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Original Article

Post Operative Management of Shivering: A Comparison Between the Efficacy of Tramadol and Pethidine

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ABSTRACT

Objective: To compare improvement in shivering and frequency of adverse effects in geriatric patients undergoing trans-urethral resection of prostate (TURP).

Study Design: Quasi-experimental study.

Place and Duration of Study: Anesthesia Department of Combined Military Hospital, Sialkot, Pakistan from Jan 2025 to Dec 2025.

Methodology: A total of 860 patients were divided into Group-A (n=430) to receive IV Tramadol and Group-B (n=430) to receive IV Pethidine. The primary outcome measure was the improvement or prevention of postoperative shivering following administration of the study drug. The secondary outcome measure included the frequency of adverse effects associated with each medication.

Results: The overall frequency of postoperative shivering was significantly lower in the Tramadol Group where 41 patients (9.5%) developed shivering compared with 98 patients (22.8%) in the Pethidine Group (p<0.001) with the grade of shivering considerably more severe in the Pethidine than the Tramadol Group (p<0.001).

Conclusion: Overall, the findings of the present study are consistent with contemporary anesthesia literature demonstrating that Tramadol is an effective and safe pharmacologic agent for preventing postoperative shivering. In addition to its superior efficacy, Tramadol exhibited a more favorable safety profile compared with Pethidine, particularly with respect to respiratory depression, sedation, and hypotension.

Keywords: Meperidine, Postoperative Shivering, Post-Anesthesia Care Unit, Spinal Anesthesia, Tramadol, Transurethral Resection of Prostate.

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INTRODUCTION

Post-operative shivering is a frequent complication following anesthesia and surgery, with an incidence reported between 20–65% depending on anesthetic technique and patient characteristics.[1] It is particularly relevant in elderly patients undergoing urological procedures such as trans-urethral resection of the prostate (TURP). Shivering in the post-operative period is not merely uncomfortable; it increases metabolic demand, oxygen consumption, carbon dioxide production, and cardiac workload, which may precipitate adverse cardiopulmonary events in geriatric populations who often have limited physiological reserves.[2]

Several mechanisms contribute to post-operative shivering, including perioperative hypothermia, anesthetic-induced thermoregulatory impairment, and surgical stress responses.[3] Elderly patients are particularly susceptible because of impaired thermoregulation, reduced subcutaneous fat, decreased metabolic heat production, and higher prevalence of comorbidities such as cardiovascular disease and diabetes.[4] TURP procedures further predispose patients to thermal disturbances due to exposure to irrigation fluids and prolonged operative time, making effective control of shivering an important component of perioperative management.

Pharmacological treatment remains the cornerstone for management of post-operative shivering. Among the available agents, Pethidine (meperidine) has traditionally been considered the drug of choice because of its unique anti-shivering properties mediated through κ-opioid receptor agonism and central thermoregulatory modulation.[5]

Tramadol, a centrally acting analgesic with μ-opioid receptor activity and inhibition of serotonin and norepinephrine reuptake, has emerged as an alternative agent for the management of post-operative shivering.[6] Recent studies have

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demonstrated Tramadol in reducing the intensity and duration of post-anesthetic shivering, though evidence in geriatric patients undergoing TURP remains limited.[7]

Given the vulnerability of elderly surgical patients and the need for effective yet safe pharmacologic control of shivering, comparative evaluation of Tramadol and Pethidine in this specific population is clinically important. Therefore, the objective of this study is to compare improvement in shivering and the frequency of adverse effects in geriatric patients undergoing trans-urethral resection of the prostate (TURP).

METHODOLOGY

This quasi-experimental study was carried out at the Anesthesia Department of Combined Military Hospital, Sialkot from January 2025 - December 2025 after approval from the ethical review board (vide letter no: ERC/65/2025 dated 01 Jan 2025). The trial was registered at www.thaiclinicaltrials.org with trial no TCTR20260428002.

Sample size was calculated using the WHO calculator keeping the confidence interval at 95%, power of test at 80% with the anticipated proportion of post-operative shivering after pre-treatment with Tramadol versus Pethidine at 16.2% versus 24.3% respectively.[8] Minimum sample size using the WHO calculator came out be 383 patients for each Group. Keeping lost to follow-up and margin for incomplete data, we included a total of 430 patients per Group making the final study sample of 860 patients. The sampling frame included all geriatric patients planned for an elective trans-urethral resection of prostate and were added into one of the two Groups using simple random sampling via computer generated slips.

