Original Article

Comparative Study of the Prophylactic Effects of Intravenous Injection of Dexmedetomidine, Ondansetron, and Pethidine on Postoperative Shivering of Abdominal Surgery under General Anesthesia: A Randomized Clinical Trial

Mitra Jabalameli, Behzad Nazemroaya[1], Mahsa Heydari[2]

Departments of Anesthesiology and [2]Critical Care, School of Medicine, Isfahan University of Medical Sciences, [1]Anesthesiology and Critical Care Research Center, Isfahan University of Medical Sciences, Isfahan, Iran

Abstract

Background: postoperative shivering is a common complication of various surgical, so far no acceptable theory has been presented on the prevention of it. The aim of this study was to compare the effect of intravenous injection of dexmedetomidine, ondansetron, and pethidine on postoperative shivering among patients under abdominal surgery. **Materials and Methods:** In a double-blind clinical trial study, 128 patients undergoing abdominal surgery were selected and randomly divided into four groups of 32. In the 4 groups, 0.5 μg/kg dexmedetomidine, 0.5 mg/kg pethidine, 0.1 mg/kg ondansetron, and the same volume of normal saline were injected intravenously when anesthetics were discontinued and the incidence and severity of postoperative shivering were determined and compared in four groups. **Results:** The incidence of postoperative shivering was 12.5% in the dexmedetomidine group, 31.3% in the ondansetron group, 31.3% in the pethidine group, and 50% in the control group (P = 0.015). The mean of shivering severity in the four groups was 1.33 ± 0.5, 0.17 ± 0.8, 1.09 ± 0.4, and 1.13 ± 0.39, and the difference between the four groups was significant (P = 0.005). **Conclusion:** The use of all three drugs of dexmedetomidine, ondansetron, and pethidine is effective in decreasing the incidence of postoperative shivering, but the use of dexmedetomidine is associated with less postoperative shivering, better hemodynamic stability, and fewer other postoperative complications.

Keywords: *Dexmedetomidine, ondansetron, pethidine, shivering, Postoperative Period*

Introduction

Postoperative shivering is one of the most common complications occurring in the recovery room among patients the occurrence of which varies (ranging from 5% to 65%) in different researches and also depending on the types of drugs used and methods of anesthesia.[1] The mechanism of shivering occurrence has not been fully identified but it may be caused by hypothermia.[2] Moreover, the lack of sufficient cortical control and inhibitory reflexes of higher centers of the central nervous system on severe spinal activities presenting in the form of clonic activity can be an explanation for postoperative shivering. In addition, it has been observed that inadequate pain control exacerbates postoperative shivering.[1] One study found that 26 factors were involved in the occurrence of postoperative shivering, factors such as age, sex, duration of surgery and anesthesia, body temperature on entry to recovery, medications used in the induction and maintenance of anesthesia, nondepolarizing muscle relaxants, vasopressor, type of surgery, and others.[1] The prevention or treatment of postoperative shivering not only relieves the patient but also reduces complications such as increased oxygen consumption and plummeting of cardiac output. There are several ways to reduce the occurrence of postoperative shivering such as opioid use that is widely common in anesthesia and pain control and also in the treatment of postoperative shivering. Among such opioids, we can mention pethidine. Pethidine with the same analgesic dose is more effective in preventing or managing postoperative shivering than other opioids.[3] Pethidine is an analgesic opioid that is used in acute pain which binds

How to cite this article: Jabalameli M, Nazemroaya B, Heydari M. Comparative study of the prophylactic effects of intravenous injection of dexmedetomidine, ondansetron, and pethidine on postoperative shivering of abdominal surgery under general anesthesia: A randomized clinical trial. Adv Biomed Res 2021;10:45.

