

Efficacy of Prophylactic Low-Dose Ketamine Versus Tramadol for Prevention of Shivering During Spinal Anesthesia

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ABSTRACT

Objective: To compare the efficacy of prophylactic low-dose Ketamine versus Tramadol for prevention of shivering during spinal anesthesia in patients undergoing lower abdominal surgeries.

Study Design: Quasi-experimental study.

Place and Duration of Study: Department of Anesthesiology, Combined Military Hospital, Rawalpindi, Pakistan, from Sep 18 to Mar 19.

Methodology: There were 86 patients of both genders between the ages of 18 and 50 years, having any type of abdominal surgery under spinal anaesthesia. Patients with coagulopathy, Ketamine allergies, pregnancy, and obesity were excluded. Five minutes after administration of drugs, patients in group A received injections of 0.05 mg/kg of Ketamine, while patients in group B received injections of 1 mg/kg of Tramadol after giving spinal anaesthesia. Using the Crossley and Mahajan scale, the degree of shivering was noted down during the operation and up to 30 minutes after surgery at intervals of 15 minutes.

Results: The mean age of patients in group A was 32.35 ± 9.46 years, while the mean age of patients in group B was 31.35 ± 8.84 years. Out of total sample of 86 patients, 57(66.28%) were male while 29(33.78%) were female. After undergoing lower abdominal surgeries under spinal anaesthesia, 34 patients (79.07%) who were given prophylactic low-dose Ketamine reported no post-operative shivering, compared to 21 patients (48.84%) who were given Tramadol ($p=0.001$).

Conclusion: This study concluded that spinal anaesthesia with Ketamine reduces postoperative shivering in individuals undergoing lower abdomen surgery compared to Tramadol.

Keywords: Abdominal Surgeries, Ketamine, Post-operative Shivering, Spinal Anesthesia.

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INTRODUCTION

Muscular action that is spontaneous, involuntary, and recurrent is considered shivering. Hypothermia, which decreases the threshold for shivering, is a common concern during and after spinal anaesthesia (SA) because vasodilation can allow for fast heat loss and core to peripheral redistribution of body heat.^{1,2} Shivering does not pose a life-threatening situation, but it can have serious side effects in those who have had cardiorespiratory disease in the past, including increased oxygen use that results in hypoxia, increased carbon dioxide production, and lactic acidosis. Additionally, it can make patients uncomfortable, exacerbate wound pain, and interfere with the monitoring of electrocardiography, blood pressure, and pulse oximetry, which could be dangerous for

patients.^{3,4} It is extremely uncomfortable for the patient, and its frequency has been reported in literature to be 40 to 70% during and after spinal anaesthesia (SA).⁵ Shivering's aetiology is still not fully understood. Postoperative shivering may be caused by both thermoregulatory and non-thermoregulatory variables, including exposure to cold weather, insufficient pain management, and opiate withdrawal.^{1,6}

Currently, numerous pharmaceutical and non-pharmacological treatments have been developed to stop shivering and hypothermia. The patient should be kept warm before and during the procedure, and the operating space shouldn't cool down. These are the two most important non-pharmacological methods described. Several drugs have been suggested for the prevention and treatment of postoperative shivering, including Ketanserin, Meperidine, Sufentanil, Alfentanil, Physostigmine, Tramadol, and Clonidine. Each of these has specific negative effects.^{7,8}

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The anti-shivering effectiveness of prophylactic Tramadol in comparison to low-dose intravenous (IV) Ketamine in our local community is poorly documented. One study confirms the effectiveness of Tramadol, whereas another supports the efficacy of Ketamine. According to a study by Akram *et al.*, using prophylactic low-dose Ketamine for lower abdominal surgeries reduced the incidence of post-operative shivering by 18.75% as compared to 46.88% with Tramadol, with a significant difference (P -value < 0.05).⁹ Another study by Hidayah *et al.*, found that prophylactic low-dose Ketamine was more effective (92%) as compared to Tramadol (84%) in preventing shivering; hence, Tramadol is preferred over spinal anaesthesia for people undergoing lower abdominal operations as compared to Ketamine.¹⁰

Because of this, we decided to investigate whether a low dose of prophylactic Ketamine is more effective than Tramadol in preventing shivering in spinal anaesthesia in patients who were undergoing lower abdomen surgeries. The findings of my research will be useful in determining which prophylactic treatment is most effective in preventing shivering in patients undergoing lower abdominal surgeries when they're under spinal anaesthesia.

