

## Original Article

# Effect of hypothermia prevention in patients undergoing gastrointestinal cancer surgery

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**Abstract:** Objective: This study aimed to explore the feasibility of hypothermia preventative nursing intervention on patients undergoing gastrointestinal cancer surgery, and analyze the effects of hypothermia prevention intervention on the prognosis of patients. Methods: A total of 89 patients undergoing surgical treatment for gastrointestinal cancer were enrolled and divided into a study group (n = 49) with hypothermia treatment during surgery and a control group (n = 40) without hypothermia treatment. The core temperature, anesthesia, resuscitation indexes, postoperative immune function and postoperative cytokine levels, and the incidence of postoperative chills and irritability were compared between the two groups. Results: There was no significant difference in body temperature between the two groups before anesthesia ( $P>0.05$ ). The study group showed higher body temperature than the control group at 30 min, 60 min and 90 min after anesthesia ( $P<0.05$ ). The study group exhibited shorter recovery time for general anesthesia, time to return to spontaneous breathing, duration of intubation and postoperative length of stay than the control group ( $P<0.05$ ). The two groups showed no significant difference in CD3+, CD4+, CD8+, CD4+/CD8+ levels before surgery ( $P>0.05$ ). The CD3+, CD4+, CD4+/CD8+ of the study group were higher than those of the control group at 1 d and 3 d after surgery ( $P<0.05$ ). The levels of IL-2 and IL-6 in the two groups were not significantly different before surgery ( $P>0.05$ ) and were lower in the study group than in the control group at 1 d and 3 d after surgery ( $P<0.05$ ). The incidence of chills and irritability in the study group were lower than those in the control group ( $P<0.05$ ). Conclusion: Intraoperative hypothermia will significantly affect the postoperative immune function and cytokine levels of patients undergoing surgery for gastrointestinal cancer. Targeted interventions effectively maintain the patient's core temperature during operation, accelerate the postoperative recovery, and reduce the incidence of complications.

**Keywords:** Hypothermia, gastrointestinal cancer, nursing intervention

## Introduction

Intraoperative hypothermia is one of the common complications of surgery and anesthesia. Data show that about 50%-70% of patients will experience intraoperative hypothermia. Unlike induced hypothermia, intraoperative hypothermia may affect many important organs, leading to adverse results, such as chills, cold limbs, and numbness, and increases the incidence of restlessness in the recovery period, resulting in abnormally high levels of catecholamines, low levels of potassium, increased volume of intraoperative blood loss, high risk of infection, and prolonged hospital stay of patients, etc. [1-4]. Therefore, it is clinically recommended to implement nursing intervention for hypothermia to improve the prognosis of patients.

Gastrointestinal cancer refers to malignant conditions of the gastrointestinal tract (GI tract) and accessory organs of digestion, including the esophagus, stomach, biliary system, pancreas, small intestine, large intestine, rectum and anus; it has the fifth highest incidence among cancers, with 5.7% of all new cancer cases attributable to the disease. Surgical treatment has become an important option to improve the clinical symptoms of cancer patients. Studies have found that gastrointestinal cancer surgery may be done with the traditional open procedures, which is characterized by the disinfection of large-area skin, long operation time, large volumes of fluid administered, and abdominal irrigation, etc., and the incidence of intraoperative hypothermia is significantly increased. Previous studies have shown

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that the incidence of intraoperative hypothermia in such cases is as high as 22.0%-84.0% [5, 6].

At present, the prevention of hypothermia during surgery has been paid more attention by medical staff, but there is still some medical staff who lack the basic knowledge of nursing intervention and blindly adopt insulation measures, resulting in the waste of human, material and financial resources [7, 8].

This study aims to explore the causes of intraoperative hypothermia in patients with gastrointestinal cancer and analyze the corresponding nursing measures, so as to accelerate postoperative recovery and improve the prognosis of patients.

### Materials and methods

#### *Baseline data*

A total of 40 patients with gastrointestinal cancer admitted to our hospital from June to December 2018, without intervention for intraoperative hypothermia, were enrolled as the control group, while 49 patients with gastrointestinal cancer who receive hypothermia intervention from January 2019 to June 2019 were included in the study group.

