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ORIGINAL ARTICLE

The Effect of Ketamine Versus Tramadol on Prophylactic Post-Spinal Shivering in Those Patients Undergoing Orthopedic Surgery

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ABSTRACT

Background/Objective: Orthopedic patients have a particularly high risk for post-spinal shivering, a typical consequence of spinal anesthesia. Without treatment, shaking may worsen wound pain, increase oxygen use, and impair healing. There have been a number of studies looking at the efficacy of ketamine and other medications for reducing post-spinal shivering. Despite this, there is a dearth of data on more effective and widely available preventive medicines. As a result, the purpose of this research was to evaluate the efficacy of 0.25 mg/kg of Ketamine (K) against 0.5 mg/kg of Tramadol (T) in preventing shivering after spinal anesthesia.

Methodology: 200 patients who were to have orthopedic surgery under spinal anesthesia were randomly chosen to participate in this prospective cohort study. Patients who were given a prophylactic dosage of intravenous ketamine prior to spinal anesthesia are referred to as the Ketamine group(n=100), whereas those who were given Tramadol are referred to as the Tramadol group (N=100). During the intraoperative phase, vital signs such as shivering intensity and frequency, blood pressure, heart rate, and axillary body temperature were monitored hourly at 10-minute intervals for a whole hour.

Results: There were 87 patients (43%) who had post-spinal shivering; this number was 32 (32%) for those given ketamine and 55(55%) for those given tramadol (p=0.001). With a p-value of 0.000, the incidence of nausea and vomiting was statistically significantly higher in the tramadol group of 82(82%). The ketamine group had significantly more intraoperative sedation than the tramadol group (p 0.007).

Conclusion: After spinal anesthesia, low-dose ketamine is more active in lowering the frequency and intensity of shivering. Therefore, we advise patients having orthopedic surgery under spinal anesthesia to take low-dose ketamine beforehand as a preventative measure against post-spinal shivering.

Keywords: Ketamine, Tramadol, Shivering, Orthopedic surgery

INTRODUCTION

Accidents, trauma, injuries, and chronic illnesses may all lead to issues with the musculoskeletal system, and orthopedic surgery is a surgical treatment used to address these issues. Spinal anesthetic is the most often used neuraxial approach in orthopedic surgery because of its superior ability to manage intraoperative discomfort, reduce blood loss, and provide postoperative analgesia (1, 2). Post-spinal shivering (PSS) is a possible consequence of spinal anesthesia that has a high occurrence in orthopedic surgery in underdeveloped countries owing to a lack of facilities to maintain normothermia, despite the fact that spinal anesthesia is the preferred method of anesthesia (3, 4). Vasodilation and lack of thermoregulatory vasoconstriction below the level of spinal block promote heat redistribution, leading to hypothermia during the intraoperative period, which increases the risk of postoperative hypothermia and postoperative spinal hypothermia (5, 6). Research shows that a number of additional variables, including the anesthetic used, the patient's age and gender, the length of time spent under anesthetic, the kind of surgery performed, the duration of the anesthetic, and the extent of the operation all have a role in determining the occurrence (7). Exacerbation of wound pain, delayed wound healing, increased metabolic demand, increased oxygen consumption, and hemostatic dysfunction might result from untreated PSS, particularly in individuals with limited cardiac reserve and arterial hypoxia (8). Fortunately, there are a number of strategies to treat PSS and many more ways to prevent it from happening (9). Reflective blankets, cutaneous forced-air warming devices, warm humidified anesthetic gases, and radiant heat are some of the nonmedical approaches used to lessen the incidence of the syndrome. This gear proved effective in maintaining a healthy core temperature, but it was expensive and impractical in many situations (10). Furthermore, it makes more sense to avoid the issue and keep the patient at a normal temperature while under neuraxial anesthesia than to try to fix it after the fact. In clinical settings, medical techniques are the gold standard since they are both reliable and economical (11) . Anti-shivering drugs such as clonidine, meperidine, tramadol, nefopam, hydrocortisone, dexmedetomidine, and ketamine have been shown to be effective in a variety of studies. Most of these medications are effective in preventing PSS, but they all have different adverse effects; hence, only two medications, ketamine and tramadol, are mentioned in research(12). Ketamine is a noncompetitive NMDA receptor antagonist that has a function in thermoregulation by lowering the body's rate of heat redistribution from the core to the periphery (13). Among its many pharmacological functions, it acts as a noncompetitive NMDA antagonist while also serving as an opioid agonist, inhibiting amine absorption in the descending inhibitory monoaminergic pain pathway, producing a local anesthetic effect, and interacting with muscarinic receptors (14). Tramadol is uncommon in that it works at several places and has a modest central effect. It increases the release of hydroxyl tryptamine (HT) and decreases the absorption of noradrenaline and serotonin by spinal cord neurons, resetting the body's thermoregulatory centre (15). When compared to other opioids, tramadol administered intravenously has a well-established anti-shivering effect with fewer side effects, quick onset, reduced recurrence, cheap cost, ready availability in the operating room, and simple implementation (16). Preventative treatment for post-spinal anesthesia trembling in the research environment often entails low-dose ketamine and tramadol. Contradictory results have been found in trials examining the efficacy of preventive low-dose ketamine and tramadol (17). There is also a lack of evidence demonstrating the efficacy of superior preventive treatments in preventing the onset, severity, and harmful effects of PSS. Evidence-based clinical treatment also requires keeping medical practitioners abreast of the latest and greatest techniques for preventing post-spinal shivering (18). Therefore, the goal of this research was to evaluate the relative efficacy of preemptive intravenous 0.25 mg/kg ketamine and preemptive intravenous 0.5 mg/kg tramadol for the prevention of PSS in patients having orthopedic surgery under spinal anesthesia.

