The effect of prophylactic rewarming on postoperative nausea and vomiting among patients undergoing laparoscopic hysterectomy: a prospective randomized clinical study

DongDong Liang, YuanLu Shan, Leilei Wang

Department of Anesthesiology, The First Affiliated Hospital of Wenzhou Medical University, Ouhai Area, Wenzhou City, Zhejiang Province, China

INTRODUCTION

Postoperative nausea and vomiting (PONV) after general anesthesia has high incidence (20%-80%). It is an uncomfortable complication that causes distress for patients. It occurs much more frequently among high-risk patients (60-70%), such as females, individuals who suffer from motion sickness, nonsmokers and individuals with a history of PONV. Laparoscopic surgery is prone to induce postoperative nausea and vomiting, which significantly increases patients’ discomfort, such that they hardly take in any nutritious food, which thus results in extending their length of hospital stay. Multiple antiemetic drugs have been applied in clinics, but the efficacy of such treatment comes with risks of adverse events such as excessive sedation, dizziness, dry mouth, dysphoria, mood changes, tachycardia and extrapyramidal signs.

Besides drug therapy, nondrug therapy also provides some help in preventing occurrences of PONV. Intraoperative skin surface rewarming is a common and rapid method that not only can prevent hypothermia but also can improve postoperative comfort. Rein et al. and Hamza et al. showed that perioperative temperature protection increased skin blood flow and heat transfer, and also lowered the requirement for analgesics and promoted higher quality of recovery. Reflective blankets, forced-air warmers and warm socks have all been used clinically to prevent shivering and maintain subjective thermal comfort postoperatively, thereby indirectly minimizing development of PONV.

The underlying mechanisms of PONV are complex and relate to the patient’s psychological state. Watcha and White believed that vagal stimuli from the intestinal tract could activate the emetic center and trigger chemoreceptors, which would result in a series of reactions to the onset...
of nausea and vomiting. Some clinical trials have shown that oral administration of warm water for four hours postoperatively had the capacity to significantly decrease the first flatus expulsion, relieve gastrointestinal spasms and help peristalsis return at an early stage of recovery.14

Therefore, we hypothesized that thermal protection for patients would prevent PONV and provide better benefit in recovery. To test this hypothesis, we applied forced-air warmers combined with warm liquid to maintain temperature fluctuation perioperatively; a 100-mm visual analogue scale (VAS) to evaluate overall postoperative PONV; and a 40-item questionnaire (QoR-40) to measure the quality of recovery.

OBJECTIVE
The aim of this study was to evaluate prophylactic rewarming following general anesthesia, to guard against postoperative nausea and vomiting among patients undergoing laparoscopic hysterectomy.

METHODS
The present study was registered in the Chinese Clinical Trial Register with the code ChiCTR-IOR-17012901. This was a prospective randomized study in which 62 patients who were candidates for laparoscopic hysterectomy under general anesthesia at a hospital in China were enrolled between July 2017 and March 2018. In accordance with the requirements of the ethics committee for clinical research (number 2017-162), the patients were given explanations about the purpose of the study protocol and they gave their written consent to participate. The clinical trial consent and QoR-40 questionnaire were explained to the patients one day before surgery.

From the surgical list, we identified the patients who were eligible to become involved in the clinical trial. Patients who conformed to the inclusion criteria were allocated before the surgery to the forced air warming (FAW) group or to the control group by means of numbers in identical sealed envelopes, according to a random number table that was created through a computer by an independent statistician. One of the anesthesiologists (WLL) made an evaluation and recorded the data after the participants had signed the consent form.

An independent nurse who was not involved in caring for these patients opened the envelopes before the operation and prepared the fluids and FAW. The FAW tube was placed beside the patient’s shoulder with the temperature at 43 °C. Two of the anesthesiologists (LDD, SYL), who were unaware of the allocation group, performed the general anesthesia and all intraoperative data recording, and another investigator (WLL) was in charge of all postoperative assessments, while blinded to the group identity.

