

Chia-Shiang Lin,<sup>6</sup> MD

Chen-Huang Liu,<sup>a</sup> MD

Chen-Jan Wang,<sup>a</sup> MD

J-Cheng Chen,<sup>a</sup> MD

Pei-Shan Tsai,<sup>6</sup> MD

Ize-Taur Wei,<sup>6</sup> MD

Chi-Chen Wu,<sup>c</sup> MD

Martin S. Mok,<sup>c</sup> MD

<sup>a</sup>Department of Anesthesiology,

TaoYuan General Hospital,

Department of Health, the Executive  
Yuan

<sup>b</sup>Department of Anesthesiology,

HsinChu Mackay Memorial Hospital

<sup>c</sup>Department of Anesthesiology, Taipei

Medical University Hospital

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## The Thermoregulatory Threshold During Surgery with Midazolam-Fentanyl-Nitrous Oxide Anesthesia

### ABSTRACT

**Background.** Intraoperative hypothermia is a common problem. Thermoregulatory responses are thought to be drastically suppressed by inhalation anesthesia. The effects of intravenous anesthetics on thermoregulatory responses in human are less well understood. In previous studies, it was shown that fentanyl-nitrous oxide and propofol-nitrous oxide decreased the threshold of vasoconstriction in general anesthesia. However, the thermoregulatory threshold of intravenous anesthetic midazolam during surgery has not been quantified.

**Aims.** The present study was undertaken to evaluate the effect of midazolam-fentanyl-nitrous oxide anesthesia on thermoregulation in patients with and those without warming and to determine the threshold temperature at which thermoregulatory vasoconstriction takes effect.

**Methods.** Fourteen unpremedicated ASA class I adult patients were anesthetized with N<sub>2</sub>O (70%), midazolam (as a 0.2 mg/kg bolus followed by a 0.5 ug/kg/h infusion) and supplemental fentanyl during elective surgery for free flap placement. Patients were randomly assigned to receive intraoperative temperature management with added warming ( $n = 5$ ) or the customary no warming ( $n = 9$ ). Significant vasoconstriction was defined as a skin-surface temperature gradient between the forearm surface and finger-tip surface of  $\geq 4$  °C, while the thermoregulatory threshold was defined as the esophageal temperature (core temperature) at which such vasoconstriction occurred.

**Results.** Vasoconstriction did not occur in patients who received added warming. They remained nearly normothermic, and the mean lowest core temperature was  $36.3 \pm 0.4$  °C. All 9 patients given the customary temperature management became hypothermic with a core temperature of  $35.2 \pm 0.7$  °C and displayed significant vasoconstriction; the mean threshold of thermoregulatory vasoconstriction was  $35.2 \pm 0.7$  °C. The difference in the thermoregulation vasoconstriction thresholds between the 2 groups was statistically significant ( $p = 0.008$ ).

**Conclusions.** We conclude that without added warming, patients under general anesthesia with midazolam-fentanyl-nitrous oxide would develop hypothermia, but thermoregulatory vasoconstriction came into play at around 35.2 °C which seemed to prevent the development of deep hypothermia during surgery. Appropriate warming measures should be taken when a patient is subjected to this combination of anesthetics for a prolonged period of time.

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