Unusual excessive sweating and hypothermia during hysterectomy under general anesthesia
–A case report–

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A 78-year-old female patient was undergone general anesthesia for total abdominal hysterectomy with bilateral salpingo-oopherectomy. Arterial blood pressure dropped 20 minutes after beginning of the surgery when uterine manipulation was started. From then, excessive sweating was found in the face and whole body and core temperature decreased to 34.3°C. Sweating and low body temperature were sustained despite of various aggressive warming efforts. Anticholinergic medication immediately put an end to an hour of excessive sweating and prevented further body temperature decline. Several possibilities of excessive sweating were discussed in this case: uterine manipulation during the light plane of general anesthesia, age related autonomic changes, use of intraoperative opioid and antihypertensive medications.

Key Words: General anesthesia, Hypothermia, Sweating.

Patients seldom sweat during general anesthesia. Although excessive draping may cause thermal sweating, this is rare in operating rooms (OR) with air conditioning systems. Surgery under general anesthesia usually induces a decrease in body temperature (BT) through a low OR temperature, evaporation from the surgical fields, the administration of unheated fluids, and heat loss due to vasodilation. Patients may respond to hypothermia with vasoconstriction and shivering and to hyperthermia with active vasodilatation and sweating. In the awakened state, the BT is strictly maintained within a 0.2°C temperature range by vasoconstriction and sweating [1,2]. During general anesthesia, however, this range becomes wider due to an increased sweating threshold and a decreased vasoconstriction threshold. These mechanisms involve hypothalamus, which is considered as the main temperature regulating center of thermal sweating. However, we experienced generalized sweating with hypothermia, which does not indicate a consequence of thermoregulatory abnormality. This report describes a case of prolonged excessive cold sweating and hypothermia during the hysterectomy under general anesthesia with several possible explanations.

CASE REPORT

A 78-year-old female patient (151 cm, 70.6 kg) with endometrial cancer was scheduled for a total abdominal hysterectomy with bilateral salpingo-oopherectomy. Her past medical history included hypertension which had been well controlled with medication (lecardipine and thiazide) for 5 years. No other metabolic diseases were found, and the preoperative physical examination, hematologic tests, chest X-ray, and electrocardiogram showed nothing unusual. No premedication was given.

In the OR, routine anesthetic monitoring devices, including noninvasive blood pressure (BP), pulse oximeter, electrocardiogram, and entropy monitors, were attached to the patient. The temperature in the OR was regulated by a central air conditioning system, which maintained the temperature at approximately 21-23°C with an indoor thermometer. At that time, the patient felt a cold sensation and shivered mildly. The
initial vital signs were as follows: BP 145/85 mmHg, pulse rate (PR) 85 beats/min, peripheral oxygen saturation (SpO₂) 95%, and BT 36.6°C. The anesthesia was induced with a target-controlled infusion of propofol and remifentanil at an effect-site concentration of 4 μg/ml and 2 ng/ml, respectively. Following the loss of consciousness of the patient, 50 mg of rocuronium bromide were administered intravenously, and the intubation was performed with a 7.5 cm inner diameter endotracheal tube. Foley catheter was inserted before draping and anesthesia was deepened few minutes before starts of surgery. However, she did not require high concentration of anesthetics: BP 108–137/68–82 mmHg, PR 54–58 beats/min, SpO₂ 100%, end-tidal CO₂ (EtCO₂) 27–30 mmHg, and state entropy (SE) 41–63 under 3.0 μg/ml of propofol and 1.5 ng/ml of remifentanil.

After 20 minutes, abdominal wall was opened and uterine manipulation was started. At that time, the patient’s BP dropped abruptly to 88/54 mmHg while other parameters shown as PR 54–57 bpm, EtCO₂ 26–27 mmHg, and SE 60–64. Ephedrine 4 mg was injected thereafter but restored 10 minutes later. From then, the patient was found to be sweating excessively in the face and the whole body (Fig. 1). An esophageal temperature probe was immediately inserted, and showed temperature of 34.8°C. The BT was measured again with tympanic membrane, which displayed the same result. Although the depth of the anesthesia was increased to 3.5 μg/ml of propofol, the excessive sweating did not stop and the patient’s SpO₂ began to drop to 95% at FiO₂ 0.4. An arterial blood gas analysis and transesophageal echocardiography were conducted and showed normal findings: pH 7.45, PaCO₂ 36 mmHg, PaO₂ 92 mmHg, HCO₃⁻ 25 mmol/L, SaO₂ 97%, K⁺ 3.1 mmol/L, Na⁺ 139 mmol/L, Ca²⁺ 1.04 mmol/L, and blood sugar 114 mg/dl.

Despite our use of warm water mattress, forced heated air blanket, heated humidification of gases and warming of intravenous fluids, the excessive sweating continued for more than thirty minutes. The patient’s esophageal temperature decreased to 34.3°C and the ear thermometer indicated “low” status. We administered 0.2 mg of glycopyrrolate intravenously. Even though the patient’s PR did not increase, the sweating ceased and the surgery was completed without adverse events. The BT did not drop further but did not increase effectively during the rest of the surgical period. The esophageal temperature was 34.5°C when the patient emerged from the anesthesia, and the extubation took over 30 minutes. The total duration of the anesthesia was 3 h 30 min and 1,400 ml of crystalloids were infused. The urine output was 90 ml, but we could not estimate the water loss from the sweating. The patient was transferred to the PACU and continuous efforts were made for 2 h 30 min to increase her BT up to 36.2°C. The patient did not complain of any discomfort and did not recall perioperative experience. We explained about several possible reasons of excessive sweating and recommended further evaluation for autonomic dysfunction at postoperative visiting. But the patient told that she had never had symptoms related to autonomic dysfunction before the surgery and refused further evaluation. She discharged after 1 week of hospitalization.