Subjects
The inclusion criteria were that the subjects needed to present the following: American Society of Anesthesiologists (ASA) physical status I/II; aged 20 to 60 years; consent to their participation in the study until the end; scheduled to undergo laparoscopic hysterectomy. Written informed consent was obtained from all subjects. All of them answered the QoR-40 questionnaire independently.

Presentation of any of the following were deemed to be exclusion criteria: allergy; bronchial asthma; coronary heart disease; obesity-related diabetes mellitus; hypertension; BMI > 30 kg/m2; cardiac, hepatic or renal dysfunction; psychiatric disease; chronic pain; fever; history of alcohol or opioid abuse; intake of any nonsteroidal analgesics or antiepileptic drugs within 48 hours before surgery; or history of gastrointestinal disease (peptic ulcer, Crohn’s disease or ulcerative colitis). Patients were withdrawn from the groups if their laparoscopy was converted to open surgery.

Sixty female patients aged 20 to 60 years who presented ASA physical status I or II and had been scheduled for primary gynecological laparoscopic surgery were randomly assigned to two groups. Patients in the FAW group received pre-warmed Ringer’s solution that was stored in a heating cabinet set at 40 °C and was applied with forced air warming (FAW) that was switched on until the end of surgery. Patients in the control group received normal general anesthesia with normal Ringer’s solution, i.e. FAW was switched off. To ensure that the surgery went smoothly, we set the patients’ intraoperative temperature to be not lower than 35 °C. In the event of lower temperatures occurring in the control group, our intention was to stop the trial and take protective measures.

Anesthesia was induced in all patients by means of propofol 2 (mg/kg) and sufentanil (0.3-0.5 μg/kg), and intubation was done using cisatracurium (2 mg/kg). Anesthesia was maintained by means of sevoflurane, propofol and remifentanil. The bispectral index (BIS) was monitored to maintain it at 45-55 in order to control the infusion speed of anesthetic drugs.

Mechanical ventilation was performed to maintain PetCO₂ at 35-40 mmHg. Sufentanil (0.1 mg/kg per 30 minutes) was administered during the surgery to provide analgesia. Intravenous ondansetron (8 mg) was administered to prevent postoperative nausea and vomiting. When patients presented spontaneous breathing, consciousness was recovered by using neostigmine and atropine, and then the tracheal tube was extracted.

Measurement
1. Postoperative nausea and vomiting were evaluated and measured by means of a 100-mm VAS at the postoperative time points of 6 hours, 24 hours and 48 hours. Additionally, we recorded any occurrences of nausea and vomiting in the ward, and the number of times of using antiemetic drugs.
2. Core temperature was recorded by using a temperature probe placed in the nasal cavity. We set 37.0 °C as the starting temperature in both groups. The changes in nasal temperature were recorded as follows: ∆T90 (ΔT90 = intubation temperature – temperature 90 minutes after intubation), ΔT30 (ΔT30 = intubation temperature – temperature 30 minutes after intubation), ΔT60 (ΔT60 = intubation temperature – temperature 60 minutes after intubation), ΔT300 (ΔT300 = intubation temperature – temperature 90 minutes after intubation).

3. The validated Chinese version of the QoR-40 questionnaire was used at three times: preoperatively (T0), 24 hours postoperatively (T1) and 48 hours postoperatively (T2).15,16 QoR-40 contains five subscales: physical comfort (PC), emotional state (ES), physical independence (PI), patient support (PS) and pain (P). Each item is rated on a scale of 1-5, and therefore the total score can range from a minimum of 40 to a maximum of 200. The QoR-40 questionnaire was used to measure the patients' physical condition after anesthesia.

4. Perioperative hemodynamics: heart rate and mean arterial pressure (MAP) were recorded at the times of the baseline, intubation and 10 minutes, 20 minutes, 30 minutes, 40 minutes, 50 minutes and 60 minutes after induction of anesthesia, and at the end of surgery.

