IM droperidol as premedication attenuates intra-operative hypothermia

[L'administration im d'une prémédication de dropéridol atténue l'hypothermie peropératoire]

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Purpose: Perioperative hypothermia results largely from core-to-peripheral heat redistribution. Droperidol, which is often used for premedication, promotes vasodilation, and thus may affect redistribution of heat. Accordingly, we tested the hypothesis that preanesthetic droperidol would affect perioperative hypothermia.

Methods: Twenty-three ASA physical status I patients scheduled for arthroscopic ligament reconstruction were randomly assigned to two groups to receive no premedication or im droperidol 0.1 mg·kg⁻¹ 30 min before anesthesia. Anesthesia was induced and maintained with propofol and fentanyl. We monitored core (tympanic) and peripheral (palm) temperatures, and skin (fingertip) blood flow for two hours after the induction of anesthesia during surgery.

Results: Before the induction of anesthesia, patients given droperidol were more deeply sedated than those given no premedication. Core temperature, which was similar in both groups before induction, decreased significantly more in the control than in the droperidol patients ($0.75 \pm 0.34^{\circ}\text{C}$ and $0.37 \pm 0.20^{\circ}\text{C}$, respectively, at 75 min after induction; $P < 0.01$). Preinduction peripheral temperature and skin blood flow were lower in the control group than in the droperidol group, but the two variables became similar in both groups after induction.

Conclusion: The results of the present study confirm our hypothesis that premedication with droperidol affects perioperative hypothermia. Droperidol may prevent core-to-peripheral heat redistribution after the induction of anesthesia.

Objectif : L'hypothermie périopératoire provient en grande partie de la redistribution de la chaleur du centre vers la périphérie. Le dropéridol, souvent utilisé en prémédication, favorise la vasodilatation et peut ainsi agir sur la redistribution de la chaleur. Nous avons donc vérifié si ce dropéridol préanesthésique a un effet sur l'hypothermie périopératoire.

Méthode : Trente-trois patients d'état physique ASA I, devant subir une reconstruction ligamentaire arthroscopique, ont été répartis au hasard en deux groupes et ont reçu, ou non, la prémédication im de 0,1 mg·kg⁻¹ de dropéridol 30 min avant l'anesthésie induite et maintenue avec du propofol et du fentanyl. Au cours de l'opération, nous avons surveillé les températures centrale (tympan) et périphérique (paume) et le débit sanguin cutané (bout du doigt) pendant deux heures après l'induction de l'anesthésie.

Résultats : Avant l'induction, les patients qui ont reçu le dropéridol ont expérimenté une sédation plus profonde que ceux de l'autre groupe. La température centrale, similaire dans les deux groupes avant l'induction, a chuté de façon significative, et plus dans le groupe témoin comparé au groupe expérimental ($0,75 \pm 0,34^{\circ}\text{C}$ et $0,37 \pm 0,20^{\circ}\text{C}$, respectivement, 75 min après l'induction ; $P < 0,01$). La température périphérique et le débit sanguin cutané ont été plus bas dans le groupe témoin avant l'induction, mais similaires dans les deux groupes après l'induction.

Conclusion : Les résultats confirment donc notre hypothèse : la prémédication avec du dropéridol a un effet sur l'hypothermie périopératoire. Le dropéridol peut empêcher la redistribution de la chaleur du centre vers la périphérie après l'induction anesthésique.

HYPOTHERMIA is common during anesthesia and surgery and has been shown to be associated with adverse clinical outcomes including postoperative shivering,¹ increased blood loss,² decreased drug metabolism and clearance,³ postoperative myocardial ischemia,⁴ wound infection,⁵ and delayed postanes-

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thetic recovery.⁶ Available data indicate that much of this hypothermia results largely from an internal core-to-peripheral redistribution of body heat.⁷ Thus, it is important to know the effect of perioperative medication and procedures on this redistribution.

Droperidol is a commonly used sedative and often used for premedication before anesthesia.⁸ In addition, it decreases α -adrenergic tone producing vasodilation, and, thus, may affect the redistribution of heat. Although the effect of droperidol on thermoregulatory responses was investigated in combination with fentanyl in animals,⁹ no clinical data is available concerning the effects of its use for premedication on core and peripheral temperatures. Accordingly, we tested the hypothesis that preanesthetic droperidol would affect perioperative hypothermia.

Patients and methods

After Institutional Review Board approval and written informed consent, we studied 23 ASA physical status I patients scheduled for arthroscopic ligament reconstruction lasting more than two hours. Obese patients, patients with thyroid disease, dysautonomia, or Raynaud's syndrome, and those taking vasodilating drugs were excluded.

