Reducing Perioperative Hypothermia in Anesthetized Patients

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Abstract

Hypothesis- The Hot Dog™ patient warming system is as effective at warming anesthetized patients to normothermia as the combination of a Bair Hugger® model 500 warming unit with a Gaymar® T/PUMP® Heat Therapy Pump Model TP-500.
Objective-To assess the effectiveness of the Hot Dog™ patient warming system , Bair Hugger® warming unit, and Gaymar® T/PUMP® Heat Therapy Pump at minimizing anesthesia induced hypothermia in dogs undergoing orthopedic surgery.
Study Design-A randomized controlled clinical trial.
Animals/Sample Population- Twenty-eight client owned dogs.
Methods-Animals were anesthetized and warmed by either, two Hot Dog conductive fabric pads, one above and one beneath; or a combination of a Gaymar® water pad beneath and a Bair Hugger® blanket above the patient. The heating devices were set on the highest setting of 43°C. Measurement of rectal body temperature was taken prior to premedication. Then while anesthetized temperatures were continuously displayed and recorded from the caudal esophagus, rectum, skin above their ribcage, and room every 15 minutes.
Results-Dogs warmed by the Hot Dog™ patient warming system maintained a higher body temperature at all sites of record and were returned to a normothermic state in 85.7% of the cases by the end of surgery. In comparison the same percent of patients, 85.7%, warmed by the combination of a Gaymar® water pad and a Bair Hugger® blanket remained hypothermic at the end of surgery and had lower temperatures at all sites of record throughout the procedure.
Conclusions-Dogs receiving the Hot Dog™ patient warming system treatment maintained significantly higher body temperatures in all recorded categories (core, rectal, and skin), than dogs receiving the Gaymar® water pad and a Bair Hugger® blanket treatment over the 3.75 hour study period.
Clinical Relevance- The Hot Dog™ patient warming system provides a superior means for perioperative thermoregulation.

Introduction

Normal body temperature for dogs is 99.5°F to 102.5°F[1]; therefore hypothermia can be defined as body temperature below 99.5°F. Anesthetic induced hypothermia is a well-recognized phenomenon, occurring in 60% to 90% of anesthetized human and animal patients. Anesthesia decreases sympathetic tone, causing generalized vasodilatation within the body and allowing core heat to mix with the peripheral thermal buffer.[2] As warm core blood moves through the peripheral limbs, it cools and returns to the core causing anesthetic induced hypothermia. Hypothermia because of general anesthesia develops within a characteristic pattern of 3 distinct phases. Initially, the core temperature has a rapid decrease by 1-1.5°C (1.8-2.88 F) during the first hour with a slower, linear decrease occurring over the next 2-3 hours. Patients then enter a plateau phase during which the core temperature remains relatively constant.[3]

Specific Aims

1. Reduce perioperative hypothermia in anesthetized patients.

2. Determine if the Hot Dog™ patient warming system is as effective at warming anesthetized patients to normothermia as the combination of a Bair Hugger® model 500 warming unit with a Gaymar® T/PUMP® Heat Therapy Pump Model TP-500.

Fig. 1 Thermogenic devices
From left to right: Hot Dog™ patient warming system & conductive fabric pad, Gaymar® T/PUMP® Heat Therapy Pump Model TP-500 & water blanket, Bair Hugger® warming unit & model 55577 blanket.

Methods

At the time of premedication a rectal temperature was taken using a MABIS 10-Second† Flexible Tip Digital Thermometer. Post induction a Mon-a-therm® Thermistor Monitor Model 4070 was used to provide constant ambient room and patient temperature readings. Internal patient temperature was recorded using Mon-a-therm® Thermistor 400 series general purpose temperature probes placed in the caudal esophagus and rectum as well as a Mon-a-therm® Thermistor YSI 400 series skin temperature probe placed on the patient's body surface. These four temperatures were recorded every fifteen minutes from the time the patient was anesthetized until the end of the surgical procedure.

Two methods were used in an attempt to maintain normothermia throughout the time the patients were anesthetized. The first method was the previous standard used by the Iowa State University Dr. W. Eugene and Linda Lloyd Veterinary Medical Center which includes a Gaymar® T/PUMP® Heat Therapy Pump Model TP-500 to warm the patient from underneath by circulating warm water through a Gaymar® water pad and a Bair Hugger® model 500 warming unit blowing warm air through a Bair Hugger® blanket model 55577 above the patient. The second method consisted of the Hot Dog™ patient warming system and associated conductive fabric pads placed both above and underneath the patient. All patients had two limbs wrapped in bubble wrap to provide additional insulation.

An analysis of variance for repeat measures and chi square analysis were run to determine the significance of the data.