Inclusion Criteria: Male patients aged ≥65 years (geriatric), scheduled for elective trans-urethral resection of the prostate (TURP) under spinal anesthesia, hemodynamically stable at the time of treatment, and provided written informed consent

Exclusion Criteria: Patients with pre-existing fever (temperature ≥38°C) or baseline hypothermia (<36°C) before spinal anesthesia, active infection/sepsis, known hypersensitivity to Tramadol or pethidine/meperidine, chronic opioid use or opioid dependence, history of seizure disorder, severe hepatic or renal impairment (risk of altered drug metabolism/clearance), significant respiratory compromise (COPD with CO_2 retention or baseline SpO_2 <92% on room air), clinically significant cardiac instability (ongoing ischemia, uncontrolled arrhythmias, or decompensated heart failure), cognitive impairment precluding valid consent/assessment, use of other anti-shivering drugs intra- or post-operatively (clonidine, dexmedetomidine, magnesium, ketamine), conversion to general anesthesia, major intra-operative complications, or refusal to participate.

The study method included all patients as per the inclusion criteria furnished. The patients were divided into Group-A (n=430) to receive IV Tramadol and Group-B (n=430) to receive IV Pethidine. A total of 860 geriatric male patients scheduled for elective trans-urethral resection of the prostate (TURP) under spinal anesthesia were enrolled in the study. Patients fulfilling the inclusion criteria were included after informed consent, while those meeting any exclusion criteria were omitted from the study. Allocation concealment was ensured using sequentially numbered, opaque sealed envelopes which were opened after the completion of surgery and transfer of the patient to the recovery area. Group-A received intravenous Tramadol (1 mg/kg), while Group-B received intravenous Pethidine (0.5 mg/kg). The study was conducted using a double-blind design. The study medications were prepared in identical syringes by an anesthetist who was not involved in patient assessment or data collection. Both the patients and the anesthetist responsible for postoperative monitoring and outcome assessment remained unaware of the Group allocation throughout the study period.

All patients underwent TURP under standardized spinal anesthesia according to the institutional protocol. Routine intraoperative monitoring included electrocardiography, non-invasive blood pressure monitoring, pulse oximetry, and temperature monitoring. Ambient operating room temperature and perioperative fluid administration were maintained according to standard clinical practice. At the completion of surgery, patients were shifted to the PACU for postoperative monitoring. Immediately upon arrival in the PACU, each patient received the designated study drug as pre-treatment in the immediate postoperative period, prior to the onset of shivering. The drug was administered slowly via intravenous injection over approximately 2–3 minutes. After administration of the assigned medication, patients were closely observed in the

recovery area over 3 hours for the occurrence of postoperative shivering and any adverse effects. Postoperative shivering was assessed using the Crossley and Mahajan shivering scale, a standardized five-point ordinal grading system used to determine the severity of shivering in patients recovering from anesthesia. Grade 0 indicated no shivering, Grade 1 represented the presence of piloerection or peripheral vasoconstriction without visible muscular activity, Grade 2 was defined as visible muscular activity limited to a single muscle Group, Grade 3 indicated muscular activity involving more than one muscle Group but not generalized shaking, Grade 4 represented generalized shivering involving the entire body.[9] This grading system was used throughout the postoperative observation period to objectively evaluate the presence and severity of shivering in the recovery area. Postoperative shivering was assessed in the recovery room by trained anesthesia residents who were blinded to the study Groups and standardized in the application of the Crossley and Mahajan shivering scale prior to study initiation. Each patient was evaluated at predefined postoperative intervals, and the highest observed shivering grade during the observation period was recorded. To minimize inter-observer variability, all assessors underwent a calibration session using simulated scenarios and pilot cases to ensure uniform interpretation of grading criteria. In addition, periodic cross-checking by a senior anesthesiologist was performed, and where discrepancies arose, a consensus decision was taken, thereby strengthening the reliability and consistency of shivering assessment across observers (Figure).

