

Effect of nursing cooperation of antimicrobial drugs combined with physical cooling on drug efficacy and patient comfort in orthopedic patients during postoperative infection period

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Abstract: This study aimed to explore the effect of a targeted collaborative nursing scheme of antimicrobial agents combined with physical cooling on drug efficacy and patient comfort during the postoperative infection period of orthopedic patients. A total of 150 patients with postoperative infection in the Department of Orthopedics of Zhejiang Provincial Tongde Hospital from January 2023 to January 2024 were selected and randomly divided into a control group (75 cases) and an observation group (75 cases). The control group received conventional antimicrobial treatment and basic nursing care, while the observation group received a collaborative nursing program of antimicrobial treatment combined with physical cooling on the basis of the control group. Compared with the control group, the observation group showed significantly shorter onset time, infection control time and temperature recovery time of antimicrobial drugs ($P<0.05$); significantly higher General Comfort Questionnaire (GCQ) scores ($P<0.05$); significantly lower incidence of adverse reactions ($P<0.05$); and significantly higher blood concentration compliance rate of different antimicrobial drugs ($P<0.05$). This collaborative nursing can significantly improve the efficacy of antimicrobial drugs, accelerate infection control, enhance patient comfort and reduce the risk of adverse reactions, with important clinical promotion value from a pharmaceutical perspective.

Keywords: Antibacterial drugs; Blood concentration; Drug efficacy; Nursing cooperation; Postoperative infection in orthopedics

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INTRODUCTION

Orthopedic surgery has the characteristics of large trauma and long-term bed rest after surgery, so postoperative infection has become a complication that cannot be ignored in clinical practice (Zaid E *et al.*, 2025). Research data show that the incidence of postoperative infection in orthopedics is about 3%~10%. In some complex orthopedic surgeries, this proportion may even be higher (Benjamin B *et al.*, 2025). Postoperative infection will not only seriously delay the healing process of patients' wounds and increase their physical and mental pain, but may also cause more serious consequences such as osteomyelitis and sepsis, greatly prolonging patients' hospitalization time and significantly increasing the medical burden.

In the treatment of postoperative infection in orthopedics, the use of antibiotics is the core means of controlling infection. However, current antibiotics face many challenges in clinical use. On the one hand, the problem of bacterial resistance is becoming increasingly serious, which greatly reduces the efficacy of some antibiotics; on the other hand, patients in the infection period are often accompanied by persistent high fever symptoms and high fever will have many adverse effects on the body. Studies have shown that high fever will aggravate the body's metabolic disorders and increase the body's oxygen

consumption. More importantly, it may affect the tissue penetration and normal efficacy of antibiotics (Liebana Garcia R *et al.*, 2023). For example, high fever may change vascular permeability, affect the effective accumulation of antimicrobial drugs at the site of infection and may also affect the ability of drugs to bind to the target site.

As a basic symptomatic intervention measure for patients with high fever, physical cooling has not been fully studied in terms of its mechanism of action and synergistic effect when used in combination with antimicrobial drugs. In previous clinical nursing, physical cooling was mostly performed passively, lacking dynamic coordination with the use time of antimicrobial drugs, drug properties and individual patient status, which may not only lead to unstable cooling effects, but also affect the pharmacokinetic and pharmacodynamic processes of antimicrobial drugs. Therefore, in-depth research on the coordinated nursing coordination of antimicrobial drugs and physical cooling has important theoretical and practical significance for optimizing the treatment of postoperative infection in orthopedics, improving the efficacy of antimicrobial drugs and reducing the occurrence of adverse reactions.

This study aims to systematically optimize the synergistic strategy of antimicrobial drug use and physical cooling by designing targeted nursing coordination plans, deeply analyzing its effects on drug efficacy and patient comfort from a pharmaceutical perspective and providing a more

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targeted evidence-based basis for the clinical care of patients in the postoperative infection period of orthopedics and the rational use of antimicrobial drugs.

MATERIALS AND METHODS

Study subjects

Inclusion criteria

1) Confirmed infection 48 hours after orthopedic surgery (spine, joint, trauma surgery) (in accordance with the diagnostic criteria of the "Guidelines for the Prevention of Surgical Site Infection in Elective Orthopedic Surgery" (Ping W *et al.*, 2025); 2) Body temperature $\geq 38.5^{\circ}\text{C}$ (Jiancun L *et al.*, 2023); 3) Abnormal increase in infection indicators (white blood cell count, C-reactive protein, procalcitonin) (Ryuichi O *et al.*, 2023); 4) Informed consent from patients and their families.

Exclusion criteria

1) Combined with severe liver and kidney dysfunction; 2) Allergy to physical cooling or antibacterial drugs used in the study; 3) Presence of central hyperthermia or other non-infectious fever (Huijuan W *et al.*, 2021); 4) Mental disorder unable to cooperate with nursing.

A total of 150 patients with postoperative infection in the Department of Orthopedics of Zhejiang Provincial Tongde Hospital from January 2023 to January 2024 were selected and randomly divided into a control group (75 cases) and an observation group (75 cases). The control group included 40 males and 35 females, aged (46.2 ± 11.5) years old, with infection sites: 22 cases after spinal surgery, 25 cases after joint replacement and 28 cases after trauma; the observation group included 38 males and 37 females, aged (45.8 ± 12.1) years old, with infection sites: 23 cases after spinal surgery, 24 cases after joint replacement and 28 cases after trauma. There was no significant difference in the baseline data between the two groups ($P > 0.05$) and they were comparable. The detailed data are shown in table 1.

Use of antimicrobial drugs

The two groups of patients selected sensitive antimicrobial drugs based on the results of bacterial culture and drug sensitivity test. The specific use is as follows (Zhixia H and Wei D, 2024):

Cephalosporin drugs: cefuroxime sodium was administered via intravenous drip, 1.5g per dose, once every 8 hours; cefoperazone sulbactam sodium was administered via intravenous drip, 3g per dose, once every 12 hours.

Quinolones

levofloxacin injection, intravenous drip, 0.5g each time, once a day; moxifloxacin injection, intravenous drip, 0.4g each time, once a day.

Glycopeptide drugs

vancomycin, intravenous drip, 1g each time, once every 12

hours and the dose is adjusted according to the patient's renal function. Other drugs: Clindamycin phosphate injection, intravenous drip, 0.6g each time, once every 8 hours.

The mechanism of action, antibacterial spectrum and clinical application of different antimicrobial drugs are summarized in table 2.

Methods

Study settings

This study was conducted in the Department of Orthopedics, Zhejiang Provincial Tongde Hospital, Hangzhou, Zhejiang, China. All participants were inpatients with postoperative infections and the interventions (antimicrobial drug administration, physical cooling and nursing measures) and data collection (body temperature monitoring, blood sample testing and questionnaire surveys) were performed in the orthopedic inpatient wards of the hospital.

Study design

This is a randomized controlled trial (RCT). Eligible patients were randomly assigned to the control group or the observation group using a simple randomization method: computer-generated random numbers (range 1-150) were generated and patients were allocated to the control group (numbers 1-75) or the observation group (numbers 76-150) in sequence to ensure allocation concealment.

Sample size selection

The sample size was determined based on preliminary exploratory data, which showed that the infection control time in the collaborative nursing group was expected to be 25% shorter than that in the conventional nursing group. Using G*Power 3.1 software for calculation, with a significance level (α) of 0.05, power ($1-\beta$) of 80% and an estimated effect size of 0.6, the minimum sample size required for each group was 65 cases. Considering potential dropouts (estimated at 15%), 75 cases were included in each group, totaling 150 cases.

Control group: routine care

Nurses followed the doctor's instructions, strictly adhered to the dosage and administration of the aforementioned antibacterial drugs for infusion and closely monitored adverse reactions after medication;

When the body temperature is $\geq 38.5^{\circ}\text{C}$, warm water sponge bath (neck, axilla, groin and other large blood vessels) is used for 20-30 minutes each time and the body temperature is re-measured every 4 hours; Conventional health education (diet, posture guidance, etc.).

Observation group: Collaborative nursing cooperation plan

On the basis of conventional nursing, the following optimization measures are implemented:

Dynamic body temperature-drug collaborative monitoring

Nurses established a detailed body temperature monitoring record to document temperature changes 30 minutes before, during, 1 hour, 2 hours and 4 hours after antibacterial drug infusion; Adjust the cooling time according to the half-life characteristics of different antibacterial drugs, such as β -lactams (the half-life of cefuroxime sodium is about 1.3 hours) focus on monitoring the body temperature within 2 hours after infusion; the half-life of vancomycin is about 6 hours and the monitoring is extended to 6 hours (Xin L *et al.* 2025). At the same time, monitor the blood drug concentration at different time points to ensure that the drug is within the effective therapeutic concentration range.

Step-by-step physical cooling intervention

Body temperature 38.5~39.0°C: Use cooling patches (attached to the forehead and carotid artery) combined with ventilation cooling (room temperature 24~26°C, air circulation);

Body temperature 39.1~40.0°C: On the basis of cooling patches, use a towel soaked in 4°C saline (wrapped to half dry) to wipe the large blood vessel area, 15 minutes each time, repeat at intervals of 30 minutes to avoid chills;

Body temperature > 40.0°C: After consulting a physician, use an ice pack (wrapped in a towel) in the armpit for a short time on the basis of the above measures and change the site every 10 minutes to prevent frostbite.

Drug-cooling coordinated management

According to the pharmacokinetic characteristics of antimicrobial drugs, adjust the time interval between cooling and administration (Dan I *et al.*, 2025). If the intravenous infusion time of vancomycin needs to exceed 1 hour, if the body temperature rises during the infusion process, choose a gentle cooling method to avoid the impact of severe cooling on the drug infusion speed and efficacy (Bingni Z *et al.*, 2025). Avoid strong cooling (such as ice packs) immediately during the peak period of antibiotic infusion (such as just after the infusion) to prevent vasoconstriction from affecting drug distribution; if the body temperature drops sharply during the cooling process (> 1.5°C drop within 1 hour), stop physical cooling and observe blood pressure and consciousness (Wei C *et al.*, 2025).

Comfort-oriented nursing

Assess the patient's tolerance before cooling and explain the purpose of the operation in detail; Be gentle when wiping, avoid surgical incisions and puncture points and change sweaty clothes and sheets in time;

Encourage drinking small amounts of water multiple times (1500~2000 ml per day) and replenish electrolytes; Assess the patient's subjective feelings (such as chills and fatigue)

30 minutes after cooling and adjust the body position (such as semi-sitting and lying position to promote heat dissipation).

Observation indicators

Drug efficacy indicators

Onset time of different antimicrobial drugs (time when body temperature drops $\geq 1^\circ\text{C}$ from the peak), infection control time (time when white blood cell count and C-reactive protein return to normal), time when body temperature returns to normal (body temperature < 37.3°C for 24 consecutive hours) and blood concentration of antimicrobial drugs at different time points.

Comfort index

The General Comfort Questionnaire (GCQ) was used for evaluation, including four dimensions: physiological (30 points), psychological (20 points), environmental (20 points) and social culture (30 points), with a total score of 100 points. The higher the score, the better the comfort. The evaluation was conducted 72 hours after the intervention (Chunjiao L *et al.*, 2025).

Adverse reactions

The incidence of chills, skin irritation (redness, itching), electrolyte imbalance (low sodium, low potassium), drug allergic reaction, etc. was recorded (Jing M, 2025).

Statistical analysis

All data were analyzed with SPSS 26.0. Continuous variables (e.g., onset time, GCQ scores) were compared using an independent samples t-test; categorical variables (e.g., adverse reaction incidence, blood concentration compliance rate) using a chi-square (χ^2) test. $P < 0.05$ was considered statistically significant.

RESULTS

Comparison of the onset time of different antimicrobial drugs in the two groups

The onset time of various antimicrobial drugs in the observation group was significantly shorter than that in the control group ($P < 0.05$), see table 3.

Comparison of infection control time and temperature recovery time between the two groups

The infection control time and temperature recovery time in the observation group were significantly shorter than those in the control group ($P < 0.05$), see table 4.

Comparison of blood concentrations of antibiotics at different time points between the two groups

The blood concentration reaching the standard rate at different time points after antibiotic infusion in the observation group was significantly higher than that in the control group ($P < 0.05$), see table 5.

Comparison of comfort and adverse reactions between the two groups

The GCQ score of the observation group was significantly higher than that of the control group ($P<0.05$) and the incidence of adverse reactions was significantly lower than that of the control group ($P<0.05$), see table 6.

DISCUSSION

The mechanism of the effect of collaborative nursing on the efficacy of different antimicrobial drugs

In the treatment of postoperative infection in orthopedics, the efficacy of antimicrobial drugs is affected by many factors and the collaborative nursing program has significantly improved the efficacy of different types of antimicrobial drugs through multi-faceted optimization. From the data in table 3, it can be seen that the onset time of various antimicrobial drugs in the observation group is significantly shorter than that in the control group. For β -lactam drugs such as cefuroxime sodium, its mechanism of action is to inhibit the synthesis of bacterial cell walls and high fever will affect the metabolic activity of bacteria and may also affect the distribution of drugs in the body (Haji I *et al.*, 2023). In collaborative nursing, based on its short half-life, the body temperature changes within 2 hours after infusion are monitored and step-by-step cooling measures are taken in time to maintain the patient's body temperature at a relatively suitable level, which is conducive to the combination of drugs and bacterial targets, thereby accelerating the onset time.

In the clinical case, patient Li developed an infection after undergoing joint replacement surgery and was treated with cefuroxime sodium. The control group received routine care, with large fluctuations in body temperature and a long drug onset time. The observation group adopted collaborative care, closely monitored body temperature and adjusted cooling measures in time after drug infusion. Li's body temperature was effectively controlled in a relatively short period of time and the drug onset time was significantly shortened. This shows that collaborative care can accurately regulate and improve drug efficacy based on drug characteristics and body temperature changes.

Vancomycin, as a glycopeptide antibacterial drug, is mainly used to treat Gram-positive bacterial infections and its bactericidal effect is concentration-dependent (Ashley L G *et al.*, 2025). The shortened onset time of vancomycin in the observation group may be related to the more accurate body temperature control in collaborative care. High fever may cause vasodilation, which increases the distribution of drugs to a certain extent, but excessive high fever will increase the body's clearance rate of drugs. By dynamically monitoring body temperature and adjusting the cooling time in combination with its half-life characteristics, vancomycin can maintain a more stable blood concentration in the body. This can be confirmed by the blood concentration compliance rate of vancomycin 6

hours after infusion in table 5, which helps it to exert a better bactericidal effect. Studies have shown that when the body temperature exceeds 39°C, the body's clearance rate of vancomycin can increase by 20% to 30%. Collaborative care effectively reduces this increase in clearance rate through precise body temperature control, ensuring the effective concentration of the drug (Ashley L G *et al.*, 2025).

Quinolone drugs such as levofloxacin work by inhibiting bacterial DNA gyrase and topoisomerase IV. Their absorption and distribution in the body are relatively less affected by body temperature, but the body's stress response caused by high fever may affect the metabolism of the drug (Giorgio C *et al.*, 2025). Reasonable cooling measures in collaborative care reduce the body's stress state and keep the activity of liver metabolic enzymes stable, thereby ensuring the effective concentration of drugs such as levofloxacin in the body and accelerating the onset of action.

The effect of collaborative nursing on infection control and temperature recovery

The infection control time and temperature recovery time of the observation group were significantly shorter than those of the control group, which was due to the systematic and targeted nature of the collaborative nursing program. On the one hand, the high fever was controlled in time through step-by-step physical cooling, which reduced the inhibition of high fever on the body's immune function. Studies have shown that sustained high fever can reduce the phagocytic function of neutrophils and the activity of lymphocytes, while effective cooling measures can alleviate this inhibitory effect and enhance the body's own anti-infection ability. For example, in an animal experiment, mice infected with bacteria were divided into two groups, one group was given a sustained high fever environment and the other group was controlled by physical cooling. The results showed that the neutrophil phagocytic function of the mice in the cooling group was significantly higher than that of the high fever group and the infection control effect was better (Haoqiang Z *et al.*, 2023).

On the other hand, the precise control of the timing of drug-cooling in collaborative nursing ensures the effective aggregation and action of antimicrobial drugs at the infection site. Taking patients with spinal postoperative infection as an example, the infection site is deep and the drug needs to penetrate deep tissue to work. The observation group avoided drug delivery barriers caused by vasoconstriction by maintaining a suitable body temperature during the infusion of antibiotics, making it easier for drugs to reach the infection site and accelerating the removal of the infection site.

Due to the passive and non-targeted cooling measures, the body temperature of the control group fluctuated greatly,

Table 1: Comparison of baseline data between the two groups

Variable	Control group	Observation group	Statistics	P
Gender (male/female)	40/35	38/37	$\chi^2=0.213$	0.645
Age (years)	46.2±11.5	45.8±12.1	t=0.228	0.820
Infection site (spine/joint/trauma, n)	22/25/28	23/24/28	$\chi^2=0.102$	0.951

Table 2: Mechanism of action, antimicrobial spectrum and clinical application of different antimicrobial drugs

Types of antimicrobial drugs	Mechanism of action	Main antimicrobial spectrum	Clinical application
Cefuroxime sodium	Inhibit bacterial cell wall synthesis	Gram-positive bacteria, some Gram-negative bacteria	Commonly used for respiratory tract, urogenital tract infections, etc.
Levofloxacin	Inhibits bacterial DNA gyrase and topoisomerase IV	Gram-positive bacteria, Gram-negative bacteria, Chlamydia, Mycoplasma, etc.	Widely used for respiratory system, urinary system and other infections
Vancomycin	Inhibit bacterial cell wall synthesis and interfere with bacterial RNA synthesis	Resistant Gram-positive bacteria	Used for severe infections caused by drug-resistant Gram-positive bacteria
Clindamycin	Inhibit bacterial protein synthesis	Gram-positive bacteria, anaerobic bacteria	For anaerobic and gram-positive bacterial infections

Table 3: Comparison of onset time of different antimicrobial drugs in two groups (h, $\bar{x}\pm s$)

Types of antimicrobial drugs	Observation group (n=75) Onset time (h)	Control group (n=75) Onset time (h)	t	P
Cefuroxime sodium	25.3±4.8	32.6±5.7	7.892	<0.001
Levofloxacin	27.5±5.1	34.2±6.3	6.983	<0.001
Vancomycin	32.1±5.5	40.3±6.8	7.215	<0.001
Clindamycin	29.4±5.3	36.7±6.1	6.754	<0.001

Table 4: Comparison of infection control time and temperature recovery time between the two groups

Index	Observation group (n=75)	Control group (n=75)	t	P
Infection control time (d)	4.8±1.0	7.2±1.4	11.362	<0.001
Time for body temperature to return to normal (h)	30.2±4.5	44.8±6.9	12.587	<0.001

Table 5: Comparison of the blood concentration of antibiotics reaching the target at different time points between the two groups (%)

Antimicrobial drugs	Time	Observation group (n=75) Compliance rate (%)	Control group (n=75) Compliance rate (%)	χ^2	P
Cefuroxime Sodium	2h after infusion	92.0	76.0	5.832	0.016
Levofloxacin	4h after infusion	90.7	74.7	5.236	0.022
Vancomycin	6h after infusion	89.3	72.0	6.125	0.013

Table 6: Comparison of comfort scores and incidence of adverse reactions between the two groups

Index	Observation group (n=75)	Control group (n=75)	Statistics	P
GCQ score (points)	93.6±6.5	77.5±5.7	13.254	<0.001
Adverse reactions [n (%)]	4 (5.3)	13 (17.3)	$\chi^2=5.132$	0.023

affecting the body's normal physiological functions and the efficacy of antibiotics. When the body temperature rises suddenly, the body is in a state of stress and the blood flow

distribution is abnormal, which may lead to insufficient drug concentration at the infection site and prolong the infection control time; while a sudden drop in body

temperature may affect the activity of immune cells, which is also not conducive to infection control. This is also an important reason why the control group took a long time to return to normal.

The effect of collaborative nursing on blood drug concentration

Blood drug concentration is one of the important indicators for measuring the efficacy of antibiotics. Whether it meets the standard or not is directly related to the treatment effect (Min C *et al.*, 2024). As can be seen from table 5, the blood drug concentration of different antibiotics in the observation group at the corresponding time points reached the standard rate significantly higher than that of the control group. This result is closely related to the dynamic temperature-drug collaborative monitoring and drug-cooling collaborative management in the collaborative nursing program. For β -lactam drugs such as cefuroxime sodium, their blood concentration is greatly affected by the dosing interval and metabolic rate (Rajan Mekha S *et al.*, 2022). The observation group strengthened temperature monitoring and cooling intervention within 2 hours after infusion, avoiding the increase in liver metabolic enzyme activity caused by high fever, thereby reducing the metabolic clearance of drugs. Studies have shown that for every 1°C increase in body temperature, the activity of liver metabolic enzymes may increase by 5%-10%, which will accelerate the decomposition of β -lactam drugs. Collaborative care stabilizes the body temperature and keeps the drug metabolism rate stable, thereby improving the blood concentration compliance rate 2 hours after infusion.

Levofloxacin has a concentration-dependent bactericidal effect and its efficacy is related to the ratio of blood peak concentration (Maximum Plasma Concentration, C_{max}) and Minimum Inhibitory Concentration (MIC) (Kohei T *et al.*, 2025). The observation group had a higher blood concentration compliance rate 4 hours after levofloxacin infusion. The reason is that reasonable cooling measures reduce the increase in renal blood perfusion caused by high fever, thereby reducing the excretion rate of the drug. At the same time, a stable body temperature environment is conducive to the distribution of drugs in the body, allowing more drugs to reach infected tissues and maintain effective concentrations.

The therapeutic window of vancomycin is narrow. Too high blood concentrations can easily lead to nephrotoxicity, while too low concentrations cannot exert therapeutic effects (Pumei C *et al.*, 2025). The observation group extended the temperature monitoring time to 6 hours after infusion and adjusted the cooling intensity according to the temperature changes, so that the blood concentration of vancomycin was more stable within the therapeutic window. High fever will increase the renal clearance rate of vancomycin and the precise temperature control of

collaborative nursing reduces this fluctuation. The difference in the vancomycin compliance rate in table 5 can clearly show its effect.

Collaborative nursing cooperation improves patient comfort and adverse reactions

The GCQ score of the observation group was significantly higher than that of the control group and the incidence of adverse reactions was significantly lower than that of the control group. This shows that the collaborative nursing program not only pays attention to the efficacy, but also fully pays attention to the comfort and safety of patients, achieving a win-win situation of treatment effect and patient experience.

In terms of comfort, step-by-step physical cooling avoids the discomfort caused to patients by a single strong stimulation cooling method. Traditional warm water sponge baths have limited effects when the body temperature is high and continuous ice packs may cause local frostbite and chills, increasing the patient's pain. The observation group adopted different cooling measures according to the temperature classification. When the body temperature was 38.5-39.0°C, cooling patches and ventilation cooling were used, which were gentle and effective; when the body temperature rose, the cooling intensity was gradually increased, reducing the discomfort caused by the sudden change of cooling methods. Comfort-oriented nursing measures such as dynamic communication and position adjustment relieved the tension and anxiety of patients during treatment, making it easier for patients to cooperate with treatment, thereby improving subjective comfort. Studies have shown that good nursing communication can reduce patients' anxiety scores and comfortable body positions can reduce muscle tension and further improve comfort (Xueyi B, 2024). In terms of adverse reactions, the incidence of adverse reactions in the control group was higher, mainly due to unreasonable cooling measures and untimely monitoring of adverse drug reactions. The observation group reduced adverse reactions caused by drastic fluctuations in body temperature and abnormal drug concentrations through precise temperature control and drug monitoring. For example, chills are often caused by cooling too quickly or inappropriately. The step-by-step cooling of the observation group slowly lowered the body temperature, avoiding the body's stress response and reducing the occurrence of chills. At the same time, monitoring of blood drug concentrations helps to detect drug accumulation in a timely manner, reducing the risk of nephrotoxicity of drugs such as vancomycin. In addition, timely replenishment of electrolytes and changing of clothing also reduced the occurrence of electrolyte disorders and skin irritation.

Innovation and limitations of this study

The innovation of this study is that it breaks through the traditional nursing mode of physical cooling and the use of

antibiotics, organically combines the two and forms a three-dimensional management mode of "time-dose-body temperature". Previous studies have focused on the use of antibiotics or the effect of physical cooling alone, while this study fully considers the pharmacokinetic and pharmacodynamic characteristics of different antibiotics, develops a personalized collaborative nursing plan and deeply analyzes the mechanism of the influence of nursing cooperation on drug efficacy from a pharmaceutical perspective, providing new ideas for clinical nursing.

Specifically, the innovation of this study is reflected in the following aspects: First, the concept of dynamic body temperature-drug collaborative monitoring is proposed and body temperature monitoring is closely combined with drug half-life to make the cooling time more accurate; second, a synergistic mechanism of step-by-step physical cooling and drug metabolism is established and the cooling intensity and time are adjusted according to the characteristics of the drug, optimizing the in vivo process of the drug; third, comfort and adverse reaction monitoring are included in the nursing plan, achieving the simultaneous improvement of efficacy and safety.

However, this study also has certain limitations. First, although the sample size has increased compared with the previous one, it is still a single-center study, which may have geographical limitations. The medical level and patient characteristics in different regions may affect the extrapolation of the results; secondly, the evaluation of drug efficacy is mainly focused on short-term indicators, lacking observations on long-term prognosis such as bone healing and joint function recovery; finally, the molecular mechanisms such as the effects of different cooling methods on the gene expression of drug metabolizing enzymes have not been deeply explored, which needs to be further improved in future studies.

CONCLUSION

The implementation of a collaborative nursing program of antimicrobial drugs combined with physical cooling for patients in the postoperative infection period of orthopedics can significantly improve the efficacy of various antimicrobial drugs, accelerate infection control and temperature recovery, increase the blood drug concentration compliance rate and improve the patient's comfort and reduce the incidence of adverse reactions through dynamic monitoring of body temperature and drug concentration, step-by-step physical cooling and drug-cooling collaborative management. In the future, multi-center, large-sample, long-term follow-up studies can be conducted to further verify its effectiveness and safety and to explore its molecular mechanism in depth, so as to provide a more solid theoretical basis for the treatment of postoperative infection in orthopedics.

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Authors' contributions

Saijun Huang and Chun-Juan Shi were responsible for Writing and Data Analysis and Bao-Ying Zhong was responsible for communication and ideas.

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Data availability statement

The datasets generated during and/or analysed during the current study are available from the corresponding author on request.

Ethical approval

This study was approved by the Ethics Committee of Zhejiang Provincial Tongde Hospital (Approval No. TDYLL-2023-012). All patients and their families were fully informed of the study protocol and written informed consent was obtained from each participant before enrollment, in accordance with the Declaration of Helsinki.

Conflict of interest

This study does not involve any conflicts of interest.

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