Address for correspondence:
Prof. Behzad Nazemroaya, Anesthesiology and Critical Care Research Center, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: behzad_nazem@med.mui.ac.ir

Received: 16 March 2020
Revised: 16 September 2020
Accepted: 19 December 2020
Published: 25 December 2021

Access this article online

Website: www.advbiores.net

DOI: 10.4103/abr.abr_55_20

Quick Response Code:

the opioid receptor in the brain, blocking the ascending pathways of pain that make a generalized depression of pain. It appears that the continuous intravenous injection of pethidine is a reasonable approach to controlling acute pain.[4] Pethidine is usually given in single doses as a preoperative drug or in multiple doses as a painkiller drug.[5] Ondansetron is a selective antagonist for the 5HT3 receptor in peripheral nerves that has antiemetic effects. It reduces the prevalence of nausea and vomiting which result from the toxic effects of drugs such as cisplatin and radiosen in high doses within the first 24 h after consumption. Ondansetron is used also to prevent nausea and vomiting before chemotherapy and radiotherapy. This is at least 70 times stronger than metoclopramide but has no effect on motions caused by dopamine agonists. Ondansetron onset takes about 30 min and it is absorbed 100% orally. Its protein binding ability is 70%–76%.[6] Dexmedetomidine is a potent and specific alpha-2 agonist used as a sedative and analgesic in the intensive care unit. This has a small amount of opioid effect, anxiolytic, sympatholytic, and is respiration protective. It also maintains better hemodynamic stability than other sedative agents.[7] The initial injection dose of dexmedetomidine is 1 μg/kg in 10 min, which can have a strong preventive effect on postoperative shivering.[8] Although there have been several studies on the effects of these drugs on postoperative shivering, there is no study to compare the efficacy of dexmedetomidine, ondansetron, and pethidine with each other in the abdomen surgery. Hence, the aim of this study is to determine the prophylactic effects of intravenous injection of dexmedetomidine, ondansetron, and pethidine on postoperative shivering.

Materials and Methods

This study was a double-blind randomized clinical trial that was performed in the medical training centers of Isfahan University of Medical Sciences. The target population of this study were patients undergoing abdominal surgery. Inclusion criteria: entering criteria were the American Society of Anesthesiologists Class I and II who were candidates for abdominal surgery under general anesthesia, ranging from 18 to 60 years of age and both sexes with the patients' consent to participate in the study. Furthermore, patients with a history of tricyclic antidepressants, monoamine oxidase inhibitors, vasoactive agents; painkiller and opiate medications, patients with musculoskeletal and nervous system diseases, thyroid disease, dysautonomia, fever, pregnancy, obesity (body mass index >27), history of cardiovascular, respiratory, endocrine or neurologic disease, allergic to magnesium sulfate, ketamine, and pethidine were not involved in the study.

In the case of severe bleeding during surgery or severe hemodynamic abnormalities, allergic reactions and shivering symptoms that needed more than 1-time treatment with pethidine were also excluded. According to the mean comparison formula and with 95% confidence interval, 80% power of the test, the standard deviation of postoperative pain severity which was equal to 1.67, and 0.8 to be the least significant difference between groups, the required sample size was estimated to be 32 patients in each group. Sampling was done by the simple method and patients depending on the time of entry who met the necessary conditions were entered into the study to reach the sample size. Furthermore, patients were distributed in a randomized block allocation method and with the required number among the groups. The study is a double-blind clinical trial in which the drugs are provided in similar and coded syringes. The patients, injector, and clinical caregiver are unaware of the syringe's content thus they are blind. Shivering severity was assessed by Crassly and Mahajan Score;

As:
0: no shiver
1: no muscle activity but the existence of piloerection, peripheral vasoconstriction, or both
2: muscle activity in one muscle group
3: Existence of contraction and muscle activity in more than 1 muscle group
4: intense muscle activity in all parts of the body.

Data collection

Beforehand, approval from the Ethics Committee (IR.MUI.REC.1398.182) of the University and informed consent from the patients were obtained. This clinical trial was registered at www.irct.ir with identification code (IRCT20160307026950N18) and obtaining written consent from patients, 128 patients were selected having inclusion criteria and distributed by random allocation method in one of 4 groups. In Group D: 0.5 μg/kg dexmedetomidine, in Group P: 0.5 mg/kg Pethidine, in Group O: 0.1 mg/kg ondansetron, and in Group N: normal saline after discontinuing the anesthetic drug was injected intravenously. All drugs were diluted in the same 50cc syringes to the same volume and were infused by syringe pump over 10 min to patients. Fluid therapy protocol in all patients was the same, according to the 4-2-1 rule during the nothing by mouth (NPO) period and the 6-8-10 rule, intraoperatively. After the patients were placed on the bed and standard monitoring devices were applied, (including a pulse oximeter, capnography, blood pressures, and electrocardiogram), anesthesia was induced by injecting fentanyl (1.5 μg/kg), atracurium (0.5 mg/kg) thiopental sodium (5 mg/kg). After confirmed endotracheal intubation, anesthesia was continued by, isoflurane (in minimum alveolar concentration value), a gas mixture with 60% N_2O in O_2, and morphine (0.1 mg/kg). The patient's ventilation was in a way that End-tidal CO_2 ($ETCO_2$) was maintained at about 30–35 cm H_2O. The central temperature was measured and recorded using a digital sublingual oral thermometer, before surgery, before drug administration, after intubation, every 15 min during the anesthesia, at

