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SHORT COMMUNICATION

Comparison of three different methods to prevent heat loss in healthy dogs undergoing 90 minutes of general anesthesia

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Abstract

Objective To compare a towel under, a warm water pad under or a forced warm air blanket over dogs as techniques to reduce heat loss during a standardized anesthetic.

Study design Prospective, randomized, crossover study.

Animals Eight, healthy, mixed breed dogs weighing 16.3–19.6 kg.

Methods Dogs were anesthetized four times for 90 minutes. Dogs were placed on a steel table (treatment TA), with a cotton towel (treatment TO) or a circulating warm water pad (treatment WP) between the dog and the table, or with, a towel under the dog and covered with a forced warm air blanket (treatment WAB). Rectal temperature (RT) was recorded at 5 minute intervals. Changes in temperature (ΔRT) were calculated as the RT at a given point subtracted from the RT before anesthesia (baseline) and compared over time.

Results After 90 minutes of anesthesia, the ΔRT was 3.42 °C ± 0.29 for TA, 2.78 °C ± 0.43 for TO, 1.98 °C ± 0.29 for WP, and 0.91 °C ± 0.27 for WAB. Significant differences in ΔRT occurred between TA and WAB at 20 minutes (0.94 °C ± 0.42, $p = 0.0206$), between TO and WAB at 30 minutes (1.16 °C ± 0.62, $p = 0.0063$), between WP and WAB at 50 minutes (0.96 °C ± 0.98, $p = 0.0249$), between TA and WP at 35 minutes (1.19 °C ± 0.54, $p = 0.0091$), between TO and WP at 70 minutes (1.12 °C ± 0.56, $p = 0.0248$), and between TA and TO at 75 minutes (0.96 °C ± 0.62, $p = 0.0313$). These differences in ΔRT between each treatment persisted from the times indicated until the end of the anesthesia.

Conclusion and clinical relevance During anesthesia, forced warm air blankets were superior to other methods tested for limiting heat loss. An efficient heat loss technique should be used for anesthesia longer than 20 minutes duration in medium sized dogs.

Keywords air, anesthesia, blanket, dog, hypothermia, warm.

Introduction

Hypothermia is a common complication of general anesthesia. The incidence in veterinary anesthesia is common. The incidence in humans is at least 70% (Torossian 2008). Body temperature is a balance between heat production and heat loss and perianesthetic hypothermia can result from impairment of the thermoregulatory centers in the hypothalamus and exposure to a cold operating room environment (Sessler 2010). Detrimental effects of hypothermia include organ dysfunction, increased susceptibility to infection, reduced wound healing, and increased hospital stays (Todd & Powell 2009; Sessler 2010). To minimize heat loss counteracting techniques can be employed during anesthesia. Techniques studied in dogs include the use of insulating materials, electric and reflective blankets, warmed IV fluids, warm abdominal lavage, circulating warm water pads, and forced warm air blankets (Evans et al. 1973; Cabell et al. 1997; Machon et al. 1999; Govendir et al. 2004; Todd & Powell 2009; Tunsmeyer et al. 2009; Kibanda & Gurney 2012). Many of these studies used clinical patients undergoing different procedures in non-controlled environments. Lack of standardization in patients, procedures, and settings could have influenced the results. Using a standardized, random, crossover design, we compared the change in body temperature in dogs placed on a stainless steel table, on a cotton towel, on a circulating warm water pad, and covered with a forced warm air blanket.

Materials and methods

Animals

This study (protocol #08261) was approved by the University of Illinois Institutional Animal Care and Use Committee. Eight mixed breed dogs undergoing four independent anesthesia events for the same procedure (gastroduodenal endoscopy and biopsies) in an unrelated study were used. Four dogs were intact males and four were intact females and ranged in weight from 16.3 to 19.6 kg. Dogs were similar in physical stature and had short hair coats. Dogs were deemed to be healthy via physical examination and values within the reference intervals on complete blood count, chemistry panel, urinalysis and fecal floatation.

Anesthetic protocol and instrumentation

Dogs were fasted for 12 hours prior to induction of anesthesia but were allowed free access to water. Dogs were kept in runs until 1 hour prior to anesthesia and then brought to the laboratory and allowed to acclimate. Dogs were sedated with butorphanol (0.2 mg kg^{-1}; Torbugesic, Fort Dodge Animal Health, IA, USA) intramuscularly. Fifteen minutes later, a 20-gauge catheter (Angiocath, Becton Dickinson, UT, USA) was placed in the cephalic vein. A temperature probe of a continuous reading digital thermometer, that was previously calibrated by the manufacturer (Traceable Digital Thermometer, VWR Laboratory, IL, USA), was inserted 20 cm into the rectum and secured to the base of the tail with medical tape. The thermometer was capable of detecting temperature changes to 0.001 °C. Anesthesia was induced with 2.5% thiopental (15 mg kg^{-1}; Pentothal, Hospira, Inc., IL, USA) IV. Dogs were intubated and anesthesia was maintained with sevoflurane (SevoFlo, Abbott Animal Health, IL, USA) delivered in oxygen via a circle system. Dogs were maintained in left lateral recumbency. Physiologic monitoring was performed via ECG, pulse oximetry, end tidal gas analysis, and indirect blood pressure, using an oscillometric technique, from a multiparameter monitor (Expert Patient Monitor, Datascope, NJ, USA). Lactated Ringer's solution (Lactate Ringer's, Abbott Animal Health, IL, USA) at room temperature was administered intravenously at 5 mL kg^{-1} $hour^{-1}$. The sevoflurane vaporizer was adjusted to maintain appropriate anesthetic depth for endoscopy and mean blood pressure greater than 60 mmHg. Each anesthetic event lasted 90 minutes. Dogs were randomly assigned to four treatments so that each dog received each of the treatments once. Dogs were allowed a minimum of a 2-week washout period between each anesthesia. Treatment TA dogs were placed directly on a stainless steel table. Treatment TO dogs were placed on a single layer cotton towel on the table. Treatment WP dogs were positioned on a 38.1 × 60.9 cm circulating warm water pad (Heated Hard Pad; Hallowell EMC, MA, USA) attached to a heated water pump (K-MOD 100 Heat Therapy Pump; Baxter, IL, USA) on the highest setting of 42 °C on top of the cotton towel. Treatment WAB dogs were placed on the cotton towel and then covered with a washable 61 × 122 cm forced warm air blanket (Warm Air Blanket-Large, Jorgensen Laboratories, CO, USA) attached to a convective warming system (Thermacare TC3000; Gaymar Industries, Inc., NY, USA) on "high" setting. The heated water pad and the forced warm air blanket devices were turned on 20 minutes prior to use to achieve peak-warming. The same thermometer, table, towel and heating devices were used for each dog. Dogs in treatment WP and WAB were positioned so that their heads and distal extremities were not in contact with the heating devices. An additional, similar, thermometer probe was secured in placed