5. Occurrences of shivering17 (at the end of surgery and in the early postoperative period up to one hour) were evaluated and recorded in two groups, as follows:
   - grade 1: no shivering
   - grade 2: mild shivering, with slight facial and cervical muscle contraction
   - grade 3: moderate shivering, consisting of obvious shivering of the head and neck, shoulders, and/or extremities
   - grade 4: severe shivering, consisting of obvious shaking all over the body

6. The patients’ demographic profiles in the two groups were recorded, including age, body mass index, intraoperative sufentanil and remifentanil consumption, liquid dosage, time of extubation and durations of anesthesia and the operation.

Data analysis and statistics
The demographic profiles were analyzed by means of the independent-sample t test. The paired-sample t test was used to test for significant differences in ∆T between the two groups. The Wilcoxon test with the Mann-Whitney U test was used to analyze PONV scores and QoR-40 scores. Repeated-measurement analysis of variance (ANOVA) followed by the Huynh-Feld correction was used for analysis on MAP and heart rate. Occurrences of shivering were tested using the chi-square test with Fisher’s exact test.

All values were presented as means ± standard deviation (SD). All the analyses were performed using the SPSS statistical software (SPSS Inc., Chicago, Illinois, USA). P-values < 0.05 were considered statistically significant.

RESULTS

1. Postoperative nausea and vomiting:
At 6 hours after the operation, the incidences of PONV were 53.3% (16/30) in the FAW group and 63.3% (19/30) in the control group, within which the vomiting rates were 20% (6/30) in the FAW group and 23.3% (7/30) in the control group. However, there was no statistically significant in VAS scores (P = 0.258). At 24 hours after the operation, the incidences of PONV were 6.7% (2/30) in the FAW group and 30% (9/30) in the control group, within which the vomiting rates in the two groups were equal, at 3.3% (1/30). The VAS scores in the control group were significantly higher than those in the FAW group (P = 0.035). At 48 hours after the operation, the incidences of PONV in the two groups were equal at 3.3% (1/30), and none of the subjects presented vomiting. There was no significant difference in VAS scores at 48 hours after the operation between the two groups (P = 0.981; Table 1).

Additionally, the proportions of the patients who presented a need for use of antiemetic drugs to relieve PONV in the ward were 46.7% (14/30) in the FAW group and 56.7% (17/30) in the control group. Ondansetron (44.3%), promethazine (1.7%) and metoclopramide (6.7%) were administered to prevent and treat nausea and vomiting in the ward.

2. Core temperature:
Starting from the baseline of intubation, there was no difference in temperature drop between the two groups. At the time of 30 minutes after intubation, there was a statistical difference in the degree of temperature decline between the two groups (FAW: ∆T30 = 0.0467 ± 0.12243; control: ∆T30 = 0.1433 ± 0.16955; P = 0.013). At the time of 60 minutes after intubation, ∆T60 (∆T60 = intubation temperature – temperature 60 minutes after intubation), ∆T60 (∆T60 = intubation temperature – temperature 60 minutes after intubation), ∆T60 (∆T60 = intubation temperature – temperature 60 minutes after intubation), ∆T60 (∆T60 = intubation temperature – temperature 60 minutes after intubation).

| Time     | FAW group | Control group | P* |
|----------|-----------|---------------|----|
| 6 hours  | 2.53 ± 2.75 | 3.47 ± 3.13 | 0.258 |
| 24 hours | 0.47 ± 1.78 | 1.00 ± 1.64 | 0.035* |
| 48 hours | 0.07 ± 0.37 | 0.10 ± 0.55 | 0.981 |

6 hours, 6 hours after operation; 24 hours, 24 hours after operation; 48 hours, 48 hours after operation; *obtained through the Wilcoxon test with Mann-Whitney U test; visual analogue scale scores at 24 hours after operation, FAW group (P = 0.035) versus control group; FAW = forced air warming.
the degree of temperature decline in the FAW group was reduced. However, in the control group, the degree of temperature decline did not reduce, thus leading to a significant difference between the two groups (FAW: $\Delta T_{60} = 0.1367 \pm 0.22664$; control: $\Delta T_{60} = 0.3367 \pm 0.20083$; $P = 0.001$). At the time of 90 minutes after intubation, the degree of temperature decline in the FAW group was significantly reduced, compared with the control group (FAW: $\Delta T_{90} = 0.1400 \pm 0.22834$; control: $\Delta T_{90} = 0.3833 \pm 0.24507$; $P = 0.001$; Figure 1).