the end of anesthesia, after extubation, on arrival to the recovery room, and then every 15 min for 1 h. Furthermore, operating and recovery room temperatures (21°C–23°C)[9] at the above mentioned times and start time and end of surgery were recorded. The mean arterial pressure, heart rate, and level of blood oxygen saturation were recorded at base times, just before the injection of studied drugs and every 15 min after surgery. At the end of the surgery, the patients were reversed using atropine (0.02 mg/kg) and neostigmine (0.04 mg/kg). After full awakening, the patients were extubated and transferred to recovery.

Duration of extubation (from anesthesia discontinuation to extubation of endotracheal tube), anesthesia duration (from the injection of drugs to unconsciousness), the duration of surgery (from the first incision to the last suture) and duration of recovery (according to Modified form Aldrete table), and duration of being awake after anesthesia (from extubation time to the patient's response to time, place, and person) were recorded. Subsequently, the patients entering the recovery received oxygen continuously through a nasal catheter at a rate of 3 l/min, then were covered with a blanket. Patients were monitored every 15 min for shivering upon arrival and then ranked based on Crosley and Mahajan score. According to the above criteria in cases with Grade 3 or 4 of shivering, 25 mg pethidine was injected and an additional dose of pethidine was recorded. Finally, the obtained data were analyzed by SPSS software version 23 software (IBM, USA) using Chi-square test, one-sided ANOVA, repeated measures ANOVA, and Kruskal–Wallis tests with the significant level $P < 0.05$ [Figure 1].). The data were entered into SPSS version 20 software (IBM, USA)

Results

In this study, 128 patients undergoing abdominal surgery in 4 groups of 32 patients receiving dexmedetomidine, ondansetron, pethidine, and control were studied. Table 1 shows the demographic and clinical distribution variables of the four groups in which there was no significant difference between the four groups. Furthermore, operation and anesthesia duration and the recovery length between the four groups had no significant difference, but the duration of the endotracheal tube extubation between the four groups had a significant difference ($P = 0.015$).

The analysis of hemodynamic parameters did not demonstrate a significant difference between the four groups during surgery and recovery. The trend of central and peripheral temperature changes during operation and recovery between the four groups was not different significantly.

The incidence of shivering was 40 patients (31.3%) including four patients (12.5%) in the dexmedetomidine group, 10 persons (31.3%) in the ondansetron group, 10 patients (31.3%) in the pethidine group, and 16 patients (50%) from the control group. Postoperative shivering frequency was significantly lower in the dexmedetomidine group ($P = 0.015$). The mean of shivering intensity in the four groups during recovery were 1.33 ± 0.39, 1.12 ± 0 0.4, 1.17 ± 8 0, and 1.13 ± 0.5, respectively, and the difference among the four groups was significant ($P = 0.005$). Studying shivering intensity in different time tables also indicated that the control group entering recovery had higher scores while it did not have a significant difference at other times [Table 2].

