Hypothermia Associated with Intrathecal Morphine

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Intrathecal administration of morphine is useful for long-lasting pain relief after surgery. When spinal anesthesia is employed for surgery of the lower abdomen or the lower limb, intrathecal injection of morphine has been combined[1-4]. Intrathecal morphine is, however, accompanied by complications such as nausea, vomiting, urinary retention, pruritus, and delayed respiratory depression[5,6]. Previously, we recommended intrathecal administration of morphine (0.1-0.2 mg) to the adult associated with intrathecal administration of local anesthetic agent for pain relief lasting for more than 20 hr after abdominal or vaginal hysterectomy without causing respiratory depression[2]. We experienced a case of accidental hypothermia after spinal anesthesia introduced with a hyperbaric tetracaine solution including 0.14 mg of morphine. To the best of our knowledge, accidental hypothermia following intrathecal morphine has not been reported.

Case Report

A 59-year-old, 43 kg man was scheduled for resection of burn scar (30 $\times$20-cm) with ulcer and grafting of split-thickness skin on the right thigh. He had a history of Raynaud's phenomenon associated with the occupational use of vibrating tools, and diagnosed at 47-years of age. His preoperative physical findings, ECG, blood chemistries, and pulmonary function tests were within normal limits. He had no history of drug allergy.

He was premedicated with 0.8 mg of alprazolam and 1.0 mg of atropine orally, 1.5 hr before induction of anesthesia. Axillary skin temperature was 35.9°C, respiratory rate 12 breaths·min^{-1}, pulse rate 78 beats·min^{-1}, and blood pressure 142/102 mmHg before premedication.

With the patient in the left lateral decubitus position, the subarachnoid space was punctured using a 25-g disposable spinal needle at the L_4-L_5 interspace. Spinal anesthesia was produced by intrathecal injection of 2.8 ml of 0.5% hyperbaric tetracaine solution with 0.125% phenylephrine and 0.005% morphine (14 mg of tetracaine, 3.5 mg of phenylephrine and 0.14 mg of morphine). Immediately after the injection, the patient was turned to the supine position. Fifteen min after spinal anesthesia, the upper level of analgesia was T_9 by pin-prick testing. Surgery was commenced at 20 min after spinal anesthesia. Heart rate

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decreased gradually from 100 to 60 beats·min^{-1}, and blood pressure also decreased gradually from 120/80 to 80/50 mmHg. He was given 1 mg of etilefrine and 100 ml of 6% hydroxyethyl starch solution intravenously. Blood pressure was restored to 110/60 mmHg but heart rate stayed at 60 beats·min^{-1}.

Two hours and 30 min after spinal anesthesia, nausea and sweating with cold skin appeared and continued. His consciousness was clear. Heart rate was 50 beats·min^{-1} and blood pressure 140/74 mmHg. Surgery was finished 20 min after the appearance of nausea and sweating. The upper level of analgesia was T_{10} by pin-prick. Arterial blood gas analysis revealed respiratory acidosis (pH 7.31, Pa_{CO_2} 50 mmHg, Pa_{O_2} 77 mmHg, base excess −1 mEq·l^{-1}). During surgery, rectal temperatures were between 35.4 and 35.8°C. Operating room temperature was maintained at 22°C. During the 4-hr period in the operating room, 1,250 ml of warm lactated Ringer's solution were given. Urinary volume was 240 ml and blood loss 100 ml.

Postoperatively, the patient was transferred to a general ward, though nausea and sweating had continued. Six hours after spinal anesthesia, axillary and oral temperatures were 33.1 and 33.5°C, respectively. Nausea, vomiting and copious sweating on the whole body were observed. He did not complain of chill. No shivering was seen. No marked finding was noted in arterial blood gas analysis data (pH 7.37, Pa_{CO_2} 41 mmHg, Pa_{O_2} 124 mmHg, base excess −1 mEq·l^{-1}). The blood gas analyzer electrodes were maintained at 37°C and temperature corrections were not made. The patient was covered with an electric heating blanket controlled thermostatically at 38°C. Despite hypothermia, he felt hot and wanted it to be removed. His sweat-drenced clothes were often

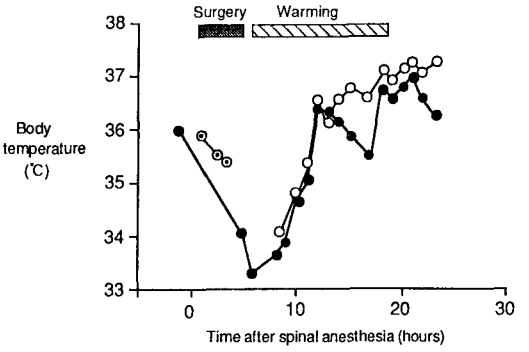

Fig. 1. Changes in rectal (⊙), bladder (○) and axillary skin (●) temperatures after spinal anesthesia.

changed. Eight hours after spinal anesthesia, the upper level of analgesia was L_1. Axillary and bladder temperatures were 33.8 and 34.0°C, respectively. Any treatments except heating blanket were not used.

