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Regulatory Effect of Integrated Body Temperature Optimization Protocol on the Rehabilitation Process during the Perioperative Period of Transurethral Resection of the Prostate (TURP)

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Abstract: *Objective:* To analyze the effect of implementing an integrated body temperature optimization protocol on patients during transurethral resection of the prostate (TURP). *Methods:* This study employed a randomized controlled trial design, selecting 102 patients who underwent TURP treatment from September 2024 to August 2025. Patients were randomly assigned using a computer-generated random number table, with an equal number in each group (n = 51). The control group received conventional perioperative care, while the experimental group implemented an integrated body temperature optimization protocol. The postoperative recovery status and the incidence of shivering or hypothermia were used as evaluation criteria to assess the clinical impact of different care protocols on patient rehabilitation. *Results:* Patients in the experimental group were able to ambulate and pass gas sooner after surgery, and the total duration of continuous bladder irrigation was significantly shorter than that in the control group ($p < 0.05$). Additionally, the incidence rates of various indicators, such as shivering severity, hypothermia, and complication rates, were lower in the experimental group compared to the control group ($p < 0.05$). *Conclusion:* For TURP patients, especially the elderly, an integrated body temperature optimization protocol can effectively reduce the incidence of shivering and promote rehabilitation.

Keywords: Integrated body temperature optimization protocol; Transurethral resection of the prostate; Body temperature care

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1. Introduction

TURP is a classic surgical method for treating benign prostatic hyperplasia (BPH) in older people, with its efficacy and safety widely validated. This procedure effectively relieves urethral obstruction and improves lower urinary tract symptoms in most patients, such as frequent urination, urgency, nocturia, and dysuria, while increasing urinary flow rate [1]. Guided by the Enhanced Recovery After Surgery (ERAS) concept, the integrated body temperature optimization protocol involves multidisciplinary collaboration in perioperative interventions based on evidence-based medicine. Its core is to alleviate the stress response caused by surgery and promote rapid recovery through a series of scientific measures. By implementing closed-loop management of preoperative pre-warming, intraoperative active warming, and postoperative continuous monitoring, it effectively addresses the issue of heat loss during the perioperative period, particularly benefiting high-risk patients such as the elderly and those undergoing prolonged surgeries. In recent years, studies have gradually combined these two approaches in the treatment of elderly TURP patients, yielding promising clinical data. This article aims to validate the above conclusions through a randomized controlled trial, hoping to provide references for future research in this direction.

2. Materials and methods

2.1. General information

A total of 102 elderly BPH patients were included in the study, receiving treatment at the hospital from September 2024 to August 2025. They were randomly assigned to the control group and the experimental group using a computer-generated random number table, with 51 patients in each group. The basic information of the two groups is as follows: in terms of age, the mean age in the control group was (73.68 ± 5.04) years, while in the experimental group, it was (74.13 ± 5.28) years. Regarding the duration of illness, the control group had an average of (4.63 ± 1.08) months, and the experimental group had (4.82 ± 1.03) months. The general information between the two groups showed $p > 0.05$.

2.2. Methods

2.2.1. Control group

Conventional perioperative care for surgical treatment included:

(1) Formation of a nursing team

The head nurse was responsible for personnel coordination, reporting patient conditions, and inspecting nursing work, while nurses were responsible for connecting with other departments and carrying out standardized and procedural nursing operations collaboratively.

(2) Preoperative care

Nurses needed to visit the ward regularly to grasp the patient's basic condition and strengthen coordination with ward nurses. They were required to prepare all necessary surgical supplies, assist in positioning the patient, and implement warming measures.

(3) Intraoperative care

Minimize skin exposure of the patient. Nurses also needed to closely cooperate with the doctor, understand the surgical procedure and the doctor's working habits, and quickly pass the required instruments to the doctor.

(4) Postoperative care

Nurses needed to wipe the patient's skin with warm water, help the patient dress, provide a warming blanket to improve body temperature, observe the placement of the drainage tube and the color and properties of the drainage fluid, coordinate work with relevant departments, properly handle tube fixation, and inform the patient and their family of postoperative precautions.

2.2.2. Experimental group

Implementation of an integrated body temperature optimization protocol with specific operations as follows:

(1) Preoperative phase

a. Baseline body temperature assessment and risk screening: Monitor the patient's axillary or oral temperature 24 hours before surgery, with a focus on high-risk groups for hypothermia, such as elderly patients, those with comorbid diabetes, malnutrition, or long-term use of sedative drugs, and establish a body temperature file. b. Preoperative diet and fluid management: Shorten the fasting and fluid restriction time according to ERAS requirements, specifically prohibiting solid food intake 6 hours before surgery and allowing oral intake of warm carbohydrate drinks, such as warm water containing glucose, 2 hours before surgery to prevent energy deficiency and decreased thermoregulatory capacity due to prolonged fasting.

