

The effects of warmed intravenous fluids, combined warming (warmed intravenous fluids with humid-warm oxygen), and pethidine on the severity of shivering in general anesthesia patients in the recovery room

Ahmad Nasiri¹, Ayob Akbari², GholamReza Sharifzade³, Pooya Derakhshan⁴

ABSTRACT

Background: Shivering is a common complication of general and epidural anesthesia. Warming methods and many drugs are used for control of shivering in the recovery room. The present study is a randomized clinical trial aimed to investigate the effects of two interventions in comparison with pethidine which is the routine treatment on shivering in patients undergoing abdominal surgery with general anesthesia.

Materials and Methods: Eighty-seven patients undergoing abdominal surgery by general anesthesia were randomly assigned to three groups (two intervention groups in comparison with pethidine as routine). Patients in warmed intravenous fluids group received pre-warmed Ringer serum (38°C), patients in combined warming group received pre-warmed Ringer serum (38°C) accompanied by humid-warm oxygen, and patients in pethidine group received intravenous pethidine routinely. The elapsed time of shivering and some hemodynamic parameters of the participants were assessed for 20 min postoperatively in the recovery room. Then the collected data were analyzed by software SPSS (v. 16) with the significance level being $P < 0.05$.

Results: The mean of elapsed time in the warmed intravenous serum group, the combined warming group, and the pethidine group were 7 (1.5) min, 6 (1.5) min, and 2.8 (0.7) min, respectively, which was statistically significant ($P < 0.05$). The body temperatures in both combined warming and pethidine groups were increased significantly ($P < 0.05$).

Conclusions: Combined warming can be effective in controlling postoperative shivering and body temperature increase.

Key words: General anesthesia, humid-warm oxygen inhalation, pethidine, postoperative shivering, shivering, warmed intravenous fluids

INTRODUCTION

Shivering is a common complication after general anesthesia. Almost 5–65% of patients suffer from this complication post general anesthesia.^[1] General anesthesia and surgery cause several physiological disorders in different organs of the patients that may appear as several complications during recovery, which need to

be identified and evaluated. One of these complications is shivering; it occurs at a frequency of around 22% in Iran.^[2] Most anesthetic drugs such as propofol (in general anesthesia) impair the thermoregulation system and cause postoperative shivering.^[3] Postoperative shivering, which is easily diagnosed, involves movements and involuntary contractions over which patients have no control.^[4] Hypothermia is known as one of the major risk factors influencing postoperative shivering.^[5] There are many risk factors related to the development of hypothermia, including aging, female gender, type of surgery, length of anesthesia, operating room temperature, patient's low weight, and

¹Assistant Professor, Birjand Health Qualitative Research Center, Birjand University of Medical Science, Birjand, Iran, ²MSc. Student, School of Nursing and Midwifery, Birjand University of Medical Sciences, Birjand, Iran, ³Assistant Professor, Social Determinant of Health Research Center, Birjand University of Medical Science, Birjand, Iran, ⁴Assistant Professor of Anesthesiology, Birjand University of Medical Science, Birjand, Iran

Address for correspondence: Mr. Ayob Akbari, School of Nursing and Midwifery, Birjand University of Medical Sciences, Birjand, Iran.
E-mail: Akbari_Ayob@bums.ac.ir

Submitted: 18-Dec-14; Accepted: 06-May-15

Access this article online

Quick Response Code:



Website:
www.ijnmrjournal.net

DOI:
10.4103/1735-9066.170014

history of infusion of cool fluids.^[6-8] Shivering leads to an increase in catecholamine release ICP (intracranial pressure), IOP (intraocular pressure), oxygen consumption, tachycardia, hypertension, metabolic acidosis, coagulation disorders, disorder in the body's nitrogen balance, changes in drug effects, increased postoperative pain, and discomfort for the patient.^[8-10] Manouchehri Pour and Jabbari Moghadam (2007) believe that patients who undergo major surgical procedures will experience more shivering, and their study on the effect of duration of anesthesia on the incidence of shivering showed that in a surgery of 3 h duration, shivering would increase by 50%.^[11] One of the analgesic drugs used commonly to treat shivering is pethidine.^[1,3] It is well-known that pethidine has several side effects such as respiratory depression, nausea, vomiting, and tachycardia.^[3,12,13] Due to the complications of pethidine, finding alternative ways to treat postoperative shivering has always been under consideration.^[8] Although pharmacological treatments are commonly used to reduce shivering, non-pharmacological methods can also be used.^[1,8] Non-pharmacological methods include preventing hypothermia by using blankets, humid-warm oxygen inhalation, intravenous fluids, and forced air warmer.^[1,8,14,15] Humid-warm oxygen inhalation can help prevent some effects such as epistaxis, mucosa dryness, and thick secretion which are difficult to eliminate, as well as cough in chronic obstructive pulmonary disease.^[16] Besides, it can help prevent hypothermia and shivering.^[8] Intravenous warm fluids can also help in treating hypothermia and postoperative shivering.^[8] Chung *et al.* (2012) showed in their study that in the group treated with infusion of warm fluids, the core temperature was higher and the incidence of shivering was low.^[17] Although preventive measures are taken to stop shivering in the operation room, the incidence of involuntary shivering is high in the recovery room.^[8] In the present study, the effects of non-pharmacological methods including intravenous fluids and combined warming (intravenous fluids and humid-warm oxygen inhalation) were compared with those pethidine on the severity of postoperative shivering in patients undergoing abdominal surgery under general anesthesia.