3. Results from QoR-40:
All the patients ($n = 30$ in each group) received the QoR-40 questionnaire at three times: before the operation (T0), 24 hours after the operation (T1) and 48 hours after the operation (T2). At T1, the patients in the control group had lower overall QoR-40 scores than the patients in the FAW group ($P = 0.027$) and lower scores for the PI and P dimensions ($P = 0.032$, $P = 0.034$ respectively). At T2, the overall QoR-40 scores in the two groups were higher and returning towards the preoperative level. Patients in the FAW group showed better recovery than those in the control group, with a statistically significant difference ($P = 0.006$). The ES and P dimensions in the control group had lower scores than those of the T group ($P = 0.024$ and $P = 0.002$, respectively; Table 2).

| Table 2. QoR-40 scores at T0, T1 and T2 among the patients |
|---------------------------------|-------------|-------------|
| **FAW group** | **Control group** | **$P$** |
| n = 30 | n = 30 |  |
| **T0** | |  |
| Overall | 195.73 $\pm$ 5.41 | 196.67 $\pm$ 4.25 | 0.556 |
| Physical comfort (PC) | 59.00 $\pm$ 1.53 | 58.97 $\pm$ 1.50 | 0.91 |
| Emotional state (ES) | 43.07 $\pm$ 2.96 | 43.10 $\pm$ 3.53 | 0.658 |
| Physical independence (PI) | 24.80 $\pm$ 0.76 | 24.87 $\pm$ 0.73 | 0.321 |
| Psychological support (PS) | 34.80 $\pm$ 0.48 | 34.77 $\pm$ 0.43 | 0.573 |
| Pain (P) | 34.10 $\pm$ 1.32 | 34.10 $\pm$ 1.185 | 0.877 |
| **T1** | |  |
| Overall | 175.50 $\pm$ 9.63 | 170.47 $\pm$ 9.35 | 0.027* |
| Physical comfort (PC) | 50.77 $\pm$ 5.46 | 49.43 $\pm$ 4.75 | 0.233 |
| Emotional state (ES) | 42.07 $\pm$ 3.48 | 41.27 $\pm$ 3.62 | 0.11 |
| Physical independence (PI) | 17.27 $\pm$ 2.26 | 15.77 $\pm$ 2.53 | 0.032* |
| Psychological support (PS) | 34.57 $\pm$ 0.73 | 34.67 $\pm$ 0.48 | 0.857 |
| Pain (P) | 30.90 $\pm$ 2.19 | 29.40 $\pm$ 2.92 | 0.034* |
| **T2** | |  |
| Overall | 190.20 $\pm$ 5.37 | 186.07 $\pm$ 6.50 | 0.006# |
| Physical comfort (PC) | 58.13 $\pm$ 2.21 | 57.70 $\pm$ 2.61 | 0.353 |
| Emotional state (ES) | 43.80 $\pm$ 2.04 | 41.83 $\pm$ 6.09 | 0.024* |
| Physical independence (PI) | 20.20 $\pm$ 2.57 | 19.60 $\pm$ 2.76 | 0.18 |
| Psychological support (PS) | 34.90 $\pm$ 0.31 | 34.90 $\pm$ 0.31 | 1 |
| Pain (P) | 33.17 $\pm$ 1.56 | 31.33 $\pm$ 2.54 | 0.002* |