METHODOLOGY

After the ethical approval from institute review board, this crossectional study was carried out at attached hospital of Akhtar Saeed medical and dental college from 01/05/2022 to 31/10/2022. After being briefed on the study's potential advantages and objectives, all participants provided written informed permission. The privacy of all participants was protected during the whole investigation. Adults who had elective orthopedic surgery performed under spinal anesthesia were eligible for inclusion in the research. Patients who experienced shivering prior to spinal anesthesia, those with hypotension or hypovolemia, those who required a blood transfusion during the study period, those who received vasodilator agents prior to spinal anesthesia, those who were premedicated with opioid analgesia, those who were given pethidine to treat shivering, those who took a different dose of ketamine or tramadol, and those who took a second dose of ketamine or tramadol Individuals undergoing orthopedic surgery under spial anesthesia were included in the research, and they ranged in age from 18 to 60 years old. Additionally, all participants were classified as either ASA class I or class II. Pethidine, tramadol, and ketamine were utilized to control post-spinal shivering in the study scenario after orthopedic surgery. Based on the decision of the responsible anesthetists, patients were divided into two groups: those who received an intravenous prophylactic dose of ketamine prior to spinal anesthesia for orthopedic surgery (K group, n=100), and those who received tramadol for the prevention of postoperative spinal pain (T group, n=100). Patients were told about the research procedure during the pre-anesthesia consultation, and written informed permission was acquired from each patient before they were included in the study and kept confidential. The hemodynamic parameters such as oxygen saturation, blood pressure, pulse rate, respiratory rate, and temperature were tracked during the process using patient monitoring equipment such as pulse oximeters, noninvasive blood pressure monitors, axillary thermometers, and electrocardiography. To avoid spinal anesthesia-induced hypotension, all patients received 10 mL/kg of normal saline prior to spinal anesthesia. Using 22-25-gauge Quincke spinal needles and 3 cc of 0.25 percent Bupivacaine, spinal anesthesia was administered while the patient was seated and with a stringent aseptic approach at L3-L4 or L4-L5. Before spinal anesthesia and after the hemodynamic stability was assessed, an intravenous prophylactic dosage of ketamine 0.25 mg/kg or tramadol 0.5 mg/kg was given for the prevention of post-spinal shivering, depending on the anesthesia provider's choice. Throughout the procedure, the shivering scale was recorded every 10 minutes for a total of 60 minutes. Additionally, using a typical non-invasive sensor, axillary body temperature was tracked for 60 min at 10-min intervals. The side effects of the procedure, such as nausea, vomiting, sedation, and hypotension, were passively monitored and recorded every 10 minutes for 60 minutes. The lead anesthetist filled out the intra-operative variables, while additional skilled data collectors gathered the postoperative variables. Throughout the data collecting and data entry processes, consistency and completeness of the data were carefully monitored. Data was expressed as mean ± standard deviation. Changes in echocardiographic parameters was analyzed with paired t-test. The correlation between two continuous variables was determined using linear regression analysis. Mean p value ≤ 0.05 was considered statistically significant. All of the statistical analyses were done using SPSS version 26.