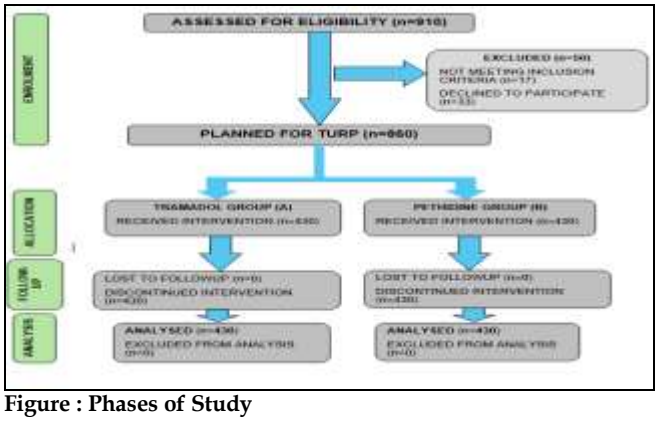

Figure : Phases of Study

The primary outcome measure was the improvement or prevention of postoperative shivering following administration of the study drug. The secondary outcome measure included the frequency of adverse effects associated with each medication. Adverse events such as nausea, vomiting, hypotension, bradycardia, excessive sedation, respiratory depression, dizziness, or pruritus were actively monitored and documented. Hemodynamic parameters including heart rate, blood pressure, respiratory rate, and oxygen saturation were recorded during the recovery period. Any patient who developed severe shivering or clinically significant complications received appropriate rescue treatment according to institutional protocols.

All statistical calculations were performed using Statistical Package for Social Sciences 31:0. Normality of the data was checked for continuous variables and was normally distributed. Variables including age, duration of surgery, PACU temperature, and PACU stay was expressed as Mean±SD and compared using the independent samples t-test. Variables including ASA status, shivering incidence, shivering grade, nausea, vomiting, sedation, respiratory depression and hypotension were expressed as frequency with percentage and compared using the Chi-square test. The *p*-value of ≤ 0.05 was considered statistically significant.

RESULTS

The final sample comprised 860 patients, with 430 patients in Group-A (Tramadol) and 430 patients in Group-B (Pethidine). The mean age of patients in G was 69.13±4.36 years, while in Group-B it was 69.82±4.94 years (p=0.030). The mean PACU temperature recorded in the Tramadol Group was 36.31±0.38°C compared with 36.17±0.41°C in the Pethidine Group (p<0.001). The mean duration of surgery was 55.18±11.97 minutes in Group-A and 57.98±12.44 minutes in Group-B (p<0.001). Similarly, the mean duration of stay in the PACU was 67.34±12.39 minutes in the Tramadol Group compared with 71.54±14.37 minutes in the Pethidine Group (p<0.001). Regarding ASA physical status distribution, 227 patients (52.8%) in Group-A and 230 patients (53.5%) in Group-B were classified as ASA-II, whereas 203 patients (47.2%) in Group-A and 200 patients (46.5%) in Group-B were classified as ASA-III, with no statistically significant difference between the two Groups (p=0.838) (Table-I).

The overall frequency of postoperative shivering was significantly lower in the Tramadol Group where 41 patients (9.5%) developed shivering compared with 98 patients (22.8%) in the Pethidine Group (p<0.001). When graded according to the Crossley and Mahajan

shivering scale, 389 patients (90.5%) in Group-A had no shivering (Grade 0) compared with 332 patients (77.2%) in Group-B. Among those who experienced shivering, Grade 2 shivering occurred in 17 patients (4.0%) in the Tramadol Group-And 51 patients (11.9%) in the Pethidine Group. Grade 3 shivering was observed in 18 patients (4.2%) in Group-A compared with 37 patients (8.6%) in Group-B, while Grade 4 shivering occurred in 6 patients (1.4%) in the Tramadol Group-And 10 patients (2.3%) in the Pethidine Group. No patients in either Group developed Grade 1 shivering (0%). The difference in the distribution of shivering grades between the two Groups was statistically significant (p<0.001) (Table-II).