Inclusion criteria: patients diagnosed with gastrointestinal cancer by imaging, pathological and laboratory tests, and required surgical treatment; those with complete medical records; those who were graded as I-III in accordance with the American Society of Anesthesiologists (ASA); those who aged  $\geq 18$  years old; those who were operated upon with general anesthesia; those with preoperative core temperature  $\geq 36^{\circ}\text{C}$ ; and those who signed informed consent. The study was approved by the Ethics Committee of Cancer Hospital of China Medical University, Liaoning Cancer Hospital & Institute.

Exclusion criteria: (1) Patients with psychiatric disorders; (2) Patients who took drugs that affected body temperature regulation before surgery; (3) Patients with severe liver and kidney dysfunction; (4) Patients with ear canal diseases who could not be tested for tympanic temperature; (5) Patients who were pregnant or breastfeeding; (6) Those who were in crisis during surgery caused the suspension of the inves-

tigation; (7) Those who voluntarily requested to withdraw.

#### *Intervention methods*

All patients underwent radical tumor resection under combined intravenous-inhalational anesthesia. Intramuscular injection of atropine 0.5 mg and diazepam 10 mg was performed 30 min before surgery. Propofol, remifentanyl and vecuronium were intravenously administered for induction. Successful tracheal intubation followed by mechanical ventilation was performed with breathing frequency of 11-14 breaths/min. During surgery, patients received continuous sevoflurane and fentanyl and cis-atracurium if necessary. Propofol/remifentanyl was administered for anesthesia maintenance. Sevoflurane inhalation was ceased after surgery for resuscitation. Patients in the control group did not receive hypothermia intervention during surgery, and patients in the study group received targeted intervention for hypothermia as follows (1) heated blankets on the bed turned on 30 min before surgery. The temperature of the electric blankets was adjusted according to the patient's intraoperative temperature. (2) Limbs, head and neck were wrapped with cotton sheets. (3) Abdominal lavage fluid was changed into warmed fluid preheated to  $40\text{-}42^{\circ}\text{C}$  and sucked away after 3 min intraperitoneal inhalation.

#### *Observation indicators*

*The multi-point temperature of patients after anesthesia:* Tympanic membrane temperature before anesthesia, 30 min, 60 min and 90 min after anesthesia were recorded. The changes in body temperature during surgery were compared between the two groups.

*Comparison of differences in anesthesia resuscitation indices between the two groups:* Recovery time for general anesthesia (RTGA), time to return of spontaneous breathing (TRSB), duration of intubation (DI) and postoperative length of stay (LOS) were recorded. Among them, RTGA indicated the time from the end of the surgery to the return of consciousness and responses to name calling. TRSB means the time from the end of the surgery to breathing frequency  $>8$  breaths/min, tidal volume 5 ml/kg. DI is the time from the end of the surgery to tracheal intubation, and the hospitalization

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**Table 1.** Comparison of baseline data between the two groups ( $\bar{x} \pm s$ )/[n (%)]

Baseline data		Study group (n = 49)	Control group (n = 40)	t/ $\chi^2$	P
Gender	Male	26	21	0.003	0.958
	Female	23	19		
Average age (years)		53.19 $\pm$ 3.22	53.21 $\pm$ 3.19	0.029	0.977
Average weight (kg)		65.39 $\pm$ 3.43	65.41 $\pm$ 3.39	0.028	0.978
Average BMI (kg/m <sup>2</sup> )		22.39 $\pm$ 3.21	22.41 $\pm$ 3.31	0.029	0.977
Temperature when entering the operation room (°C)		37.19 $\pm$ 0.31	37.21 $\pm$ 0.29	0.312	0.756
Operation time (min)		251.28 $\pm$ 29.39	250.98 $\pm$ 30.19	0.047	0.963
Indoor temperature (°C)		23.29 $\pm$ 0.21	23.21 $\pm$ 0.19	1.865	0.066
Intraoperative blood loss (ml/kg)		14.38 $\pm$ 2.32	14.41 $\pm$ 2.29	0.061	0.951
Intraoperative infusion volume (ml/kg)		77.98 $\pm$ 10.29	78.01 $\pm$ 9.98	0.014	0.989
Education level	illiteracy	8	5	0.541	0.711
	Primary school	12	9		
	Junior high school	13	11		
	High school and more advanced	16	15		
Marital status	Married	45	36	0.091	0.763
	Single	4	4		
Classification	Gastric cancer	20	16	0.218	0.918
	Colorectal cancer	18	16		
	Esophageal cancer	11	8		

time after the surgery is recorded by the nursing staff.