**DISCUSSION**

Sweating is not a common phenomenon during general anesthesia. In general, the potential causes of excessive sweating during surgery except for the thermal sweating include severe physiologic stress, metabolic or respiratory disturbances such as thyrotoxicosis, hypoglycemia, gout, pheochromocytoma, hypoxia, or hypercarbia [3]. Many drugs inhibiting the reuptake of serotonin and norepinephrine can
also provoke excessive sweating [4]. Aging itself is associated with altered autonomic nervous system, too [5]. Moreover, sweating has been reported in patients with autonomic dysfunctions such as Parkinson’s disease, DM, pure autonomic failure (PAF), or cold induced sweating syndrome (CISS) [5-8]. Autonomic sweating is also possible during general anesthesia, because general anesthesia today is mostly kept in light plane with the concomitant use of muscle relaxants. The patient in this case had been taking antihypertensive drugs, including a calcium channel blocker and diuretics. Although these drugs can trigger excessive sweating in rare cases, the patient had been taking the drugs for a long time and had not experienced side effects before the surgery.

Opioids have been reported to induce excessive sweating [4,9-11]. Indeed, there have been two case reports of excessive sweating and hypothermia in spinal anesthetized patients with intrathecal morphine injections [9,10]. In these cases, the patients’ temperatures had decreased to 33.6 and 35.2°C within 180 and 210 minutes of the spinal opioid administration, respectively, and had been reversed with naloxone or conservative treatment. Temperature control is mediated by numerous opioid receptors in the hypothalamus, and the spread of spinal opioids was regarded as the reason for interference with the temperature set point [10]. Oral methadone and transdermal fentanyl have been reported to induce excessive sweating [4,11], which could be due to opioid-induced mast cell release of histamine. Although small dose of remifentanil was used, it is likely to have been one of the causes of the sweating in this case.

Also, aging is associated with decline of autonomic nervous function which leads to impairment of thermoregulatory capacity in a high proportion of old people [12]. Furthermore, the central nervous system including hypothalamus is vulnerable during general anesthesia in geriatrics [5]. Although autonomic function could not be tested in this case, age itself could have influenced to abnormal temperature regulation.

Autonomic nervous system dysfunctions can also cause abnormal sweating. Hirayama [6] reported that sweating alterations happened with a frequency of 30-50% in patients suffering from Parkinson’s disease, and abnormal excessive hyperhidrosis during hemodialysis was also reported in a patient with DM neuropathy [13]. Very rarely, there is a report of cold induced sweating in PAF [7]. PAF is a sporadic neurodegenerative disorder characterized by slowly progressive severe autonomic dysfunction while CISS is an autosomal recessive disease that is related with mutations of the CRLF1 receptor gene with typical dysmorphic features [7,8]. PAF is a slowly progressive disease and orthostatic hypotension usually occurs as an early symptom. This patient had a single abrupt onset of sweating and no history of autonomic dysfunctions or no clinical findings of CISS. Therefore, PAF and CISS are not likely the causes of excessive sweating in this patient.

Besides, hyperthermia stimulates sweat glands which are predominantly innervated by sympathetic nerve through the mediation of acetylcholine. However, non-thermogenic stimulation such as stress, pain, or anxiety may induce sweating from both sympathetic through the mediation of adrenaline and noradrenaline, or parasympathetic through the mediation of acetylcholine [3,14]. Both forms of autonomic sweating begin immediately after stimulation, but the clinical aspects are rather different: sympathetic sweating involves hot and focal sweating with an elevated BP and PR, while parasympathetic sweating is characterized by cold and generalized sweating with a depressed BP and PR [3]. Surgical stimulation mostly produces a sympathetic response, although hemorrhage, pain, or some types of surgical trauma: tractions of the mesentery or stretching of the uterine cervical canal may also cause a parasympathetic response [3]. Under the light plane of anesthesia, these reflexes are not completely depressed, and may produce parasympathetic reaction. In this case, abrupt onset of hypotension and sweating during uterine manipulation might indicate possibility of autonomic sweating.

As we mentioned above, the causes of sweating are cautiously examined for treatment of excessive sweating. Every attempt such as avoid hyperthermia, adjusting anesthetic depth, control of blood sugar, provide adequate oxygenation and ventilation, treatment of metabolic disease, avoid sympathetic stimulation, and cessation of surgical manipulations will be helpful to stop sweating according to the triggering factors. Vasopressor can be used when the BP or PR falls and the excessive fluid loss may need to be supplemented in order to maintain the cardiac output [3]. If the sweating is extensive or prolonged, the patient should be checked for other autonomic changes. Hypothermia should be treated aggressively to avoid complications such as delayed emergence, postanesthetic shivering, impaired coagulation, wound infections, and delayed wound healing. Anticholinergic drugs might be used to inhibit cholinergic sweating; however, adrenergic blocking agents are useful to cease sweating when excessive sweating is developed by increased sympathetic activity [3].

In conclusion, excessive sweating was presented during general anesthesia and reversed with anticholinergic medication.
in this report. Surgical stimulation, use of remifentanil, or autonomic changes with aging may considered to be the causes of sweating. When excessive sweating is noted during anesthesia, the causes should be assessed promptly, as it may be the sign of a serious condition, or may cause serious complication itself. Appropriate treatment should also be administered.

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