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Temporal changes in core body temperature in anesthetized adult horses

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Objective—To examine temporal patterns of core body temperatures in adult horses during general anesthesia and to determine the efficacy of forced-air warming blankets in attenuating decreases in core body temperatures.

Animals—5 clinically normal adult horses.

Procedure—Horses were assigned to each of 2 trials, warmer and no-warmer, in a randomized crossover design. Horses were instrumented with a thermistor-tipped pulmonary arterial catheter to measure core body temperature. Induction and maintenance of and recovery from general anesthesia were performed in an air-conditioned surgical suite where room temperature and relative humidity were maintained at approximately 21 C and 40%, respectively. Core body temperature measurements were recorded every 5 minutes during 2.5 hours of anesthesia and during recovery until horses could stand. Data were analyzed, using ANOVA for repeated measures.

Results—Without warming, mean core body temperature decreased steadily (0.37 ± 0.18 C/h). Forced-air warming significantly decreased that rate to 0.19 ± 0.09 C/h. In both trials, there was an additional, rapid, significant decrease in core body temperature when horses were moved to the recovery area, which was apparently the result of conductive heat loss to the cold floor. Recovery time and time required for core body temperature to return to baseline were unaffected by forced-air warming during anesthesia and recovery.

Conclusions and Clinical Relevance—Core body temperature decreases steadily in adult horses anesthetized in a cool, dry environment. Forced-air warming devices can attenuate this decrease. Additional body heat can be lost rapidly when anesthetized horses are positioned on cold surfaces during recovery. (*Am J Vet Res* 1999;60:556–562)

Thermoregulation is defined as the appropriate, coordinated, centrally mediated response to thermal stress.[1] During general anesthesia, body temperature decreases primarily as a result of heat lost through radiation, convection, and conduction from the anesthetized patient to the cold environment of the operating room. This is attributable primarily to anesthetic-induced inhibition of thermoregulatory responses that act to conserve core body heat through peripheral vasoconstriction.[2] Anesthetic-induced impairment of thermoregulation results in alteration of temperature thresholds for response to thermal stimuli; warm-response thresholds are raised, and cold-response thresholds are lowered.[2] Similar patterns of inhibition have been observed in humans anesthetized with inhaled and intravenous anesthetic agents.[2,3]

Hypothermia during general anesthesia is considered uncommon in adult horses presumably owing to a large body weight to body surface area relationship.[4] Investigations[5-7] of the effects of long duration general anesthesia in horses suggest that body temperature remains at slightly below normal for several hours. However, core body temperature was not measured in these studies, and thermal gradients between horse and environment were not reported. To the author's knowledge, perianesthetic hypothermia has not been investigated specifically in adult horses. In humans, intraoperative hypothermia develops in 3 phases.[8] After induction of anesthesia, core body temperature decreases as body heat is redistributed from the core to the periphery secondary to peripheral vasodilation resulting from anesthetic-induced inhibition of thermoregulatory cold-response threshold. Later, loss of core body heat through radiation, convection, and conduction exceeds metabolic heat production, which results in a slow, linear decrease in core body temperature.[9] Lastly, continued heat loss eventually results in core body temperature decreasing to the anesthetic-lowered, cold-response threshold, at which point thermoregulatory peripheral vasoconstriction is reestablished to limit transfer of core heat to the environment. Subsequently, core body temperature stabilizes, although peripheral body temperature continues to decrease.[10]

It is hypothesized that, in the cool, dry environment of an air-conditioned operating room, fluctuation in core body temperature in anesthetized horses will follow a similar temporal pattern. The purpose of this study was to test this hypothesis by measuring core body temperature via the pulmonary artery in anesthetized adult horses. Additionally, the effects of active warming of horses by use of a forced-air warming device during anesthesia were examined.

Materials and Methods

Horses—Five clinically normal adult horses (2 females, 3 males) of various breeds were studied. Mean body weight was 524 kg (range, 499 to 568 kg), and mean age was 18.6 years (range, 9 to 34 years). Horses were pastured together before the study. Each horse was housed in a box stall 24 hours before each trial and was returned to the stall for an additional 24 hours before being returned to pasture. Horses were considered clinically normal on the basis of physical examination findings and results of hematologic analyses.

Experimental protocol—Each horse underwent 2 experimental trials designated warmer and no warmer. In the

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