DETERMINATION OF NORMAL ELECTROCARDIOGRAPHIC REFERENCE VALUES IN LONG-EARED HEDGEHOGS (*HEMIECHINUS AURITUS*)

Masoud Selk Ghaffari, DVM, PhD, Nima Mohseni Abbas abadi, DVM, Iman Azhari, DVM, and Seyed Mehdi Rajaei, DVM, DVSc

Abstract

A total of 10 healthy anesthetized long-eared hedgehogs (*Hemiechinus auritus*) were used to determine normal electrocardiographic reference values for this species. Each animal was anesthetized with intramuscular ketamine and diazepam. Standard 6-lead electrocardiography (leads I, II, III, aVR, aVL, and aVF) were obtained in hedgehogs positioned in right lateral recumbency. All recorded rhythms were regular sinus rhythm and the mean heart rate was 264 ± 53 beats per minute. Mean electrical axis was between −19° and +6° in the entire study population (mean ± standard deviation; −6 ± 10°). The P wave was always positive on lead I, II, and aVF. There was no correlation between electrocardiographic values, sex, and weight of the animals. Mean heart rate in this species was slightly higher than in African hedgehogs (*Atelerix albiventris*) and less than in the Amur hedgehogs (*Erinaceus amurensis*). QT interval was slightly higher than in both the Amur and African hedgehogs. Mean electrical axis in long-eared hedgehogs showed a left axis shift compared with the African hedgehogs.

Key words: QT interval; ECG; hedgehog; heart; cardiac evaluation

Hedgehogs, members of the order Erinaceomorpha and family Erinaceidae, are small mammals with bodies that are covered with spines.[1] However, the dermal spines are not present on the tail, face, lower parts of the legs, or ventral abdomen of these animals.

Within the past decade, African pygmy (*Atelerix albiventris*) hedgehogs have increased in popularity as a companion animal in the US, although they may be illegal in some states.[2] Hedgehogs have also become popular in recent years among pet owners in Iran. Long-eared hedgehogs (*Hemiechinus auritus*) are native to the northern Iran and are the most common species maintained as pets in Iran.

Hedgehog diseases are important for veterinarians to know and understand owing to a growing interest in this animal species among pet owners and an increase in cases of rescued hedgehogs requiring veterinary care. There are published reports of cardiomyopathy[3,4] and congestive heart failure[5] diagnosed in hedgehogs presenting with clinical disease signs. Dilated cardiomyopathy appears to be common in pet hedgehogs, and necropsy findings from several cases have been described.[3,4] Affected hedgehogs are typically greater than 3 years or older, although the disease may occur in animals as young as 1 year of age.[6] The cause of cardiomyopathy in

From the Department of Clinical Sciences, College of Veterinary Medicine, Islamic Azad University, Karaj Branch, Alborz, Iran.
Address correspondence to: Seyed Mehdi Rajaei, DVM, DVSc, Department of Clinical Sciences, College of Veterinary Medicine, Islamic Azad University, Karaj Branch, Alborz, Iran, Moazen Boulevard, Karaj, 31485-313, Alborz, Iran. E-mail: mehdi_13r@hotmail.com

1557-5063/16/2101-$30.00
http://dx.doi.org/10.1053/j.jepm.2016.04.008

hedgehogs has not been definitively determined, although toxins, stress, obesity, genetics, and nutritional imbalances, such as vitamin E, selenium, taurine, choline, and tryptophan deficiencies, have been proposed.[3,5-7]

Clinical signs associated with cardiac disease in hedgehogs are related to cardiopulmonary dysfunction and include dyspnea, moist rales, lethargy, anorexia, weight loss, dehydration, heart murmur, ascites, and acute death. Death may occur without clinical signs, but overt disease is observed in most cases.[2,8] Cardiac disease should be considered if a hedgehog is presented with a heart murmur, irregular rhythm, or weak femoral pulses. Diagnostic testing to confirm heart disease involves radiographic imaging, echocardiography, and electrocardiography (ECG).[2,8] Therapy with digoxin, furosemide, and enalapril may be helpful initially, but the long-term prognosis for hedgehogs with congestive heart failure is poor.[1,2]