*Comparison of postoperative immune function between the two groups:* The fasting venous blood samples of two groups were collected before surgery, at 1 d, and 3 d after surgery. After centrifugation in a centrifuge, the levels of CD3+, CD4+, CD8+, CD4+/CD8+ were detected by immunofluorescence.

*Comparison of postoperative cytokine levels between the two groups:* The fasting venous blood samples of the two groups of patients were collected before surgery, at 1 d and 3 d after surgery, and were allowed to stand at room temperature for 2-h. The sample was centrifuged for 5 min, and then the supernatant was stored at -80°C. After the completion of sample collection, double antibody sandwich enzyme-linked immunosorbent assay (ELISA) was used to detect IL-2 and IL-6 levels following the kit instructions.

*Comparison of the incidence of postoperative complications between the two groups:* The incidence of postoperative chills and irritability of the two groups of patients was recorded separately, and the difference was compared between the two groups.

### Statistical analysis

SPSS 20.0 software was used for statistical analysis. The measurement data were expressed in the form of ( $\bar{x} \pm s$ ) and compared by Student's t test. The enumeration data was expressed in the form of [n (%)] and compared by chi-square test.  $P < 0.05$  indicated a statistical significance [9].

### Results

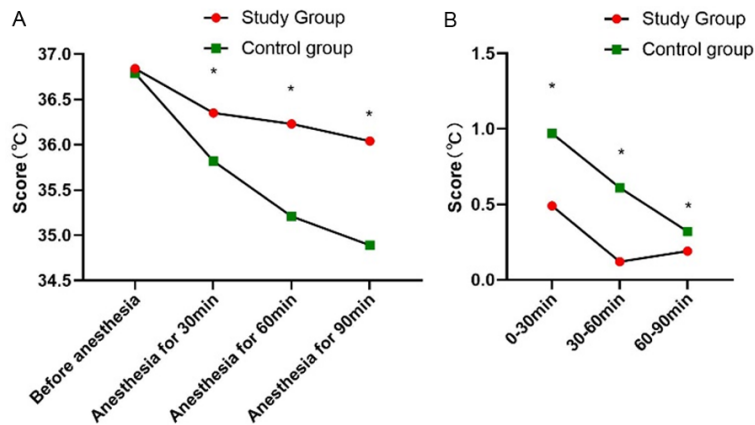
#### *Comparison of baseline data between the two groups*

There was no significant difference in general clinical data between the two groups such as gender, age, weight, marital status, education level, operation time, or temperature when entering the operation room, etc. ( $P > 0.05$ ) (Table 1).

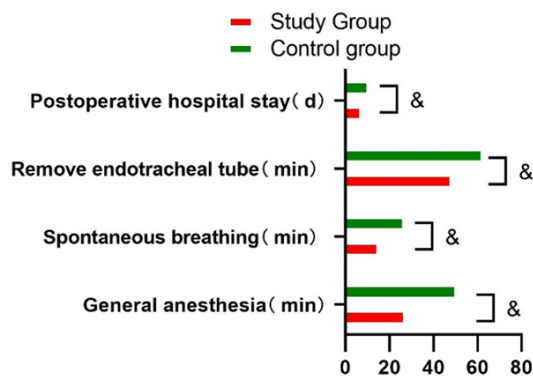
#### *The multi-point temperature of patients after anesthesia*

There was no significant difference in body temperature between the two groups before anesthesia ( $P > 0.05$ ). After anesthesia, the average body temperature of the two groups showed a downward trend, but the study group had a

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**Figure 1.** Comparison of body temperature between the two groups. There was no difference in body temperature between the two groups before anesthesia ( $P>0.05$ ). The body temperature of the study group was significantly higher than that of the control group at 30 min, 60 min and 90 min ( $P<0.05$ ) (A); The decrease in body temperature in the study group was significantly lower than that in the control group ( $P<0.05$ ) (B); \* indicates that the difference between the two groups is statistically significant.



