Determination of circadian rhythm of body temperature in laboratory mice and rats by rectal probe

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Background: Body temperature is regulated not only homeostatically, but also undergoes regular daily fluctuations. Therefore, it is important that the time point of measurement be taken into consideration when determining body temperature values. In this study, rectal body temperature of laboratory mice and rats was determined using a digital thermometer. Over a period of four weeks, measurements were done on four time points per day.

Materials and Methods: 40 B6C3F1/Crl mice, 40 Wistar WU (Crl: WU), and 40 Fischer (F344/Crl) rats (each group 20 ♂ / 20 ♀ ), 5 weeks of age at delivery, were purchased from Charles River Deutschland, Sulzfeld, Germany. After one week acclimatization to the standard laboratory conditions (room temperature 22 ± 2 °C, relative humidity 55 ± 15 %, air change rate 10-15 times/h, 12:12 h light/dark cycle, 7 p.m. to 7 a.m. light off), animals were accustomed to the handling and temperature measurements during a 14-day training period. The care of the laboratory animals and all temperature measurements were performed by a single person. Rats were removed from their cages by their chests and slightly restrained on the observer’s arm for rectal temperature measurement. Mice were taken from their cages by their tails. For body temperature measurement, the animals were held by their tail and their forepaws rested on the observer’s chest. On six different days (days 1, 2, 5, 7, 14, 27) over a period of four weeks, rectal body temperature was measured at defined daily time points (6 a.m., 12 a.m., 6 p.m., 12 p.m.) using a digital thermometer of 0.1 °C accuracy (MD 3060, Beckmann und Egle, Kernen, Germany) and a flexible measurement probe (MD 3024). Between measurements, the probe was lubricated with vaseline. The probe was inserted 1.5 cm into the rectum of mice and 5 cm into the rectum of rats.
Results: The mean measurement time of the digital thermometer was 5 ± 1 sec. in mice and 8 ± 2 sec. in rats. By measuring the temperature at four different time points per day, a circadian rhythm of rectal body temperature could be confirmed in both species. The low values of the circadian rhythm of body temperature were measured during the light phase (7 a.m. – 7 p.m.) and the high values during the dark phase (7 p.m. – 7 a.m.).

Conclusion: Habituation to handling and rectal body temperature measurement as well as a thermometer with a very short measurement time and a standardized insertion of the temperature probe are necessary to get reliable temperature values. Furthermore the stress-induced hyperthermia, even induced by a slight disturbance (i.e., animal caretaking, previous measurements), and its time dependent temperature decrease to “baseline” values (normothermia), should be taken into consideration when selecting the different measurement time points. If these requirements are met, temperature values measured by rectal probe are comparable with telemetrically recorded values.

Key Words: Laboratory mice and rats, rectal body temperature measurement, circadian rhythm