RESULTS

200 participants were recruited for the present study and divided into two study groups Ketamine (n=100) and Tramadol (n=100). The mean± S. D of the patients age was in ketamine and tramadol group was 42.01±9.3 and 43.04±9.32 years (Table 1). No significant association (p=0.435) in the patient age was observed in the both groups. Ketamine group contains equal proportion of male and female participants that is 50%, while tramadol group contains 45% males and 55% females' participants. No significant association (p=0.487) in the patient's gender was observed in the both groups. The mean± S. D of the patient's weight was in ketamine and tramadol group was 73.53±12.4 and 73.32±12.6Kg. No significant association (p=0.4816) in the patient age was observed in the both groups. In ketamine group 53% of the participants have ASA class I and 47% have Class II, while tramadol group have 58% Class I ASA participants and 42% Class II ASA participants. No significant association (p=0.372) in the patient age was observed in the both groups.

Table 1: Demographic Characteristics of the participants in study groups

Parameters	Ketamine(n=100)	Tramadol (n=100)	P Value
Age	42.01±9.3	43.04±9.32	0.435
Gender			
Male	50	45	
Female	50	55	0.487
Weight	73.53±12.4	73.32±12.6	0.816
ASA Status			
I	53	58	
II	47	42	0.372

The preoperative ketamine group had a mean arterial pressure (MAP) of 92.52±2.76 and a mean heart rate (HR) of 81.63±2.5. The MAP and HR for those using tramadol were 94.04±3.3 and 80.24±9.2, respectively. After 20, 30, 40, 50, and 50 there was a statistically significant difference between the groups in intraoperative hemodynamic parameters, with a p-value for MAP less than 0.000, 0.001, 0.000, 0.000, and 0.006. After 10, 20, 30, and 50, there was a statistically significant difference between the groups in intraoperative hemodynamic parameters, with a p-value for MAP less than 0.017, 0.000, 0.000, and 0.031 (Table 2). No statistically significant difference in core body temperature between the two groups was After spinal anesthesia, patients whose temperatures were lowered with tramadol exhibited lower overall body temperatures (Figure 1). The mean± S. D of the patients IV fluid volume in ketamine and tramadol group was 914.69±63.3 and 930.93±65.6mL (Table 3). A significant association (p=0.007) in the patient fluid IV was observed in the both groups. The mean± S. D of the patients IV fluid volume in ketamine and tramadol group was 914.69±63.3 and 930.93±65.6mL (Table 3). A significant association (p=0.007) in the patient fluid IV was observed in the both groups. The mean± S. D of the patient's intraoperative blood loss volume in ketamine and tramadol group was 96.895±9.0 and 101.085±8.6 mL (Table 3). A significant association (p=0.000) in the patient fluid IV was observed in the both groups.

Table 2: Intraoperative hemodynamic parameters of the study groups

Hemodynamic parameter	Ketamine (n=100)	Tramadol (n=100)	P Value
Baseline MAP (Mean± S. D)	92.52±2.76	94.04±3.3	0.000
10 minutes	86±1.66	86.04±1.6	0.862
20 minutes	82.17±2.27	79.61±5.8	0.000
30 minutes	81.75±2.25	79.22±7.5	0.001
40 minutes	82.67±2.05	79.37±7.6	0.000
50 minutes	82.43±2.28	79.21±8.1	0.000
60 minutes	82.79±2.23	80.14±9.2	0.006
Baseline HR (Mean± S. D)	81.63±2.5	80.24±9.2	0.15
10 minutes	80.91±3.24	78.42±9.5	0.017
20 minutes	80.86±3.73	75.5±8.6	0.000
30 minutes	80.01±4.1	76.06±9.1	0.000
40 minutes	81.04±4.05	79.57±9.8	0.168
50 minutes	82.47±2.3	80.39±9.2	0.031
60 minutes	86.06±1.7	85.97±1.8	0.707

There was a statistically significant difference (p=0.002) between the two groups in terms of the prevalence of post-spinal shivering (87 out of 200, or 43%) Figure 2. Compared to the ketamine group, the tramadol group had a significantly greater incidence of shivering (Table 4) and overall grade 3 and 4 shivering were prevalent (Figure 3).

