pISSN 1598-298X
J Vet Clin 30(6) : 456-458 (2013)

Journal of Veterinary Clinics
www.ksvc.or.kr

Evaluation of Electrocardiographic Index in Healthy Raccoon Dogs (*Nyctereutes procyonoides*)

Won-Woo Hong*, Jong-Taek Kim*, Dong-Keun Yang, Hyo-Seung Nam*** and Changbaig Hyun***[1]**

**Section of Wildlife Medicine, College of Veterinary Medicine, Kangwon National University, Chuncheon 201-100, Korea*
***Viral Disease Division, Animal, Plant and Fishery Quarantine Inspection Agency, Anyang, Korea*
****Section of Small Animal Internal Medicine, College of Veterinary Medicine, Kangwon National University, Chuncheon 201-100, Korea*

(Accepted: December 11, 2013)

Abstract : The aim of this study is to evaluate the reference value for electrocardiogram in healthy captive raccoon dogs. Forty-one free-ranging adult raccoon dogs rescued from Wildlife rescue centre, Kangwon National University were enrolled in this study. The 6-lead electrocardiogram was obtained in all raccoon dogs without any chemical restraints. The mean heart rate was 146.10 ± 43.31 beats/min (95% confidence interval 132.84~159.36 beats/min). The mean respiration rate was 35.73 ± 11.56 breaths/min (95% confidence interval 32.19~39.27 breaths/min). The mean systolic blood pressure was 136 ± 29.26 mmHg (95% confidence interval 127.99~145.91 mmHg). Electrocardiographical features were also evaluated in all raccoon dogs. The mean duration and amplitude of P-wave were 38.2 ± 4.0 ms (range 28-40 ms) and 0.128 ± 0.039 mV (range 0.09~0.20). The mean duration and amplitude of QRS complexes were 48.5 ± 7.2 ms (range 36-60 ms) and 1.330 ± 0.650 mV (range 0.15~2.30). The range of the mean electrical (QRS) axis was −91° ~ +96° (10°~60°; 95% of confidence interval). The mean corrected QT (QTc) interval was 273.7 ± 32.7 ms (range 212-333 ms), while the mean PR interval was 76.1 ± 10.0 ms (range 50-82 ms). To the authors' knowledge, this is the first study to provide references in electrocardiogram (ECG) in healthy captive raccoon dogs.

Key words **:** Racoon dog, ECG, Heart, QTc, *Nyctereutes procyonoides*.

Introduction

The raccoon dog (*Nyctereutes procyonoides*) is a canid species which is originally indigenous to East Asian countries including Korea, Japan and China (3,4). Although the raccoon dog looks similar to the raccoon (*Procyon lotor*), both species are not closely related. The raccoon dog is regarded as an important wildlife carrier transmitting hazardous infectious diseases including rabies, paratyphoid, anthrax and tuberculosis. Despite the importance of raccoon dogs for transmission of several infectious diseases, diagnostic parameters for normal vital signs, routine laboratory tests and cardiac index has been rarely studied (3). Therefore the aim of this study is to evaluate the reference value for electrocardiography in healthy captive raccoon dogs.

Materials and Methods

Fourty-one clinically healthy mature raccoon dogs based on clinical and routine laboratory tests captured throughout Korea for research purpose were enrolled in this study. Prior to study, we obtained the approval of the animal ethics committee of Kangwon National University for the research. This animal testing program, including animal care and cardiac examination was performed in strict adherence to the guidelines of the National Research Council of Korea. Routine health check including physical examination, hematology and serum chemistry was performed on all raccoon dogs to exclude clinically abnormal subjects.