The mean of postoperative pain severity in the four dexmedetomidine, ondansetron, pethidine, and control groups was 0.6 ± 1.3, 2.4 ± 1.9, 1.8 ± 0.7, and 1.9 ± 0.4, respectively, the difference between groups was significant as well ($P < 0.001$). The mean scores of sedative administration in four groups of dexmedetomidine, magnesium sulfate, pethidine, and control were, respectively, 1.18 ± 0.17, 1.21 ± 0.2, 1.34 ± 0.44, and 1.25 ± 0.17 and it did not indicate any significant difference between the four groups ($P = 0.082$). Given in Table 3, 20 patients (15.6%) had hemodynamic abnormality including 2 (6.3%) in the dexmedetomidine group, 4 (12.5%) in the ondansetron group, 6 (18.8%) from the pethidine group, 8 (25%) in the control group. There were no significant differences between the four groups ($P = 0.19$). The complication types included 4 cases having hypertension, 8 cases of hypotension, 4 cases of tachycardia, and 4 cases of bradycardia which had no significant differences between the four groups ($P = 0.1$). Moreover, 11 patients (34.4%) of the dexmedetomidine group, 16 patients (50%) of the ondansetron group, three patients (9.4%) of the pethidine group, and 13 (40.6%) patients of the control group received pethidine, and there was a significant difference between the four groups ($P = 0.005$). The received pethidine mean dose was significantly different between the four groups. The dexmedetomidine group had the lowest and the control group received the highest amount of pethidine ($P = 0.035$). There was no significant difference in the prevalence of nausea occurrence between the four groups, but the vomiting was significantly different between the groups ($P = 0.013$). The results are shown in Table 3.

Discussion

Postoperative shivering is a challenging issue in the field of anesthesia and surgery since this complication can lead to secondary complications in addition to the patient's discomfort. As a result, various methods have been introduced to reduce the occurrence and severity of this complication. In the present study, demographic characteristics showed no significant differences among the four groups and had no disrupting effect on hemodynamic and respiratory parameters, or the intensity of shivering, pain, and sedation score. Therefore, it is most likely that the observed differences between the groups could be related to the preemptive administration of the medications

