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Original Article

Effect of thermal insulation on preventing hypothermia during laparoscopic radical resection for colorectal cancer

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Abstract: Objective: To evaluate the effect of thermal insulation nursing in the operating room on preventing hypothermia during laparoscopic radical resection of colorectal cancer. Methods: Sixty colorectal cancer patients undergoing laparoscopic radical resection from June 2022 to August 2023 were included. The research group received thermal insulation nursing interventions using medical heaters and infusion heaters, while the control group received routine nursing measures. Clinical data including vital signs, intraoperative and postoperative complications, recovery time, nursing satisfaction, and psychological and sleep status were compared between the two groups. Results: Thirty minutes after skin incision, both groups showed decreased body temperature, and systolic and diastolic blood pressure compared to pre-surgery levels, with no significant difference between groups ($P > 0.05$). However, the research group exhibited lower rates of intraoperative hypothermia, postoperative infection, and other complications, as well as shorter postoperative recovery times, hospital stays, anxiety, and depression scores compared to the control group ($P < 0.05$). Additionally, the research group demonstrated higher comfort scores, shorter sleep latency, longer actual sleep time, and higher nursing satisfaction rate ($P < 0.05$). Conclusion: Thermal insulation nursing intervention in the operating room during laparoscopic radical resection of colorectal cancer contributes to maintaining vital signs, preventing intraoperative hypothermia, reducing postoperative complications, expediting recovery, and improving psychological well-being and sleep quality. This intervention enhances patient comfort and nursing satisfaction in perioperative care.

Keywords: Colorectal cancer, laparoscopic radical resection of colorectal cancer, operating room warming care, hypothermia

Introduction

Colorectal cancer ranks among the most prevalent malignancies affecting the digestive tract, manifesting in symptoms such as defecation difficulties, bloody stools, and abdominal pain [1-3]. The disease significantly compromises patients' quality of life and carries a high mortality risk. Clinical management of colorectal cancer emphasizes proactive treatment, with surgery being the cornerstone approach. Surgical intervention aims to excise tumor lesions, control disease progression, and extend patient survival.

Advancements in laparoscopic techniques have made minimally invasive abdominal surgery the primary modality for colorectal cancer treatment. Laparoscopic radical resection has emerged as an effective and minimally invasive surgical approach for managing colorectal cancer [4-6]. However, the invasive nature of laparoscopic procedures leads to intraoperative blood loss, compounded by the cooling effects of anesthetic agents. Factors such as operating room temperature, duration of surgery, intravenous fluid administration, exposure of body surfaces, and blood loss contribute to perioperative hypothermia [7]. Hypothermia adversely impacts patient health, surgical outcome, and postoperative recovery.

Therefore, comprehensive nursing interventions are crucial during the perioperative period of laparoscopic colorectal cancer radical resection to ensure optimal surgical outcome and enhance patient prognosis. A prospective study on unintentional perioperative hypothermia in

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children undergoing laparoscopic surgery highlighted the inadequacy of current temperature management methods and passive heating systems in preventing hypothermia [8].

Operating room thermal insulation nursing is a targeted intervention aimed at preventing hypothermia by addressing intraoperative factors [9]. Despite the widespread adoption of laparoscopic surgery, the impact of prewarming on such procedures remains unclear due to limited research. Prewarming has been shown to mitigate temperature drops in laparoscopic surgery patients at risk for hypothermia, yet its effect on reducing complications and improving psychological well-being through operating room warming care is not well-established.

In recent years, operating rooms in Shengzhou People's Hospital have implemented various warming care measures for patients undergoing laparoscopic radical resection for colorectal cancer, yielding promising outcomes. This study aims to evaluate the role of operating room warming care in preventing hypothermia during laparoscopic radical colorectal cancer surgery and to assess patient satisfaction regarding postoperative complications, comfort, psychological status, and sleep quality.

Materials and methods

General information

This was a retrospective study. From June 2022 to August 2023, complete clinical data were collected from colorectal cancer patients who underwent laparoscopic colorectal cancer radical resection in Shengzhou People's Hospital. Clinical data were gathered including gender, age, body mass index, and colorectal cancer tumor stage. Thirty colorectal cancer patients who received thermal insulation nursing intervention in the operating room were assigned to the research group, while 30 patients who received routine nursing measures constituted the control group. The study was conducted with approval from the Ethics Committee of Shengzhou People's Hospital.