**Figure 2.** Comparison of the differences in anesthesia and resuscitation indices between the two groups. The comparison showed that RTGA, TRSB, DI and postoperative LOS in the study group were significantly shorter than those in the control group ( $P<0.05$ ); & represents that the difference of the same index between the groups is statistically significant.

higher temperature at 30 min, 60 min and 90 min than the control group ( $P<0.05$ ). Analysis showed that the decrease in body temperature of the patients in the study group was significantly lower than that of control group during the periods of 0-30 min, 30-60 min, and 60-90 min ( $P<0.05$ ) (Figure 1).

### Comparison of anesthesia and resuscitation indices between the two groups

The comparison showed that RTGA, TRSB, DI and postoperative LOS of the study group were

significantly shorter than those of the control group ( $P<0.05$ ) (Figure 2).

### Comparison of postoperative immune function between the two groups

No significant difference was found in CD3+, CD4+, CD8+, CD4+/CD8+ levels before surgery between the two groups ( $P>0.05$ ). The CD3+, CD4+, CD4+/CD8+ of the two groups of patients at 1 d after surgery were significantly lower than those before surgery ( $P<0.05$ ), and the CD3+, CD4+, and CD4+/CD8+ levels of the study group were higher than those of the control group ( $P<0.05$ ). The CD3+, CD4+, CD4+/CD8+

levels showed a significant increase at 3 d after surgery compared with those at 1 d after surgery ( $P<0.05$ ), and the study group still showed higher levels of CD3+, CD4+, CD4+/CD8+ than the control group ( $P<0.05$ ) (Figure 3).

### Comparison of postoperative cytokine levels between the two groups

The levels of IL-2 and IL-6 of the two groups revealed no significant difference before surgery ( $P>0.05$ ), and were significantly improved at 1 d and 3 d after surgery ( $P<0.05$ ). Meanwhile, the IL-2 and IL-6 levels of the study group were lower than those of the control group at 1 d and 3 d after surgery ( $P<0.05$ ) (Figure 4).

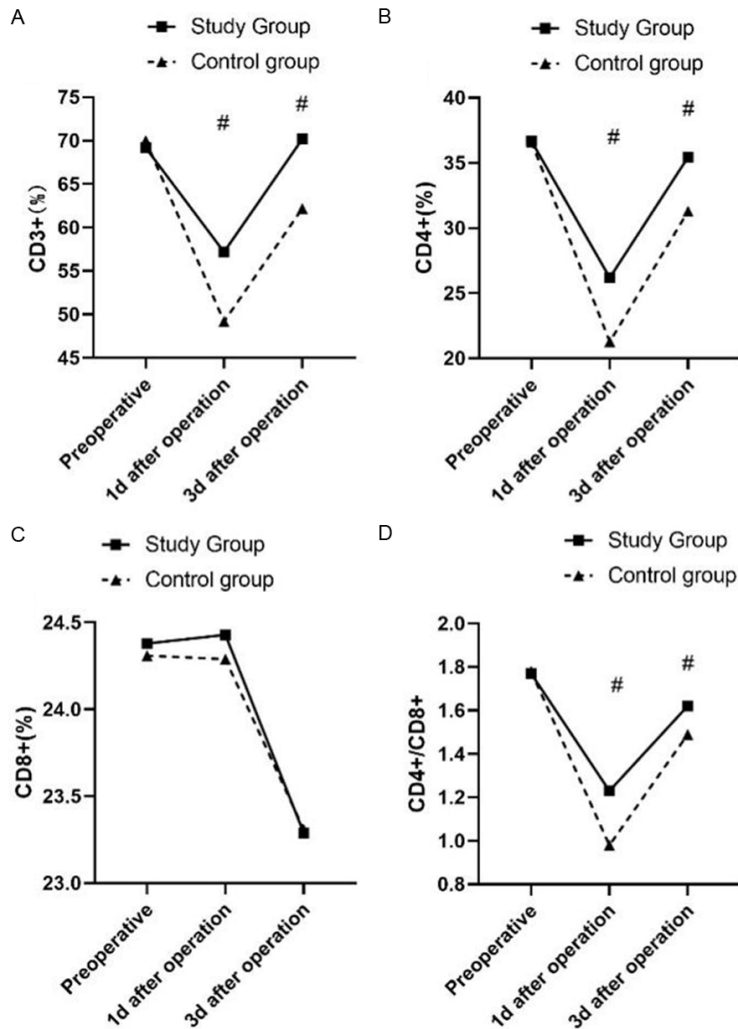
### Comparison of the incidence of postoperative complications between the two groups

The study group had 3 cases of postoperative chills and 2 cases of irritability, with an incidence of 10.20%. The control group had 7 cases of postoperative chills and 4 cases of irritability, with an incidence rate of 27.50%, and difference between the two groups was significantly different ( $P<0.05$ ) (Table 2).