Values are expressed as mean $\pm$ standard deviation (SD) or number of patients. T0, before surgery; T1, 24 hours after surgery; T2, 48 hours after surgery; FAW group, forced air warming group; obtained through the Wilcoxon test with Mann-Whitney U test; *$P < 0.05$; **$P < 0.01$. At T1 and T2, overall scores in FAW group ($*P = 0.027$ and $*P = 0.006$, respectively) versus control group. At T1, PI and P scores in FAW group ($*P = 0.032$ and $*P = 0.034$, respectively) versus control group. At T2, ES and P scores in FAW group ($*P = 0.024$ and $*P = 0.002$, respectively) versus control group.
4. Perioperative hemodynamics:
No significant differences were seen between the two groups in terms of the perioperative MAP and heart rate (HR) (FAW: MAP = 84.4000 ± 11.36555; control: MAP = 81.7233 ± 12.21111; P > 0.05; FAW: HR = 66.0844 ± 10.06888; control: HR = 64.9811 ± 9.96222; P > 0.05; Figure 2). Both MAP and heart rate values decreased at the time of tracheal cannulation and then maintained a lower level than the baseline. However, these values tended to remain within an acceptable range once surgery had commenced.

5. Occurrence of shivering:
Occurrences of shivering were associated with high incidence of low temperature, compared with the control group (P = 0.024; Table 3).

6. Patient characteristics:
Sixty-two patients who were candidates for laparoscopic hysterectomy under general anesthesia were enrolled for this study. Two patients were excluded as a result of factors such as changes to the surgical procedure and blood sample loss. Thus, 60 female patients were included between July 2017 to March 2018, and were divided into two groups (FAW and control). There were no significant differences between the groups regarding age, body mass index, intraoperative sufentanil (34.80 ± 5.85 μg versus 35.53 ± 6.54 μg) and remifentanil consumption (679.00 ± 256.72 μg versus 728.27 ± 270.34 μg), liquid dosage (1033.33 ± 224.89 ml versus 1000.00 ± 227.43 ml), time of extubation, and durations of anesthesia and the operation (P > 0.05; Table 4).

DISCUSSION
PONV is a commonly encountered symptom among patients in a variety of clinical settings. PONV causes distress for patients and affects postoperative recovery quality, although the precise mechanism is still unclear. The main finding in our study was that prophylactic rewarming (pre-warmed Ringer’s solution with FAW) could effectively ameliorate the condition of PONV at 24 hours after the operation. It also helped to improve the quality of early recovery among these laparoscopic hysterectomy patients, 24 hours and 48 hours after the operation.

Perioperative hypothermia has been found to tend to induce occurrence of nausea and vomiting, in many studies. In our study, temperature values in both groups decreased markedly after intubation. However, the degree of temperature decline in the FAW group was reduced, compared with the control group, from the time of 30 minutes after intubation to the time of 90 minutes after intubation. The results suggested that pre-warming fluids applied in association with FAW were able to provide steady...
heat transfer throughout the surgical procedure and minimized the core temperature loss, which was caused mostly by surgical and anesthesia factors.

It is hard to maintain normothermia at a typical operating room temperature. Some studies have reported that general anesthesia has the capacity to reduce metabolic heat production by about 30%. However, perioperative warming devices may compensate for this.22

In our study, hypothermia possibly caused occurrences of PONV, notably at 24 hours after the operation (the rate of occurrence of nausea and vomiting was 6.7% in the FAW group versus 30% in the control group). VAS scores at 24 hours in the FAW group were much lower than those in the control group. This suggested that the patients in the FAW group were in a better physical condition at 24 hours after the operation, with low occurrence of PONV. However, the use of antiemetic drugs in the ward in the two groups was 46.7% in the FAW group and 56.7% in the control group.

Some studies have shown that occurrences of nausea are more resistant to interventions.23 The data from the ward suggested to us that clinicians in the ward were possibly prescribing antiemetic drugs as prophylaxis for PONV. Quigley et al. stated that most clinically encountered episodes of PONV were typically short-lived and self-limited.24 Because of the prophylactic antiemetic drugs, the number of times that patients in the FAW group asked for relief from nausea diminished.