(2) Intraoperative phase

a. Irrigation fluid warming and constant temperature control: Continuous irrigation of the surgical field with irrigation fluid is required during the operation, with a volume of several liters. Using room-temperature irrigation fluid can lead to significant heat loss, so it is necessary to warm the irrigation fluid to 37–38 ℃ using a dedicated warming device and deliver it through a constant-temperature infusion line to reduce heat loss caused by the temperature difference between the irrigation fluid and the body. b. Body surface and environmental warming: Maintain the operating room temperature at 25–26 ℃ and avoid direct cold air blowing on the patient. Cover the non-surgical areas of the patient's trunk and lower limbs with a warm air blanket, with the temperature adjusted to 38–40 ℃, exposing only the perineal surgical area. Wrap the limbs with warming socks to reduce peripheral heat dissipation. Use a 37 ℃ warmer for intravenous infusion or blood transfusion to avoid a decrease in body temperature caused by cold fluid infusion.

(3) Postoperative phase

a. Monitoring body temperature during the recovery period: Monitor the patient's axillary or forehead temperature every 30 minutes after returning to the ward or the anesthesia recovery room for 24 hours until the body temperature stabilizes above 36 ℃. Promptly address any body temperature below 36 ℃ or shivering. b. Stepwise warming intervention: For mild hypothermia (35.5–36 ℃), provide additional warming blankets and use a 36–37 ℃ constant-temperature blanket to avoid overheating and sweating. For moderate hypothermia (35–35.5 ℃), in addition to body surface warming, supplement heat by nasogastric or oral administration of 37–38 ℃ warm saline, while avoiding rapid warming-induced vasodilation. Do not use local high-temperature devices such as hot water bottles.

2.3. Observation indicators

(1) Record the postoperative recovery status of the patients.

(2) Shivering severity

Evaluate the shivering severity of patients in both groups using the Wrench grading scale for shivering, ranging from grade 0 to grade 4.

(3) Observe whether the two groups develop complications such as wound infection, nausea and vomiting, arrhythmia, muscle soreness, headache, and respiratory depression, as well as hypothermia events.

2.4. Statistical methods

Clinical validation of the research data was conducted using unified SPSS 25.0 software. Normally distributed measurement data were expressed as ($\overline{x} \pm s$), and the t-test was performed. Count data (n%) were used to calculate the χ^2 value using standard methods. A difference was considered statistically significant when $p < 0.05$.

3. Results

3.1. Postoperative indicators in both groups

As shown in **Table 1** below, patients in the experimental group were able to ambulate and pass gas significantly sooner after surgery, and the duration of continuous bladder irrigation was shorter compared to the control group ($p < 0.05$).

Table 1. Analysis of postoperative recovery status in both groups of patients

Group	Number of cases	Ambulation time (d)	Time to first flatus (h)	Duration of continuous bladder irrigation (d)
Experimental group	51	1.28 ± 0.39	14.87 ± 3.14	1.80 ± 0.37
Control group	51	3.48 ± 0.46	28.71 ± 4.52	3.65 ± 0.61
t		26.051	17.958	18.518
p		0.000	0.000	0.000

3.2. Incidence of shivering in both groups

Table 2 shows that the probability of Grade 0 shivering in the experimental group was higher than that in the control group, with $p < 0.05$. The incidences of other grades were relatively lower or absent, but without statistical significance, $p > 0.05$.

Table 2. Comparison of shivering severity between the two groups (n%)

Group	Number of cases	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Experimental group	51	40 (78.4)	8 (15.7)	3 (5.9)	0 (0.0)	0
Control group	51	29 (56.9)	15 (29.4)	5 (9.8)	2 (3.9)	0
χ^2		5.420	2.750	0.542	2.040	-
p		0.019	0.097	0.461	0.153	-

3.3. Statistics on complications and hypothermia

Upon reviewing Statistical **Table 3**, it was found that both categories of data were lower in the experimental group, with a p-value of less than 0.05 between the groups.

Table 3. Comparison of complication rates and hypothermia rates between the two groups (n%)

Group	Number of cases	Wound infection	Nausea and vomiting	Arrhy thmia	Muscle ache	Head ache	Respiratory depression	Total incidence of complications	Incidence of hypothermia
Experimental group	51	1	1	0	1	0	0	3 (5.9)	1 (12.0)
Control group	51	2	3	0	3	1	1	10 (19.6)	7 (13.7)

χ^2	4.319	4.883
p	0.037	0.027

4. Discussion

This study systematically evaluated the regulatory effects of an integrated body temperature optimization protocol on the perioperative rehabilitation process of elderly patients undergoing transurethral resection of the prostate (TURP) through a prospective randomized controlled trial involving 102 cases [2]. The data analysis results clearly demonstrated significant benefits of this systematic intervention strategy across multiple dimensions of clinical outcomes. In terms of early postoperative recovery indicators, patients in the experimental group who received the integrated body temperature optimization protocol exhibited a marked trend toward accelerated rehabilitation. The mean time to ambulation in the experimental group was 1.28 days, the mean time to first flatus was 14.87 hours, and the mean duration of continuous bladder irrigation was 1.80 days. These three core rehabilitation time-point indicators were significantly shorter than the corresponding values in the control group (3.48 days, 28.71 hours, and 3.65 days, respectively), with highly statistically significant differences between the groups. The simultaneous optimization of these three time indicators collectively delineated a steeper and more efficient postoperative recovery trajectory. This "upgrade" in recovery speed can be traced back to the physiological basis of maintaining body temperature stability, which sustains metabolic and homeostatic balance in the body. The maintenance of core body temperature avoids negative physiological effects such as coagulation dysfunction, slowed drug metabolism, and decreased tissue oxygen supply caused by hypothermia, creating optimal metabolic conditions for tissue repair, gastrointestinal motility recovery, and early mobilization of systemic functions [3,4].

