EFFECT OF RADIANT HEAT ON THE METABOLIC COST OF POSTOPERATIVE SHIVERING

A. SHARKEY, R. H. GULDEN, J. M. LIPTON AND A. H. GIESECKE

SUMMARY

Hypothermia and postoperative shivering are uncomfortable and may be dangerous. This study demonstrates that postoperative shivering may be controlled quickly and effectively with radiant heat, thereby reducing oxygen consumption and increasing thermal comfort. (Br. J. Anaesth. 1993; 70: 449-450)

KEY WORDS


Postoperative shivering occurs in a significant number of patients in modern recovery rooms and it may increase oxygen consumption by as much as 400% [1]. If the oxygen demand induced by postoperative shivering exceeds the ability of depressed respiratory and circulatory systems to deliver oxygen to tissues, a relative oxygen debt or “demand hypoxia” can result, placing poorly perfused tissues at risk of ischemia.

When applied to the blush area (the face, neck and upper chest regions that have a high density of thermoreceptors and sensitivity to warmth) radiant heat was found to inhibit shivering in obstetric patients [2] and in healthy volunteers [3] without significant side effects. The present study was designed to determine the influence of such local application of radiant heat on the metabolic consequences of postoperative shivering.

METHODS AND RESULTS

After approval by the local institutional Review Board, we studied 19 visibly shivering patients who had undergone Caesarean section or tubal ligation (ASA I or II; ages 18–40 yr (mean 26.7 (SEM 1.4) yr); weight 55–96 kg (mean 73.9 (2.5) kg), body surface area 1.49–1.94 m² (mean 1.74 (0.3) m²) after operation in the recovery room. Anaesthesia was performed under spinal block (seven radiant heat and three control patients), extradural block (one radiant heat, four control) or combined spinal-extradural block (three radiant heat, one control). All patients received Bicitra 15 ml orally 45 min before operation; and diazepam 10 mg orally was given to those patients undergoing tubal ligation. All nine Caesarean sections were performed under combined spinal-extradural or extradural anaesthesia using 0.75% hyperbaric bupivacaine 1.5–1.8 ml, followed by plain 0.5% bupivacaine 3 ml mixed with fentanyl 200 µg, injected into the extradural space via an indwelling catheter. All extradural catheters were removed after operation. Fentanyl 50–100 µg was administered i.v. after delivery to provide additional pain control. The remaining 10 patients underwent tubal ligation under spinal anaesthesia (5% lignocaine 70 mg in 7.5% glucose). All patients received fentanyl 50–100 µg i.v. during surgery.

By means of a table of random numbers, the shivering patients were allocated to receive either radiant heat or warmed blankets after operation. Each patient was covered with a canopy connected to a Deltatrac Metabolic Monitor (Sensormatic; Yorba Linda, CA) which continuously sampled expired gases and calculated oxygen consumption and carbon dioxide production. Arterial pressure, SpO₂, and ECG (lead II) were monitored continuously.

After 10 min of baseline observation, patients received either radiant heat or warmed blankets. Six infra-red bulbs (750 W) arranged in two rows were suspended 45 cm above the sternum to illuminate the blush region, which was covered with one layer of lightweight cotton cloth. Skin temperature was monitored constantly via dual thermistors applied to the chest, providingautofeedback regulation of power to the lamps; the temperature was maintained at 41 ± 0.1 °C to prevent thermal injury. After a 10-min warming period, the heat lamps were switched off and recordings were continued for an additional 10 min.

All data were subjected to statistical analysis using repeated-measure ANOVA and Tukey’s protected t test (two-tail), with P < 0.05 considered significant. The two groups were not statistically different in weight, height, body surface area, age, anaesthetic or temperature on arrival in the recovery room. The absolute VO₂ is shown in figure 1.

Baseline (shivering) oxygen consumption in the radiant heat and warmed blankets groups was not statistically different (P > 0.05). However, with the application of radiant heat, VO₂ significantly de-

AIDAN SHARKEY, M.B., B.CH., B.A.O., F.F.A.R.C.S.I.; RICHARD HEATH GULDEN, M.D.; JAMES M. LIPTON, PH.D.; ADOLPH H. GIESECKE, M.D.; Department of Anaesthesiology, The University of Texas Southwestern Medical School, 5333 Harry Hines Blvd, Dallas, Texas 75235-9068, U.S.A. Accepted for Publication: November 2, 1992.

Correspondence to A.H.G.
creased ($P < 0.01$), whereas it remained increased in the warmed blankets group.

All radiant heat patients ceased visible shivering within 5 min of application of the heat and stated that they felt more comfortable. When the lamp was turned off, six of the eight patients resumed shivering and requested that the lamp be turned on again. Oxygen consumption increased in radiant heat patients, but did not return to baseline. All patients warmed with blankets complained of cold.

**COMMENT**

Intraoperative hypothermia was documented as a clinical entity more than 100 years ago [4]. Since then, many measures have been recommended to prevent heat loss during surgery and anaesthesia [5] but, despite this, the cold patient is still an "accepted concomitant" of postoperative recovery [6]. Such hypothermia is a primary factor in postoperative shivering.

Postoperative shivering may occur when the CNS temperature control systems emerge from anaesthesia and react to "cold" signals from thermoreceptors, which then initiate shivering, a thermogenic response.

Marked increases in oxygen consumption can occur in postoperative shivering, with an accompanying increase in postoperative morbidity and mortality. Our study demonstrates that postoperative shivering can be quickly and effectively controlled by warming the "blush" region and radiant heat. This treatment decreases oxygen consumption and, thus, reduces the immediate risks to cardiovascular and respiratory systems.

**REFERENCES**