MATERIALS AND METHODS

The present study was registered in IRCT with the code 2014012016278N1. This double-blind clinical trial was performed with 87 patients who were candidates for abdominal surgery under general anesthesia in the Emam Reza hospital in Birjand from June to September 2014. To begin with, the goal and method of the study were explained to the patients and written consents were obtained from them in accordance with ethical considerations; then they were randomly assigned to three groups including two intervention

groups and a pethidine group as routine treatment. The elapsed time of shivering and some hemodynamic parameters (pulse, blood pressure, arterial blood oxygen saturation, temperature) of the participants were assessed for 20 min postoperatively at three time intervals (0, 10, and 20 min after entry to the recovery room).^[14] All patients were covered with a normal bed room blanket after the operation in the recovery room. In the recovery room, the presence or absence of shivering was assessed and recorded in the three groups based on the following four-point scale:

- No shivering
- Mild shivering, slight facial and cervical muscle contraction
- Moderate shivering, obvious shivering in head and neck, shoulders, and/or extremities
- Severe shivering, obvious shaking all over the body.^[18]

Patients in warmed intravenous fluids group received pre-warmed ringer serum (38°C) accompanied by room temperature-humid oxygen and 3 ml of intravenous normal saline as placebo. Patients in combined warming group received pre-warmed Ringer serum (38°C) accompanied by 8 l/min humid-warm oxygen (37°C) and 3 ml of normal saline as a placebo for pethidine. Patients in pethidine group received 0.4 mg/kg intravenous pethidine accompanied by room temperature serum (25.5°C) and room temperature-humid oxygen.

Inclusion criteria were: American Society of Anesthesiologists (ASA) class 1 and 2 patients (ASA1 patients: People with normal health without any systemic disorder such as heart disorder, respiratory disorder, or endocrine disorder and ASA2 patients: People with a mild controlled systemic disease which did not limit their activities); 20–60 years old; undergoing abdominal surgery under general anesthesia; duration of surgery between 1 and 3 h; consenting to participate in the study till the end; patients with shivering grade 2 or 3 (patients with grade 1 shivering had no shivering and the ones who were in grade 4 had severe shivering, obvious shaking all over the body; so, none of them were recruited in the study); normothermic patients (preoperative tympanic temperature); not receiving corticosteroids, nonsteroidal analgesics, antihypertensive drugs, antiepileptic drugs, blood and blood products; not having endocrine disorder, vascular disease, hypertension, ischemic heart disease, fever, drug addiction, obstructive pulmonary disease, and brain lesions, according to their medical records.

Exclusion criteria were: Spinal or epidural anesthesia, younger than 20 or older than 60 years, length of surgery less than 1 h or more than 3 h, score 4 of shivering (because it requires immediate treatment), ASA class 3 and 4 patients.

Induction method of anesthesia in all patients was same which used 3 µg/kg fentanyl, 2 mg/kg propofol, and 0.5 mg/kg atracurium every 30 min. Maintenance of anesthesia in all patients was performed with 150 µg/kg/min propofol and 0.2 mg/kg atracurium every 30 min and 1 µg/kg fentanyl later at 1.5 h for not feeling pain. All patients received 7 ml/kg Ringer serum at room temperature. Body temperature and recovery temperature, and humidity were measured and recorded using tympanic infrared thermometer (Beurer Medical FT60, ULM, Germany) and wall thermometer (Beurer Medical TFA, Wertheim, Germany). The Monitoring device was manufactured in Iran.

