

Original Article

Comparison of Tramadol and Pethidine for Postanesthetic Shivering in Elective Cataract Surgery

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ABSTRACT

Background: Postoperative shivering is a common event of unknown etiology with an incidence of 5-65%. This study intended to compare the efficacy of tramadol with that of pethidine in controlling postanesthetic shivering.

Methods: This double-blind clinical trial was performed on 300 consecutive patients underwent general anesthesia for elective cataract surgery. Intravenous tramadol 1 mg/kg or pethidine 0.5 mg/kg was administered for alternate subjects who developed postanesthetic shivering. They were monitored in the recovery room for 1 hour and the cessation time of shivering, recurrence of the event, duration of recovery, respiratory depression, nausea, vomiting, and arterial O₂ saturation were recorded.

Results: One hundred and twenty patients (40%) had postanesthetic shivering. In the tramadol group, shivering terminated within 8 minutes after injection (mean 5 min). They had not recurrence of shivering, respiratory depression, reduction in SpO₂ and nausea or vomiting during recovery. In the pethidine group, shivering terminated within 13 minutes (mean 9 min) after injection, but in 10 patients it recurred after 30 minutes. In this group 28 patients had respiratory depression, reduction in SpO₂, nausea and vomiting but none of them needed any medication.

Conclusion: Tramadol is superior to pethidine as it induced a faster termination of postanesthetic shivering and did not entail adverse effects on the respiratory system and SpO₂, recurrence of shivering or nausea and vomiting. Easy availability and minimum monitoring requirements are other advantages of tramadol.

Keywords: Postoperative Shivering, General Anesthesia, Postoperative Complications, Tramadol, Pethidine.

Postoperative shivering is a common untoward event seen in 60% of patients recovering from general anesthesia and 30% after epidural anesthesia¹. The incidence varies depending on the type of anesthesia (inhalational or intravenous), gender, age, and the duration of the anesthesia or the operation¹. Administration of halothane, enflurane, and isoflurane has been associated with post-anesthesia shivering in more than 60% of cases². The etiology is not clearly known, but the predisposing factors for postoperative shivering are: heat loss, cold infusion or transfusion, general anesthesia (inhalational and intravenous anesthetics), and regional anesthesia¹. Shivering commonly occurs within the first 30 minutes of recovery³. Mild shivering increases oxygen consumption to a level comparable to light exercise, whereas intense shivering can dramatically increase oxygen consumption and

carbon dioxide production up to 500 percent^{1, 2} and thus increases the minute ventilation¹. Consequently, the heart rate, blood pressure, and stroke volume all increase for compensation and the cardiac output may raise to five fold of its normal value¹. Intraocular pressure also raises secondary to an increase in carbon dioxide due to postoperative shivering.

In the patients with cardiopulmonary dysfunction, who cannot afford the compensatory mechanisms, post-anesthesia shivering decreases the mixed venous blood oxygen saturation¹. Moreover, hypoxia, lactic acidosis, and hypercar-

bia can complicate the recovery¹. Therefore, in these patients postoperative shivering must be primarily prevented, and promptly controlled if it occurs.

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The pharmacologic management of postoperative shivering currently includes recommended antishivering drugs such as pethidine, tramadol, ketanserin, propofol, physostigmine, nefopam, alfentanil, and sufentanil². Pethidine is an opioid with antishivering effects through μ and σ receptors. Intravenous pethidine (25 mg) is effective in reducing postoperative shivering, probably through κ receptors in the thermoregulation center. In this regard pethidine has shown to reduce the threshold of shivering in a linear fashion. It has an efficacy of 30-95%², but its side effects are nausea, vomiting, and respiratory depression⁴. Tramadol is an analgesic which blocks the reuptake of norepinephrine and 5-HT, and has some affinity to μ but not other opioid receptors. It has been used for postoperative analgesia. During a non-controlled clinical trial on a limited number of patients it has been reported that tramadol poses excellent antishivering effect by increasing the shivering threshold¹.

