Original Article

Comparison of the Efficacy of Intravenous Dexmedetomidine, and Tramadol for Control of Post-Spinal Shivering in Obstetric Patients Undergoing Lower Segment Caesarean Section

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ABSTRACT

Objective: To compare the efficacy of intravenous dexmedetomidine and tramadol in controlling post-spinal shivering among obstetric patients undergoing lower segment caesarean section under spinal anesthesia.

Study Design: A randomized clinical trial study

Place and Duration of Study: This study was conducted at the Department of Anesthesia and Intensive Care, Sheikh Zayed Medical College and Hospital, Rahim Yar Khan, Pakistan, from August 2025 to January 2026.

Methods: A total of 142 pregnant women aged 18 to 60 years scheduled for lower segment caesarean section under spinal anesthesia were enrolled and randomly allocated into two equal groups: dexmedetomidine group (n = 71) and tramadol group (n = 71). Patients in the dexmedetomidine group received intravenous dexmedetomidine 0.5 µg/kg, while those in the tramadol group received intravenous tramadol 0.5 mg/kg prior to spinal anesthesia.

Results: Baseline demographic and physiological characteristics were comparable between the two groups. The incidence of post-spinal shivering was significantly lower in the dexmedetomidine group compared with the tramadol group (16.9% vs 38.0%, p = 0.006). The onset of shivering occurred later in the dexmedetomidine group (24.6 ± 5.3 minutes) than in the tramadol group (18.2 ± 6.1 minutes, p < 0.001). Sedation scores were higher in patients receiving dexmedetomidine (p = 0.001).

Conclusion: Intravenous dexmedetomidine demonstrated superior efficacy compared with tramadol in reducing the incidence and severity of post-spinal shivering in obstetric patients undergoing caesarean section.

Key Words: Dexmedetomidine, Tramadol, Spinal Anesthesia, Cesarean Section, Postoperative Shivering

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INTRODUCTION

Spinal anesthesia is widely regarded as the preferred anesthetic technique for lower segment caesarean section (LSCS) because of its technical simplicity, rapid onset, cost-effectiveness, and favorable maternal and neonatal safety profile[1]. However, perioperative shivering remains one of the most frequent and troublesome complications of neuraxial anesthesia in obstetric practice.

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The reported incidence of shivering during caesarean delivery under spinal anesthesia ranges from 40% to 80%[2], while the median incidence in parturients has been estimated at approximately 52%[3]. Shivering is defined as involuntary, repetitive skeletal muscle activity triggered by thermoregulatory mechanisms in response to perioperative hypothermia[4]. It is commonly precipitated by redistribution of core heat to the periphery after sympathetic blockade, peripheral vasodilation, heat loss from exposure to a cool operating environment, and loss of warm body fluids during surgery[2,5].

The consequences of perioperative shivering extend beyond discomfort alone. It increases oxygen consumption, carbon dioxide production, and lactic acid generation, and may interfere with monitoring of blood pressure, pulse oximetry, and electrocardiography[5]. In addition, shivering may increase intraocular and intracranial pressure, worsen postoperative pain, and delay postoperative recovery[6]. In obstetric patients, severe shivering may also negatively affect maternal satisfaction and early maternal-newborn interaction[7].

A range of pharmacological agents has been investigated for prevention and control of post-spinal shivering, including meperidine, tramadol, clonidine, fentanyl, ketamine, ondansetron, and dexmedetomidine[8]. Tramadol is a centrally acting analgesic with anti-shivering properties mediated through modulation of central thermoregulation, inhibition of serotonin and norepinephrine reuptake, and weak μ-opioid receptor agonism[9,10]. In obstetric patients, intravenous tramadol has shown effective control of shivering and has been reported to achieve faster shivering cessation than pethidine in some studies[10]. Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, exerts anti-shivering effects by suppressing central thermoregulatory control, decreasing sympathetic outflow, and lowering the shivering threshold without clinically significant respiratory depression[5,11]. Its efficacy has been demonstrated in both obstetric and non-obstetric populations, and growing evidence suggests that it may be superior to several conventional anti-shivering agents[11,12]. Despite the high burden of caesarean deliveries in Pakistan, locally relevant comparative evidence regarding anti-shivering agents in obstetric patients remains limited. A Pakistani randomized trial demonstrated the clinical utility of dexmedetomidine as an adjuvant during caesarean section[1], while another local study from Quetta highlighted the continuing relevance of post-spinal shivering and compared tramadol with ondansetron in caesarean patients[13].

METHODS

A randomized clinical trial was conducted in the Department of Anesthesia and Intensive Care, Sheikh Zayed Medical College and Hospital, Rahim Yar Khan, Pakistan, over a period of six months from August 2025 to January 2026 after approval from the institutional ethical review committee. Pregnant women scheduled for lower segment cesarean section under spinal anesthesia were enrolled after obtaining written informed consent. The study compared the efficacy of intravenous dexmedetomidine and tramadol for the prevention of post-spinal anesthesia shivering in obstetric patients. The sample size was calculated using the WHO sample size calculator, and a total of 142 patients were included and randomly allocated into two equal groups using simple random sampling: Group D (Dexmedetomidine, n=71) and Group T (Tramadol, n=71).

