TITLE: ACTIVE THERMOREGULATION DURING ISOFLURANE ANESTHESIA

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Introduction. Thermoregulatory responses are thought to be drastically suppressed by general anesthesia.[1,2] In a previous study, it was shown that core temperature changes during halothane/oxygen and N_2O/fentanyl anesthesia were similar in patients undergoing ophthalmic surgery.[3] In both groups, core temperature decreased to 36.2°C after 2 h of anesthesia and then remained constant for the duration of surgery. Steady-state temperatures in these patients appeared to result from a passive interaction with the environment. The present study tested the hypothesis that thermal steady-state is passive in warm patients but that active thermoregulation (increased vasoconstriction and nonshivering thermogenesis) occurs in patients who become sufficiently hypothermic.

Methods. Five unpremedicated adults undergoing ophthalmic, breast, and abdominal surgery were anesthetized with isoflurane/air. Esophageal temperature and skin temperature gradients (forearm — finger tip) were measured with Mon-a-Therm® thermocouples. Vasoconstriction was also determined using a Periflux® laser doppler perfusion monitor.[4] Cutaneous blood flow accurately reflects hypothalamic thermoregulation.[5] Skin temperature gradients correlate well with other measures of vasoconstriction and are minimally affected by ambient temperature.[6] Nonshivering thermogenesis was assessed by measuring oxygen consumption calculated from the inspired and expired oxygen concentrations, expired oxygen and carbon dioxide concentrations, and expired gas volume.

Results. Two patients remained relatively warm (steady-state temperatures ≥ 35.8°C) and did not demonstrate vasoconstriction (fig. 1). Three others became hypothermic (steady-state core temperatures ≤ 34.5°C) and demonstrated profound vasoconstriction with cutaneous blood flow (determined by laser doppler) decreasing more than 10-fold, and skin temperature gradient increasing > 8°C (fig. 2). Changes in flow determined by laser doppler and skin temperature gradients occurred rapidly and simultaneously. There were no significant changes in oxygen consumption.

Discussion. Nonshivering thermogenesis during anesthesia appears to be a less important thermoregulatory mechanism than has been reported in normal subjects.[7] Vasoconstriction was not detected in patients who remained warm, suggesting that thermal steady-state resulted from a passive interaction with the environment. Conversely, profound vasoconstriction was associated with thermal steady-state in patients whose esophageal temperatures were ≤ 34.5°C. These results demonstrate significant inhibition of normal thermoregulatory responses, but indicate that surgical patients are not poikilothermic.

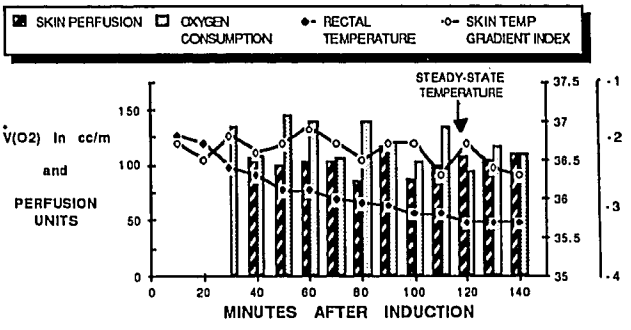

Figure 1. Rectal temperature, skin perfusion, skin temperature gradients, and oxygen consumption in a patient undergoing ophthalmic surgery during isoflurane/air anesthesia.

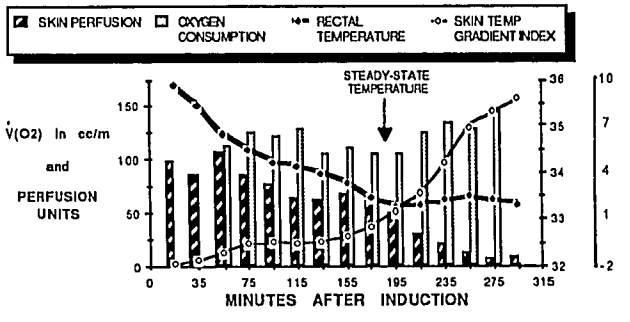

Figure 2. Rectal temperature, skin perfusion, skin temperature gradients, and oxygen consumption in a patient undergoing abdominal surgery.

References.

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