A NOVEL DEVICE FOR LOCALLY HEATING VENTILATED RODENT CAGES

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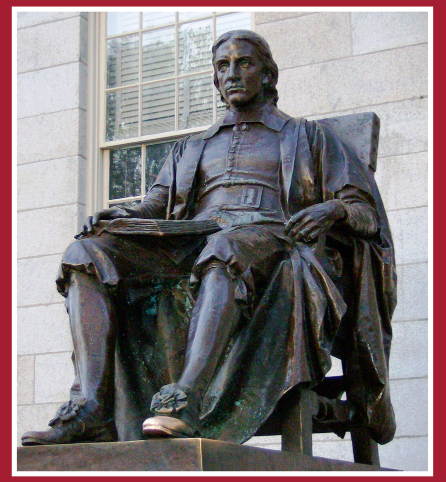


INTRODUCTION

A mouse or rat's thermoneutral zone (TNZ), the outside temperature at which the least metabolic energy is needed by an organism to maintain its core temperature, is ~28-30°C; by contrast, man's TNZ is ~22°C. One of us (RSS) maintained a gnotobiotic mouse breeding and research facility at 25°C (27°C inside the cage) for decades at a very high production index, in contrast to most rodent vivaria that are maintained at a human TNZ for workplace comfort and energy conservation. But when rodents are housed at such cooler temperatures, their compensatory energy expenditure can alter cardiovascular physiology and host immune response to tumors, to name a few consequences (1, 2). Recent studies have shown that nesting materials provided in the cage permit mice to stay warm without expending as much energy, but different mouse strains use different environmental enrichment materials differently for this purpose, so standardized practices may not suffice (3). Therefore, a novel device was evaluated as an alternative approach for heating a mouse's immediate environment without subjecting personnel to warmer rooms and energy budgets to higher expenses.

MATERIALS + METHODS

A single-sided IVC mouse cage rack (Allentown, Inc., Allentown, NJ) calibrated at 50 changes/hour of HEPA-filtered air and fitted with an automatic watering system (Edstrom Industries, Inc., Waterford, WI) was sanitized, flushed, and steam-autoclaved per our usual process prior to use. Cages for the study (75J Micro-VENT System®, Allentown, Inc., Allentown, NJ) were sanitized, filled with ¼"corn cob bedding (Bed O'Cobs®, Anderson Lab Bedding, Maumee, OH) and steam-autoclaved per our usual process prior to use. All slots on the rack contained cages with bedding but no animals.

The heating device consisted of an electric manual power controller (BT-Z 120V-10amp, HTS/Amptek®, Stafford, TX) connected to customized Duo-Tape® heater tape (1"W X 60"L, 498W@ 120V w/ molded plug, HTS/Amptek®, Stafford, TX) (Figures 1A and 1B). The heater tape was threaded the entire length of an air supply manifold serving a single row of cages (Figures 2A and 2B) and plugged into an electrical outlet. Supply air in that manifold was heated by turning on the power controller half-way to maximum while intra-cage temperature and humidity were measured with a Traceable® digital humidity and temperature meter (VWR International, Bridgeport, NJ). Cages connected to neighboring air supply manifolds immediately above and below the manifold containing the heating device as well as room temperature were also monitored. No other racks and no animals were in the room at the time. Temperature and % relative humidity in 4 heated cages and 4 adjacent unheated cages were recorded hourly for 5 hours. A 2-tailed independent (unpaired) Student's t test was used to determine if there were significant differences between the 2 cage groups when each was compared to its starting values.

