

STANDARD OPERATING PROCEDURES
DIVISION OF COMPARATIVE MEDICINE UNIVERSITY OF
SOUTH FLORIDA

SOP#: 028.2

Date Issued: 5/04

Date Revised: 4/12

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TITLE:	Thermal Regulation of the Anesthetized Patient
SCOPE:	Research and Animal Care Personnel
RESPONSIBILITY:	Facility Manager, Professional Staff
PURPOSE:	To Outline the Proper Procedures for Maintaining Body Temperature of the Anesthetized Patient Animal.

I. PURPOSE

1. This procedure outlines methods and the use of equipment to maintain body temperature in anesthetized rodents and non-rodent mammals, when loss of body temperature is a concern.

II. RESPONSIBILITY

1. It is the responsibility of the facility managers to ensure that all equipment is appropriately calibrated, and certified, in good working order, and available for research personnel as requested.
2. It is the responsibility of the veterinary professional, and managerial staff to ensure that all research and technical staff using these methods and equipment are adequately trained and experienced.

III. BACKGROUND

1. Anesthetic drugs suppress the homeostatic controls of the central nervous system. Anesthetics depress the central hypothalamic thermoregulatory mechanism and predispose the anesthetized animal to hypothermia (i.e., lowered body temperature).
2. Hypothermia is an even greater problem in anesthetized rodents because of a very large body surface area relative to body mass, which causes a greater loss of body heat.
3. Pre-operative removal of hair, wetting of the skin during aseptic preparation, and cold metal surgical surfaces contribute to the development of hypothermia. Opening a body cavity will further accelerate the loss of body heat.
4. Hypothermia can be fatal. Steps taken to reduce heat loss and maintain normal body temperature contribute to a smooth operative procedure and uneventful patient recovery.

5. Whenever feasible, body core temperature may be best monitored using either an esophageal thermometer placed in the esophagus to the level of the heart in large animals, or a rectal thermometer in rodents. Rectal body temperature measures regional changes in temperature and falls more slowly than core body temperature but is a useful and convenient way of monitoring relative changes.

IV. PROCEDURES

1. The risk of hypothermia can be reduced by warming surgical preparation solutions before use, insulating the patient from cool ambient temperatures and surfaces, using warmed fluids if supplemental fluids are provided, and by using a thermostatically controlled circulating water warming blanket.

NOTE: Electric heating pads are not permitted as a source of supplemental heat for the anesthetized nonrodent mammal.

NOTE: Anesthetic-induced hyperthermia (i.e., elevated body temperature, the opposite concern) can be seen in some breeds of dogs and pigs.

2. Consider elevating the operating room temperature. Although uncomfortable for the operating room staff, maintaining a high ambient room temperature can be beneficial to the patient.
3. Insulate the patient from cool ambient temperatures and cold working surfaces using towels and blankets. Surgical drapes provide insufficient insulation against heat loss. With heavier, larger mammals, consider using a foam mattress under the anesthetized patient to provide insulation and padding.
4. Water bottles warmed higher than the core body temperature of the anesthetized patient, but $<42^{\circ}\text{C}$ can safely contribute to the prevention of hypothermia in smaller animals.
5. Warmed intravenous fluid bags (e.g., a one liter bag warmed in the microwave on high setting for two minutes) can serve effectively as warm beds for rodents.
6. Pouches filled with saturated solutions of sodium acetate (e.g., DeltaPhase Isothermal Pad) can be activated and used for up to 1 hour with anesthetized patients, or folded over fluid lines or syringes to keep the contents warm.
7. **Electric thermal pads may be used in anesthetized rodents** post-operatively provided they are designed/intended for use in animals/patients and **used as an indirect source of heat only**. Animals must be monitored continuously until capable of purposeful movement.

NOTE: If the skin of the anesthetized patient is poorly perfused because of depth of anesthesia, vasoconstriction, or pressure, the local heat level of electrically heated pads or panels may produce burns without raising the core body temperature.

8. Disposable warm water circulating pads can be used both above and below the anesthetized small patient animal. Heated water blankets wrapped around the feet and legs of all available limbs has been shown to prevent heat loss better than when a heating blanket is applied to the trunk of anesthetized dogs.
9. Circulating warm water blankets (e.g., Gaymar T/Pump and T/Pad Heat Therapy System) must be used for larger animals in accordance with **SOP #1124** entitled **GAYMAR® Circulating Thermal Water System**.
10. Post-operatively animals should be recovered on a warming blanket.
11. Forced air warmers with quilts can effectively warm the patient nonrodent mammal before, during and after a surgical procedure.

V. EQUIPMENT USE

1. Prior to distribution to research staff, thermal regulation equipment should be visually inspected by the facility managers, or designee, to ensure the equipment is in good condition.
2. Prior to using thermal regulation equipment on animals the user must verify the equipment is functional.
3. Always place a layer of absorbent cloth (e.g., draping, towels) between the animal and a circulating water pad in accordance with **SOP #1124**. **Never place animal directly on pad.**
4. While anesthetized and during recovery from anesthesia, animals must be continuously observed.
5. **Anesthetized patients and equipment must be periodically monitored and assessed at least every 45 minutes** to ensure that:
 - a. **Body core temperature is maintained** within the desired range. This minimum interval does not obviate other body core temperature monitoring interval requirements demanded by the protocol or other SOPs.
 - b. The maximum surface area of the patient is presented to the source of thermal support for adequate warming, but that the source of heat and the surface of the anesthetized animal are not too hot by assessing with a hand placed between the animal and the source of supplemental heat.
 - c. **Equipment does not malfunction or overheat** placing the patient animal at risk of burns.
6. Anesthetized patient animals involved in protracted procedures should be moved to ensure adequate microcirculation especially around pressure points and at least every 45 minutes.

7. **When capable of purposeful movement** animals may be placed in a primary enclosure and monitored periodically.
8. Post procedurally rodents can be kept warm by placing them in microisolator caging and positioning the caging on an electric heating pad so that approximately $\frac{1}{2}$ the cage-floor is in contact with the heating pad. This will allow the animal to move towards or away from the heat source. **Animals must be monitored continuously until recovered from anesthesia**, and turned over at least every 20 minutes, until capable of purposeful movement. (Post- procedural warming of rodents that have recovered from anesthesia using this method must be monitored periodically. This form of thermal support does not constitute an appropriate form of long-term housing beyond a 12 hour period.)
9. Each electric heating pad must be labeled with a laminated card on its cord that reads, “**Caution: For use in warming rodent cages post-operatively only. Never place an animal directly on the heating pad. Carefully monitor the patient. Inappropriate use can result in animals being seriously burned.**”

Approved:

Date: