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Original Article

Effects of anesthesia recovery nursing combined with heat-preservation nursing on the state of stress and recovery agitation of general anesthesia patients during surgery

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Abstract: Objective: The purpose of this study was to investigate the effects of anesthesia recovery nursing combined with heat-preservation nursing on the state of stress and recovery agitation of general anesthesia patients during surgery. Methods: The clinical data of 107 general anesthesia patients who were admitted to our hospital were collected retrospectively and were divided into Group A and Group B according to the nursing methods. Group A received only conventional nursing, while Group B received anesthesia recovery nursing combined with heat-preservation nursing. The surgical conditions, recovery conditions, changes in blood pressure and heart rate during anesthesia recovery, changes in levels of norepinephrine, C-reactive protein (CRP) and adrenaline before and after surgery, incidence of agitation, agitation scores, and incidence and grading of chills during emergence agitation (EA) were compared between the two groups. Results: There was no significant difference in the amount of blood loss, infusion volume and duration of surgery between Group A and Group B ($P > 0.05$). The total recovery time, tracheal extubation time and post-anesthesia care unit (PACU) retention time in Group B were shorter than those in Group A ($P < 0.05$). The levels of norepinephrine, CRP and adrenaline in Group B were lower than those in Group A after surgery ($P < 0.05$). DBP, SBP and HR in Group B were lower than those in Group A during anesthesia recovery ($P < 0.05$). The incidence rate (11.11%) of agitation in Group B was lower than that (39.62%) in Group A ($P < 0.05$). The incidence rate (9.26%) of chills in Group B was lower than that (43.40%) in Group A ($P < 0.05$). Conclusion: Anesthesia recovery nursing combined with heat-preservation nursing is conducive to reducing the state of stress and the incidence of recovery agitation in patients undergoing surgery.

Keywords: General anesthesia, anesthesia recovery nursing, heat-preservation nursing, state of stress during surgery, recovery agitation

Introduction

Clinically, anesthesia, is primarily adopted for painless examination and surgery, it can eliminate pain and improve surgical compliance while maintaining normal vital signs of patients, laying an effective basis for smooth surgery [1, 2].

General anesthesia is one of the most commonly used anesthesia methods in clinical practice. Anesthetic drugs are injected via veins, administered to the respiratory tract and muscles to exert their efficacies in the body, and thus inhibit the central nervous system (CNS) [3]. After general anesthesia, the patients experience a loss of physiological consciousness, such as loss of muscle reflexes, consciousness and pain; this inhibition of the CNS is reversible [4]. After the drug is metabolized, the patients restore muscle responses and consciousness.

Studies have revealed that surgery patients are subject to multiple factors, such as low temperature in the operating room (OR), long duration of surgery, intake of low-temperature drugs in the body and disinfection of the body surface during general anesthesia, leading to a rapid drop in the patient's body temperature

during anesthesia. This reduces the rate of drug metabolism and prolongs the recovery time of anesthesia [5]. In addition, patients may experience agitation and abnormal excitement during anesthesia agitation, significantly affecting the patients' heart rate (HR) and blood pressure [6, 7]. Therefore, in order to reduce the state of stress and the incidence of agitation during surgery, it is necessary to actively seek a scientific and proper nursing method to conduct intervention for general anesthesia patients.

Previously, general anesthesia patients usually receive conventional nursing, but the effectiveness, initiative and scientificness of nursing need to be further improved [8, 9]. At present, most scholars advocate the use of anesthesia recovery nursing and heat-preservation nursing for the intervention of general anesthesia patients, and most clinical studies have shown that ideal application results can be achieved. In view of this, we conducted feasibility and innovative research on anesthesia recovery nursing combined with heat-preservation nursing for general anesthesia patients.

Materials and methods

Clinical data

The clinical data of 107 general anesthesia patients admitted to our hospital were collected retrospectively and were divided into Group A (n=53) and Group B (n=54) according to nursing methods. Group A received only conventional nursing, while Group B received anesthesia recovery nursing combined with heat-preservation nursing. (1) Inclusion criteria: patients without contraindications for surgery and anesthesia; those without symptoms, such as fever, infection; those with the duration of surgery of 3-6 h; those with normal body temperature before surgery; and those without serious cardiac, hepatic and renal dysfunction were included. All patients signed an informed consent. This study was conducted with approval by the Medical Ethics Committee of the Central Hospital of Wuhan. (2) Exclusion criteria: patients who withdrew from the study; those with serious nervous system diseases; those with serious cardiopulmonary diseases; those with abnormal preoperative body temperature; those with an allergic constitution; and those with preoperative infection were excluded.

Methods

Patients in Group A received conventional nursing care. Patients were asked about the history of drug application before conventional nursing, so as to understand whether there were contraindications of drugs. Before anesthesia, the catheterization was well prepared, and the humidity and temperature in the operating room were properly adjusted. After surgery, the patients were sent to the ward when they sufficiently recovered from the anesthesia in the anesthesia recovery room.

Patients in Group B received anesthesia recovery nursing combined with heat-preservation nursing:

Anesthesia recovery nursing: (1) Promotion of health education: Before surgery, nursing staff provided the patients with the health education of anesthesia, so as to deepen their understanding of basic knowledge of anesthesia, and help reduce their fears. Nursing staff explained the purposes and functions of the indwelling drainage tube, urinary catheter and stomach tube to the patients, established an excellent nurse-patient relationship through active communication, helped patients establish a positive attitude towards the treatment, reduce negative emotions, such as anxiety and tension, and improve treatment compliance. (2) Enhancement of body position nursing: After surgery, nursing staff assisted the patients in being placed in a supine position. A proper body position can avoid compressing blood vessels and nerves and slowing down blood flow. If the patients had circulatory, respiratory or central nervous system diseases, the changes in vital signs need to be closely observed during anesthesia recovery. Once abnormal conditions were identified, measures were taken in time to avoid agitation. (3) Proper control of application time of sedative and analgesic drugs: Although the patients did not feel pain during surgery, they had obvious pain after surgery. Therefore, the patients were treated with sedative and analgesic drugs strictly according to the physician's advice, and the application time of drugs was strictly controlled to avoid agitation. (4) Deepening analysis of arterial blood gases (ABG): After surgery, incr-

eased analysis of ABG was performed for the patients. During inhalation anesthesia, the patients' respiratory tracts can be easily blocked, resulting in unsmooth breathing. If effective measures are not taken in time, it may develop into hypercapnia or hypoxemia, causing symptoms, such as agitation and headache. Therefore, the patients are closely observed after surgery.

Heat-preservation nursing: Before surgery, the temperature and humidity in the OR was controlled properly, the operating table was heated properly by a heater, and the changes in multiple signs of patients were closely observed during surgery. Preoperative preparations were well prepared, the relevant personnel were well familiarized with all procedures for surgery, and the duration of surgery was shortened to the greatest extent. The fluids infused in the patients during surgery were heated to 37°C by a warmer so as to avoid the incidence of hypothermia during surgery. The flushing fluid needed during surgery was placed in a thermostat for heat preservation. Skin heat dissipation is one of the effective ways to cool the human body. Therefore, when disinfection was performed during surgery, any unnecessary skin exposure was avoided on the premise of ensuring the full exposure of the surgical field. The skin in other sites was covered with insulation blankets, and warm-preservation measures were taken to avoid the rapid decrease in the body temperature during surgery. The wet heat exchanger was installed above the endotracheal intubation to ensure that the humidity and temperature of the inhaled gas were in a constant state, and the blood flow could be effectively promoted using a blood circulation pump.

Observation indices

(1) Surgical conditions, including the amount of intraoperative blood loss, intraoperative infusion volume and duration of surgery.

(2) Anesthesia recovery conditions, including complete recovery time, tracheal extubation time and post-anesthesia care unit (PACU) retention time.

(3) Blood pressure and HR: The changes in diastolic blood pressure (DBP), systolic blood pressure (SBP) and HR before surgery and during anesthesia recovery were compared.

(4) Indices for the state of stress [10]: The changes in the levels of norepinephrine, C-reactive protein (CRP) and adrenaline before and after surgery were compared between the two groups. The levels of norepinephrine and adrenaline were measured by radioimmunoassay (RIA), and CRP was measured by immunoturbidimetry and immune-nephelometry strictly according to the kit instructions.

(5) Scores and incidence of agitation [11]: The incidence and score of agitation during anesthesia recovery were compared between the two groups. No agitation is 0 points, improved agitation during sputum aspiration after timely explanation and comfort is 1 point, measures taken for stopping catheter withdrawal and other symptoms is 2 points, a strong struggle that needs to be stopped by multiple people is 3 points.

(6) Grading and incidence of chills [12]: The incidence and grading of chills were compared between the two groups. Grade 0: without any symptoms of chills. Grade I: straight-erected hair. Grade II: with muscle twitching of a muscle group. Grade III: with muscle twitching of > 1 muscle groups, without whole body twitching. Grade IV: with whole body twitching.

Statistical analysis

The statistical analysis was performed using SPSS 22.0, and the measurement data were expressed using mean ± standard deviation (mean ± SD). The data conforming to a normal distribution were detected using *t* test, and those not conforming to a normal distribution were detected using Mann-Whitney U test. The enumeration data were expressed using [n (%)], and the comparison of enumeration data between groups was carried out using chi-squared test. $P < 0.05$ indicated a statistically significant difference.

Results

Comparison of basic data between the two groups

In Group A, male and female patients occupied 57.41% and 41.51%, respectively, while those in Group B accounted for 61.11% and 38.89%, respectively. There was no significant difference in sex, age, mean anesthesia time, ASA

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

Data		Group A (n=53)	Group B (n=54)	t/X^2	*P*
Sex (cases)	M	31 (57.41)	33 (61.11)	0.076	0.782
	F	22 (41.51)	21 (38.89)		
Age (years)		53.63±1.05	53.68±1.01	0.251	0.802
Mean anesthesia time (min)		4.25±0.15	4.28±0.12	1.143	0.255
ASA grading (cases)					
Grade I		29 (54.72)	27 (50.00)	0.196	0.625
Grade II		24 (45.28)	27 (50.00)		
Types of surgery (cases)					
Breast surgery		5 (9.43)	6 (11.11)	0.015	0.096
Biliary tract surgery		9 (16.98)	11 (20.37)		
Urinary surgery		18 (33.96)	17 (31.48)		
Gastrointestinal surgery		21 (39.62)	20 (37.04)		

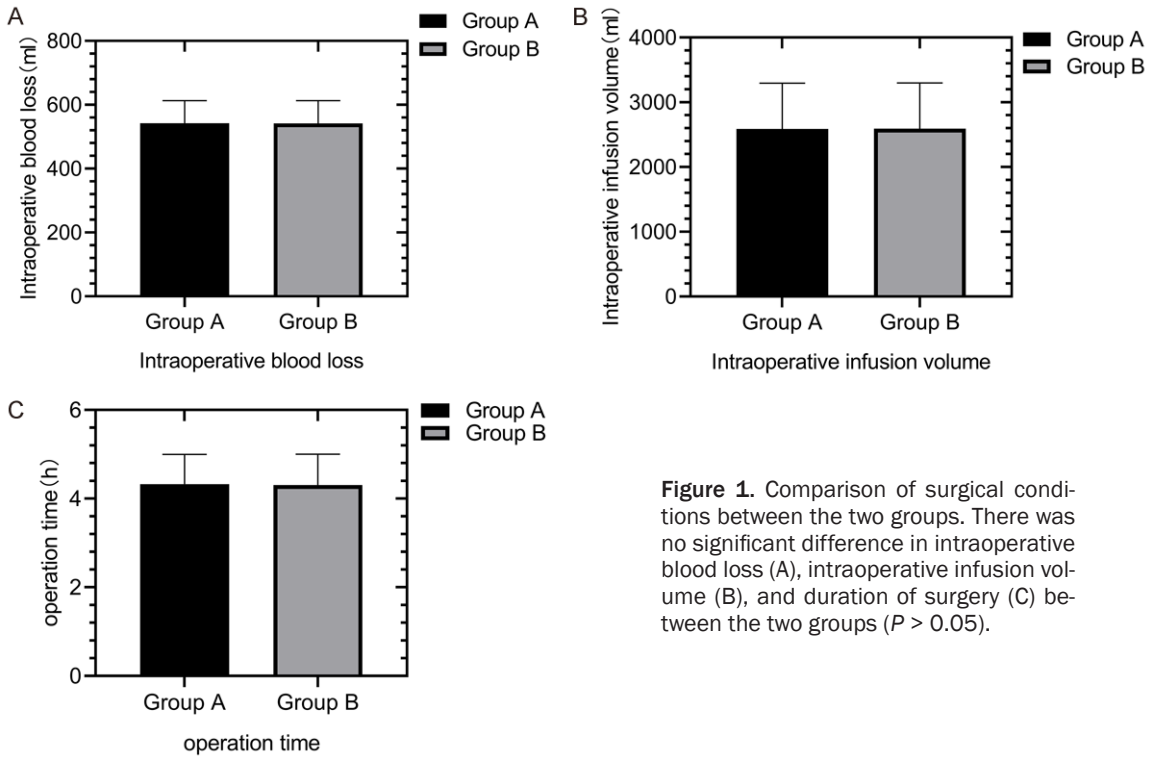

Figure 1. Comparison of surgical conditions between the two groups. There was no significant difference in intraoperative blood loss (A), intraoperative infusion volume (B), and duration of surgery (C) between the two groups ($P > 0.05$).

grading and types of surgery between the two groups ($P > 0.05$) (**Table 1**).

Comparison of surgical conditions between the two groups

The amount of intraoperative blood loss was (492.16±12.58) ml in Group A and (491.18±12.19) ml in Group B, showing no significant difference between the two groups ($P > 0.05$). Intraoperative infusion volume was (2089.63±9.63) ml in Group A and (2091.18±9.12) ml in Group B, indicating no significant difference between the two groups ($P > 0.05$). The duration of surgery was (3.85±0.12) h in Group A and (3.82±0.16) h in Group B, showing no significant difference between the two groups ($P > 0.05$) (**Figure 1**).

Comparison of anesthesia recovery between the two groups

The total recovery time, tracheal extubation time and PACU retention time in Group B

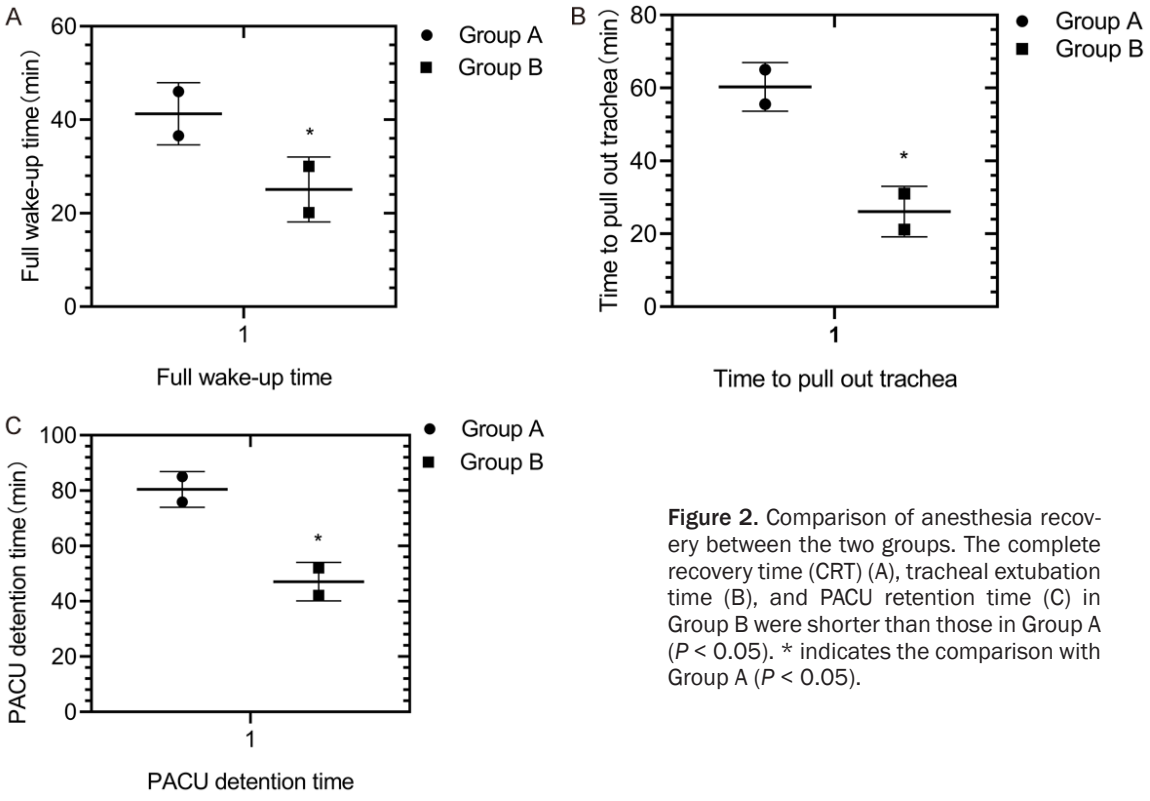

Figure 2. Comparison of anesthesia recovery between the two groups. The complete recovery time (CRT) (A), tracheal extubation time (B), and PACU retention time (C) in Group B were shorter than those in Group A ($P < 0.05$). * indicates the comparison with Group A ($P < 0.05$).

were (20.15±1.05) min, (21.18±0.58) min and (42.15±8.88) min, respectively; which were shorter than those of (36.59±2.58) min, (55.58±1.89) min and (75.88±8.98) min, respectively in Group A: showing significant differences between the two groups ($P < 0.05$) (**Figure 2**).

Comparison of blood pressure and HR between the two groups

There was no significant difference in DBP, SBP and HR between the two groups before surgery ($P > 0.05$). Compared with those before surgery, DBP, SBP, HR were increased in the two groups during anesthesia recovery after surgery, and the differences were significant ($P < 0.05$). However, DBP, SBP and HR in Group B were lower than those in Group A during anesthesia recovery, and the differences were significant ($P < 0.05$) (**Figure 3**).

Comparison of stress indices between the two groups

There was no significant difference in the levels of norepinephrine, CRP and epinephrine between the two groups before surgery ($P > 0.05$). Compared with those before surgery, the levels of norepinephrine, CRP and adrenaline were increased in the two groups after surgery, and the differences were significant ($P < 0.05$). However, the levels of norepinephrine, CRP and adrenaline in Group B were lower than those in Group A after surgery, and the differences were significant ($P < 0.05$) (**Figure 4**).

Comparison of scores and incidence of agitation between the two groups

There were 48 cases scored with 0 points, 1 case with 1 point, 2 cases with 2 points and 3 cases with 3 points of agitation in Group B. There were 32 cases with 0 points, 10 cases with 1 point, 6 cases with 2 points and 5 cases with 3 points in Group A. The incidence (11.11%) of agitation in Group B was significantly lower than that (39.62%) in Group A ($P < 0.05$) (**Table 2**).

Comparison of grading and incidence of chills between the two groups

There were 49 chills cases scored with Grade 0, 1 chills case with Grade I, 2 chills cases with Grade II, 1 chills case with Grade III and 1 chills case with Grade IV in Group B. There were 30

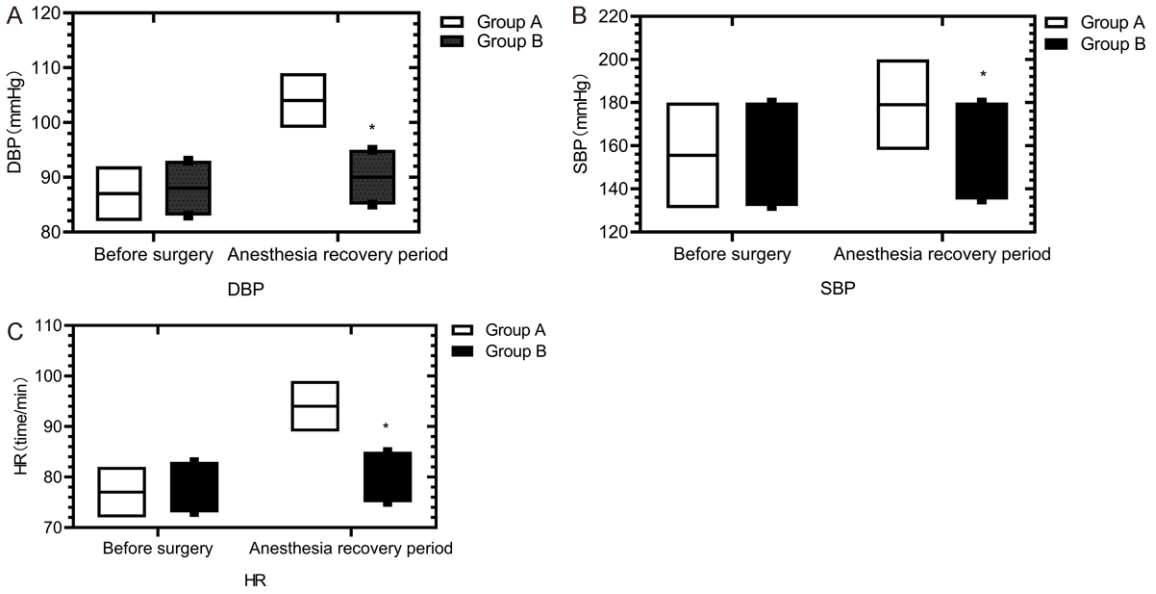

Figure 3. Comparison of blood pressure and HR between the two groups. (A) shows the comparison of DBP between the two groups before surgery ($P > 0.05$). The DBP in Group B was lower than that in Group A during anesthesia recovery ($P < 0.05$). (B) suggests the comparison of SBP between the two groups before surgery ($P > 0.05$). The SBP in Group B was lower than that in Group A during anesthesia recovery ($P < 0.05$). (C) reveals the comparison of HR between the two groups before surgery ($P > 0.05$). The HR in Group B was lower than that in Group A during anesthesia recovery ($P < 0.05$). * indicates the comparison with Group A ($P < 0.05$).

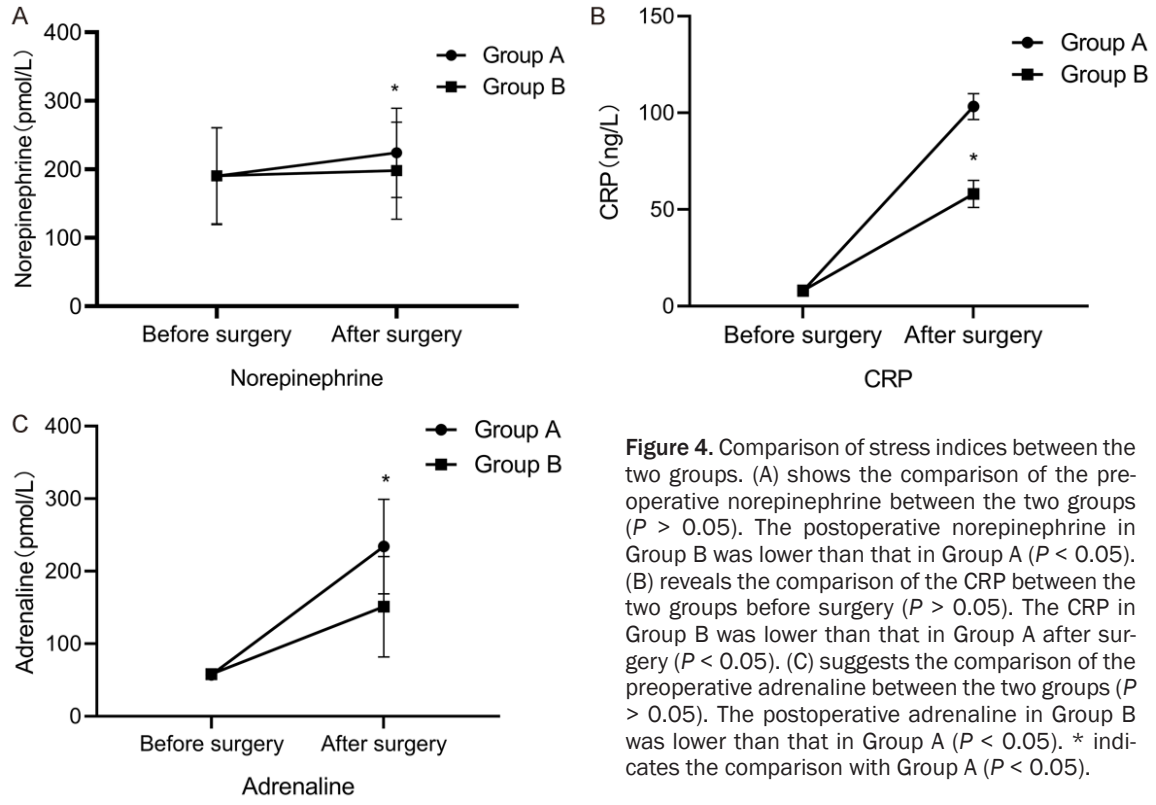

Figure 4. Comparison of stress indices between the two groups. (A) shows the comparison of the preoperative norepinephrine between the two groups ($P > 0.05$). The postoperative norepinephrine in Group B was lower than that in Group A ($P < 0.05$). (B) reveals the comparison of the CRP between the two groups before surgery ($P > 0.05$). The CRP in Group B was lower than that in Group A after surgery ($P < 0.05$). (C) suggests the comparison of the preoperative adrenaline between the two groups ($P > 0.05$). The postoperative adrenaline in Group B was lower than that in Group A ($P < 0.05$). * indicates the comparison with Group A ($P < 0.05$).

chills cases scored with Grade 0, 4 chills cases with Grade I, 6 chills cases with Grade II, 7 chills cases with Grade III and 6 chills cases with Grade IV in Group A, respectively. The inci-

Table 2. Comparison of scores and incidence of agitation between the two groups [n (%)]

Group	Number of cases	0 point	1 point	2 points	3 points	Total incidence
Group A	53	32 (60.38)	10 (18.87)	6 (11.32)	5 (9.43)	21 (39.62)
Group B	54	48 (88.89)	1 (1.85)	2 (0.37)	3 (5.56)	6 (11.11)*
X^2						11.525
P						0.001

Note: * indicates the comparison with Group A, $P < 0.05$.

Table 3. Comparison of grading and incidence of chills between the two groups [n (%)]

Group	Number of cases	Grade 0	Grade I	Grade II	Grade III	Grade IV	Total incidence
Grade A	53	30 (56.60)	4 (7.55)	6 (11.32)	7 (13.21)	6 (11.32)	23 (43.40)
Grade B	54	49 (90.74)	1 (1.85)	2 (3.70)	1 (1.85)	1 (1.85)	5 (9.26)*
X^2							16.133
P							0.000

Note: * indicates the comparison with Group A, $P < 0.05$.

dence (9.26%) of chills in Group B was significantly lower than that (43.40%) in Group A ($P < 0.05$) (**Table 3**).

Discussion

As one of the anesthesia methods, general anesthesia has been widely applied in multiple large-scale surgeries [13]. Studies have revealed that hypothermia after anesthesia can cause agitation and chills during the recovery period [14]. After a decrease in the body temperature, the skeletal muscle contracts rhythmically, oxygen consumption increases, and the cardiac load increases during anesthesia. Under the combined action of multiple physiological changes, poisoning symptoms may occur in patients [15]. In addition, hypothermia during surgery can affect the metabolic circulation and coagulation function, increasing the risk of surgery [16, 17]. After surgery, the patients during anesthesia recovery reveal a high blood pressure, a high HR and multiple abnormal symptoms of agitation induced by sympathetic nerve excitement, and cardiovascular and cerebrovascular diseases may occur in severe cases. If the patients have symptoms of agitation and out-of-control behaviors during the recovery period, it may easily lead to abnormal dropping of the endotracheal intubation and gastric tube, causing serious consequences [18, 19]. Relevant studies have revealed that postoperative agitation in some general anesthesia patients may be related to the lack of anesthesia knowledge, poor breathing, and pain after anesthesia disappears [20]. Therefore, in order to reduce the incidence of agitation and alleviate the stress response, it is necessary to actively seek a scientific and proper nursing method to conduct interventions for general anesthesia patients.

In this study, the levels of norepinephrine, CRP and adrenaline after surgery, and blood pressure and HR during anesthesia recovery in Group B were lower than those in Group A, exhibiting that anesthesia recovery nursing combined with heat-preservation nursing can effectively maintain the stability of vital signs of general anesthesia patients and alleviate the stress response. The mechanism of action of anesthesia recovery nursing combined with heat-preservation nursing was explored, and the patients were provided with the health education of anesthesia-related knowledge before surgery. This is conducive to enhancing patients' understanding of anesthesia-related knowledge, making full preparations before surgery, and relieving nervousness and fears of the patients. After surgery, the patients were placed in the proper body position, thus relieving the compression of blood vessels and nerves, slowing down the blood flow speed, and handling any abnormalities in time, thereby effectively preventing recovery agitation [21, 22]. The proper use of sedative and analgesic drugs and strict control of their application time can relieve patients' pain and reduce the incidence of recovery agitation [23]. In addition, intraoperative heat preservation methods

can reduce the adverse stimulation induced by sympathetic nerve excitement, alleviate the degree of intraoperative stress response, and improve the safety of surgery. Second, the results of this study revealed that Group B was superior to Group A in postoperative recovery and the incidence of agitation and chills, suggesting that anesthesia recovery nursing combined with heat-preservation nursing can promote the postoperative recovery of general anesthesia patients and reduce the incidence of chills and agitation. Liu et al. have found that agitation and chills of the patients in the enhanced heat-preservation nursing group were lower than those in the conventional nursing group, and the postoperative recovery was better than that in the conventional nursing group, which was highly similar to the results of this study [24]. The investigation results of the mechanism of action of anesthesia recovery nursing combined with heat-preservation nursing have shown that hypothermia obviously damages the thermoregulation center, controls the contraction and relaxation of skeletal muscles, causes the incidence of chills and agitation, and elevates the oxygen consumption of the body [25]. In this study, the temperature and humidity of the OR are properly controlled before surgery, so as to ensure that the patients can adapt to the indoor temperature and humidity after entering the OR. Full preparations are made before surgery, relevant personnel are well familiarized with procedures for surgery, the duration of surgery is shortened to the greatest extent, the loss of patients' body temperature is reduced and hypothermia is avoided during surgery [26, 27]. Heating multiple liquids during surgery can avoid a stress response and the stimulation of low temperature liquids on patients' bodies. The use of an insulation blanket during surgery can avoid unnecessary skin exposure, help prevent hypothermia during surgery and reduce the incidence of chills and recovery agitation [28].

Although this study has achieved some results, there is the limitation of small sample size. Therefore, the future studies with a larger sample size, a longer time period and a more comprehensive analysis should be performed.

In summary, anesthesia recovery nursing combined with heat-preservation nursing for general anesthesia patients is conducive to reducing the state of stress during surgery and the incidence of recovery agitation.

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Disclosure of conflict of interest

None.

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References

[1] Macones GA, Caughey AB, Wood SL, Wrench IJ, Huang J, Norman M, Pettersson K, Fawcett WJ, Shalabi MM, Metcalfe A, Gramlich L, Nelson G and Wilson RD. Guidelines for postoperative care in cesarean delivery: Enhanced Recovery After Surgery (ERAS) society recommendations (part 3). Am J Obstet Gynecol 2019; 221: 247.e1-247.e9.

[2] Mahanna-Gabrielli E, Schenning KJ, Eriksson LI, Browndyke JN, Wright CB, Culley DJ, Evered L, Scott DA, Wang NY, Brown CHt, Oh E, Purdon P, Inouye S, Berger M, Whittington RA, Price CC and Deiner S. State of the clinical science of perioperative brain health: report from the American Society of Anesthesiologists Brain Health Initiative Summit 2018. Br J Anaesth 2019; 123: 464-478.

[3] Edwards DA, Hedrick TL, Jayaram J, Argoff C, Gulur P, Holubar SD, Gan TJ, Mythen MG, Miller TE, Shaw AD, Thacker JKM and McEvoy MD. American society for enhanced recovery and perioperative quality initiative joint consensus statement on perioperative management of patients on preoperative opioid therapy. Anesth Analg 2019; 129: 553-566.

[4] Miralpeix E, Mancebo G, Gayete S, Corcoy M and Solé-Sedeño JM. Role and impact of multimodal prehabilitation for gynecologic oncology patients in an Enhanced Recovery After Surgery (ERAS) program. Int J Gynecol Cancer 2019; 29: 1235-1243.

[5] Stambough JB, Bloom GB, Edwards PK, Mehaffey GR, Barnes CL and Mears SC. Rapid re-