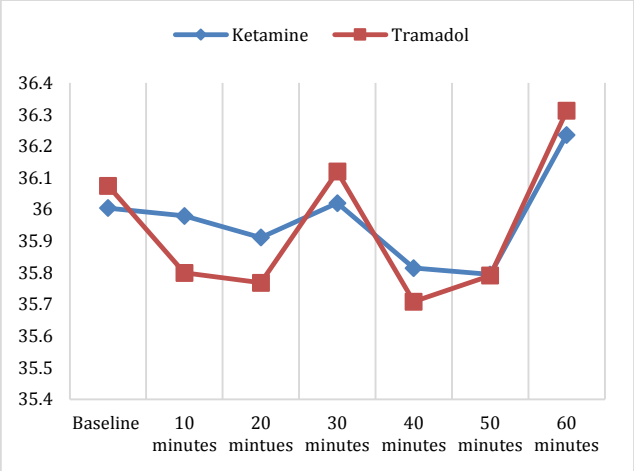

Figure 1: Axillary Body temperature in study groups

Table 3: Intraoperative patient status and duration of prophylactic agent in patients

Characteristics	Ketamine (n=100)	Tramadol (n=100)	P Value
Total intravenous fluid used (mL)	914.69±63.3	930.93±65.6	0.007
Blood loss during surgery (mL)	96.895±9.0	101.085±8.6	0.000
Duration of prophylactive agent (min)	52.96±3.7	50.09±7.6	0.002

Table 4: Incidence of shivering in study groups

	Shivering Incidence		
Groups	Yes	No	P Value
Ketamine	32	68	
Tramadol	55	45	0.001

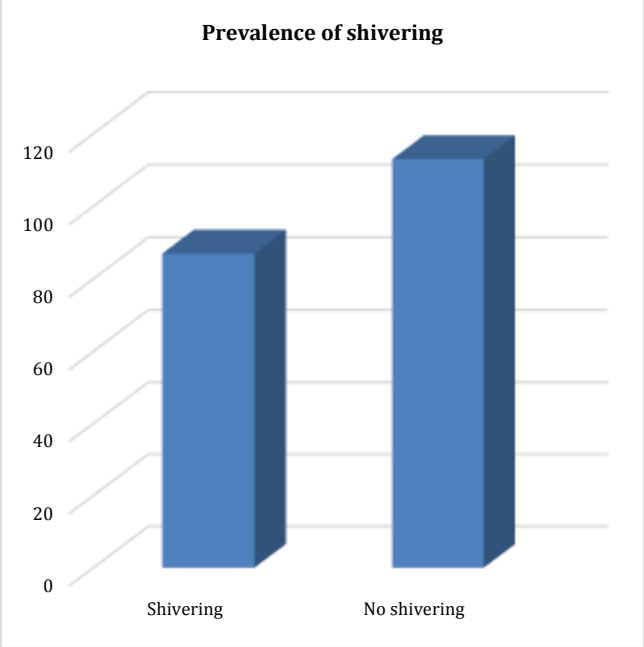

Figure 2: Prevalence of Shivering in study population

With a p-value of 0.000, the incidence of nausea and vomiting was statistically significantly higher in the tramadol group of 82(82%). The ketamine group had significantly more intraoperative sedation than the tramadol group (p 0.007) (Table 5).

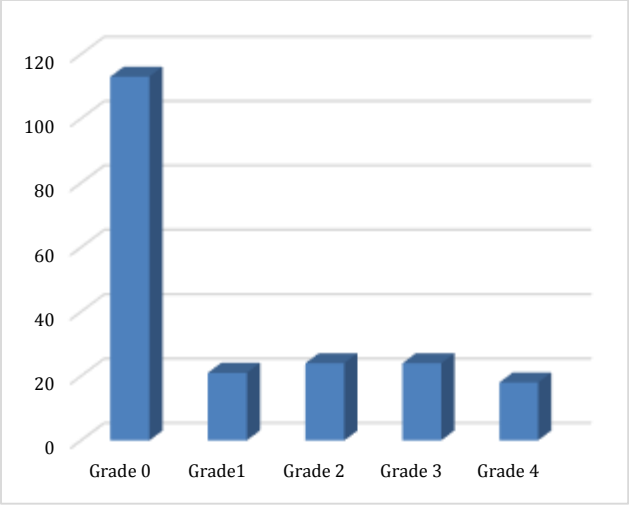

Figure 3: Shivering grade prevalence in study population

Table 5: Adverse effect of a prophylactive agent in study groups

Variables	Ketamine (n=100)	Tramadol (n=100)	P Value
Nausea and Vomiting			
Yes	7	82	
No	93	18	0.000
Sedation			
Yes	30	14	
No	70	86	0.007