In addition, we observed that frequency of occurrence of postoperative shivering increased in the control group. Along with PONV, shivering caused discomfort for the patients recovering from general anesthesia, even though none of them presented temperatures under 35 °C. This possibly implied that pre-warming decreased the risk of surgical complications. Patients were able to absorb nutrients earlier, which was conducive to recovery.25

Furthermore, the QoR-40 scores suggested that the higher these were, the faster and better the quality of recovery were. The FAW group showed better status for physical independence (PI) and pain (P) than the control group at 24 hours after the operation. Meanwhile, presence of pain itself increased the occurrences of PONV. Prophylactic rewarming effectively relieved the condition of nausea and vomiting among these patients undergoing laparoscopic hysterectomy.

Table 4. Demographic data of the patients included

| Items                           | FAW group n = 30 | Control group n = 30 | p     |
|---------------------------------|------------------|----------------------|-------|
| Age; years                      | 48.63 ± 4.41     | 47.17 ± 4.54         | 0.21  |
| Body mass index; kg/m²          | 22.74 ± 2.66     | 23.64 ± 2.41         | 0.173 |
| Duration of anesthesia; minutes | 77.30 ± 29.23    | 91.53 ± 31.91        | 0.077 |
| Duration of operation; minutes  | 116.87 ± 132.41  | 108.63 ± 31.196      | 0.741 |
| Crystalloids; ml                | 1033.33 ± 224.89 | 1000.00 ± 227.43     | 0.57  |
| Sufentanil; μg                  | 34.80 ± 5.85     | 35.53 ± 6.54         | 0.65  |
| Remifentanil; μg                | 679.00 ± 256.72  | 728.27 ± 270.34      | 0.472 |
| Time of extubation, minutes     | 5.00 ± 3.09      | 5.83 ± 5.07          | 0.445 |

FAW group, forced air warming group; values are expressed as mean ± standard deviation (SD) or number of patients. No significant differences between the two groups.
REFERENCES

1. Kranke P, Eberhart LH. Possibilities and limitations in the pharmacological management of postoperative nausea and vomiting. Eur J Anaesthesiol. 2011;28(11):758-65. PMID: 21799417; doi: 10.1016/j.eja.2011.03.024

2. Apfel CC, Läärä E, Koivuranta M, Greim CA, Roewer N. A simplified risk score for predicting postoperative nausea and vomiting: conclusions from cross-validations between two centers. Anaesthesiology. 1999;91(3):693-700. PMID: 10485781; doi: 10.1097/00000542-199909000-00022

3. Pardo M, Miller R. Basics of anesthesia. 7th ed. Philadelphia, PA: Elsevier; 2017. ISBN: 97803232401159

4. Watcha MF, White PF. Postoperative nausea and vomiting: its etiology, treatment, and prevention. Anesthesiology. 1992;77(1):162-84. PMID: 1609990; doi: 10.1097/00000542-199207000-00023

5. Chandrakantan A. Glass PS. Multimodal therapies for postoperative nausea and vomiting, and pain. Br J Anaesth. 2011;107 Supp 1:127-40. PMID: 22156268, doi: 10.1093/bja/aer358

6. Madrid E, Urrútia G, Roqué i Figuls M, et al. Active body surface warming systems for preventing complications caused by inadvertent perioperative hypothermia in adults. Cochrane Database Syst Rev. 2016;4:CD009016. PMID: 27098439; doi: 10.1002/14651858.CD009016.pub2

7. Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. Study of Wound Infection and Temperature Group. N Engl J Med. 1996;334(19):1209-15. PMID: 8606715; doi: 10.1056/NEJM199605303341901

8. Rein EB, Filvedt M, Wallæe L, Raeder JC. Hypothermia during laparotomy can be prevented by locally applied warm water and pulsating negative pressure. Br J Anaesth. 2007;98(3):331-6. PMID: 17259258, doi: 10.1093/bja/ael369

9. Hamza MA, Schneider BE, White PF, et al. Heated and humidified insufflation during laparoscopic gastric bypass surgery: effect on temperature, postoperative pain, and recovery outcomes. J Laparoendosc Adv Surg Tech A. 2005;15(1):6-12. PMID: 15772469; doi: 10.1089/lap.2005.15.6

