Daily Rhythms of Blood Pressure, Heart Rate, and Body Temperature in Fed and Fasted Male Dogs

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Summary

Daily or circadian rhythmicity in physiological processes has been described in a large number of species of birds and mammals. However, in dogs, most studies have either failed to detect rhythmicity or have found that rhythmicity reflects merely an acute exogenous effect of feeding rather than an autonomous rhythmic process. In the present study, we investigated the rhythmicity of body temperature, blood pressure, and heart rate in dogs fed daily as well as in dogs deprived of food for 60 h. Our results document clear rhythmicity in all three parameters and demonstrate that the rhythmicity is independent of the feeding schedule. The failure of various previous investigations to document daily rhythmicity in dogs is probably due to lack of experimental rigour rather than to weakness of daily rhythmicity in dogs.

Introduction

Daily oscillation in the levels of physiological variables in animals has been described for a multitude of variables, including locomotor activity, body temperature, heart rate, blood pressure, hormonal secretion, and urinary excretion (Dunlap et al., 2004; Refinetti, 2005). Extensive research has established that, in mammals, a circadian pacemaker located in the suprachiasmatic nucleus of the hypothalamus generates daily rhythmicity, which is modulated by environmental cycles of light and darkness, food availability, ambient temperature, and other factors (Van Esseveldt et al., 2000; Helfrich-Förster, 2004). To the extent that daily rhythmicity is a fundamental characteristic of animal physiology, thorough understanding of circadian rhythms is a necessity for effective veterinary practice (Piccione and Caola, 2002; Piccione and Refinetti, 2003).

Although studies conducted on small laboratory rodents and large farm animals have yielded highly reproducible results, studies on dogs have been rather inconsistent. Numerous investigators failed to detect daily rhythmicity in body temperature (Hawking et al., 1971; Marvin and Reese, 1986) or in the secretion of various hormones, including prolactin (Gobello et al., 2001), cortisol (Koyama et al., 2003), and growth hormone (Gobello et al., 2002). In other instances, rhythmicity was detected in body temperature (Rawson et al., 1965; Miyazaki et al., 2002), cardiovascular parameters (Mishina et al., 1999; Matsunaga et al., 2001; Miyazaki et al., 2002), and other functions (Corea et al., 1996; Liesegang et al., 1999) but the rhythmicity seemed to reflect merely an exogenous effect of feeding rather than an endogenous rhythmic process. While it is possible that canine physiology is unique in its lack of endogenous rhythmicity, it is also possible that studies conducted on dogs have lacked the experimental rigour necessary for the identification of rhythmicity. In a previous study, we showed that daily rhythmicity of body temperature can be reliably detected in Beagle dogs, even though the robustness of the rhythm was weaker than in laboratory rodents and farm animals (Refinetti and Piccione, 2003). Although feeding did not seem to be the cause of the rhythmic pattern, we did not address the issue of feeding-induced hyperthermia experimentally. In the present study, we investigated the rhythmicity of body temperature, blood pressure, and heart rate in dogs fed daily as well as in dogs deprived of food for 60 h.

Materials and Methods

The study was carried out on 10 1-year-old male dogs (purebred Beagle, mean body mass = 11 kg). The animals had been in our facilities for 2 months prior to the beginning of the study. They were visually inspected daily and were examined by a veterinarian monthly.

The animals were housed in individual pens (140 × 200 cm) lined with wood shavings. The pens were separated by concrete walls but had screen doors, which allowed the dogs to hear and smell each other but not to see or contact each other. Light timers were set to maintain a light–dark cycle with 12 h of light and 12 h of darkness each day (lights on at 08:00 hours). Ambient temperature was thermostatically maintained at 21 ± 2°C. Relative humidity was kept in the range of 50–60%.

The dogs were divided into two groups of five animals for 48 consecutive hours of recording. One group of dogs received normal feeding (270 g of a certified dog diet provided at