

DARVALL Solving Peri-anesthetic Hypothermia

Peri-Anesthetic Hypothermia (body temperature < 96.8°F) occurs in up to 80% of anesthetized cats and dogs. This can be due to their small body size, altered peripheral perfusion from premedication or anesthetic drugs, intubation by-passing the nose, inhaling cold gases and heat loss from skin surface or open body cavities. Prevention of peri-anesthesia hypothermia has focused on body surface heat conservation and surface skin warming using electric or warm water under-blankets, but this has proven to be ineffective and can burn animals (see graph: blue line).

Heat loss is exponential. Premedication causes mild hypothermia with dogs and cats typically losing 1 - 2°F over 30 to 60 minutes before anesthesia induction. This initial drop in core body temperature precedes the precipitous, critical heat loss of 2 to 5°F that occurs in the first 15 to 30 minutes after induction during clip & prep time. Once animals are draped for surgery, heat loss slows (see graph: blue line). The Darvall Warm Air Blanket System can raise body temperature in surgery but heat gain is also exponential. There is typically a 30 to 45 minute lag from onset of warming until an increase in body temperature is observed (see graph: magenta line). During this lag period skin, subcutaneous tissue and blood warming occurs. Simultaneous use of Darvall's heated breathing circuits will enhance the warming response to warm air blanket heating (see graph: yellow line). If the procedure time is less than 45 to 60 minutes, surface warming electric heat pads insulated by a towel, combined with Darvall's heated breathing circuits, may be as effective as warm air blankets (see graph: red line). Warming hypothermic animals recovering from anesthesia is a slow and laborious process often taking more than 1 to 2 hours.



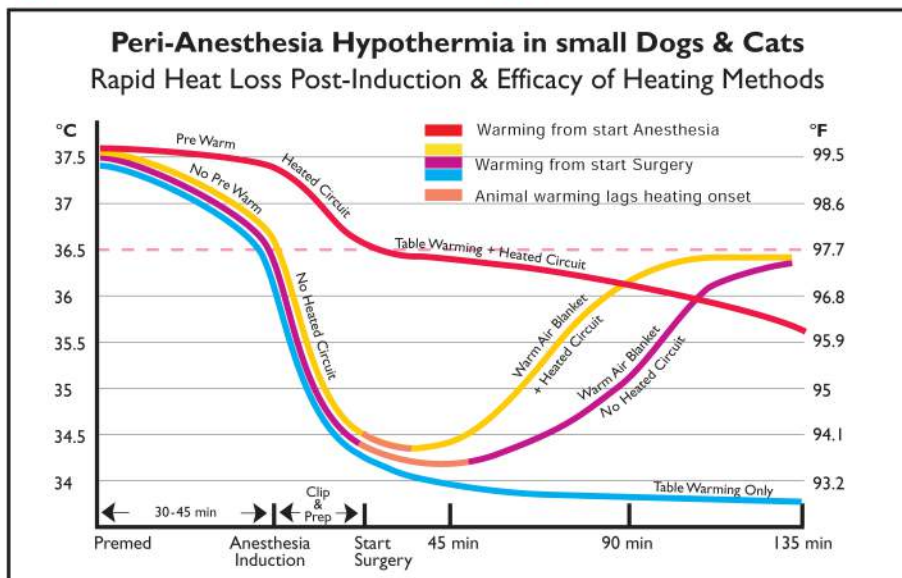
Dog with full thickness skin burns following anesthesia and use of a circulating water-filled blanket. The water heater thermostat was suspected to be faulty.

volume of warm air at a constant 109°F and can effectively pre-warm caged animals before anesthesia. It takes at least 30 minutes to properly pre-warm cats and small dogs and 45 minutes for larger dogs (see Page 6).

Warming Inspired Gas - Darvall's totally new Heated Anesthesia Breathing Systems.

Rapid heat loss occurs during clip and prep time when the animal is being moved which results in poor surface heat transfer from heat mats. Darvall's innovative Heated Anesthesia Breathing Circuits warm inspired gases from the first breath after intubation, targeting the post-induction rapid heat loss occurring during "clip & prep". Inspired gas is usually cold, about room temperature. Darvall's Heated Breathing Circuits have a heating element imbedded into the ribbing of the smooth-wall tubing. A sensor molded in the tubing at the Y piece connector monitors gas temperature and the microprocessor controls heating. From the end of the heated tubing to the end of the endotracheal tube, the warmed gas typically loses 18°F, so in the inspired limb of the anesthesia circuit, gas is heated to 109-113°F, resulting in 93-99°F gas in the animal's airway. Closed loop feedback is provided by an esophageal temperature probe which enables the microprocessor to monitor the animal's body temperature and turn off heating if > 99°F.

To be effective, the Heated Tubing should be used from the moment of intubation. Because animals only breathe 10 to 15 breaths/min with about 1 second inspiration under anesthesia, heated breathing circuits alone won't raise body temperature.



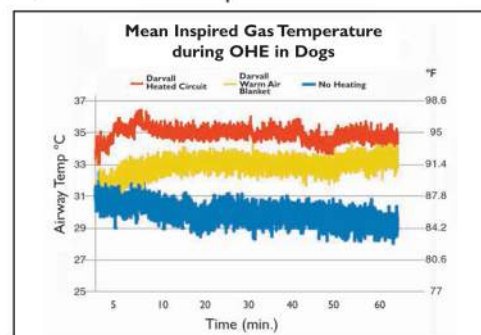
Hypothermia in anesthesia occurs with the most rapid heat loss occurring during clip/prep time. Warming hypothermic animals is difficult (blue line). Darvall's Heated Breathing Circuits* (HBC) used from the moment of intubation reduce this heat loss (red line). Darvall's Warm Air Blankets (WAB) can warm hypothermic animals in surgery (magenta line), which is faster when combined with HBC (yellow line). Warming premedicated animals with WAB for 30-45 min. before induction can also reduce post-induction hypothermia (red line)

Adapted from Dunlop C. Heated Smooth Wall Circuits (Abst) WCVA Capetown S Africa Sept. 23-27 2012

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Warming devices can burn animals. The margin of safety for causing significant thermal injury is surprisingly narrow. Skin can be burned from devices supplying as little as 115°F constant surface heat for one hour. Containers of warm water, heated wheat bags or 'on-off' electric heat pads not specifically designed for sedated or anesthetized animals, which can't move away from excessive heat, can cause severe burns. Thermostatically controlled constant warming devices such as warm air blankets with even heat distribution are safer.

Pre-Warming with the Darvall Warm Air Cage Blanket System. Providing thermal support before anesthesia may seem counter-intuitive, but recent research shows that effectively warming patients from the time of premedication to the time of induction can prevent the initial, mild drop in body temperature and then slow the rapid, critical heat loss immediately following anesthesia induction¹. The Darvall Warm Air Blanket System is thermostatically controlled and safely delivers a high



Inspired Gas Temperature with Darvall Heated Circuit, Darvall Forced Warm Air Blanket or no heating, 9 dogs/treatment, 6.2±3.1 kg (Mean±SD); 14±7 lb, 20±17 months, surgery time 96±27 minutes.

Lee S. Honours Thesis, University of Sydney, 2013.