## Discussion

During surgery, due to various factors such as anesthesia drugs, surgical procedures, room environment, etc., patients are more likely to suffer from hypothermia. Generally, a core tem-

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**Figure 3.** Comparison of postoperative immune function between the two groups. There was no significant difference in CD3+, CD4+, CD8+, CD4+/CD8+ levels between the two groups before surgery ( $P>0.05$ ); Both CD4+ and CD4+/CD8+ showed a significant decrease compared with preoperative levels ( $P<0.05$ ). The CD3+, CD4+ and CD4+/CD8+ levels of the study group were higher than those of the control group (A, B, D); The two groups showed a significant increase in CD3+, CD4+ and CD4+/CD8+ levels at 3 d after surgery compared with that at 1 d after surgery (A, B, and D); there is no significant difference in CD8+ levels between the two groups on the first and third days after surgery (C); # represents that the difference between the groups is statistically significant.

perature below 36°C is called intraoperative hypothermia, affecting 50%-70% of surgical patients [10-13].

Skin heat dissipation, fluid infusion, blood loss, and stress also contribute to hypothermia during surgery. Intraoperative hypothermia has a greater impact on the body. Some investigations have found that intraoperative hypothermia will increase the postoperative incision

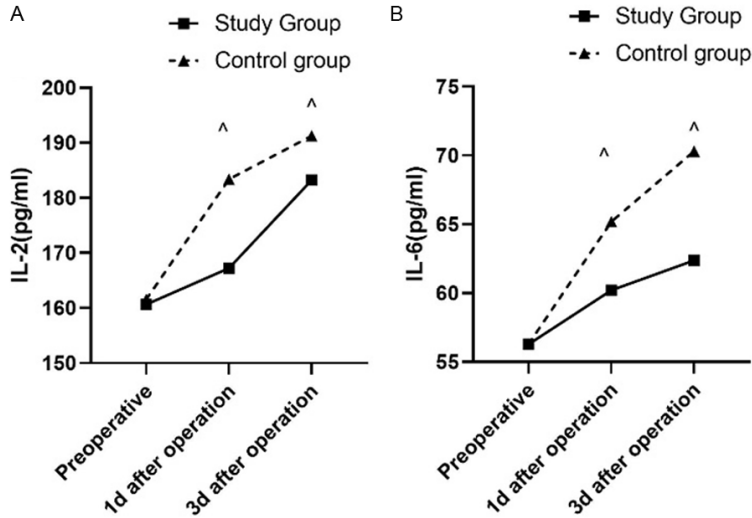
infection rate, prolong the coagulation time, and increase the incidence of various cardiovascular system complications. Some studies have pointed out that hypothermia will directly affect the bone marrow immune system, which will also reduce platelet function, inhibit coagulation reaction, increase blood viscosity, and induce thrombosis. At present, more clinical attention has been paid to the importance of intraoperative hypothermia, and effective measures have been taken to prevent hypothermia during surgery [14-17].

This study analyzes the preventive measures for hypothermia during surgery for gastrointestinal cancer by establishing treatment different groups. The results showed that compared with the control group, the core temperature of the study group was significantly higher at 30, 60 and 90 min after anesthesia, suggesting that preventive measures can effectively maintain the intraoperative temperature of patients with gastrointestinal cancer undergoing surgery. Some studies have pointed out that patients with gastrointestinal cancer have long operation times and large volume of blood loss during surgery. Compared with other patients during surgery, patients with gastrointestinal cancer are

more prone to hypothermia, which affects their prognosis. It is extremely important to implement appropriate hypothermia interventions [18, 19]. This study reveals that hypothermia is a common complication during surgery. Hypothermia not only affects the individual's central nervous system, but also prolongs the postoperative metabolism of anesthesia drugs and excretion time and increases the incidence of complications. Anesthetic drugs can inhibit



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**Figure 4.** Comparison of postoperative cytokine levels between the two groups. The levels of IL-2 and IL-6 in the study group are lower than those in the control group at 1 d and 3 d after surgery ( $P < 0.05$ ) (A, B); ^ represents that the difference in the same index between two groups is statistically significant.

