Correlation between Surface Temperature and Core Body Temperature in Long-Evans Rats

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Introduction

There is a significant need for body temperature measurement in rats used in research (i.e. as a humane endpoint). Body temperature is traditionally measured either by placing a thermometer into the large intestine of the test subject via the anus or implanting telemetry equipment. Rectal temperature is the gold standard for measurement but is difficult to perform in a conscious rat as it can be stressful to the animal and has inherent risk of tissue damage. Telemetry is extremely invasive and has a high risk of side effects and complications. In this study we determined if surface body temperature, measured at the xiphoid process of the sternum, correlated to core body temperature in adult female Long-Evans rats.

Infrared Thermometer

We used a commercially available, infrared (IR) thermometer capable of reading a 1mm region in 150ms (±0.75°C, Optris LS, Micro-Epsilon, Raleigh, NC) from a distance of 62 mm. The reading region of 1mm is significantly smaller than other infrared temperature recording devices and is ideally suited to rodents. The device emits two lasers which converge when the device is 62mm from the target surface, obviating the need for actual measuring. All recordings in this study we taken at the xiphoid process of the sternum; animals were not shaved prior to recording surface temperature.

Experimental Design

Twenty-four adult female Long-Evans rats were anesthetized with isoflurane gas (induced at 4%, then maintained at 2% in pure oxygen) and temperature measurements were taken both traditionally (rectal temperature with a wire thermistor) and using a handheld, non-contact infrared recording device. Anesthesia induced a gradual, anticipated hypothermia that was used to compare these two methods of body temperature measurement over a range of temperatures. Animals were placed on a commercially available rodent table capable of warming (VisualSonics, Toronto, Canada). Animals were maintained at a table temperature of either 40°C or room temperature (20-22°C) to quantify the effect of exogenous warming on rat body temperature during anesthesia and determine the robustness of the IR measurements. Recordings were taken at 10 minute intervals for 60 minutes (time points = 0, 10, 20, 30, 40, 50, and 60 minutes).

Results

Surface temperature strongly correlates to core body temperature in rats anesthetized on an unheated surface (Pearson’s r = 0.963, note Y axis starts at 24°C).

Surface temperature moderately correlates to core body temperature in rats anesthetized on a heated surface (Pearson’s r = 0.810, note Y axis starts at 25°C). The lower correlation is most likely related to the narrower range of temperatures encountered with the heated surface.

Conclusions

- Surface temperature was predictive of core temperature in adult female Long-Evans rats using the IR recording device when anesthetized on an unheated surface.
- There was no statistical difference in core body temperature in rats on a heated vs. unheated surface during the first 20 minutes of gas anesthesia (implications for short term procedures) – this is unlike a similar study in mice performed by our group which found a significant drop in body temperature in mice on an unheated surface at the first time point (10 minutes) [LASA Annual June 2014 pp 54-56].
- Surface temperature measurement has potential as a marker of animal health, a prognostic indicator, and as an experimental endpoint (possible alternative to death as endpoint).