10. Erkola O. Nitrous oxide: laparoscopic surgery, bowel function, and PONV. Acta Anaesthesiol Scand. 1994;38(8):767-8. PMID: 887093; doi: 10.1111/j.1399-6576.1994.tb04000.x

11. Tjoakarfa C, David V, Ko A, Hau R. Reflective Blankets Are as Effective as Forced Air Warmers in Maintaining Patient Normothermia During Hip and Knee Arthroplasty Surgery. J Arthroplasty. 2017;32(2):624-7. PMID: 27546475; doi: 10.1016/j.arth.2016.07.015

12. Conway A, Ersotelos S, Sutherland J, Duff J. Forced air warming during sedation in the cardiac catheterisation laboratory: a randomised controlled trial. Heart. 2017;104(8):685-90. PMID: 28988209; doi: 10.1136/heartjnl-2017-312191

13. Lee HY, Kim G, Shin Y. Effects of perioperative warm socks-wearing in maintaining core body temperature of patients undergoing spinal surgery. J Clin Nurs. 2018;27(7-8):1399-407. PMID: 29396880; doi: 10.1111/jocn.14284

14. Çalışkan N, Bulut H, Konan A. The Effect of Warm Water Intake on Bowel Movements in the Early Postoperative Stage of Patients Having Undergone Laparoscopic Cholecystectomy: A Randomized Controlled Trial. Gastroenterol Nurs. 2016;39(5):340-7. PMID: 27684632; doi: 10.1097/SGA.0000000000000181

15. Myles PS, Weitkamp B, Jones K, Melick J, Hensen S. Validity and reliability of a postoperative quality of recovery score: the QoR-40. Br J Anaesth. 2008;94(1):11-5. PMID: 17045040; doi: 10.1093/oxfordjournals.bja.a013366

16. Tanaka Y, Yoshimura A, Tagawa K, Shida D, Kawaguchi M. Use of quality of recovery score (QoR40) in the assessment of postoperative recovery and evaluation of enhanced recovered after surgery protocols. J Anesth. 2014;28(10):156-9. PMID: 24413678; doi: 10.1007/s00540-013-1781-7

17. Rai S, Verma S, Pandey HP, Yadav P, Patel A. Role of butorphanol and ondansetron premedication in reducing postoperative shivering after general and spinal anesthesia: A randomised comparative study from North India. Anesth Essays Res. 2016;10(2):319-2. PMID: 27212768; doi: 10.4103/0259-1162.172724

18. Gan TJ, Diemunsch P, Habib AS, et al. Consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg. 2014;118(10):85-113. PMID: 24356162; doi: 10.1213/ANE.0000000000000002

19. Curzytek K, Kubera M, Trojan E, et al. The effects of pessimism on cell-mediated immunity in rats. Prog Neuropsychopharmacology Biol Psychiatry. 2018;80(Pt C):95-303. PMID: 28595946; doi: 10.1016/j.pnpbp.2017.04.034

20. Wenisch C, Narzt E, Sessler DI, et al. Mild intraoperative hypothermia reduces production of reactive oxygen intermediates by polymorphonuclear leukocytes. Anesth Analg. 1996;82(4):810-86. PMID: 8615502; doi: 10.1097/00000539-199604000-00023

21. Heier T, Caldwell JE. Impact of hypothermia on the response to neuromuscular blocking drugs. Anesthesiology. 2006;104(5):1070-80. PMID: 16645461; doi: 10.1097/00000542-200605000-00025

22. Sessler DI. Perioperative Thermoregulation and Heat Balance. Lancet. 2016;387(10038):2655-64. PMID: 26775126; doi: 10.1016/S0140-6736(15)00981-2

23. Singh P, Yoon SS, Kuo B. Nausea: a review of pathophysiology and therapeutics. Therap Adv Gastroenterol. 2016;9(9):810-6. PMID: 20170199; doi: 10.1177/1756283X15618131