Patients were randomly assigned to one of two groups to receive no premedication (Group C) or intramuscular droperidol 0.1 mg·kg⁻¹ on the ward 30 min before entering the operating room (Group D). The temperature in the ward and the operating room was adjusted to 24–25°C. After an *iv* infusion of acetated Ringer's solution was initiated in the left hand at a rate of 10 mL·kg⁻¹·hr⁻¹, anesthesia was induced with 1.5 mg·kg⁻¹ propofol and 23 μ g·kg⁻¹ fentanyl. Tracheal intubation was facilitated with 1.5 ~ 2.0 mg·kg⁻¹ vecuronium. Anesthesia was maintained with 6 ~ 8 mg·kg⁻¹·hr⁻¹ propofol and 2 ~ 5 μ g·kg⁻¹·hr⁻¹ fentanyl. Ventilation was adjusted to maintain the end-tidal PCO₂ near 35 mmHg. The fresh gas flow of oxygen 1 L·min⁻¹ and air 5 L·min⁻¹ was administered via a semi-closed circle system without airway heating or humidification. The patients were only covered with a single surgical drape of synthetic cloth, and no active warming system was used during the study.

The level of sedation was assessed before the induction of anesthesia using a sedation score of 1–4, where 1=asleep, 2=drowsy, 3=calm, and 4=alert. Ambient temperature was measured at the level of the patient, well away from any heat-producing equipment before the induction of anesthesia. Core and peripheral temperatures were monitored for two hours after the induction of anesthesia. Core temperature was measured at the tympanic membrane. The aural probe

(Tympanic Temperature Sensor, Respiratory Support Products, CA, USA) was inserted, and the external ear was covered with a cotton pad. Peripheral temperature was measured at the palm that was kept open with the shoulder abducted. The skin surface thermometer probe (Skin Temperature Sensor, Respiratory Support Products, CA, USA) was placed on the right palm and covered with cotton. Peripheral blood flow was measured at the palmar side of the right index finger, to which a plate-type probe of a laser Doppler flowmeter (ALF 2100, Advance, Tokyo, Japan) was attached. Recording of core and peripheral temperatures and blood flow was started at least 15 min after the placement of the probes and conducted every 15 min during the two hours of the study.

Heart rate, blood pressure, and arterial oxygen saturation were monitored throughout the study period using three lead electrocardiography, sphygmomanometer, and pulse oxymetry, respectively, and recorded every five minutes. The sphygmomanometer and the pulse oxymeter were placed on the right arm and the left fingertip, respectively.

Sample size was determined by power analysis of ANOVA based on the variability observed in our pilot study and the ability to detect a difference in the decrease in core temperature of 0.3 with beta set at 0.2 and alpha set at 0.05. Results are expressed as mean $\pm$ SD unless otherwise stated. Morphometric and anesthetic data in both groups were compared using Student's *t* test and χ^2 test, as appropriate. Continuous variables including temperatures, peripheral blood flow, heart rate, blood pressure, and arterial oxygen saturation were analyzed using repeated measures ANOVA, and Dunnett test or Student's *t* test for post hoc testing. The Mann-Whitney U test was used to determine a difference in the sedation level. *P* < 0.05 was considered statistically significant.

Results

Of 23 patients enrolled in the study, 13 patients received no premedication (Group C) and ten droperidol (Group D). The two groups did not differ in morphometric and anesthetic data, including the dose of fentanyl and volume of fluid administered for the study period of two hours (Table).

Patients in Group D were more deeply sedated than those in Group C before the induction of anesthesia (Figure 1). Preinduction core (tympanic) temperature was comparable in the two groups before induction: 36.30 $\pm$ 0.26°C and 36.14 $\pm$ 0.22°C in Groups C and D, respectively. In contrast, peripheral temperature and peripheral blood flow were significantly lower in Group C than in Group D before induction (Figures 2 and 3).

TABLE Morphometric and anesthetic data

	Group C (n=13)	Group D (n=10)
Age (yr)	27 ± 11	25 ± 10
Sex (M/F)	7/6	3/7
Height (cm)	166 ± 9	160 ± 8
Weight (kg)	63 ± 14	58 ± 9
Ambient temperature (°C)	24.7 ± 0.3	24.5 ± 0.2
Mean arterial pressure (mmHg)	84 ± 13	85 ± 14
Heart rate (beats·sec ⁻¹)	68 ± 7	69 ± 13
Fentanyl dose (µg)	423 ± 83	430 ± 82
Fluid replacement (mL)	678 ± 173	600 ± 106

Values are expressed as the mean ± SD or absolute numbers.

Patients in Group C received nothing for premedication; those in Group D received droperidol.

There were no differences between the two groups in: morphometric; ambient temperature, mean arterial pressure and heart rate before the induction of anesthesia; and the dose of fentanyl and volume of fluid administered during the study period of two hours.

After the induction of anesthesia, core temperature decreased significantly in both groups, but the decrease in core temperature in group D was significantly smaller than that in group C. (Figure 4). In contrast, time courses of peripheral temperature and peripheral blood flow fluctuations were similar in the two groups during surgery.

The heart rate, blood pressure, and pulse oximetry data were similar in the two groups throughout the study period and did not change significantly except immediately after the administration of propofol.