Inclusion criteria: 1. Diagnosis of colorectal cancer confirmed through imaging and pathological examination, with indications for laparoscopic radical resection of colorectal cancer. 2. Age between 18 and 80 years. 3. Expected survival time of at least 3 months. 4. Maintenance of intact clinical data.

Exclusion criteria: 1. Pregnancy or breastfeeding in female patients. 2. Presence of severe infections as comorbidities. 3. Coexistence of multiple organ dysfunction. 4. Concurrent mental or cognitive impairment. 5. Presence of other malignant tumors.

Methods

In the control group, the following routine intervention model was employed in the operating theater: 1. Adjustment of operating room temperature one hour before patient entry, setting it between 24°C to 26°C, and ensuring operating theater preparation in advance. 2. Upon patient entry, adjusting air-conditioning to 22°C and maintaining a constant temperature mode. 3. Guiding the patient to a comfortable supine position, with soft pads placed at points of contact between the patient's skin and the bed surface. 4. Continuous monitoring of crucial indices during the operation to maintain the patient's temperature within the range of 36.0-37.3°C. 5. After anesthesia recovery, transferring the patient back to the ward and conducting a handover with the ward nurse, guiding the nurse to monitor the patient's crucial indices post-surgery.

The research group implemented operating room thermal insulation nursing interventions in addition to routine nursing procedures. Drawing from previous nursing experiences, the research group identified possible factors contributing to hypothermia during laparoscopic radical resection of colorectal cancer and devised a comprehensive operating room thermal insulation nursing plan for patients, outlined as follows: 1. Active patient warming during surgery using a medical heater to maintain body temperature between 36.0-37.3°C. Continuous monitoring of body temperature throughout the procedure was conducted, with prompt intervention using a thermodynamic blanket if temperature anomalies arose. 2. Utilization of an infusion warmer during intravenous fluid administration to ensure the temperature of the fluids remains optimal. Prior to peritoneal lavage solution application, the lavage solution is warmed to approximately 37°C to prevent low fluid temperature-induced effects on body temperature.

Table 1. Comparison of general information

Item	Control group (n = 30)	Research group (n = 30)	t	P
Gender				
Male	17	18	0.069	0.793
Female	13	12		
Age	50.15±5.36	50.20±5.18	-0.037	0.971
Body mass index	23.54±3.86	23.38±3.75	0.164	0.870
Tumor staging				
Phase I	19	18	0.071	0.791
Phase II	11	12		

Outcome measures

Main outcome measures: 1. Body temperature was compared at the beginning of anesthesia, 30 minutes after surgery, and at the end of surgery in both groups. 2. Incidence of intraoperative hypothermia and postoperative infection was compared in both groups.

Secondary outcome measures: 1. Vital signs, including systolic and diastolic blood pressure, were measured 30 minutes after skin incision before surgery and during surgery. 2. Postoperative recovery time was assessed, which included the time to first meal intake, first flatulence, duration of bed rest, and length of hospitalization. 3. Nursing satisfaction was evaluated three days after operating room care using a hospital-developed satisfaction questionnaire. Scores range from 0 to 100, with ratings categorized as dissatisfied (0-59 points), generally satisfied (60-80 points), and very satisfied (81-100 points). The proportion of patients classified as satisfied (very satisfied or generally satisfied) is calculated. 4. Comfort score was assessed using the General Comfort Questionnaire, consisting of 28 items scored from 1 to 4 points each. Total scores range from 28 to 112, with higher scores indicating greater comfort. 5. Psychological score was measured using the Anxiety Self-Rating Scale and Depression Self-Rating Scale, with scores ranging from 0 to 100. A score of 50 is considered critical according to domestic norms, with higher scores indicating more pronounced anxiety and depression. 6. Sleep status indexes, including sleep onset latency and actual sleep duration, were monitored verbally by patients and their families. Sleep quality was assessed using the Pittsburgh Sleep Quality Index with scores ranging from 0 to 21 and higher scores indicating poorer sleep quality.