Table-I: Demogrpahic and Operative Variables (n=860)

Variables	Group-A (n=430)	Group-B (n=430)	*p*-value
Mean Age (Years)	69.13±4.36	69.82±4.94	0.030
Mean Post-Anesthesia Care Unit Temperature (Degree Celsius)	36.31±0.38	36.17±0.41	<0.001
Mean Duration Of Surgery (Minutes)	55.18±11.97	57.98±12.44	<0.001
Mean Post-Anesthesia Care Unit Stay (Min)	67.34±12.39	71.54±14.37	<0.001
American Society of Anesthesiologists (ASA) Status			
ASA-II	227(52.8%)	230(53.5%)	0.838
ASA-III	203(47.2%)	200(46.5%)	

Table-II: Shivering Incidence And Shivering Grade (N=860)

Variables	Group-A (n=430)	Group-B (n=430)	*p* value
Frequency of shivering	41 (9.5%)	98 (22.8%)	<0.001
Grade of shivering			
Grade 0 (no shivering)	389 (90.5%)	332 (77.2%)	<0.001
Grade 1	00 (0%)	00 (0%)	
Grade 2	17 (5.0%)	51 (11.9%)	
Grade 3	18 (4.2%)	37 (8.6%)	
Grade 4	06 (1.4%)	10 (2.3%)	

The incidence of nausea was 72 patients (16.7%) in the Tramadol Group-And 56 patients (13.0%) in the Pethidine Group, which was not statistically significant (p=0.125). Similarly, vomiting occurred in 32 patients (7.4%) receiving Tramadol compared with 20 patients (4.7%) receiving Pethidine, and this difference was also not statistically significant (p=0.086). However, sedation was significantly more frequent in the Pethidine Group, occurring in 68 patients (15.8%) compared with 40 patients (9.3%) in the Tramadol Group (p=0.004). A significant difference was also observed for respiratory depression, which occurred in 12 patients (2.8%) in Group-B compared with 1 patient (0.2%) in Group-A (p=0.002). Additionally, hypotension was observed in 24 patients (5.6%) in the Pethidine Group compared with 10 patients (2.3%) in the Tramadol Group, and this difference was statistically significant (p=0.014). These findings indicate that Pethidine was associated with a higher frequency of sedation, respiratory depression, and hypotension compared with Tramadol (Table-III).

Table-III: Adverse Effects Profile Between Both Groups (N=860)

Variables	Group-A (n=430)	Group-B (n=430)	*p*-value
Nausea	72 (16.7%)	56 (13.0%)	0.125
Vomiting	32 (7.4%)	20 (4.7%)	0.086
Sedation	40 (9.3%)	68 (15.8%)	0.004
Respiratory depression	01 (0.2%)	12 (2.8%)	0.002
Hypotension	10 (2.3%)	24 (5.6%)	0.014

DISCUSSION

Postoperative shivering is a well-recognized complication following spinal anesthesia and may lead to increased oxygen consumption, metabolic demand, and cardiovascular stress. Elderly patients undergoing trans-urethral resection of the prostate are particularly susceptible due to impaired thermoregulatory mechanisms and exposure to large volumes of irrigation fluids. In the present study, Tramadol demonstrated superior efficacy in reducing both the incidence and severity of postoperative shivering compared with pethidine. Additionally, Tramadol showed a safer adverse-effect profile with lower rates of respiratory depression, sedation, and hypotension.

Shrestha *et al.* (2021) conducted a comparative study assessing Tramadol and meperidine for the control of post-spinal anesthesia shivering. They reported that Tramadol significantly reduced both the incidence and severity of shivering compared with meperidine. These findings are consistent with our results where the overall frequency of shivering was significantly lower in the Tramadol Group (9.5%) compared with the Pethidine Group (22.8%).[10]

Gupta *et al.* (2023) evaluated pharmacological strategies for preventing postoperative shivering and demonstrated that Tramadol was effective in reducing shivering incidence while maintaining hemodynamic stability. Their study highlighted the dual mechanism of Tramadol involving opioid receptor activity and inhibition of serotonin and norepinephrine reuptake, which enhances thermoregulatory control. Similar observations were noted in the present study where

Tramadol showed superior effectiveness in preventing postoperative shivering.[11]

Patel *et al.* (2022) performed a comparative evaluation of Tramadol and meperidine in patients undergoing spinal anesthesia and found that Tramadol achieved faster control of shivering with fewer adverse cardiopulmonary effects. Their findings align with the results of our study, which demonstrated a lower incidence of respiratory depression and hypotension in patients receiving Tramadol .[12]