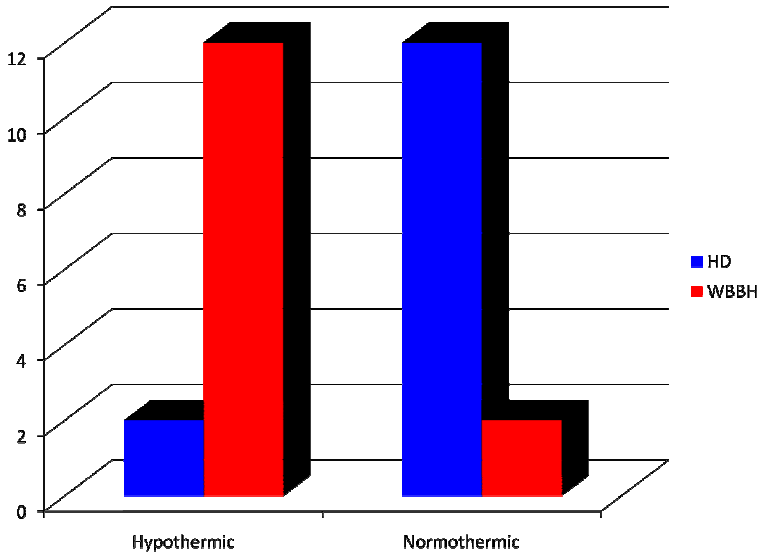

Fig.2 Number of dogs hypothermic vs normothermic.
12 of the 14 dogs in the Bair Hugger® / Gaymar® group remained hypothermic (<99.5°F) at the end of the procedure while the exact opposite was the case for the Hot Dog™ group; 12 of 14 were normothermic; Significance : chi square $p < 0.01$.

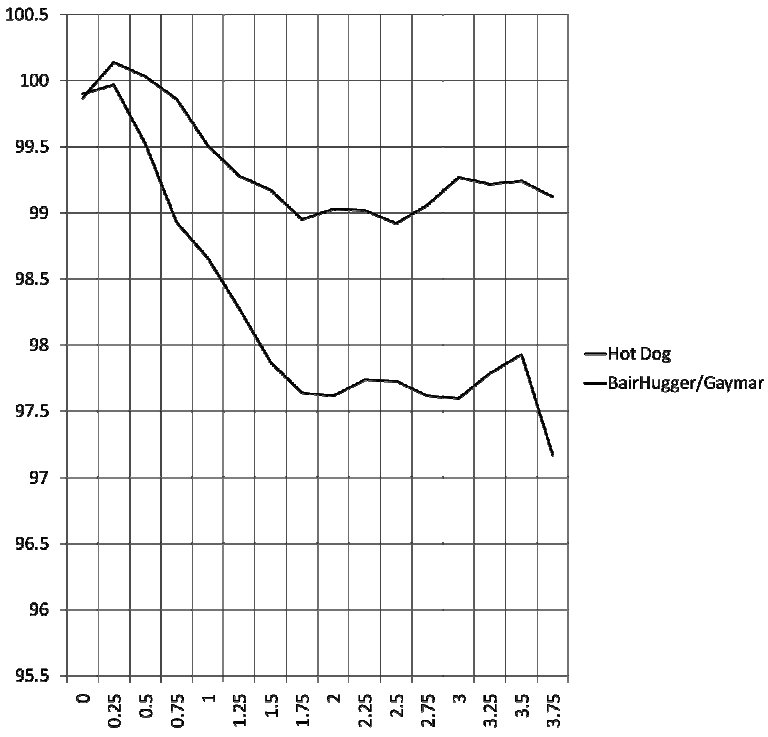

Fig. 3 Average Rectal Temperature.
Change in the average rectal temperature of each group throughout the procedure; Significance: ANOVA $p < 0.001$.

Results and Discussion

An analysis of variance for repeat measures determined that neither the group body weights nor the room temperatures were significantly different from one another. After determining that the environment and populations were not statistically different we compared temperature outcomes from the two groups.

A major and possibly the most noteworthy outcome we looked at was the ability of the thermogenic devices to return patients to normothermia by the end of the procedure. As Figure 2 illustrates; the Hot Dog™ patient warming system was significantly better at attaining this; chi square $p < 0.01$. Figure 3 shows the average rectal temperature of dogs in each group over the length of the procedure. It's clear the Hot Dog™ patient warming system group remained significantly warmer; ANOVA $p < 0.001$.

Esophageal temperature was also significantly higher in the group receiving the Hot Dog™ patient warming system treatment; averaging 1.1°F above the group receiving the Bair Hugger® / Gaymar® treatment. Another significant difference was the temperature of the patient's skin above the ribcage. The average skin temperature of dogs in the Bair Hugger® / Gaymar® group was 100.1°F while the Hot Dog™ group averaged 104.5°F. Another indicator of reduced heat loss was the dog's total change in rectal temperature recorded at premedication, prior to anesthesia, compared to its rectal temperature at the end of the procedure. The dogs treated with the Hot Dog™ patient warming system yielded an average decrease of 0.7°F while the group treated with the BairHugger/Gaymar systems averaged a decrease of 2.7°F. Esophageal, rectal, and skin temperatures were all significantly different. The Hot Dog™ patient warming system was proven to not only be as effective at warming anesthetized patients to normothermia as the combination of a Bair Hugger® model 500 warming unit with a Gaymar® T/PUMP® Heat Therapy Pump Model TP-500; but is superior in this trial.

Conclusions

Perioperative Hypothermia is a real concern and even mild hypothermia can have severe effects. Wound infections are among the most common serious complications of anesthesia and surgery. Hypothermia can predispose a patient to wound infections both by directly impairing immune function and triggering thermoregulatory vasoconstriction, which in turn decreases wound oxygen delivery.[4] Additionally hypothermia is uncomfortable[5] and physiologically stressful; elevating blood pressure, heart rate, and plasma catecholamine concentrations.[6] The effects are considerable and the list continues; increased duration of hospital stay, transfusions required, intraoperative blood loss, myocardial damage (troponin release), urinary excretion of nitrogen, postoperative shivering, and so on.[4]

Every anesthetized patient will experience at least one phase of hypothermia and an effort should be made to reduce it to minimize the associated complications. In our study of anesthetized dogs undergoing orthopedic surgery, the Hot Dog™ patient warming system was more effective at reducing perioperative hypothermia.

References

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