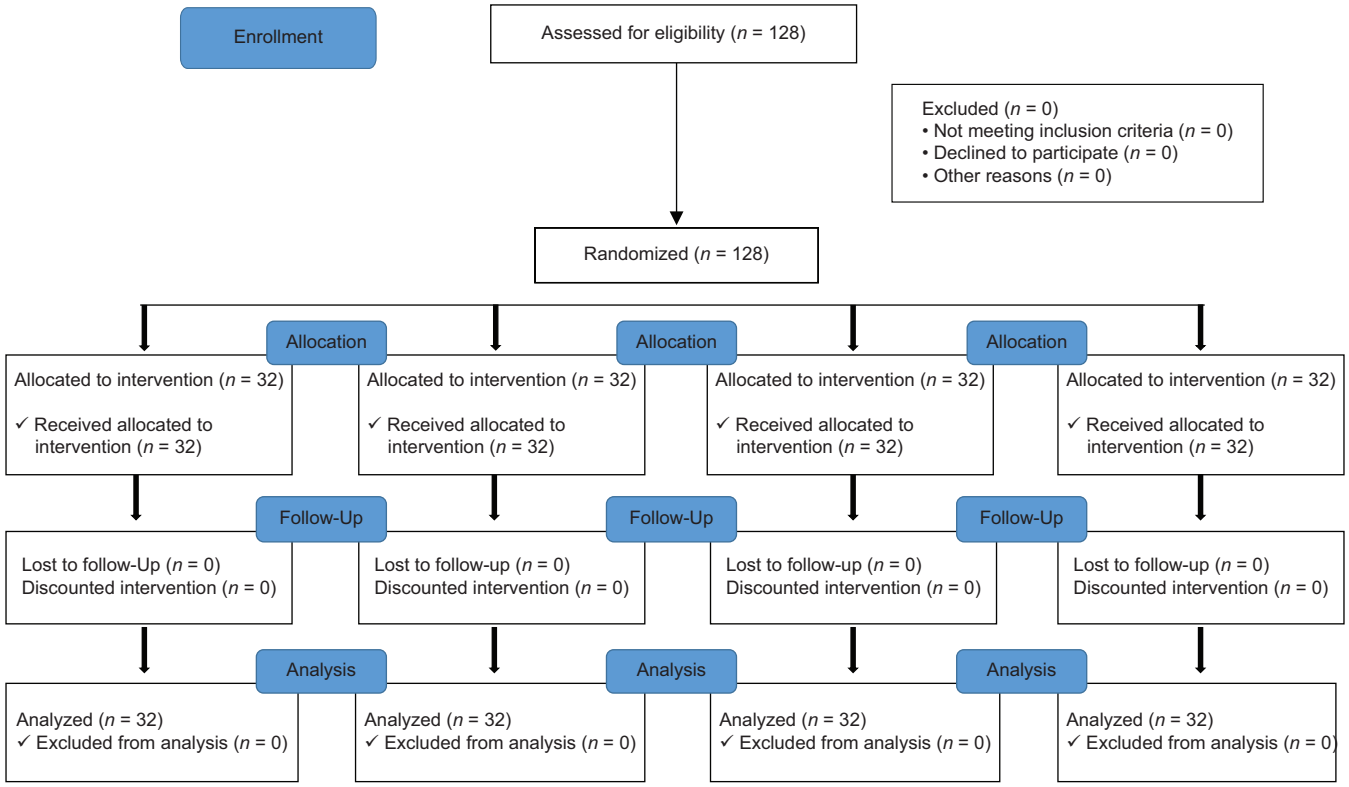

Figure 1: Study flow diagram

Table 1: Distribution of demographic and general variables in four groups

Variable	Unit	C (Group)	P (Group)	O (Group)	D (Group)	*P**
Age	Years	44.7±9.4	45.7±8.8	45.2±9.4	51.2±11.2	0.14
BMI	kg/m^2	25.39±7.05	30.17±9.2	27.77±7.61	28.33±8.1	0.13
Variable	**Unit**	**C (Group)**	**P (Group)**	**O (Group)**	**D (Group)**	***P****
Gender (%)	Female	17 (53.2)	15 (46.8)	15 (46.8)	18 (56.2)	0.86
	M	15 (46.8)	17 (53.2)	17 (53.2)	14 (43.8)	
ASA (%)	I	26 (81.2)	25 (78.1)	24 (75)	19 (59.4)	0.2
	II	6 (18.8)	7 (21.9)	8 (25)	13 (40.6)	
BUD (%)		6 (18.75)	6 (18.75)	5 (15.6)	8 (24.2)	0.75
Variable	**Unit**	**C (Group)**	**P (Group)**	**O (Group)**	**D (Group)**	***P****
SD	Min	104.5±41.3	100.5±42.7	113.3±46.6	128.8±70.3	0.14
AD	Min	109.9±27.6	110.6±36.9	114.4±24.0	117.8±26.0	0.6
ED	Min	13.7±5.7	16.5±8.2	17.7±6.8	20.2±10.4	0.015
RD	Min	60.6±4.7	65.9±12.4	66.9±13.8	67.2±9.2	0.05

*One-way ANOVA test, **Independent *t*-test. BMI: Body mass index, BUD: Background underlying disease, SD: Surgery duration, AD: Anesthesia duration, ED: Extubation duration, RD: Recovery duration, C: Control, P: Pethidine, O: Ondansetron, D: Dexmedetomidine

and most likely related to the type of prescription and used drugs. Vital parameters such as blood pressure, heart rate, and blood oxygen saturation during surgery and recovery did not show significant differences between the groups, and no case of serious hemodynamic complications requiring medical intervention was observed either. It can be acknowledged that the drugs used, both in type and dosage, had no adverse effects on the patient and could be considered safe anesthetic drugs. In a previous study by He *et al*., they found that ondansetron had a significant effect on postoperative shivering compared to placebo, whereas there was no difference between ondansetron and pethidine. In addition, there was no difference between ondansetron, pethidine, and placebo in the risk of bradycardia, but ondansetron was associated with a lower risk of hypotension than placebo. However, there was no difference in hypotension risk between ondansetron and pethidine.[10] Central and peripheral temperatures did not differ significantly between the four groups during the course of operation and anesthesia. Overall, the trend of body temperature changes during the study period was balanced and similar between the

Table 2: Distribution of frequency and intensity of shivering in the recovery of the four groups