All electrocardiographical (ECG) examination was done by physical restraint without sedation and anesthesia. Heart rate was determined, and the presence of any murmurs, gallops, or arrhythmias was recorded. Next, a 6-lead surface ECG was recorded with a CARDIOVIT AT-1VET Veterinary ECG (Schiller AG, Baar, Switzerland) by attaching ECG electrodes via alligator clips in standard limb lead configuration while the raccoon dogs were in right lateral recumbency. ECG measurements were obtained at a paper speed of 50 mm/sec and a sensitivity of 10 mm/mV. The mean value of three measurements was calculated for each ECG variable on lead II. The corrected QT interval was calculated by Bazett's Formula (QT Interval / √ (RR interval). The mean ± standard deviation value was calculated for each electrocardiographical index from each raccoon dogs.

[1]Corresponding author.
E-mail : hyun5188@kangwon.ac.kr

Table 1. Limb lead electrocardiographic variables in 41 clinically healthy raccoon dogs

Variable	Mean ± SD (Male)	95%confidence interval (Male)	Mean ± SD (Female)	95% Confidence interval (Female)	Mean ± SD (Total)	95%confidence interval (Total)
RR interval duration (ms)	442.63 ± 130.01	390.61-494.64	404.00 ± 103.56	354.77-453.23	426.61 ± 119.92	389.90-463.32
P wave duration (ms)	37.38 ± 7.55	34.35-40.40	39.12 ± 18.69	30.23-48.00	38.10 ± 13.17	34.07-42.13
PR interval duration (ms)	70.67 ± 10.84	66.33-75.00	86.82 ± 61.91	57.39-116.25	77.37 ± 40.81	64.88-89.86
QRS duration (ms)	41.88 ± 10.10	37.83-45.92	47.00 ± 20.80	37.11-56.89	44.00 ± 15.44	39.27-48.73
QT interval duration (ms)	178.13 ± 22.91	168.96-187.29	173.71 ± 22.30	163.10-184.31	176.29 ± 22.49	169.41-183.17
QTc (sec)	0.27 ± 0.03	0.26-0.28	0.28 ± 0.02	0.27-0.29	0.27 ± 0.03	0.26-0.28
P wave height (mV)	0.11 ± 0.04	0.10-0.13	0.11 ± 0.04	0.09-0.13	0.11 ± 0.04	0.10-0.12
R wave height (mV)	0.99 ± 0.67	0.72-1.26	0.86 ± 0.88	0.44-1.27	0.93 ± 0.76	0.70-1.16
S wave height (mV)	−0.06 ± 0.11	−0.10 - −0.02	−0.11 ± 0.17	−0.19 - −0.03	−0.08 ± 0.14	−0.12 - −0.04
T wave height (mV)	0.26 ± 0.29	0.14-0.37	0.18 ± 0.22	0.08-0.28	0.22 ± 0.26	0.14-0.30
P axis (°)	21.75 ± 43.24	4.45-39.05	47.88 ± 43.72	27.10-68.66	32.59 ± 44.82	18.87-46.31
QRS axis (°)	23.71 ± 43.06	6.48-40.94	3.41 ± 46.77	−18.82-25.64	15.29 ± 45.21	1.45-29.13
T axis (°)	11.75 ± 71.34	−16.79-40.29	11.82 ± 86.89	−29.48-53.13	11.78 ± 77.11	−11.82-35.38

Male: n = 24, Female: n = 17, Total: n = 41

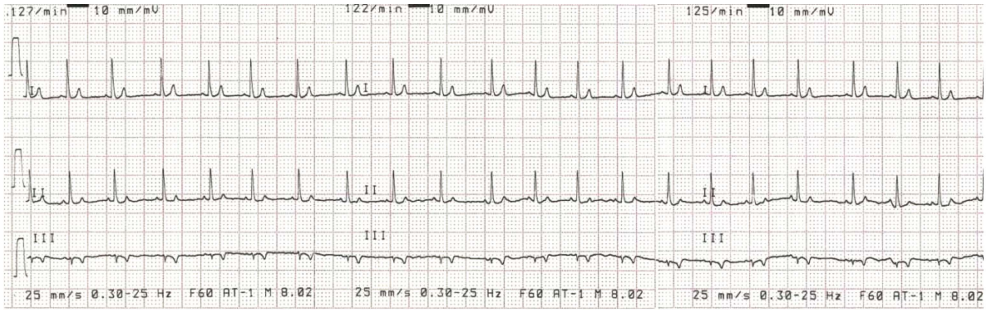

Fig 1. Electrocardiogram showing normal sinus rhythm in a raccoon dogs enrolled in this study.