**Table 2.** Comparison of the incidence of postoperative complications between the two groups [n (%)]

Group	Number of cases	Chills	Irritability	Total incidence
Study group	49	3 (6.12)	2 (4.08)	5 (10.20)
Control group	40	7 (17.5)	4 (10.00)	11 (27.5)
$\chi^2$	-	2.858	1.227	4.468
P	-	0.091	0.268	0.035

central thermoregulatory control. Inhaled anesthetics and intravenous anesthetics can widen the threshold range of regulatory responses, which makes it difficult to induce thermoregulatory responses [20, 21]. This study adopted precautionary measures in advance. Electric blankets were placed on the operating bed to wrap the patients' limbs, head and neck and reduce the heat dissipation of the skin. This mechanism significantly delayed the temperature decrease of the patients during surgery. The results showed that the temperature decrease of the study group was significantly lower than that of the control group in the three time periods of 0-30 min, 30-60 min and 60-90 min post anesthesia.

The results also showed that the postoperative anesthesia and resuscitation indices of the study group such as RTGA, TRSB, DI and postoperative LOS were significantly lower than those of the control group, suggesting that

hypothermia prevention care can help accelerate the recovery from anesthesia process. The authors of this study believed that RTGA is mainly affected by the residual anesthetic drugs in the body. The metabolic rate of anesthetic drugs will be significantly reduced at low body temperature. Some studies have pointed out that 3°C of decrease in central temperature will result in 30% of decrease in the propofol metabolic rate. Studies have shown that hypothermia can significantly reduce renal blood flow, resulting in a decrease in glomerular filtration rate and a decrease in renal clearance rate, thereby reducing the ability of the kidney to excrete anesthetic drugs [22, 23]. Patients in the study group exhibited better control of body temperature and higher enzyme activity, drug metabolism rate, and renal excretion rate than the control group, so RTGA of the study group was shorter than that of the control group. The comparison of LOS

suggests that hypothermia interventions can also help improve the postoperative outcomes.

Immunosuppression is the main manifestation of the impact of surgery on the immune function. Patients with gastrointestinal cancer have low immune function. The suppression of immune function will increase the risk of postoperative infection and the metastasis of cancer cells, which is not conducive to the patient's postoperative recovery [24]. Existing studies have shown that surgical stress, hypothermia, anesthetic drugs, blood loss, and bad moods can induce perioperative immunosuppression [25]. Through dynamic evaluation, it was found that compared with preoperative levels, CD3+, CD4+, etc. all showed a significant decrease and indicated immunosuppressive reactions. The difference between the groups showed that hypothermia intervention reduced the degree of immunosuppression, effectively

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reducing the damage to the patient's immune function. This was also confirmed by the comparison of IL-2 and IL-6 levels. Since IL-2 and IL-6 levels are indicators of reactions to inflammation, high levels often represent the suppression of immune responses. In this study, postoperative IL-2 and IL-6 levels of the study group were lower than those of the control group, indicating the effectiveness of hypothermia intervention. The comparison of complication rate suggests that hypothermia intervention can reduce the incidence of postoperative chills and irritability. The reason may be that intraoperative hypothermia intervention maintains central core temperature and helps prevent complications. Good hypothermia prevention care can accelerate the metabolism of anesthetic drugs and help reduce the incidence of irritability.

In summary, intraoperative hypothermia will significantly affect the postoperative immune function and cytokine levels of patients with gastrointestinal cancer. By implementing appropriate hypothermia interventions, the core temperature of patients can be effectively maintained during surgery, and postoperative recovery can be accelerated, reducing the incidence of complications. The shortcomings of this study are as follows: (1) The study period is short and the sample size is small; and (2) The monitoring of the patient's central core temperature is performed only during the period of anesthesia. A study with a larger sample size with perioperative temperature monitoring will be conducted in the future to provide more clinical references.

### Disclosure of conflict of interest

None.

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