Variable	Time	C (Group)	P (Group)	O (Group)	D (Group)	*P**
Shivering frequency (%)	Enter PACU	13 (40.6)	0	2 (6.3)	2 (6.3)	<0.001
	15th min	4 (12.5)	0	2 (6.3)	2 (6.3)	0.016
	30th min	2 (6.3)	0	0	1 (3.1)	0.042
	45th min	2 (6.3)	2 (6.3)	0	0	0.16
	60th min	2 (6.3)	0	0	0	0.01
Shivering NTST	Enter PACU	2.41±0.87	1.94±0.88	2.16±0.81	1.31±0.64	<0.001
	15th min	1.78±0.66	1.53±0.51	1.72±0.77	1.44±0.61	0.083
	30th min	1.56±0.62	1.19±0.40	1.44±8.0	1.25±0.51	0.053
	45th min	1.25±0.59	1.25±0.76	1.25±0.44	1.19±0.54	0.87
	60th min	1.06±0.25	1.94±0.74	1.28±0.46	1.13±0.42	0.34

*Independent *t*-test. C: Control, P: Pethidine, O: Ondansetron, D: Dexmedetomidine, PACU: Postanesthesia care unit

Table 3: Frequency distribution of postoperative complications of four understudied groups

Variable	C (Group)	P (Group)	O (Group)	D (Group)	*P*
Hypertension (%)	0	1 (3.1)	2 (6.3)	1 (3.1)	
Hypotension (%)	3 (9.4)	3 (9.4)	1 (3.1)	1 (3.1)	0/04
Tachycardia (%)	4 (12.5)	0	0	0	
Bradycardia (%)	1 (3.1)	2 (6.3)	1 (3.1)	0	
Nausea (%)	8 (25)	3 (9.4)	6 (6.18)	3 (9.4)	0.23
Vomiting (%)	11 (34.4)	3 (9.4)	6 (6.18)	2 (6.3)	0.013
Pethidine (%)	13 (40.6)	3 (9.4)	16 (50)	11 (34.4)	0.005
Pethidine (mg) (%)	22.7±2.6	20±0.0	25.7±9.6	18.3±3.9	0.035

C: Control, P: Pethidine, O: Ondansetron; D, Dexmedetomidine

groups. The occurrence of postoperative shivering in the dexmedetomidine group was significantly lower than the other groups, whereas shivering in the ondansetron and pethidine groups was similar. There was also a significant difference in the severity of shivering between the groups and according to the findings of our study, it seems that the use of dexmedetomidine as a precursor can reduce the occurrence of postoperative shivering. Moreover, in addition to dexmedetomidine, the use of ondansetron and pethidine also appeared to decrease postoperative shivering compared to the control group who received no drug. In this regard, the results of a previously mentioned study by He *et al*. have shown that compared to ondansetron and placebo, ondansetron had a remarkable effect on reducing postoperative shivering compared to placebo, while there was no difference between ondansetron and pethidine, and these findings corroborate with our study results. This study concluded that ondansetron could effectively prevent postoperative shivering.[10]

In a further study by Entezari Asl *et al*. using ondansetron instead of meperidine was recommended as ondansetron was more efficient at reducing postoperative shivering (50%–13.3%) and it had fewer complications especially in patients with unstable hemodynamic conditions[11,8] In a study by Abdel-Ghaffar *et al*. on the optimal dose of dexmedetomidine in shivering control with the least hemodynamic abnormalities, after treatment with three different doses of 0.2, 0.3, and 0.5 mg/kg body weight, they concluded that a dose of 0.3 mg/kg, had the greatest effect on treating postoperative shivering after spinal anesthesia. It also had positive hemodynamic and sedation effects.[12] A study by Thomas *et al*. has also shown that continuous dexmedetomidine infusion has a much greater advantage than its bolus type, but only intravenous administration of the drug has been suggested for a maintenance dose.[13] In the study of Doufas *et al*., the synergistic effect of dexmedetomidine and meperidine on postoperative shivering and its effect on reducing the sedative effect of the two drugs have been observed.[14] Furthermore, in the study by Nasseri *et al*., the occurrence and severity of postoperative shivering in the cesarean section was lower in patients who received dexmedetomidine (compared to the patients who received placebo); however, hypotension, bradycardia, nausea, and vomiting were similar between these two groups.[15] Moreover, in a study conducted by Bicer *et al*., intravenous injection of a dose of 1 microgram per kilogram with the dosing of 0.5 mg/kg of dexmedetomidine had no significant difference in reducing postoperative shivering.[16] In our study, investigating other postoperative complications showed that the occurrence of hypotension was lower in the pethidine and control groups than in the dexmedetomidine and ondansetron groups. On the other hand, there was also a significant difference in vomiting, pethidine, and pethidine dose between groups; and these were lower in the dexmedetomidine group, which was similar to the results of the studies by Abdel-Ghaffar,[12] Doufas[14] and Nasseri[15] about hemodynamic[12] disorders and the occurrence of nausea and vomiting[14] and those who received a pethidine dose.[15]