Results

Twenty healthy adult raccoon dogs (12 males, 8 females) were evaluated. The mean body weight was 4.37 ± 0.86 kg (range 3~5.7 kg). The mean rectal body temperature was 38.96 ± 0.72°C (range 38.8~40.8°C). The mean heart rate at rest was 120.2 ± 38.7 bpm (range 92-172 bpm), while the mean respiration rate at rest was 32.7 ± 9.6/min (range 20-52/min). There were no detectable heart murmurs in raccoon dogs enrolled in this study. Some raccoon dogs (8/20) had irregular heart rhythm (sinus arrhythmias) which is common in dogs. ECGs showed a normal sinus rhythm in all 20 raccoon dogs. All measurements were similar to those reported for domestic canines (Table 1). Wandering pacemaker was noticed in 3/20 dogs. The mean duration and amplitude of P-wave were 38.2 ± 4.0 ms (range 28-40 ms) and 0.128 ± 0.039 mV (range 0.09~0.20). The QRS morphology was similar in appearance to domestic canines (Fig 1). Sinus arrhythmias were noticed in 8/20 raccoon dogs. The mean duration and amplitude of QRS complexes were 48.5 ± 7.2 ms (range 36-60 ms) and 1.330 ± 0.650 mV (range 0.15~2.30; Table 1). The range of the mean electrical (QRS) axis was −91° ~ +96° (10°~60°; 95% of confidence interval). T-waves were monophasic and positive in eight of 20 raccoon dogs, ten raccoon dogs had monophasic negative T-waves, and two raccoon dogs had isoelectric T-waves in lead II (Table 1). The mean corrected QT (QTc) interval was 273.7 ± 32.7 ms (range 212-333 ms), while the mean PR interval was 76.1 ± 10.0 ms (range 50-82 ms; Table 1).

Discussion

The raccoon dog (*Nyctereutes procyonoides*) is not closely related to raccoons (*Procyon lotor*), although the appearance in both species are quite similar (3). The raccoon dogs are distantly related to domestic dogs. The raccoon dogs are important to human society as a pet, a fur animals and carrier animals for certain zoonotic diseases (i.e. Rabies) (3).

However, there has no concrete study for references for vital signs and cardiac examination (e.g. ECG and thoracic radiography), to date. To the authors' knowledge, this is the first study to provide ECG in healthy, free-ranging raccoon dogs.

Electrocardiographically, the raccoon dogs have voltages between dogs and cats, as similarly to raccoons (*Procyon lotor*) (2). In most normal dogs, heart rates range is between 60-160 bpm (70-160 bpm in adult dogs; 60-140 bpm in giant breeds; up to 180 bpm in toy breeds; up to 220 bpm in puppies). The heart rhythm of dogs shows almost normal sinus rhythm, respiratory sinus arrhythmia, and wandering SA pacemaker in common.

