrates a stable and very clear ECG waves which is why it has been accepted as a standard and monitoring lead in large animals⁹. These findings showed that this lead can easily be recorded from the ostrich and the ECG configurations are much clearer than the forms reported for other birds on limb leads^{3,8,14}.

The heart rate was calculated by measuring the R-R intervals at the end of ECG trace at the time when the birds seemed to be more in a relaxed state than at the beginning of the ECG recording. The average heart rate of chicks was statistically higher than the heart rate of the older ostriches (Table 1). The durations of P-wave and QRS complexes of the 2 groups are significantly different, which could be due to the size of the heart. The



Fig. 1: Three traces of ECG recorded on a base apex lead with the paper speed of 25 mm/s and calibration of 5 mm/mV. Upper trace (A) was recorded from chicks <3 months old, the middle one (B) from a 6-month-old which shows mild sinus arrhythmia, and the bottom one (C) from a 13-month-old ostrich.

Q-T interval of chicks was significantly shorter than that of the older ostriches. This might be due to a higher heart rate in this group. However, the difference in heart rate had no effect on the P-R interval. There is no value for the heart rate of the ostrich to be compared with. In 2 reported studies, ostriches were under general anaesthesia^{2,6}. In 1 report the heart rate under anaesthesia was 65–70 beats/min⁶. The heart rate of developing ostrich embryos was found to be about 185 beats/min¹², which is slightly higher than the value reported for ostrich chicks in this study. Average heart rate of 2 emus was reported to be 50 beats/minute³. Although we attempted to minimise the levels of stress, the heart rate reported here for the 4–15-month-old ostriches were higher than expected, and this suggest that radiotelemetry would be the method of choice to obtain a resting heart rate from birds in this age class.

Sinus arrhythmia was one of the dysrhythmias observed in this group of ostriches. This dysrhythmia has been considered as a physiological irregularity in most mammals and birds which could be due to variability of the blood pressure and consequently the vagal tone. Sinus arrhythmia was the most common rhythmic irregularity on the ECGs of 79 free-ranging birds⁵. This rhythm disturbance was also reported in macaws and cockatoos under isoflurane anaesthesia⁸. Premature atrial contraction was observed only in 1 ostrich which was clinically normal. Premature ventricular contractions (PVC) have been reported in an ostrich under general anaesthesia⁶. Whether anaesthesia produced the PVCs, or whether they were due to myocardial diseases, stress or pain, is not known. Preanaesthetic ECG was not recorded in this case. Ventricular arrhythmia, especially premature ventricular contractions

(PVC), was the most common arrhythmia in a report in broiler chickens which was considered to be one of the causes of sudden death syndrome in this species¹⁰. The clinical importance of cardiac dysrhythmias in the ostrich remains to be evaluated in future studies.

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