24. Quigley EM, Hasler WL, Parkman HP. AGA technical review on nausea and vomiting. Gastroenterology. 2001;120(1):263-86. PMID: 11208736; doi: 10.1053/gast.2001.20516

25. Just B, Delva E, Camus Y, Lienhart A. Oxygen Uptake during Recovery from Naloxone Relationship with intraoperative Heat Loss. J Pain Symptom Manage. 2014,28(10):1991-7. PMID: 25700277; doi: 10.1016/j.jpainsymman.2014.04.030

26. Yang Y, Wu J, Li H, et al. Prospective investigation of intravenous patient-controlled analgesia with hydromorphone or sufentanil: impact on Open Access mood, opioid adverse effects, and recovery. BMC Anesthesiology. 2018;18(1):37. PMID: 29636011; doi: 10.1186/s12871-018-0500-1
The effect of prophylactic rewarming on postoperative nausea and vomiting among patients undergoing laparoscopic hysterectomy: a prospective randomized clinical study

ORIGINAL ARTICLE

Sao Paulo Med J. 2020; 138(5):414-21

27. Carver CS, Lattie EG. Depression, Pessimism, and Health. In: International Encyclopedia of the Social & Behavioral Sciences, 2nd ed. Oxford Elsevier; 2015. p. 207-13. doi: 10.1016/B978-0-08-097086-8.14076-0.

28. Pama MR, Janse M, Sprangers MAG, Fleer J, Ranchor AV. Reducing discrepancies of personal goals in the context of cancer: A longitudinal study on the relation with well-being, psychological characteristics, and goal progress. Br J Health Psychol. 2017;23(1):128-47. PMID: 28960718; doi: 10.1111/bjhp.12278.

29. Schmied H, Kurz A, Sessler DI, Kozeck S, Reiter A. Mild hypothermia increases blood loss and transfusion requirements during total hip arthroplasty. Lancet. 1996;347(8997):289-92. PMID: 8569362; doi: 10.1016/s0140-6736(96)90466-3.

30. Napadow V, Sheehan JD, Kim J, et al. The brain circuitry underlying the temporal evolution of nausea in humans. Cereb Cortex. 2013;23(4):806-13. PMID: 22473843; doi: 10.1093/cercor/bhs073.

31. Drozd R, Rojek-Sito K, Rygula R. The trait ‘pessimism’ does not interact with cognitive flexibility but makes rats more vulnerable to stress-induced motivational deficits: Results from the attentional set-shifting task. Behav Brain Res. 2017;335:199-207. PMID: 28842268; doi: 10.1016/j.bbr.2017.08.028.

32. Hamilton JG, Waters EA. How are multifactorial beliefs about the role of genetics and behavior in cancer causation associated with cancer risk cognitions and emotions in the US population? Psychooncology. 2018;27(2):640-7. PMID: 29024169; doi: 10.1002/pon.4563.

Authors’ contributions: DongDong Liang: conceptualization (lead), formal analysis (lead), project administration (lead), supervision (lead) and writing-original draft (lead); YuanLu Shan: study conception and design (supporting), analysis and interpretation of data (supporting), drafting the article and revisions (supporting), final approval for the article to be published and agreement to be accountable for all aspects of the work, especially regarding clinical data collection. LeiLei Wang: study conception (supporting), analysis and interpretation of data (supporting), drafting the article and revisions (supporting), final approval for the article to be published and agreement to be accountable for all aspects of the work, especially regarding the clinical follow-up data collection.

Sources of funding: None
Conflict of interest: None

Date of first submission: April 7, 2020
Last received: June 14, 2020
Accepted: July 6, 2020

Address for correspondence:
DongDong Liang
Department of Anesthesiology, The First Affiliated Hospital of Wenzhou Medical University, Ouhai Area, Wenzhou city, Zhejiang province, China. 325000
Tel. +86-577-55579372, +86-13758468959
E-mail: amysparks@aliyun.com

© 2020 by Associação Paulista de Medicina
This is an open access article distributed under the terms of the Creative Commons license.