METHODOLOGY

After taking permission from the hospital's ethical committee (IERB), Approval certificate No.305) this Quasi-experimental study was carried out at Anesthesia Department of CMH, Rawalpindi, Pakistan, from Sep 18 to Mar 19. Sample size of 86 cases (33 in each group) is calculated using an online calculator (www.openepi.com) with 80% power of test and 95% confidence interval, while taking the expected frequency of shivering to be 32% in Ketamine group and 6% in Tramadol group patients respectively.¹¹ Eighty-six patients ($n=86$) were enrolled to undergo spinal anaesthesia for elective procedures.

Inclusion Criteria: Patients in this study ranged from 18 to 50 years old and belonged to either ASA classification I or II, undergoing any one of the following procedures: cystolithotomy, appendectomy, hernioplasty, vaginal and abdominal hysterectomy.

Exclusion Criteria: Patients were not allowed to participate in study if they had a history of ischemic heart disease, psychiatric or psychological problems, epilepsy, glaucoma, or allergy to the study medicines. Patients whose initial body temperature was below

36.5 degrees Celsius or above 38.0 degrees Celsius, were likewise excluded from the study.

Just after administration of SA, patients were randomly divided into two groups: Ketamine was assigned to Group-K, and Tramadol to Group-T. The randomization process involved utilizing computer-generated random numbers and the sealed envelope technique.

Patients were placed in a seated position before receiving spinal anesthesia and the procedure was carried out in the midline of the L3-L4 or L4-L5 interspaces with a spinal needle measuring 27 gauge. The process was carried out using an aseptic method. For spinal anesthesia, a combination of 12.5 mg (2.5 ml) of hyperbaric bupivacaine at a concentration of 0.5% and 25 micrograms (mcg) of fentanyl was employed as the local anesthetic agent. The temperature in the operation area was kept between 18 and 20 degrees Celsius at all times. There were two study groups: Group-K, administered with Ketamine (0.2 mg/kg IV), and Group-T, administered with Tramadol (0.5 mg/kg IV). The study drugs, concealed in coded syringes, were prepared by an anesthetist not participating in patient management. Additionally, 5 mL coded syringes containing the study drugs were provided to the anesthetists in charge, who were kept unaware of the study group allocations. The drugs were administered as an IV bolus. Using the Crossley and Mahajan scale, shivering was noted during the operation, up to 30 minutes afterward, and at 15-minute intervals.⁶ The patients were kept under surveillance in the recovery room for thirty minutes. During that time, the observer, who was also blinded to the medicine being studied, continued to monitor the previously discussed parameters. The self-created proforma was used to record the demographic information and effectiveness of both groups.

A program for statistical analysis was used to analyze the data, SPSS (Statistical Package for the Social Sciences version 23.0). We calculated frequency and percentage for qualitative variables. The means and standard deviations of quantitative features were calculated. Chi-square test was used to assess the effectiveness of the two groups, with a p -value of < 0.05 considered significant.

RESULTS

The study's participants ranged in age from 18 to 50, with a mean age of 31.35 ± 9.12 years. The mean age of the patients in groups K and T was 32.35 ± 9.46 years

and 31.35 ± 8.84 years, respectively. The majority of the 63 patients (73.26%) were between the ages of 18 and 35 years. The male-to-female ratio of these 86 cases was 2:1, with 57(66.28%) males and 29(33.72%) females. 53(61.73%) of the 86 patients were ASA-I, and 33(38.27%) were ASA-II (Figure). Patients are distributed based on the type of procedure. Surgery required an average of 30.44 ± 5.86 minutes. The demographic data of the subjects is shown in Table-I.

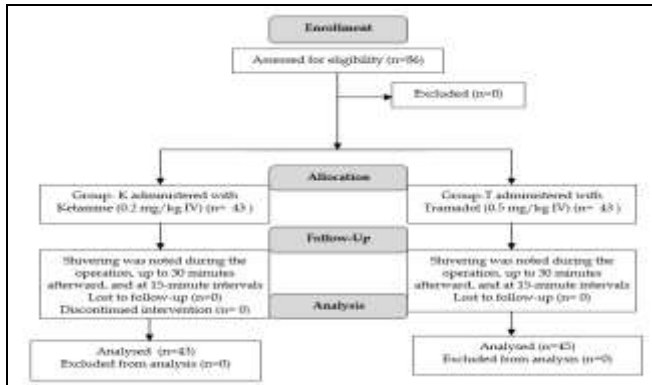


Figure: Patient Flow Diagram

Table-I: Demographic Details of Patients Included in This Study (n=86)