The core objective of the body temperature optimization protocol, maintaining perioperative body temperature homeostasis, was robustly validated through direct comparison of the incidence rates of shivering and hypothermia. According to the Wrench grading scale, patients in the experimental group experienced significantly reduced postoperative shivering severity, with a 78.4% proportion of Grade 0 (no shivering), significantly higher than the 56.9% in the control group. Although the incidence rates of shivering Grades 1 to 4 did not show statistically significant differences between the groups, the absolute advantage in the proportion of Grade 0 cases fully indicated that the integrated protocol effectively prevented moderate to severe shivering. Shivering is a vigorous heat-producing reaction of the body in a cold environment, which itself consumes a large amount of energy, increases myocardial oxygen consumption, exacerbates pain and discomfort, and is an important source of postoperative stress [5]. The effective control of shivering incidence in the experimental group was the result of the synergistic effects of a series of measures, including preoperative pre-warming, active warming of irrigation fluid and body surface during surgery, and postoperative stepwise warming. More critically, the overall incidence of hypothermia in the experimental group was controlled at 2.0%, while it was as high as 13.7% in the control group, with a significant difference between the groups. Hypothermia, typically defined as a core body temperature below 36 ℃, has far-reaching harms, including but not limited to increasing the risk of surgical site infection, impairing immune function, affecting the coagulation cascade, and prolonging anesthesia recovery time. In this study, the experimental group constructed a three-dimensional "heat protection network" through closed-loop body temperature management, encompassing source control, pathway intervention, and monitoring, successfully reducing the incidence of this severely disruptive homeostatic event to an extremely low level. The effective prevention of hypothermia served as the cornerstone for a series of subsequent favorable clinical outcomes [6].

The significant reduction in the incidence of complications was one of the most direct and clinically meaningful endpoint benefits derived from body temperature homeostasis. In this study, the overall postoperative complication rate in the experimental group was 5.9%, significantly lower than the 19.6% in the control group. The reduction in complications was the result of the synergistic effects of multiple factors, with body temperature optimization playing a pivotal role. First, maintaining normal body temperature is fundamental for preserving immune function. Hypothermia can inhibit the chemotaxis, phagocytosis, and killing functions of neutrophils, directly increasing the risk of surgical site infection [7]. The extremely low wound infection rate in the experimental group was closely related to this mechanism. Second, body temperature stability helps maintain normal coagulation function. Hypothermia can affect platelet function, prolong prothrombin time and partial thromboplastin time, and increase surgical field bleeding, which may not only prolong bladder irrigation time but also serve as a risk factor for deep vein thrombosis. The shorter bladder irrigation time in the experimental group indirectly confirmed better intraoperative hemostasis. Furthermore, complications such as nausea, vomiting, and arrhythmias are closely related to surgical stress, anesthesia drug metabolism, and autonomic nervous system dysfunction [8]. Body temperature stability provided a guarantee for a smooth anesthesia recovery period by reducing shivering reactions, lowering systemic stress levels, and maintaining more stable autonomic nervous system tone. Therefore, the low complication rate of 5.9% in the experimental group was not coincidental; it was a comprehensive outcome achieved by body temperature management, which protected immune, coagulation, neuroendocrine, and other systemic functions, constructing a solid “protective wall” for patients.

5. Conclusion

Based on the aforementioned data, the regulatory effects of the integrated body temperature optimization protocol on the perioperative rehabilitation process of TURP can be summarized as a physiological optimization process with “body temperature homeostasis” as the core regulatory target, generating systemic and positive cascade reactions through multi-link interventions [9]. This protocol transcends the fragmented and passive warming measures in traditional perioperative care, replacing them with an evidence-based, proactive, precise, and integrated management system that spans the preoperative, intraoperative, and postoperative periods. Its regulatory mechanisms are manifested at three levels: at the metabolic level, it ensures the optimal temperature range for enzyme activity by maintaining core body temperature, enabling efficient energy metabolism, protein synthesis, and drug biotransformation in the body, which provides the material and energy basis for tissue repair and gastrointestinal function recovery. At the circulatory and coagulation level, it avoids vasoconstriction, increased blood viscosity, and coagulation dysfunction caused by hypothermia, optimizing tissue perfusion, reducing surgical wound bleeding, and promoting hemostasis and healing [10]. At the neuroendocrine and immune level, it significantly reduces shivering reactions, lowers excessive stress activation of the hypothalamic-pituitary-adrenal axis, and maintains normal immune cell function, thereby reducing the overall intensity of surgical trauma to the body. This protocol is characterized by standardized operation, high cost-effectiveness, and safety without invasiveness, making it easily promotable in clinical settings.

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Disclosure statement

The author declares no conflict of interest.

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