Statistical methods

The statistical analysis software chosen for data computation was SPSS 22.0. The χ^2 test was employed for comparing counted data, while measured data, conforming to normal distribution, underwent intragroup before-after comparison using the paired sample t-test. Between-group comparisons utilized the independent sample t-test. Multiple repeated measures data were analyzed through repeated measures ANOVA followed by post hoc Bonferroni test. A significance level of $P < 0.05$ indicated statistical significance.

Results

General information

A comparison of gender, age, body mass index, and tumor stage between the two groups revealed no significant differences ($P > 0.05$), indicating a good balance in the general characteristics of the groups and ensuring comparability. See **Table 1**.

Vital signs

At 30 minutes after intraoperative skin incision, the control group exhibited significant reductions in body temperature, systolic, and diastolic blood pressure compared to preoperative values ($P < 0.05$). Conversely, no significant changes were observed in these vital signs in the research group when compared to preoperative levels ($P > 0.05$). See **Table 2**.

Body temperatures at different times

A significant difference in body temperatures was observed between the two groups (F interaction = 17.710, $P < 0.001$, skewed $\eta 2 = 0.383$). Post-hoc Bonferroni analysis revealed a significant decrease in body temperature in the control group from preoperative to intraoperative 30 minutes and to the postoperative period ($P = 0.391$). However, no significant difference was observed between intraoperative 30 minutes and the postoperative period in the control group ($P > 0.05$). In contrast, no signifi-

Table 2. Comparison of vital signs ($\bar{x} \pm s$)

Group	Time	Control group (n = 30)	Research group (n = 30)	t	P
Systolic blood pressure (mmHg)	Preoperative	116.42±9.83	116.66±9.74	-0.095	0.925
	Intraoperatively	108.57±7.91	115.73±9.27	-3.218	0.002
	t	3.408	0.379		
	P	0.001	0.706		
Diastolic blood pressure (mmHg)	Preoperative	76.51±6.26	76.43±6.39	0.049	0.961
	Intraoperatively	70.27±5.48	75.93±6.15	-3.764	< 0.001
	t	4.108	0.309		
	P	< 0.001	0.759		

Table 3. Comparison of body temperatures at different times

Group	When starting anesthesia	30 minutes after the operation starts	At the end of surgery	F	P	Partial η2
Control group (n = 30)	36.75±0.46	35.79±0.33	35.66±0.27			
Research group (n = 30)	36.70±0.52	36.58±0.42	36.45±0.38			
Group main effect				60.487	< 0.001	0.510
Time main effect				50.535	< 0.001	0.466
Group*time				23.584	< 0.001	0.289

Table 4. Comparison of intraoperative and postoperative complication rates [n (%)]

Group	Intraoperative hypothermia	Postoperative infection	Overall incidence
Control group (n = 30)	4 (13.33%)	4 (13.34%)	8 (26.67%)
Research group (n = 30)	0 (0%)	2 (6.67%)	2 (6.67%)
χ^2	4.286	0.741	4.320
P	0.038	0.389	0.038

cant changes in body temperature were noted in the research group from preoperative to intraoperative 30 minutes and to the postoperative period (P > 0.05). See **Table 3**.

Intraoperative and postoperative complication rates

Compared to the control group, the research group exhibited a lower incidence of complications such as intraoperative hypothermia and postoperative wound infection (P < 0.05). See **Table 4**.

Postoperative recovery time

The research group showed shorter recovery time compared to the control group, including the time to first meal intake after surgery, time to first flatulence, duration of bed rest, and length of hospitalization (P < 0.05). See **Table 5**.

Comfort and psychological scores

Post-care assessments revealed that the research group had significantly higher comfort scores compared to the control group, while exhibiting lower anxiety and depression scores. Moreover, both groups displayed marked improvement in comfort scores following care, whereas anxiety and depression scores decreased significantly. Notably, depression scores decreased significantly in both groups (all, P < 0.05). See **Table 6**.

Sleep status indicators

After care, both groups experienced significant improvements in sleep onset latency, actual sleep duration, and sleep quality scores. In comparison to the control group, patients in the research group exhibited shorter sleep onset latency, improved sleep quality scores, longer sleep duration, and lower sleep quality scores (P < 0.05). See **Table 7**.