Discussion

The results of the present study showed that premedication with droperidol reduced intraoperative redistribution hypothermia. Patients given droperidol developed hypothermia after the induction of anesthesia, but the decrease in core temperature was smaller than that in patients who received no premedication. Since the use of droperidol did not affect peripheral temperature during surgery, it seems that core-to-peripheral heat redistribution after induction was smaller in patients who received droperidol than in those who did not.

The effects of droperidol on thermoregulatory mechanisms have been examined while being used in combination with fentanyl in rats. According to the results of a study by Wixson *et al.*,⁹ the combination caused a decrease in rectal temperature but the depression of thermoregulation was minimal as compared with pentobarbitone, ketamin-xylazine and ketamine-

FIGURE 1 The number of patients in each sedation score in the two groups. *Significantly different between groups.

FIGURE 2 Time course of peripheral (palm) temperature. While preinduction (Pre) temperature was significantly higher in patients given droperidol than in the others, both groups of patients showed similar course after the induction (Ind) of general anesthesia. *Significantly different from control group.

diazepam. However, no study has focused on the effects of droperidol alone.

In addition to volatile¹⁰ and *iv* anesthetics including propofol,¹¹ a variety of anesthetic adjuvants^{12,13} have been shown to impair thermoregulatory responses in humans. However, the effects of preanesthetic sedatives on perioperative hypothermia have not been ade-

FIGURE 3 Time course of skin (index fingertip) blood flow. While preinduction (Pre) blood flow was significantly greater in patients given droperidol than in the others, both groups of patients showed similar course after the induction (Ind) of general anesthesia. *Significantly different from control group.

FIGURE 4 Time course of change in core (tympenic membrane) temperature (ΔT_{tym}). The two groups of patients developed a significant decrease after induction (Ind), but the ΔT_{tym} was greater in patients without premedication than those given droperidol. *Significantly different from control group.

quately investigated. Recently, Bernard *et al.*¹⁴ showed that oral clonidine as premedication did not impair redistribution hypothermia in patients during orthopedic surgery performed under general anesthesia. Clonidine, an α_2 adrenoceptor agonist, reduces sympathetic tone but produces peripheral vasoconstriction related to α_2 adrenergic stimulation.¹⁵

Droperidol has potent sedative and alpha blocking properties, and thus may produce cutaneous vasodilation more than clonidine does. In this study, patients given droperidol developed higher peripheral blood flows and peripheral temperatures before the induction of general anesthesia. In contrast, preanesthetic droperidol did not alter preinduction core temperature. Thus, it is highly likely that, in a patient given droperidol, the initial small core-to-peripheral temperature gradient minimized subsequent redistribution hypothermia after general anesthesia was induced.

Similar findings have been observed in patients given vasodilators before surgery. In a study by Vassiliev *et al.*,¹⁶ patients undergoing hip arthroplasty who received nifedipine, a calcium-channel blocker, both the night before and the morning of surgery developed less intraoperative hypothermia than those who did not receive the vasodilator. Morioka *et al.*¹⁷ minimized redistribution hypothermia by applying transdermal nitroglycerin before gastrointestinal surgery.

It should be noted that a vasodilating effect might further aggravate redistribution hypothermia depending on the time of administration. Vasodilation that occurs well before induction of anesthesia can reduce the core-to-peripheral tissue temperature gradient and minimize subsequent redistribution during surgery. However, when given only immediately before induction, nifedipine lowered core temperature more profoundly.¹⁶

It may be surprising that preanesthetic droperidol did not alter preinduction core temperature in the present study, in view of a recent study by Matsukawa *et al.*¹⁸ showing that *im* midazolam, which is also often used for premedication, induced a concentration (dose) dependent decrease in core temperature. The authors suspected that midazolam-induced vasodilation allowed redistribution of heat from the core thermal compartment to peripheral tissues. According to their study, midazolam $0.075 \text{ mg} \cdot \text{kg}^{-1}$ decreased core temperature $0.6 \pm 0.1^\circ\text{C}$ for 30 min. However, their subjects (young healthy volunteers) were kept in a room at a temperature of about 22°C , whereas ours (patients) were kept in a ward at a temperature of $24\text{--}25^\circ\text{C}$. The core-to-peripheral temperature gradient before premedication was smaller in our patients than in their subjects.

Limitations to this study include the effects of ambient temperature. Since the patients' environment was based on institutional and Japanese standards, the ambient temperature measured in the present study was higher than that of most previous studies.^{19–21} Higher ambient temperatures would keep peripheral temperatures higher. In fact, peripheral temperature

measured at the palm in patients given droperidol before the induction of anesthesia was $35.77 \pm 0.56^\circ\text{C}$ and the initial core-to-peripheral gradient was only $0.37 \pm 0.49^\circ\text{C}$. In a colder environment, thus, the results might have been different.

In conclusion, the results of the present study confirm our hypothesis that premedication with droperidol affects perioperative hypothermia. Droperidol can provide adequate sedation and vasodilatation, may decrease core-to-peripheral heat redistribution, and minimize hypothermia after the induction of anesthesia.

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