Conclusion

Findings of our study showed that the use of all three drugs (dexmedetomidine, ondansetron, and pethidine) was effective in reducing the occurrence of postoperative shivering but comparatively, using dexmedetomidine was associated with a lower occurrence of postoperative shivering, better hemodynamic stability, as well as less occurrence of postoperative complications.

Therefore, it seems that using this drug for reducing postoperative shivering is preferable to ondansetron and pethidine. However, given the limitations of this study, such as the small sample size, further studies are recommended.

Financial support and sponsorship

Isfahan University of Medical sciences

Conflicts of interest

The authors declare that they have no conflict of interest.

References

1. Teymourian H, Mohajerani SA, Bagheri P, Seddighi A, Seddighi AS, Razavian I. Effect of ondansetron on postoperative shivering after craniotomy. World Neurosurg 2015;84:1923-8.
2. Sajedi P, Nazemroaya B. Comparing the effectiveness of antishivering action of meperidine alfentanil, sufentanil, fentanyl and tramadol after general anesthesia. Shiraz E-Med J 2006;7:20409.
3. Parsa T, Dabir S, Radpay B. Efficacy of pethidine and buprenorphine for prevention and treatment of postanesthetic shivering. Tanaffos 2007;6:54-8.
4. Edwards DJ, Svensson CK, Visco JP, Lalka D. Clinical pharmacokinetics of pethidine: 1982. Clin Pharmacokinet 1982;7:421-33.
5. Mather LE, Meffin PJ. Clinical pharmacokinetics of pethidine. Clin Pharmacokinet 1978;3:352-68.
6. Milne RJ, Heel RC. Ondansetron. Therapeutic use as an antiemetic. Drugs 1991;41:574-95.
7. Bae HB. Dexmedetomidine: An attractive adjunct to anesthesia. Korean J Anesthesiol 2017;70:375-6.
8. Kim YS, Kim YI, Seo KH, Kang HR. Optimal dose of prophylactic dexmedetomidine for preventing postoperative shivering. Int J Med Sci 2013;10:1327-32.
9. Hakim M, Walia H, Dellinger HL, Balaban O, Saadat H, Kirschner RE, *et al*. The effect of operating room temperature on the performance of clinical and cognitive tasks. Pediatr Qual Saf 2018;3:e069.
10. He K, Zhao H, Zhou HC. Efficiency and safety of ondansetron in preventing postanaesthesia shivering. Ann R Coll Surg Engl 2016;98:358-66.
11. Entezari Asl M, Isazadehfar Kh, Akhavanakbari G, Khoshbaten M. The effect of ondansetron in prevention of postoperative shivering after general anesthesia in gynecological surgery. Iran Red Crescent Med J 2012;14:316-7.
12. Abdel-Ghaffar HS, Mohamed SA, Fares KM, Osman MA. Safety and efficacy of dexmedetomidine in treating post spinal anesthesia shivering: a randomized clinically controlled dose-finding trial. Pain Physician 2016;19:243-53.
13. Thomas A, Satyaprakash MV, Elakkumanan LB, Bidkar PU, Mishra SK. Comparison of different regimens of intravenous dexmedetomidine on duration of subarachnoid block. J Anaesthesiol Clin Pharmacol 2016;32:497-500.
14. Doufas AG, Lin CM, Suleman MI, Liem EB, Lenhardt R, Morioka N, *et al*. Dexmedetomidine and meperidine additively reduce the shivering threshold in humans. Stroke 2003;34:1218-23.
15. Nasseri K, Ghadami N, Nouri B. Effects of intrathecal dexmedetomidine on shivering after spinal anesthesia for cesarean section: A double-blind randomized clinical trial. Drug Des Devel Ther 2017;11:1107-13.
16. Bicer C, Esmaoglu A, Akin A, Boyaci A. Dexmedetomidine and meperidine prevent postanaesthetic shivering. Eur J Anaesthesiol 2006;23:149-53.