The amplitude of P wave is normal up to 0.4 mV. The duration of the P wave should not exceed 0.04 sec in dogs. It should be positive in leads II, aVF, and isoelectric or positive in lead. Amplitude of R wave of QRS complex is normal up to 2.5-3.0 mV in lead II, III, and aVF (more than 2years of age). Duration of the QRS complex up to 0.05sec is normal (0.06 second in large breeds). Normal MEA (mean electrical axis) is +40 degrees clockwise to +100 degrees for the dog. T waves may be positive, negative, or biphasic. In most normal cats, heart rates range between 140-180 bpm (up to 240 bpm). Heart rhythm of cats shows almost normal sinus rhythm, physiologic sinus tachycardia (sTach) in common. The amplitude of P wave is normal up to 0.2 mV in lead II and avF. The duration of P wave should not exceed 0.04 sec in cats. It should be positive. QRS complex is more variable than in the dog. The R wave is usually low (maximum is 0.9 mV). Duration is under 0.04sec. The mean electrical axis is most commonly from 0 degrees to +160 degrees. T waves are usually positive, occasionally negative or biphasic (1). When compared with that fallowing, the raccoon dogs were closer to dogs in heart rate and heart rhythm. But wave heights and durations of raccoon dogs were closer to cats.

Acknowlegements

This work was supported financially by a grant (Z1541780-2012-13-02) from the Animal, and Plant Quarantine Agency, Ministry of Agriculture, Food and Rural Affairs (MAFRA), Republic of Korea.

References

1. Ettinger SJ, Feldman EC. Electrocardiography and Cardiac Arrhythmias. In: Textbook of Veterinary Internal Medicine. Philadelphia: Elsevier Saunders. 2004: 1040-1076.
2. Hamlin RL, Hren J, Sparrow PV. Electrocardiographic evaluation of the healthy raccoon (Procyon lotor). Am J Vet Res 1986; 47: 814-817.
3. O S-Y. Detection of antibody against rabies virus and blood analysis in Korean raccoon dogs (Nyctereutes procyonoides koreensis). PhD Thesis, Seoul National University. 2011: 18-21.
4. Ruo JI. Study of ecology, hematologic and serum biochemistry value in Korean wild raccoon dog (Nyctereutes procyonoides). PhD Thesis, Seoul National University. 2008: 9-24.

건강한 너구리(*Nyctereutes procyonoides*)들의 심전계 지표에 대한 평가

홍원우*・김종택*・양동근・남효승***・현창백***[1]**

*강원대학교 수의학과 야생 동물의학실, **농림수산검역검사본부, ***강원대학교 수의학과 소동물 내과교실

요 약 : 포획된 건강한 너구리들의 심전도의 기준값을 평가하는 것이 본 논문의 주된 목적이다. 41마리의 방목되고 있는 다 자란 너구리들이 강원대학교 야생동물구조센터에 의해 구조되었으며 본 논문에 이용되었다. 어떠한 화학적 보정도 사용하지 않고 6-유도 심전도를 측정하였다. 평균 심박수는 146.10 ± 43.31박동수/분 이었다(95% 신뢰구간 132.84~159.36 박동수/분). 평균 호흡수는 35.73 ± 11.56 호흡수/분 이었다(95% 신뢰구간 32.19~39.27 호흡수/분). 평균 수축기 압력은 136 ± 29.26 mmHg 이었다(95% 신뢰구간 127.99~145.91 mmHg). 모든 너구리들의 심전계의 특징들을 또한 평가하였다. P-파의 평균 너비와 높이는 38.2 ± 4.0 ms (범위 28-40 ms) 와 0.128 ± 0.039 mV (범위 0.09~0.20)이었다. QRS파의 평균 너비와 높이는 48.5 ± 7.2 ms (범위 36-60 ms) 와 1.330 ± 0.650 mV (범위 0.15~2.30)이었다. 평균전기축(QRS)은 −91°~ +96° (10°~60°; 95% 신뢰구간)이었다. 평균 교정 QT 간격(QTc)은 273.7 ± 32.7 ms (범위 212-333 ms)이었고, PR간격은 76.1 ± 10.0 ms (범위 50-82 ms)이었다. 본 논문은 포획된 건강한 너구리들의 심전도(ECG)의 기준값을 제공하는 최초의 논문이다.

주요어 : 너구리, 심전도, 심장, QTc, *Nyctereutes procyonoides*.