Data collection tool consisted of a questionnaire to record patients' demographic information and a checklist of the recorded postoperative parameters. Validity of the information recording form was confirmed by content validity through references and guides of university professors. Reliability of the measurement tools was confirmed by careful measurement and confirmation of their calibration and sensitivity. The devices (thermometers and monitoring) were calibrated, while their specificity and sensitivity had been determined by the manufacturing company and the medical technologist engineer in the related hospital. The research colleague filling the forms of data record and the subjects were blinded to the study to increase the validity of the data. Upon arrival to the recovery room, the degree of shivering of patients who experienced shivering was first determined; then the patients were randomly assigned to one of three study groups. In this study, the letter A, B, and C were typed on 87 cards in equal numbers. Letter A represented the pethidine group, letter B the intravenous warm serum group, and letter C represented the combined warm group. When patients meeting inclusion criteria were enrolled in the study, the colleague nurse removed one card from the box, based on which the patient entered the respective group. The logged card was not put back in the box anymore. After the data were collected, they were analyzed by analysis of variance (ANOVA), analysis of covariance (ANCOVA), Kruskal–Wallis test, repeated ANOVA test, least significant difference (LSD) test, Friedman test, Wilcoxon test, Tukey test, Mann–Whitney U test, and repeated measurements through SPSS version 18. The significance level was considered as $P < 0.05$. The study was approved by the Ethics and Research Committee of Birjand University of Medical Sciences (Code: 1393-02-03).

Ethical considerations

First, the researcher explained the objectives and procedure of the study to the participants and ensured them of confidentiality of information and possibility of participants leaving the study at their own will. Then, the participants provided informed consent. All the procedures

and treatments in this study were performed under the supervision of an anesthesiologist who was a co-researcher.

RESULTS

The variables of gender, age, length of surgery, and the temperature and humidity of recovery room were analyzed by statistical tests (ANOVA) and were not found to be statistically significant ($P < 0.05$) [Table 1].

The pre-intervention temperatures in the two intervention groups and the pethidine group were significant ($P < 0.05$), whereas the difference between the two intervention groups was not significant ($P > 0.05$) [Table 2]. The ANCOVA test showed that with elimination of the effect of pre-intervention temperature variable, the mean of body temperature at 10 and 20 min after intervention in the three groups was statistically significant ($P < 0.05$). The previous results were repeated again; thus, the effect of the confounding variable were excluded from this study and with remove this effect obtained the previous result [Table 3]. The mean of elapsed time in the warmed intravenous serum group, the combined warming group, and the pethidine group were 7 (1.5), 6 (1.5), and 2.8 (0.7) min, respectively, which was statistically significant ($P < 0.05$) [Table 4]. At the 10th and 20th minutes of intervention, shivering was not seen in patients. At the 10th minute of intervention, the difference between pethidine group 37 (0.3°C) and warm intravenous serum group 37 (0.5) was statistically significant ($P = 0.03$). The difference between pethidine group and combined warming group 37 (0.8) was also statistically significant ($P = 0.01$). However, the difference between warm intravenous serum group and combined warming group was not significant ($P > 0.05$) [Table 2]. At the 20th minute of intervention, the difference between pethidine group 37 (0.3) and warm intravenous serum group 37 (0.5) was not significant ($P > 0.05$), but the Tukey test showed significant difference between pethidine group and combined warming group 38 (0.5) ($P = 0.01$). Also, the difference between warm intravenous serum group and combination warming group was significant ($P = 0.04$) [Table 2]. The mean of warmed intravenous serum group's body temperature at three time intervals (0, 10, and 20 min after entry to the recovery room) was not statistically significant ($P > 0.05$); but in both combined warming and pethidine groups, this element increased significantly ($P < 0.05$) [Table 2].

DISCUSSION

All the previous studies on this subject have focused on the effect of drugs, and none have compared non-pharmacological methods with pharmacological ones. In our study, the non-pharmacological methods included warmed intravenous fluids and combined warming (warmed intravenous fluids

Table 1: Comparison of some characteristics of participants in the three groups

Variables	Group 1 (warming intravenous serum group)		Group 2 (combined warming group)		Group 3 (pethidine group)		P
	Mean	SD	Mean	SD	Mean	SD	
Age (years)	51	9.6	53.3	12.2	51.4	15.2	0.75
Length of surgery (min)	43	10	40	10	37.7	12	0.14
Temperature of RR (°C)	23.03	0.82	23.03	0.83	23	0.84	0.98
Humidity of RR (%)	33.8	1.7	33.7	1.8	34.5	1.2	0.159
Gender (F/M)	14	15	15	14	9	20	0.23

SD: Standard deviation, Group 1: Warmed intravenous serum group, Group 2: Combination warming group, Group 3: pethidine group, RR: Recovery room, F: Female, M: Male