Shakya *et al*. (2020) conducted a randomized clinical study comparing Tramadol and Pethidine for treatment of post-spinal anesthesia shivering and concluded that Tramadol was equally or more effective than Pethidine in controlling shivering episodes. They also reported that Tramadol was associated with fewer respiratory complications, which corresponds closely with the present findings where respiratory depression occurred more frequently in the Pethidine Group.[13]

Bansal *et al*. (2020) evaluated the comparative efficacy of Tramadol and Pethidine in the management of postoperative shivering and reported that Tramadol significantly decreased shivering incidence while maintaining better cardiovascular stability. Their results support the present study findings where Tramadol was associated with a significantly lower rate of hypotension compared with pethidine.[14]

Kumar *et al.* (2021) investigated the prophylactic role of Tramadol in preventing shivering following spinal anesthesia and demonstrated that Tramadol significantly reduced postoperative shivering when administered during the perioperative period. These findings are consistent with the methodology and outcomes of the current study, where prophylactic administration of Tramadol in the immediate postoperative period effectively reduced shivering incidence.[15]

Thapa *et al*. (2022) examined postoperative shivering management in elderly surgical patients and emphasized that Tramadol offers effective anti-shivering activity with minimal respiratory compromise. Their observations are particularly relevant to the present study population of geriatric TURP patients, where Tramadol demonstrated a more favorable respiratory safety profile compared with pethidine.[16]

Kumar *et al*. (2021) compared Tramadol and Pethidine for control of post-anesthetic shivering and reported that Tramadol significantly reduced moderate to severe shivering episodes. Their findings correspond with the present study results where higher grades of shivering (Grade 3 and Grade 4) were observed more frequently in the Pethidine Group.[17]

Rao *et al*. (2022) reviewed pharmacological interventions used for postoperative shivering and concluded that Tramadol remains one of the most effective agents due to its multimodal mechanism of action and favorable safety profile. Their conclusions support the current findings where Tramadol demonstrated superior efficacy and fewer adverse cardiopulmonary events compared with pethidine.[18]

Joshi *et al*. (2023) highlighted the importance of optimizing postoperative recovery and minimizing complications following regional anesthesia. They emphasized that effective prevention of postoperative shivering improves patient comfort and recovery outcomes. The results of the present study support this perspective, as the reduced incidence of shivering in the Tramadol Group may contribute to improved postoperative recovery in elderly surgical patients.[19]

Elvan *et al*. (2020) investigated pharmacological approaches for preventing postoperative shivering and demonstrated that Tramadol is an effective agent for reducing shivering due to its central thermoregulatory effects. Their findings reinforce the results of the present study, which showed that Tramadol significantly decreased the occurrence and severity of postoperative shivering.[20]

Overall, the findings of the present study are consistent with contemporary anesthesia literature demonstrating that Tramadol is an effective and safe pharmacologic agent for preventing postoperative shivering. In addition to its superior efficacy, Tramadol exhibited a more favorable safety profile compared with pethidine, particularly with respect to respiratory depression, sedation, and hypotension. These results suggest that Tramadol may represent a preferable anti-shivering medication for geriatric patients undergoing TURP under spinal anesthesia.

LIMITATIONS OF STUDY

Despite the strengths of this study, certain limitations should be acknowledged. First, the study was conducted at a single tertiary-care center, which may limit the generalizability of the findings to other clinical settings. Second, the study focused only on geriatric patients undergoing TURP under spinal anesthesia, and therefore the

results may not be directly applicable to other surgical populations or anesthetic techniques. Finally, long-term postoperative outcomes and patient satisfaction were not evaluated, which could be explored in future studies.

CONCLUSION

The present study demonstrated that Tramadol was more effective than Pethidine in reducing the incidence and severity of postoperative shivering in geriatric patients undergoing trans-urethral resection of the prostate under spinal anesthesia. Patients receiving Tramadol experienced significantly fewer episodes of shivering as well as lower grades of shivering compared with those receiving pethidine. In addition, Tramadol showed a more favorable safety profile, with a lower incidence of sedation, respiratory depression, and hypotension. These findings suggest that Tramadol may be considered a safer and more effective pharmacologic option for the prevention and management of postoperative shivering in elderly patients undergoing TURP procedures.

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Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

OA & SA: Data acquisition, critical review, approval of the final version to be published.

MS & AH: Conception, study design, drafting the manuscript, approval of the final version to be published.

KMY & RMN: Data analysis, data interpretation, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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