Body temperature was elevated gradually (fig. 1). Nineteen hours after spinal anesthesia, the warming blanket was removed. Twenty hours after spinal anesthesia, bladder temperature was elevaed to 37.2°C, and he complained of feeling cold. Sweating also decreased but persisted for 27 hr. Nausea persisted for 31 hr. The patient requested no postoperative medication. No marked changes in pulse rate and blood pressure were noted postoperatively.

Disucussion

Temperatures were measured at different site of the body in this patient. Rectal temperature during surgery and bladder temperature after surgery were monitored as core temperature, although axillary temperature was monitored throughout the course of this episode. These non-uniform temperature measurements made difficult to interpret consecutive and accurate core temperature. However, in this patient, the lowest bladder temperature was 34°C, the lowest oral temperature

33.5°C and the lowest axillary temperature 33.1°C.

Intraoperative hypothermia is frequently seen, because 1) exposure to cold increases environmental heat loss, 2) general anesthesia decreases metabolic heat production, and 3) anesthetic drugs inhibit thermoregulatory responses[7]. During spinal anesthesia, central thermoregulation remains intact, providing some protection from hypothermia. Nonetheless, hypothermia occurs because of anesthetic depression of regional thermal sensations, excessive environmental heat loss, regional depression of vasoconstriction and shivering, and redistribution of heat within the body[7,8]. If the patient is not sedated, vasoconstriction and shivering occur above the level of the block[8]. In our patient, rectal temperatures were maintained at 35.4-35.8°C during surgery, but 3 hr after surgery core temperatures decreased further 1.4-1.8°C. The patient did not complain of coldness or chill. Shivering was not observed. We administered alprazolam alone before induction of anesthesia but did not use any other sedatives during and after surgery. The half-life of alprazolam is 12 ± 2 (SD) hr[9]. Therefore, alprazolam may contribute to the inhibition of central thermoregulation. We do not suspect that spinal anesthesia itself was responsible for hypothermia in this patient.

We observed profuse sweating on the whole body in spite of hypothermia in this patient. We supposed that the thermoregulatory response to cold stress was impaired by the anesthetic drugs or others. The drugs administered to this patient during the course of anesthesia consisted intrathecally of 0.8 g of glucose, 14 mg of tetracaine, 3.5 mg of phenylephrine and 0.14 mg of morphine, and intravenously of 1 mg of etilephrine, 100 ml of hydroxyethyl starch, 0.25 mg of atropine, 2 g of glucose and 1,250 ml of lactated Ringer's solution. All the drugs except tetracaine and morphine would not be related to central anesthesia which inhibits the thermoregulatory response to cold.

Morphine alters the set point of the hypothalamic thermoregulatory mechanisms, so that body temperature falls slightly[10]. Intraventricular administration of morphine in patients with cancer pain decreases rectal temperature[11]. Hypothermia produced by morphine is due to cutaneous vasodilation and sweating. Could morphine injected into the lumbar subarachnoid space spread to the thermoregulatory center located in the anterior hypothalamus? Yamaguchi et al.[12] reported the effect of low-dose intrathecal morphine on pain relief and the incidence of side effects after cholecystectomy in 139 patients. Delayed-onset respiratory depression occurred in four of 15 patients given 0.15 mg of morphine and in four of 17 patients given 0.20 mg of morphine intrathecally. Vomiting was sometimes observed in these patients. Respiratory depression, nausea and vomiting are attributed to intrathecal morphine spread to the brain stem and higher centers. The bulk movement of CSF from the lumbar space to the cisterna magna occurs within 3-6 hr[13,14]. The absorption of morphine into the systemic circulation and redistribution back into CSF may not be related to respiratory depression, especially in this patient administered low-dose intrathecal morphine. The impairment of the thermoregulatory center would occur such as delayed respiratory depression by intrathecally administered morphine. In this patient, respiratory depression was observed 3 hr after spinal anesthesia and then it was followed by nausea and sweating. However, we cannot explain why the impairment of the thermoregulatory cen-

ter occurred in this patient alone.

In summary, we experienced an unusual hypothermia in a patient who received spinal anesthesia with hyperbaric tetracaine and 0.14 mg of morphine. It can be assumed that morphine spread cephalad through the CSF and caused depression of the hypothalamic set point for temperature regulation.

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