FIGURE 1A AND 1B: HEATING DEVICE

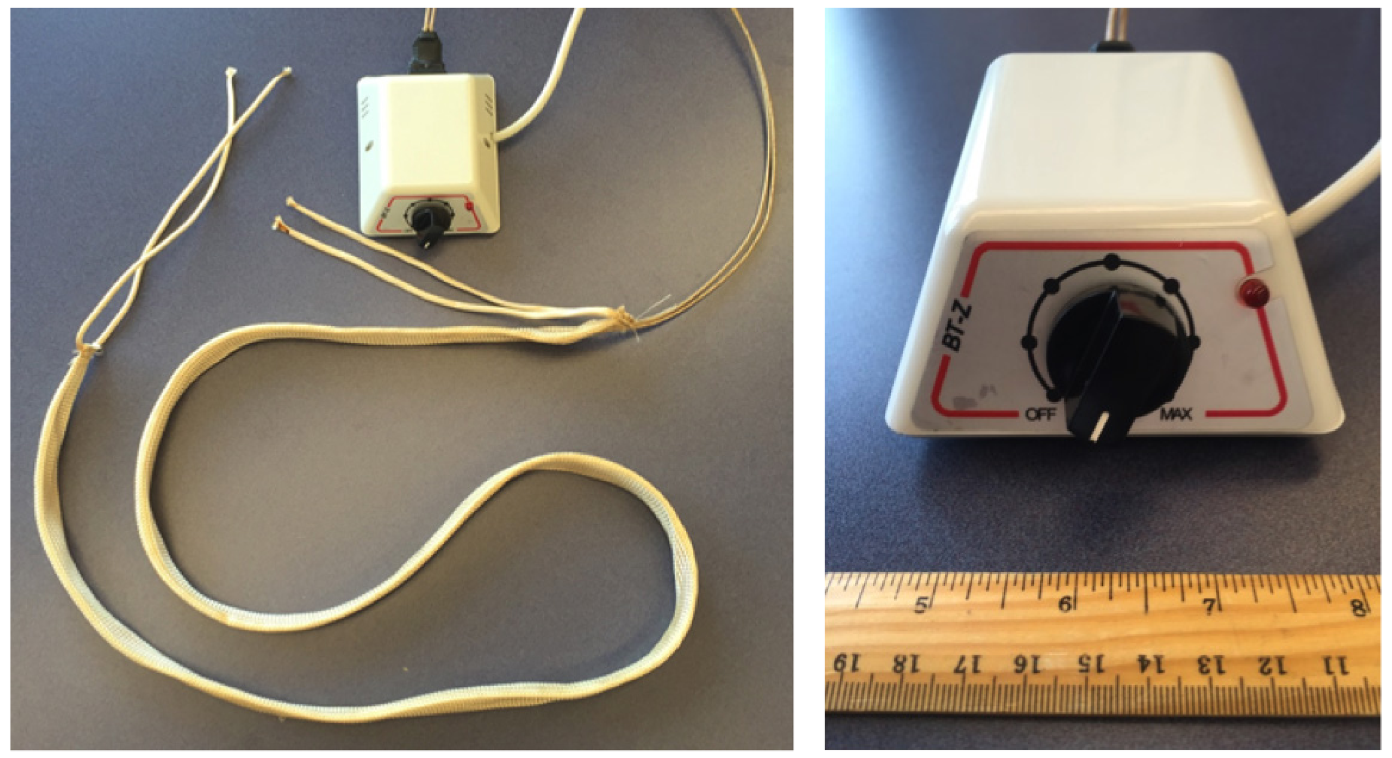


FIGURE 2A AND 2B: HEATING DEVICE INSTALLED IN IVC RACK AIR SUPPLY MANIFOLD

Figure 3A. Mean Temperature Difference (°C) vs. Time 0

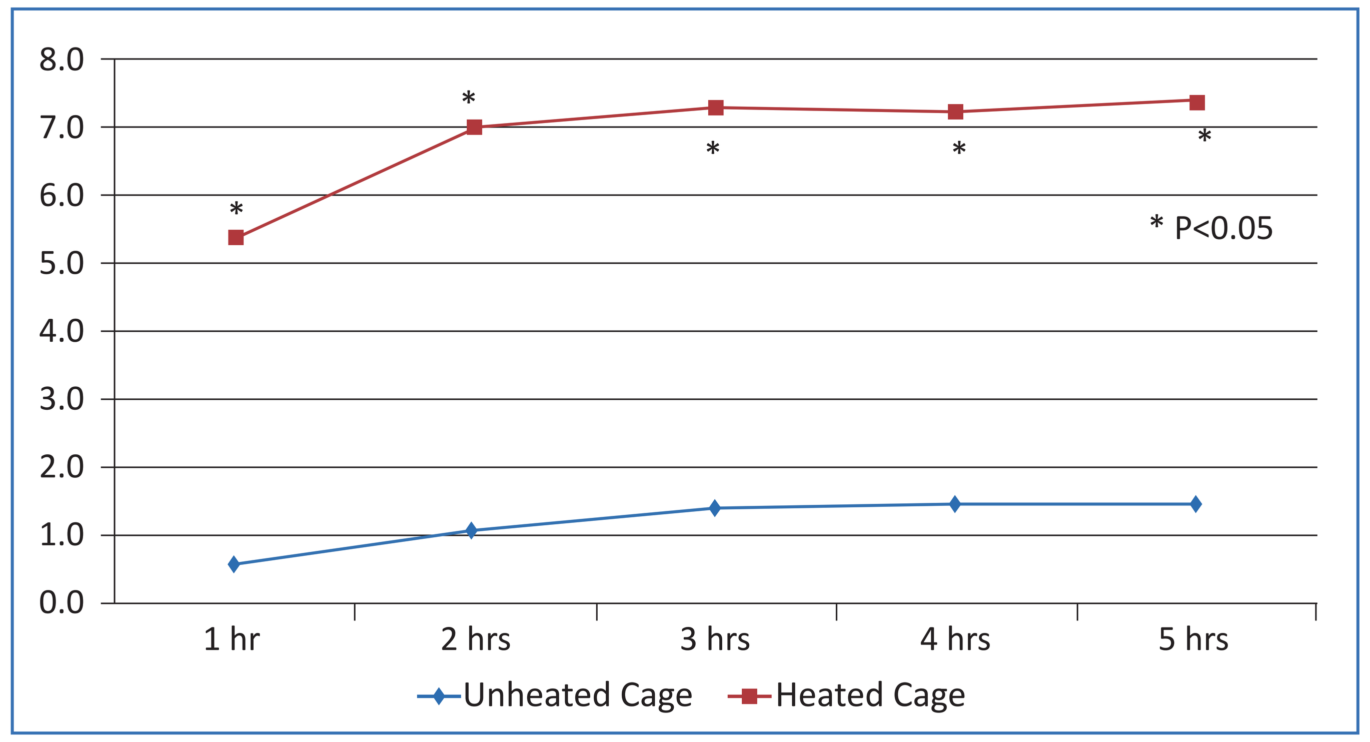
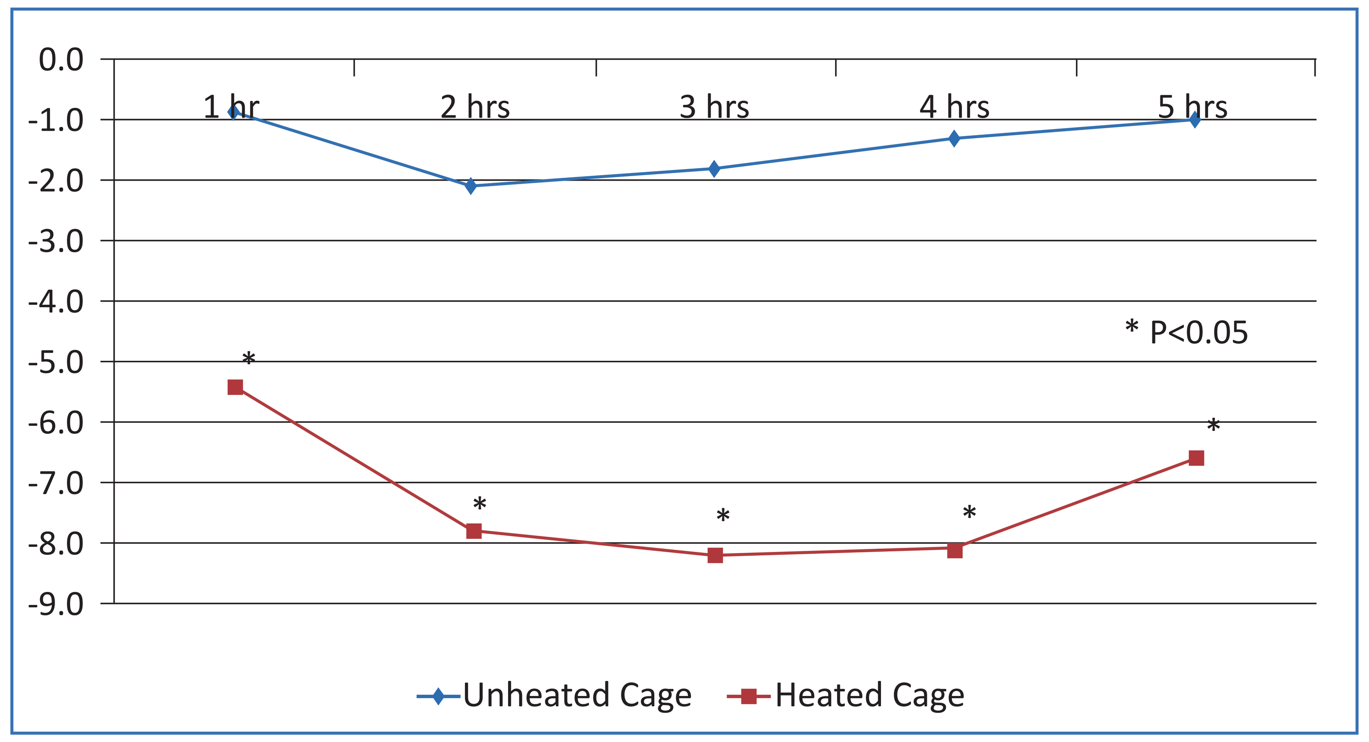


Figure 3B. Mean % Relative Humidity Difference vs. Time 0



RESULTS

The heater tape and its connections fit well with the IVC rack and were easy to set up. Cages in the row connected to the air supply manifold were significantly (P<0.05) warmer and drier compared to T0 than cages immediately below or above that row for 5 hours (Figures 3A and 3B). The device is inexpensive (total materials cost ~ $150) and durable, as well as easily sanitized, operated, installed, and detached. This device may be advantageous for studies involving metabolism and physiology where rodent TNZ temperatures are required, maintaining pups of fragile phenotypes, and recovery from anesthesia. The same device may be appropriate for rats since they also are subjected to differential TNZ effects (1). On the cautionary side, elevated cage temperatures may increase aggression amongst male mice (4). Furthermore, the air supply manifold containing the device, as well as stainless steel lixit valves inside those cages, were hot to the touch within 1 hour, leading to a recommendation of water bottles over automatic watering. Thus, care is advised when considering such strategies for heating cages.

References:

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