DISCUSSION

Shivering after spinal anesthesia is a typical issue for patients undergoing surgery. Preventing postoperative shivering is an important clinical practice. Anti-shivering medications used during surgery include ketamine and tramadol. Some pharmacological medicines, such as ketamine, pethidine, and tramadol, have been shown to be effective in reducing post spinal shivering, whereas other treatments, such as these, have received conflicting data. While pethidine is more effective than other medications in preventing PSS, it is also more likely to cause side effects such as respiratory depression, vomiting, arterial nausea, oxygen desaturation, and sedation in some patients (19, 20). But moderate sedation and hallucinations aren't among the side effects of low-dose ketamine and tramadol. Prophylactic low-dose ketamine and tramadol have shown mixed results in reducing post-spinal tremor, according to several investigations (6). Although large dosages of ketamine and tramadol were effective in reducing post-spinal tremors, these drugs' negative effects prevented them from being widely used [31, 32]. In this research, we examined the efficacy of low-dose ketamine and tramadol in preventing shivering during orthopedic surgery under spinal anesthesia. In this research, post-spinal shivering occurred in 43% of participants. There is a greater incidence of shivering than was found in research conducted in North West Ethiopia (25.6%) (7). When compared to the range of 8-14.4% seen in other research (21, 22), our finding is much greater. As a counterpoint, our finding is lower than that of the research done Pakistan. This distinction may have resulted from the use of pre-warmed intravenous fluid (IV) and the maintenance of an operating room temperature of 24 to 26 ^{0} C (23). The present research found that individuals who received low-dose ketamine had a significantly decreased incidence of post-spinal shivering compared to the tramadol group. Research on the efficacy of ketamine done in Nigeria, confirmed these results (24). The research done in India, on the other hand, found no statistically significant difference between the two preventative medications. In the present investigation, lengthy follow-up was employed, however this may be because PSS was only captured for 30 minutes following surgery (25). Shivering occurred during surgery in 32% of the ketamine group and 55% of the tramadol group. This

is in accordance with the findings of a research done Pakistan (26), which found that intraoperative shivering occurred in 18.75% of the ketamine group and 46.88% of the tramadol group. Our research results were not consistent with a study published in Gondar, they observed shivering in 41.5% among the ketamine group and 53.7% among the tramadol group (12). However, Pakistani research found that just 6% of those using tramadol experienced shivering. MAP was found to be significantly higher in the ketamine group compared to the tramadol group during surgery. This finding agrees with that of an Indian investigation which found that individuals given ketamine had greater mean arterial blood pressure than those given a tramadol (27). It was shown in the published trials conducted in India that intraoperative hemodynamic parameters did not significantly alter in the ketamine and tramadol groups (28). Ketamine is a sympathomimetic drug that raises MAP, therefore this may be the result of a preload with pre-warmed IV fluid to 37 ^{0} C. Consistent with a comparative study performed in Pakistan, which found a significantly lower incidence of nausea and vomiting in the ketamine group (29), our findings showed a significantly higher incidence of intraoperative nausea and vomiting in the tramadol group. Another research found that those who took tramadol or pethidine were more likely to experience nausea and vomiting than those who took a placebo. Comparing the incidence of nausea and vomiting between the ketamine and placebo groups, a study conducted at in Thailand found no statistically significant difference (32% in the ketamine group compared to 0% in the placebo group; this could be attributable to the infusion of the prophylactive agent and pre-warmed intravenous fluid used for the load groups (6). In comparison to the tramadol group, the ketamine group had significantly more cases of mild drowsiness. Sedation ratings were also measured and found to be significantly greater in the ketamine group compared to the tramadol group in one research (30). In contrast, research in India found that both ketamine and tramadol produced much greater sedation ratings than dexamethasone. Midazolam and fentanyl might have been used as a premedication for this (31). Previous research in India found that placebo patients had a higher decrease in body temperature than those given ketamine, tramadol, or clonidine. After spinal anesthesia, our research found that both ketamine and tramadol significantly reduced mean temperatures relative to baseline and time. This finding agrees with that of research done in (32). Another research done at the institution civil hospital in Aizawl, Mizoram, found that ketamine significantly reduced core temperature compared to the control group. This may be because spinal anesthetics have a vasodilatory effect (33).

CONCLUSION

In this research, shivering was much more common in the tramadol group (55%) than in the ketamine group (32%). Compared to tramadol, low-dose ketamine was more effective in lowering the frequency and incidence of shivering during spinal anesthesia. Furthermore, in comparison to tramadol, low-dose ketamine restored hemodynamics with a lower incidence of intraoperative nausea and vomiting. Patients having orthopedic surgery under spinal anesthesia have two prophylactic options: either low-dose ketamine or tramadol. However, low-dose ketamine is more effective and widely accessible. As a result, it is suggested that PSS may be avoided by using a modest dosage of ketamine.

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