Normal electrocardiographic values have been previously published for the Amur hedgehog (*Erinaceus amurensis*),[9] African hedgehog,[7] and other members of the order Insectivora including the Asian musk shrew (*Suncus murinus*),[10] Etruscan shrew (*Suncus etruscus*),[11] and short-tailed shrew (*Blarina brevicauda*).[12] Electrocardiographic reference ranges are also available for the pet ferret.[13] The objective of this study was to establish initial data on the normal electrocardiographic features of long-eared hedgehogs anesthetized with a combination of ketamine and diazepam.

MATERIALS AND METHODS

The study was approved by the Iran society for prevention of cruelty to animals in accordance with Iranian ethical codes for studies on laboratory animals. A total of 10 apparently healthy long-eared hedgehogs were used for this investigation, including 5 females and 5 males. The range of body weights of the animals varied from 200 to 580 g (mean ± standard deviation [SD] = 313 ± 111 g).

The hedgehogs were individually housed in separate cages that were provided with a normal constant temperature (24°C to 26°C) in an air conditioned room and exposed to a constant 24-hour lighting cycle that included 12 hours of light conditions and 12 hours of dark conditions for 1 week before initiating the study. The subject animals were fed a commercial diet (Spike's Delite Pro Diet, Pet-Pro products, MiddleTown, MO 63359, USA), vegetables, fruits, and plants. Water was available ad libitum. All hedgehogs were considered healthy on the basis of a complete physical examination (i.e., no signs of lethargy, cardiac murmur, and dyspnea), complete blood count results (Table 1), and whole body radiographic images. Heart rate, respiratory rate, and body temperature of all hedgehogs were 180 to 240 beats per minute, 27 to 40 breaths per minute, and 36°C to 37°C, respectively. Radiographic evaluation of the thorax revealed no abnormalities in any animals and cardiac parameters (vertebral heart score and heart length[7]) were within normal limits.

TABLE 1. Complete blood count results (average) for long-eared hedgehogs (*Hemiechinus auritus*)

Test	Result
Packed cell volume	35%
Hemoglobin	5.3 g/dL
Red blood cell count	3×10^6/μL
Mean corpuscular volume	53 fl
Mean corpuscular hemoglobin	17.6 pg
White blood cell count	14×10^3/μL
Neutrophils (segmented)	8.1×10^3/μL
Lymphocytes	4.3×10^3/μL
Monocytes	0.4×10^3/μL
Eosinophils	0.98×10^3/μL
Platelet count	285106/μL

Each animal was weighed and anesthetized through the use of Ketamine 20 mg/kg, intramuscular (Ketamine 10%; Alfasan International BV, Woerden, Holland) and Diazepam 1 mg/kg, intramuscular (ZEPADIC®109; Caspian Tamin Pharmaceutical Co, Rasht, Iran). Immediately after recumbency, animals were provided with heat support (27°C to

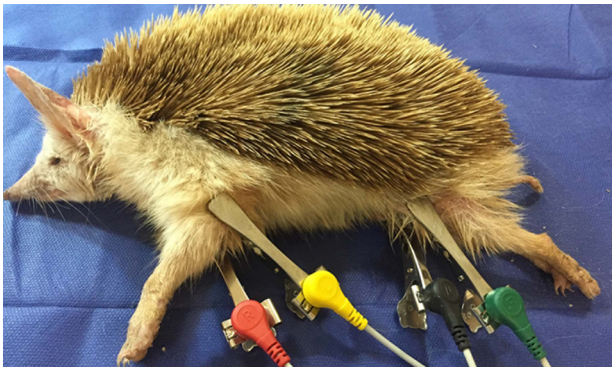

FIGURE 1. Position for ECG recording of a long-eared hedgehog (*Hemiechinus auritus*). Electrodes are attached to the skin at the level of the olecranon on the caudal aspect of the forelimb and over the patellar ligaments on the cranial aspect of the hind limbs. The oxygen mask has been temporarily removed.