covery after total joint arthroplasty using general anesthesia. J Arthroplasty 2019; 34: 1889-1896.
[6] Jakobsson JG. Recovery and discharge criteria after ambulatory anesthesia: can we improve them? Curr Opin Anaesthesiol 2019; 32: 698-702.
[7] Ilyas S, Simmons S and Bampoe S. Systematic review of enhanced recovery protocols for elective caesarean section versus conventional care. Aust N Z J Obstet Gynaecol 2019; 59: 767-776.
[8] Battaglini D, Robba C, Rocco PRM, De Abreu MG, Pelosi P and Ball L. Perioperative anaesthetic management of patients with or at risk of acute distress respiratory syndrome undergoing emergency surgery. BMC Anesthesiol 2019; 19: 153.
[9] Worrall DM, Tanella A, DeMaria S Jr and Miles BA. Anesthesia and enhanced recovery after head and neck surgery. Otolaryngol Clin North Am 2019; 52: 1095-1114.
[10] Pan Y, Zhuang J, Zeng J, Chen M, Bo Z, Fang L, Sun X, Yin X and Song H. Preoperative blindfold training prevents pediatric psychological behavior disorders during the anesthesia recovery period: a randomized controlled trial. J Perianesth Nurs 2019; 34: 1205-1214.
[11] Steward JE, Kitley WR, Schmidt CM and Sundaram CP. Urologic surgery and COVID-19: how the pandemic is changing the way we operate. J Endourol 2020; 34: 541-549.
[12] Lee HG, Bae HB, Choi JI, Pyeon T, Kim S and Kim J. Febrile convulsions during recovery after anesthesia in an infant with history of MMR vaccination: a case report. Medicine (Baltimore) 2019; 98: e17047.
[13] Shortal BP, Hickman LB, Mak-McCully RA, Wang W, Brennan C, Ung H, Litt B, Tarnal V, Janke E, Picton P, Blain-Moraes S, Maybrier HR, Muench MR, Lin N, Avidan MS, Mashour GA, McKinstry-Wu AR, Kelz MB, Palanca BJ and Proekt A. Duration of EEG suppression does not predict recovery time or degree of cognitive impairment after general anaesthesia in human volunteers. Br J Anaesth 2019; 123: 206-218.
[14] Pengelly J, Pengelly M, Lin KY, Royse C, Royse A, Bryant A, Williams G and El-Ansary D. Resistance training following median sternotomy: a systematic review and meta-analysis. Heart Lung Circ 2019; 28: 1549-1559.
[15] Kruthiventi SC, Laporta ML, Deljou A, Knopman DS, Petersen RC, Schroeder DR, Sprung J and Weingarten TN. Preoperative cognitive impairment associated with oversedation during recovery from anesthesia. J Anesth 2020; 34: 390-396.
[16] Wijk L, Udumyan R, Pache B, Altman AD, Williams LL, Elias KM, McGee J, Wells T, Gramlich L, Holcomb K, Achtari C, Ljungqvist O, Dowdy SC and Nelson G. International validation of Enhanced Recovery After Surgery Society guidelines on enhanced recovery for gynecologic surgery. Am J Obstet Gynecol 2019; 221: 237.e1-237.e11.
[17] Eriksson K, Wikström L, Broström A and Pakpour AH. Predictors for early physical recovery for general and orthopedic patients after major surgery: structural equational model analyses. Pain Manag Nurs 2020; 21: 371-378.
[18] Enten G, Shenouda MA, Samuels D, Fowler N, Balouch M and Camporesi E. A retrospective analysis of the safety and efficacy of opioid-free anesthesia versus opioid anesthesia for general cesarean section. Cureus 2019; 11: e5725.
[19] Nelson O, Sturgis B, Gilbert K, Henry E, Clegg K, Tan JM, Wasey JO, Simpao AF and Gálvez JA. A visual analytics dashboard to summarize serial anesthesia records in pediatric radiation treatment. Appl Clin Inform 2019; 10: 563-569.
[20] Bach-Rojecky L, Vađunec D, Lozić M, Žunić K, Špoljar GG, Čutura T, Erceg D and Primorac D. Challenges in anesthesia personalization: resolving the pharmacogenomic puzzle. Per Med 2019; 16: 511-525.
[21] Hirsch M, Geisz-Everson M, Clayton BA, Wilbanks B, Golinski M, Kremer M and Nicely KW. It's never just a block: an analysis of regional anesthesia closed claims. AANA J 2019; 87: 365-373.
[22] Peters A, Siripong N, Wang L and Donnellan NM. Enhanced recovery after surgery outcomes in minimally invasive nonhysterectomy gynecologic procedures. Am J Obstet Gynecol 2020; 223: 234.e1-234.e8.
[23] Bhatia A and Buvanendran A. Anesthesia and postoperative pain control-multimodal anesthesia protocol. J Spine Surg 2019; 5: S160-S165.
[24] Liu Y and Li L. Clinical study on the effects of temperature holding nursing care on the intraoperative stress and postoperative anesthesia recovery in patients under general anesthesia. Hebei Medicine 2014; 1200-1203.
[25] Bolotsky A, Butler D, Dong C, Gerace K, Glavin NR, Muratore C, Robinson JA and Ebrahimi A. Two-dimensional materials in biosensing and healthcare: from in vitro diagnostics to optogenetics and beyond. ACS Nano 2019; 13: 9781-9810.
[26] Pesonen E, Silvasti-Lundell M, Niemi TT, Kivisaari R, Hernesniemi J and Mäkinen MT. The focus of temperature monitoring with zero-heat-flux technology (3M Bair-Hugger): a clini-

cal study with patients undergoing craniotomy. J Clin Monit Comput 2019; 33: 917-923.
[27] Craig A, Deerwester K, Fox L, Jacobs J and Evans S. Maternal holding during therapeutic hypothermia for infants with neonatal encephalopathy is feasible. Acta Paediatr 2019; 108: 1597-1602.
[28] Schmidl L, Schmidl G, Gawlik A, Dellith J, Hübner U, Tympel V, Schmidl F, Plentz J, Geis C and Haselmann H. Combining super-resolution microscopy with neuronal network recording using magnesium fluoride thin films as cover layer for multi-electrode array technology. Sci Rep 2019; 9: 16110.