Table 5. Comparison of postoperative recovery time ($\bar{x} \pm s$)

Group	Time to first meal intake (h)	Time to first flatulence (h)	Duration of bed rest (d)	Length of hospitalization time (d)
Control group (n = 30)	64.27±6.86	56.47±5.24	5.80±1.03	22.9±9.42
Research group (n = 30)	53.67±4.88	50.30±4.46	4.53±0.97	18.56±6.64
t	6.896	4.911	4.916	2.063
P	< 0.001	< 0.001	< 0.001	0.044

Table 6. Comparison of comfort and psychological scores ($\bar{x} \pm s$, points)

Group	Time	Control group (n = 30)	Research group (n = 30)	t	P
Comfort rating	Before care	81.40±5.96	81.67±6.18	-0.172	0.864
	After care	93.27±6.27	102.30±6.01	-5.695	< 0.001
	t	-7.516	-13.108		
	P	< 0.001	< 0.001		
Anxiety score	Before care	54.40±4.48	54.20±4.56	0.171	0.865
	After care	45.57±3.94	40.93±3.72	4.690	< 0.001
	t	8.106	12.351		
	P	< 0.001	< 0.001		
Depression score	Before care	56.23±5.15	56.07±5.20	0.120	0.905
	After care	47.00±4.35	41.86±3.86	4.841	< 0.001
	t	7.499	12.018		
	P	< 0.001	< 0.001		

Table 7. Comparison of sleep status indicators ($\bar{x} \pm s$)

Group	Time	Control group (n = 30)	Research group (n = 30)	t	P
Sleep onset latency (min)	Before care	64.47±12.75	64.00±12.59	0.144	0.886
	After care	42.63±8.71	33.80±7.91	4.111	< 0.001
	t	7.747	11.125		
	P	< 0.001	< 0.001		
Actual sleep duration (h)	Before care	4.17±1.23	4.23±1.28	-0.185	0.854
	After care	6.80±0.89	7.83±0.91	-4.432	< 0.001
	t	-9.488	-12.555		
	P	< 0.001	< 0.001		
Sleep quality score (points)	Before care	15.17±2.18	15.07±2.26	0.174	0.862
	After care	12.53±1.61	10.80±1.32	4.551	< 0.001
	t	5.336	8.936		
	P	< 0.001	< 0.001		

Nursing satisfaction

Analysis of patient satisfaction with nursing services revealed that the overall satisfaction rate was significantly higher in the research group compared to the control group ($P < 0.05$). See **Table 8**.

Discussion

Normal body temperature is maintained at approximately 37°C through neurohumoral regulation, which ensures the stability of physiological functions [12]. However, during surgery, the body's ability to generate heat through shivering or vasoconstriction is impaired due to the effects of anesthetic drugs and surgical exposure [13]. Consequently, the patient's body temperature gradually decreases. Excessive hypothermia can lead to unstable vital signs, increased risk of coagulation disorders, hindrance to successful surgery completion, as well as increased surgical complication risk and healthcare cost [14-16].

Table 8. Comparison of nursing satisfaction [n (%)]

Group	Very satisfied	Generally satisfied	Dissatisfied	Overall satisfaction rate
Control group (n = 30)	15 (50.00%)	11 (36.67%)	4 (13.33%)	26 (86.67%)
Research group (n = 30)	18 (60.00%)	12 (40.00%)	0 (0%)	30 (100.00%)
χ^2		4.316		4.286
P		0.116		0.038

Clinically, the phenomenon of a patient's core body temperature dropping below 36°C during the perioperative period due to various reasons is referred to as intraoperative hypothermia (IPH) [17]. Currently, two methods are used to prevent IPH in clinical settings: passive insulation and active insulation. Passive insulation aims to promote heat retention, while active insulation applies external heat to the skin and surrounding tissues [18]. While most medical literature reports on hypothermia focus on open heart surgery, e.g. a retrospective study on patients with gastrointestinal tumors revealed an overall IPH incidence of 25.7% despite the use of active and passive intraoperative temperature management [19]. Specifically, the hypothermia incidence was 43.0%, 31.8%, 19.5%, and 5.8% for gastric, rectal, colon, and esophageal cancers, respectively [20]. Despite modern supportive care, the mortality rate among patients with moderate to severe unintentional hypothermia in hospitals remains close to 40% [21]. Therefore, sufficient attention must be paid to intraoperative hypothermia, and this issue should be considered during nursing interventions to ensure smooth surgery and promote patients' rapid recovery post-surgery.