Table 2: Comparison of body temperature in patients of the three groups during the study

Body temperature	Group 1 (warming intravenous serum group)		Group 2 (combined warming group)		Group 3 (pethidin group)		P
	Mean	SD	Mean	SD	Mean	SD	
Arrival to recovery room	37.3	0.3	37.1	0.6	36.7	0.4	0.00
10 min	37	0.5	37	0.8	37	0.3	0.001
20 min	37	0.3	38	0.5	37	0.3	0.00

Table 3: Comparison of body temperature in the three groups at 10 and 20 min with elimination of pre-intervention temperature (ANCOVA)

Time (min)	Group 1 (warming intravenous serum group)		Group 2 (combined warming group)		Group 3 (pethidine group)		P
	Mean	SD	Mean	SD	Mean	SD	
10 th min	37.1	0.1	37.3	0.1	37.5	0.1	0.00
20 th min	37.2	0.09	37.3	0.09	37.8	0.08	0.00

Table 4: Comparison of elapsed time in the three groups during the study

Elapsed time (min)	Group 1 (warming intravenous serum group)		Group 2 (combined warming group)		Group 3 (pethidine group)		P
	Mean	SD	Mean	SD	Mean	SD	
	7	1.5	6	1.5	2.8	0.7	0.00

Elapsed time: Shivering stop time

with humid-warm oxygen), which were compared with pharmacological method (pethidine as routine treatment). The mean elapsed time of pethidine group was 2.8 (0.7) min. This finding is in line with that of Emadi *et al.*, who compared the effects of pethidine and tramadol on postoperative shivering in general anesthesia and showed that pethidine can control shivering within 3.5 min.^[3] Also, Zamiri *et al.* compared the effects of intravenous pethidine and clonidine in the treatment of postoperative shivering and recorded the elapsed time of pethidine to be 2.4 min.^[19] Some studies evaluated the effect of warm-humid oxygen on hypothermia and postoperative shivering. Steven Frank *et al.* studied the effect of humid-warm oxygen on body temperature in the recovery room and reported that this method can increase the body temperature and decrease the shivering incidence.^[20] These findings are consistent with

our findings indicating the positive effect of humid-warm oxygen inhalation in preventing shivering. In the present study, humid-warm oxygen inhalation could stop shivering within 6 (1.5) min and could increase the body temperature. Some studies also evaluated the effect of warm intravenous serum on hypothermia and postoperative shivering. A study by Camus *et al.* considered the effects of warm intravenous fluids on intraoperative hypothermia and postoperative shivering during prolonged abdominal surgery and showed that this method combined with skin surface warming could reduce the incidence of postoperative shivering significantly.^[21] Also, Xu *et al.* studied the effect of warm intravenous serum on shivering in abdominal surgery and reported that the method could increase the body temperature and decrease the shivering incidence significantly.^[22] However, our study results did not show significant increase in body temperature

at three intervention time intervals in the warm intravenous group. Oshvandi *et al.* studied the effect of warm intravenous serum on postoperative shivering and showed the incidence of shivering to be 13% in the intervention group and 35% in the control group, which means that shivering incidence in patients who received warm serum infusion was almost one-third of that in the control group.^[6] Our results showed that postoperative warm intravenous serum usage can control shivering at 7 (1.5) min, but using a combined warming can control shivering at 6 (1.5) min, and differences between the two intervention groups were significant. The body temperature in the combined warming group showed significant increase at the three time intervals, implying that combined warming is more effective than warm intravenous fluids on postoperative shivering in the recovery room and is therefore suggested.

CONCLUSION

Considering the elapsed time and the increase of body temperature in the combined warming group, this method can be suggested in patients undergoing abdominal surgery with grades 2 and 3 of shivering. It can be concluded that application of the convenient, easy, and low-cost method of warm-humid oxygen can be helpful in treating postoperative shivering resulting from general anesthesia in abdominal surgery. Using this method to control shivering can also prevent the complications of analgesic. Combined warming (warm intravenous fluids and warm-humid oxygen) can be effective in controlling postoperative shivering and in increasing the body temperature, and is therefore suggested.

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How to cite: Nasiri A, Akbari A, Sharifzade G, Derakhshan P. The effects of warmed intravenous fluids, combined warming (warmed intravenous fluids with humid-warm oxygen), and pethidine on the severity of shivering in general anesthesia patients in the recovery room. Iranian J Nursing Midwifery Res 2015;20:712-6.

Source of Support: Nil, **Conflict of Interest:** None declared.