Parameters	Characteristics	Group-K Frequency (%) n=43	Group-T Frequency (%) n=43	Total
Age (years)	18-35	31(72.09%)	32(74.42%)	63(73.26%)
	36-50	12(27.91%)	11(25.58%)	23(26.74%)
Type of surgery	Hernioplasty	13(30.23%)	14(32.56%)	27(31.40%)
	Appendectomy	18(41.86%)	18(32.56%)	36(41.86%)
	Cystolithotomy	09(20.93%)	08(18.60%)	17(19.77%)
	Hysterectomy	03(6.98%)	03(6.98%)	6(6.98%)
Duration of surgery	≤30 Min	20(46.51%)	23(53.49%)	43(50.00%)
	> 30 Min	23(53.49%)	20(46.51%)	43(50.00%)

In patients undergoing lower abdominal surgeries, prophylactic low-dose Ketamine was effective in reducing post-operative shivering in 34(79.07%) patients as compared to 21(48.84%) patients in the Tramadol group, as shown in Table-II. Table-III presents stratification of efficacy data on various parameters in two groups (Group K and Group T) with corresponding characteristics, comparing their efficacy, age distribution, gender, ASA classification, type of surgery, and surgery duration. The *p*-values indicate statistical significance. Notable findings include significant differences in age distribution (18-35 years and 36-50 years), gender, ASA classification (I and II), hernioplasty, and surgery duration (≤30 minutes), suggesting potential associations or effects in these areas.

Table-II: Efficacy of Treatment Drugs in Preventing Shivering in Patients Undergoing Lower Abdominal Surgeries Under Spinal Anesthesia (n=86)

Parameters	Characteristics	Group-K	Group-T	<i>p</i> -value
Efficacy	Yes	34(79.07%)	21(48.84%)	0.003
	No	09(20.93%)	22(51.16%)	

Table-III: Association of efficacy with respect to age groups (n=86)

Parameters	Characteristics	Group-K		Group-T		p-value
		Efficacy n(%)		Efficacy n(%)		
		Yes	No	Yes	No	
Age (years)	18-35	24(27.91)	07(8.13)	17(19.76)	15(17.44)	0.043
	36-50	10(11.62)	02(2.32)	04(4.65)	07(8.13)	0.021
Gender	Male	22(25.58)	06(6.97)	15(17.44)	14(16.27)	0.034
	Female	12(13.95)	03(3.48)	06(6.97)	08(9.30)	0.039
ASA Classification	I	19(22.09)	06(6.97)	12(13.95)	16(18.60)	0.015
	II	05(5.81)	03(3.48)	09(10.46)	06(6.97)	0.907
	Hernioplasty	09(10.46)	04(4.65)	04(4.65)	10(11.62)	0.035
	Appendectomy	15(17.44)	03(3.48)	13(15.11)	06(6.97)	0.291
	Cystolithotomy	08(9.30)	01(1.16)	04(4.65)	04(4.65)	0.079
	Hysterectomy	02(2.32)	01(1.16)	00(0.0)	03(3.48)	0.083
Surgery Duration (min)	≤30	14(16.27)	06(6.97)	12(13.95)	11(12.79)	0.233
	>30	20(23.25)	03(3.48)	09(10.46)	11(12.79)	0.911

DISCUSSION

This quasi-experimental study reports that prophylactic low-dose Ketamine reduces post-operative shivering as compared to Tramadol in lower abdominal surgeries. The age range in this study was from 18 to 50 years, with a mean age of 31.35 ± 9.12 years. Out of these 86 patients, 57(66.28%) were males, and 29 (33.72%) were females. In subjects experiencing lower abdominal surgeries, prophylactic low-dose Ketamine was effective in reducing post-operative shivering in 34(79.07%) patients as compared to 21 (48.84%) patients in the Tramadol group. A study by Lopez *et al.*, has shown reduced incidence of postoperative shivering during spinal anesthesia for lower abdominal surgeries by 18.75% as compared to 46.88% with Tramadol when prophylactic low-dose Ketamine was used ($P < 0.005$).¹²

Health care professionals have always placed a high priority on treating and relieving patients' symptoms. Shivering is a serious issue that can occur both during and after a subarachnoid block and can be extremely upsetting for the patient. In the literature, its frequency has been observed to be 40 to 70%.¹⁰ Lima *et al.*, explained that anesthesia-induced disruption of thermoregulatory regulation, a cool operating room atmosphere, and variables peculiar to surgery that cause excessive heat loss may all contribute to hypothermia.¹³ Hypothermia is a medical emergency and should be treated immediately. Intraoperative hypothermia triggers a thermogenic shivering response in the body as it strives to recover from normothermia. This happens regardless of the etiology of hypothermia, which is reported in the literature by Paal *et al.*¹⁴