This study was designed to compare the antishivering effects of tramadol and pethidine, in a sample of adult patients undergoing general anesthesia for cataract surgery.

Materials and Methods

The current study was a double-blind clinical trial on the patients underwent elective cataract surgery in Farabi Hospital, Tehran, in 2003. Three hundred consecutive patients participated in this trial and their age, gender, and weight were recorded. The inclusion criteria were: age of over 14 and under 65 years old, ASA physical status I or II, the operation time of 1 to 2 hours, the operation and recovery rooms ambient temperature of 25 °C, negative drug history for opioids, barbiturates or benzodiazepines, negative history of underlying respiratory diseases, unanimity of the anesthetic technique and type of anesthesia. The patient's written informed consent was obtained on the possibility of postoperative shivering that would necessitate pharmacologic intervention. The exclusion criteria were: the physical status III or IV, hemodynamic instability, operation time of less than 1 or more than 2 hours, receiving respiratory support or sedatives / analgesics post-operatively.

All 300 patients were anesthetized by a single anesthesiologist using the same techniques and drugs: Atracurium 0.5 mg/ kg, sodium thiopentone 5 mg/ kg, fentanyl 1.5 μ g/kg, halothane and O₂.

A nurse anesthetist prepared two syringes labeled A and B, with A containing pethidine 0.5 mg/kg (50 mg/1 ml; Gerot Pharmazeutika Vienna, Austria for Darupakhsh, Iran), and B containing tramadol 1 mg/kg (100 mg/2 ml; Darupakhsh, Iran), both diluted in normal saline to obtain equal volumes of 5 ml.

The ambient temperature at the operation room and the recovery was set at 25°C. After the operation, the patients were placed on a sheeted bed, transferred to the recovery room where they were covered with blanket and were given supplemental O₂ as 4 L/min by face mask. If the patients developed postoperative shivering in the recovery room, a second nurse anesthetist who was blind to the content of the syringes would administer intravenous A or B, alternatively. In the recovery room all the patients were monitored by pulse oximetry, electrocardiography, and automatic blood pressure measurements for 1 hour.

The evaluated variables were: the time of cessation of shivering following drug administration, recurrence of shivering, respiratory depression, arterial oxygen saturation (SpO₂), nausea, vomiting, and the duration of recovery, which were assessed and recorded by a third nurse anesthetist who was blind to the drugs and group of the patient. If the patients had reduced arterial SO₂, oxygen was administered at 6 liters/minute via facial mask.

Data were presented as mean \pm SD or n (%) where appropriate. The quantitative variables were compared using t-test. For the qualitative variables the Chi-square and Fisher exact tests were used. Statistical analysis was performed on a computer using SPSS version 11 software.

Results

Of 120 patients who developed post-anesthetic shivering, 60 received pethidine, and the rest received tramadol. All of the patients had undergone general anesthesia for elective cataract surgery. Baseline characteristics of the patients are

presented in table 1. Two groups were not significantly different in the baseline characteristics.

It was seen that tramadol controlled shivering earlier and more effectively than pethidine, as there was no recurrence of shivering by tramadol and also all of the adverse effects observed in this study, occurred in the pethidine group (table 2). The respiratory depression, nausea and vomiting that developed in the pethidine group were transient and resolved spontaneously. The patients of

both groups had not epilepsy following medications.

Duration of recovery period was not significantly different between two groups (44 ± 10 in tramadol vs. 46 ± 12 in pethidine groups) and the patients of both groups had full recovery within 40-55 minutes and were transferred to the relevant wards.

Table 1. Baseline characteristics of the two study groups. Data are mean \pm SD or n (%).