In traditional perioperative nursing practices, preoperative care typically centered on simple instructions to the patient, intraoperative care focused on positioning guidance, general thermal care, and vital sign monitoring, while postoperative nursing prioritized critical index monitoring and pain education [22-24]. Although these measures addressed perioperative nursing issues to some extent, they insufficiently addressed the issue of intraoperative hypothermia.

The present study examines patients undergoing laparoscopic radical colorectal cancer surgery, exploring nursing interventions aimed at preventing intraoperative hypothermia. Two groups were established: a routine care group and an interventional group implementing enhanced thermal care in the operating room. The interventional group, building on the routine care provided to the control group, introduced active thermal care measures such as warming blankets, heaters, and infusion warmers. These measures were tailored to the specific surgical phases where hypothermia risk was highest and adjusted as the surgery progressed. The retrospective comparison results revealed that systolic and diastolic blood pressure of patients in the control group significantly decreased during surgery 30 minutes after skin incision compared to the preoperative period. However, there were no significant changes observed in temperature, or systolic or diastolic blood pressure of patients in the research group compared to the preoperative period. Clinical comparative observations indicated that patients in the observation group, receiving thermal insulation nursing care in the operating room, exhibited minimal fluctuations in body temperature. Notably, nasopharyngeal temperature in the observation group was lower at the onset of surgery for 30 minutes but significantly increased by the operation compared to the control group. Moreover, only 4 patients in the observation group achieved the nursing target temperature at the beginning of surgery for 30 minutes, whereas 26 patients in the experimental group reached the target temperature at this time, with a significant difference between the two groups. At the end of surgery, the temperature of patients in the observation group increased to 24 cases, while the control group remained at 26 cases. This discrepancy may be attributed to the conventional nursing model's inability to offset the decline in body temperature resulting from surgical exposure or anesthesia drugs during laparoscopic radical resection of colorectal cancer. The patients in the observation group received assistance in maintaining a dynamic balance between heat production and dissipation through external warming methods such

as inflatable heating blankets and preheating before infusion. In comparison with the control group, the incidence of intraoperative hypothermia, postoperative infections, and other complications was lower among patients in the research group. Additionally, the time to first meal intake, time to first flatulence, duration of bed rest, and length of hospitalization were shorter, suggesting that targeted hypothermia prevention not only enhances patient health but also improves safety. This preventive approach not only raised intraoperative patient temperatures but also contributed to maintaining stability in crucial indices, thereby reducing the risk of postoperative complications. Similar findings have been reported in previous studies [25]. The analysis suggests that the time-dependent decrease in blood pressure may be attributed to vasoconstriction inhibition by anesthetics used during induction and maintenance of general anesthesia. Involuntary hypothermia leads to an increased demand for blood transfusion, and aggressive warming methods enable safe skin warming, thereby reducing perioperative blood loss [26]. This study revealed that patients in the research group exhibited lower anxiety and depression scores, improved sleep quality, higher comfort scores, and greater overall satisfaction with nursing services compared to the control group. These findings indicate that thermal insulation care in the operating theater not only enhances patient comfort but also positively impacts their psychological well-being, sleep quality, and overall quality of life. The implementation of thermal insulation care reduces the incidence of intraoperative hypothermia and postoperative complications, ensuring surgical efficacy and promoting postoperative recovery while minimizing patient discomfort. This, in turn, mitigates adverse effects on patients' psychology, sleep, and quality of life, leading to higher satisfaction with nursing services.

In conclusion, thermal insulation nursing intervention in the operating theater during laparoscopic radical surgery for colorectal cancer maintains intraoperative vital signs, prevents hypothermia, reduces temperature fluctuations, and mitigates postoperative complications. It facilitates faster postoperative recovery, enhances physical comfort, improves psychological well-being and sleep quality, and boosts overall satisfaction with operating theater nursing services. Clinically, it can be advocated as the preferred approach for preventing intraoperative hypothermia in patients undergoing laparoscopic radical colorectal cancer surgery. However, due to the limited sample size, further research is warranted to investigate the broader impacts of implementing thermal nursing interventions to prevent intraoperative hypothermia in patients undergoing radical surgery for rectal cancer.

Disclosure of conflict of interest

None.

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