In a study comparing the effectiveness of low-dose Ketamine, Tramadol, and Pethidine in reducing perioperative shivering in patients having spinal anaesthesia, Gemechu *et al.*, found that low-dose Ketamine was more effective than Tramadol (p 0.005).¹⁵ Low-dose Ketamine (0.25 mg kg⁻¹) was found to be considerably more effective than Ondansetron (4 mg dosage) in avoiding shivering during lower abdominal surgery under spinal anaesthesia by Wang *et al.*¹⁶

When it comes to preventing postoperative shivering after general anesthetic induction Thangavelu *et al.*, observed that Ketamine 0.5 mg kg⁻¹ I/V was just as effective as Pethidine 20 mg.¹⁷ Ketamine lowers shivering via blocking the adrenergic impacts of norepinephrine or by reducing hypothalamic thermogenesis that does not involve shivering. The literature extensively supports the objectives of this study. Ketamine has been compared with various drugs to ensure its efficacy in reducing post-operative shivering.

According to research by Khan *et al.*, a low-dose Ketamine infusion during surgery lowers the likelihood that patients may experience postoperative shivering after receiving anaesthesia based on Remifentanyl.¹⁸ They concluded that Ketamine has a protective effect against remifentanyl-induced NMDA receptor antagonistic activity, caused the shaking when under anaesthesia. Ketamine (0.5 mg/kg intravenously) was found to be successful in preventing shivering after spinal anaesthesia, according to Goich *et al.*¹⁹ The shivering during spinal anaesthesia in the Ketamine group was much less than that in the other groups, according to a study done by Samimi *et al.*²⁰

In summary, the cumulative evidence synthesized across the current literature strongly aligns with and reinforces our own clinical findings. Ultimately, this study underscores that the prophylactic intravenous administration of low-dose Ketamine (0.5 mg/kg) offers a significantly more robust reduction in perioperative shivering when compared to Tramadol (1 mg/kg) during spinal anaesthesia. The data of this trial show that Ketamine not only provides superior thermoregulatory stability but also presents a highly effective, predictable prophylactic strategy. These insights ultimately suggest that integrating low-dose Ketamine into standard anesthetic protocols could substantially enhance patient comfort and mitigate the

physiological stressors associated with post-spinal shivering in the clinical setting.

LIMITATIONS OF STUDY

A key limitation of this study was that core temperature was not monitored. For patients undergoing lower abdominal procedures under spinal anaesthesia, we recommend prophylactic low-dose intravenous Ketamine until newer agents with improved safety profiles and fewer adverse effects become available.

CONCLUSION

This study demonstrated that prophylactic Ketamine is more effective than Tramadol in reducing postoperative shivering among patients undergoing lower abdominal surgery under spinal anaesthesia. Ketamine provided better control of shivering, contributing to improved patient comfort during the perioperative period. Therefore, low-dose intravenous Ketamine may be considered a useful prophylactic option for preventing shivering in such surgical patients.

Conflict of Interest: None.

Discolure:

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Authors' Contribution

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

MA & AAQ: Data acquisition, data analysis, critical review, approval of the final version to be published.

FN & S: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AH & IA: Conception, data acquisition, drafting the manuscript, 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.

REFERENCES

1. Crowley LJ, Buggy DJ. Shivering and neuraxial anesthesia. *Reg Anesth Pain Med* 2008; 33(3): 241-252. <https://doi.org/10.1016/j.rapm.2007.11.006>.
2. Yimer HT, Hailekiros AG, Tadesse YD. Magnitude and associated factors of postanesthesia shivering among patients who operated under general and regional anesthesia, Northwest Ethiopia: a cross-sectional study. *J Anesth Clin Res* 2015; 6(11): 1-5. <https://doi.org/10.1093/bja/aei148>
3. Abdelrahman RS. Prevention of shivering during regional anesthesia: comparison of midazolam, midazolam plus Ketamine, Tramadol, and Tramadol plus Ketamine. *Life Sci J* 2012; 9(2): 132-139. <https://doi.org/10.1111/j.1365-2044>
4. Kim YA, Kweon TD, Kim M, Lee HI, Lee YJ, Lee KY. Comparison of meperidine and nefopam for prevention of shivering during spinal anesthesia. *Korean J Anesthesiol* 2013; 64(3): 229-233. <https://doi.org/10.4097/kjae.2013.64.3.229>