		Pethidine	Tramadol	Total	P value
Age (year)		33.5 \pm 15	38 \pm 18	36 \pm 16	0.145
Gender	Male	33 (52)	31(48)	64 (54)	0.855
	Female	27 (48)	29 (52)	56 (46)	
Weight (kg)		57.5 \pm 12	61.5 \pm 11	59.5 \pm 12	0.061
Physical class	I	48 (80)	41 (69)	89 (74)	0.210
	II	12 (20)	19 (31)	31 (26)	

Table 2. Outcomes following the administration of the medications. Data are mean \pm SD or n (%).

	Pethidine	Tramadol	Total	P Value
Cessation of Shivering (min)	9 \pm 1.8	5 \pm 1.3	7 \pm 2.6	0.0004
Recurrence of Shivering	10 (16.7)	0 (0)	10 (8.3)	0.001
Respiratory depression	9 (15)	0 (0)	9 (7.5)	0.002
Decreased SpO2	6 (10)	0 (0)	6 (5)	0.012
Nausea	5 (8.3)	0 (0)	5 (4.2)	0.02
Vomiting	8 (13.3)	0 (0)	8 (6.7)	0.003

Discussion

Different pharmacologic and non-pharmacologic modalities are used to control postoperative shivering¹. In the current study we investigated the effects of intravenous pethidine and tramadol, for

the management of post-anesthetic shivering in the recovery room. Our results shows the superiority of tramadol to pethidine for the following reasons: 1) Earlier onset of action (cessation of shivering); tramadol was effective with an aver-

age time of 4 minutes earlier than pethidine (means of 5 minutes vs. 9 minutes), 2) No recurrence of shivering with tramadol, 3) No respiratory depression or decrease in SpO₂ with tramadol, 4) Shorter duration of recovery with the minimum monitoring requirements, and 5) Less adverse effects and safe usage even by non-anesthetists. Moreover, tramadol is more accessible, i.e. does not require official registration and written formalities of opioids prescription.

Our results are in accordance with that of Bhatnagar's study² on higher efficacy of tramadol over pethidine in controlling the postoperative shivering without recurrence. However, our study was carried on a noticeably larger group of patients than Bhatnagar's study².

In another study, Tarkkila et al⁵ compared the respiratory effects of tramadol and pethidine and observed that unlike pethidine (0.6 mg/kg), equivalent doses of tramadol did not lead to respiratory depression⁴.

Alfonsi et al⁵ tried pethidine, fentanyl, and lidocaine for management of post-anesthetic shivering and observed that lidocaine was ineffective, while fentanyl controlled the shivering but to a lesser degree than pethidine. Their finding on the recurrence of shivering following administration of pethidine was similar to our results. In another study by Grundmann et al⁶ on comparing the preventive effect of pethidine with that of clonidine for post-anesthetic shivering it has been shown that pethidine was less effective in preven-

tion of the event and the recurrence rate was higher (25% with pethidine vs. 5% with clonidine).

Other experiments on the efficacy of several drugs suggested that pethidine and clonidine, and to a lesser extent physostigmine and pentazocine could control post-anesthetic shivering^{7, 8, 9, 10} while alfentanil was ineffective⁷. Urapidil had some effect in one study¹¹, but entailed more side effects than pethidine or clonidine. However, another study failed to show its effectiveness at all¹⁰. Moreover, doxepam¹³ and nalbupine¹⁴ were as effective as pethidine in controlling postoperative shivering.

Our second test drug, tramadol, was previously shown by Trekova¹⁵ to be more effective than the placebo and without any adverse effects. Also, Mathew et al¹² showed the effectiveness of tramadol for prevention of postoperative shivering at doses of 1 and 2 mg/kg with respective success rates of 96% and 98%, which are in the same range as our result of 100% success rate with a dose of 1 mg/kg.

The result of this study shows that for management of postoperative shivering, tramadol 1 mg/kg is superior to pethidine due to its earlier onset of action, less untoward consequences (reduced arterial oxygen saturation, respiratory depression, nausea, and vomiting), less formalities of prescription, and its higher safety when used as an analgesic in the hands of non-anesthetists.

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