5. Aasim SA, Reddy S, Reddy V, Reddy M, Chandarkanth C. Randomised double-blind Comparative study of Tramadol and Dexmedetomidine for post-spinal anesthesia shivering. *J Chalmers Anand Rao Institute Med Sci* 2016; (1): 18-21. <https://doi.org/10.4103/0019-5049.135031>
6. Aloysius L, Balakrishnan M, Ravindran S, Jagathnath Krishna KM. Effect of preoperative warming on post-induction core temperature and incidence of postoperative shivering in patients under general anesthesia. *Ain Shams J Anesthesiol* 2023; 15: 1-7. <https://doi.org/10.1186/s42077-023-00308-8>
7. Ghazi A, Nia FJ, Far KI. Comparison of Low-Dose Ketamine and Propofol Effects on Preventing Shivering in Cesarean Section under Spinal Anesthesia. *J Hunan Uni Natural* 2021; 48(11): 223-228. <https://doi.org/10.1016/j.jclinane.2012.11.014>
8. Ameta N, Jacob M, Hasnain S, Ramesh G. Comparison of prophylactic use of Ketamine, Tramadol, and dexmedetomidine for prevention of shivering after spinal anesthesia. *J Anaesthesiol Clin Pharmacol* 2018; 34(3): 352-355. https://doi.org/10.4103/joacp.JOACP_211_16
9. Zhou Y, Mannan A, Han Y, Liu H, Guan HL, Gao X, et al. Efficacy and safety of prophylactic use of ketamine for prevention of postanesthetic shivering: a systematic review and meta-analysis. *BMC Anesthesiol* 2019; 19(1): 245. <https://doi.org/10.1186/s12871-019-0910-8>
10. Hidayah MN, Liu CY, Joanna OS. Ketamine and Tramadol for the prevention of shivering during spinal anaesthesia. *Clin Ter* 2014; 165(4): 193-198. <https://doi.org/10.7417/CT.2014.1732>
11. Ahmed ZU, Aziz MA, Khan SN. Comparative study of Tramadol versus Ketamine for postoperative shivering. *Pak J Med Health Sci* 2018; 32(3): 1348-1350.
12. Lopez MB. Postanesthetic shivering - from pathophysiology to prevention. *Rom J Anaesth Intensive Care* 2018; 25(1): 73-81. <https://doi.org/10.21454/rjaic.7518.251.xum>
13. Lima GF, Gebreedhn EG, Gebregzi AH, Desta YT, Kassa AA. Efficacy of intravenous and low-dose Ketamine in the prevention of post-spinal anesthesia shivering following cesarean section. *Int J Womens Health* 2017; 9: 681-688. <https://doi.org/10.2147/IJWH.S139655>
14. Paal P, Pasquier M, Darocha T, Lechner R, Kosinski S, et al. Accidental hypothermia: 2021 update. *Int J Environ Res Public Health* 2022; 19(1): 501. <https://doi.org/10.3390/ijerph19010501>
15. Gemechu AD, Gebremedhin TD, Andebiku AA, Solomon F, Sorsa A. The effect of ketamine versus tramadol on prophylactic post-spinal shivering in those patients undergoing orthopedic surgery: a prospective cohort study design, 2020. *BMC Anesthesiol*. 2022 Nov 24; 22(1): 361. <https://doi.org/10.1186/s12871-022-01906-z>
16. Wang J, Wang Z, Liu J, Wang N. Intravenous dexmedetomidine versus tramadol for treatment of shivering after spinal anesthesia: a meta-analysis of randomized controlled trials. *BMC Anesthesiol* 2020; 20(1): 104. <https://doi.org/10.1186/s12871-020-01020-y>
17. Thangavelu R, George SK, Kandasamy R. Prophylactic low-dose ketamine infusion for prevention of shivering during spinal anesthesia: A randomized double blind clinical trial. *J Anaesthesiol Clin Pharmacol* 2020; 36(4): 506-510. https://doi.org/10.4103/joacp.JOACP_201_19
18. Khan MJ, Khan S, Khan R. Prophylactic low-dose ketamine in preventing peri-operative shivering during spinal anesthesia in orthopedic patients. *J Popul Ther Clin Pharmacol* 2023; 30(7): 568-573. <https://doi.org/10.53555/jptcp.v30i7.5096>
19. Goich K, Pastore D, Koutsenko B, et al. A Scoping Review: Ketamine for the Prevention of Perioperative Shivering in Patients Undergoing Spinal Anesthesia. *Cureus* 2024; 16(8): e66630. <https://doi.org/10.7759/cureus.66630>
20. Samimi Sadeh S, Hashemi E, Aminnejad R, Bastanagh E. The Impact of Optimal Dose of Ketamine on Shivering Following Elective Abdominal Hysterectomy: A Randomised Comparative Study. *Anesth Pain Med* 2020; 10(5): e106220. <https://doi.org/10.5812/aapm.106220>