Females aged between 18 and 60 years of age who had a cesarean were eligible to be included. The patients who were hypersensitive to opioids or bupivacaine, cardiovascular disease, hypertension, psychosis, antepartum hemorrhage, cord prolapse, or fetal distress were excluded. Preoperative demographic and clinical data took place. An 18-gauge intravenous cannula was placed on admission to the operating room, and the standard monitoring (electrocardiography, heart rate, non-invasive blood pressure, oxygen saturation, and temperature) was implemented.

Group D patients were using dexmedetomidine 0.5 μg/kg in 10 mL normal saline, and Group T patients were using tramadol 0.5 mg/kg in 10 mL of normal saline. The study medication was as an intravenous infusion during 10 minutes just before spinal anesthesia. All patients were given warmed lactated Ringer solution at the ratio of 10 mL/kg during 30 minutes before anesthesia. The spinal anesthesia was done at L3-L4 or L4-L5 between 25-gauge Quincke needle containing 2.8 mL (14 mg) of 0.5% hyperbaric bupivacaine. The intraoperative monitoring comprised of heart rate, blood pressure, mean arterial pressure, oxygen saturation, and temperature at baseline and every five minutes.

A four-point scale of shivering (0-4) was used with a grade of 0 representing no shivering and 4 representing generalized shivering. The Ramsay sedation scale was used to determine sedation. In case of grade 3 or 4 shivering 15 minutes after the drug administration, rescue treatment was performed with intravenous pethidine 25mg. Unfavorable events such as hypotension, bradycardia, nausea, vomiting, and hallucinations were noted and handled following the usual procedures.

Data were analyzed using SPSS version 20. Continuous variables were presented as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Comparisons between the two groups were performed using analysis of variance (ANOVA) for continuous variables and the chi-square test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The mean age of the overall study population was 29.4 ± 4.8 years (range 19–39 years). Patients in Group D had a mean age of 29.1 ± 4.7 years while those in Group T had a mean age of 29.7 ± 4.9 years, with no statistically significant difference between groups (p=0.48). Most patients were between 26 and 35 years of age.

Baseline hemodynamic parameters were also comparable between both groups before spinal anesthesia. The mean baseline mean arterial pressure (MAP), heart rate, and oxygen saturation showed no statistically significant difference between groups.

The incidence of post-spinal shivering was significantly lower in the dexmedetomidine group compared with the tramadol group. Shivering occurred in 12 patients (16.9%) in Group D compared with 27 patients (38.0%) in Group T, showing a statistically significant difference (p=0.006).

Table No.1: Demographic and baseline characteristics of the study population (n=142)

Variable	Group D (Dexmedeto-midine) n=71	Group T (Tramadol) n=71	p-value
Age (years) Mean ± SD	29.1 ± 4.7	29.7 ± 4.9	0.48
Age Group (years)			
18–25	18 (25.4%)	16 (22.5%)	
26–30	29 (40.8%)	31 (43.7%)	
31–35	17 (23.9%)	18 (25.4%)	
>35	7 (9.9%)	6 (8.4%)	0.89
Gestational Age(weeks) Mean ± SD	38.2 ± 1.1	38.4 ± 1.0	0.31
Duration of Surgery (min) Mean ± SD	54.7 ± 9.3	56.1 ± 8.9	0.37
Parity			
Nulliparous	19 (26.8%)	21 (29.6%)	
Primiparous	20 (28.2%)	18 (25.4%)	
Multiparous	32 (45.0%)	32 (45.0%)	0.92

Table No.2: Baseline physiological parameters of patients

Parameter	Group D (n=71) Mean ± SD	Group T (n=71) Mean± SD	p-value
Mean Arterial Pressure (mmHg)	91.3 ± 7.2	92.1 ± 6.9	0.53
Pulse Rate (bpm)	88.6 ± 9.1	89.8 ± 8.7	0.44
SpO_2 (%)	98.4 ± 1.1	98.2 ± 1.2	0.37
Tympanic Temperature (°C)	36.7 ± 0.3	36.8 ± 0.3	0.28
Room Temperature (°C)	24.1 ± 0.6	24.0 ± 0.7	0.61

Table No.3: Incidence and severity of shivering

Variable	Group D (n=71)	Group T (n=71)	p-value
Shivering present	12 (16.9%)	27(38.0%)	0.006
Shivering absent	59 (83.1%)	44(62.0%)	
Severity of Shivering			
Grade 1	5 (7.0%)	7 (9.9%)	
Grade 2	4 (5.6%)	9 (12.7%)	
Grade 3	2 (2.8%)	7 (9.9%)	
Grade 4	1 (1.4%)	4 (5.6%)	0.03

The mean time to onset of shivering was longer in the dexmedetomidine group compared with the tramadol group. Patients in Group D experienced shivering at a mean time of 24.6 ± 5.3 minutes, while Group T developed shivering earlier at 18.2 ± 6.1 minutes, which was statistically significant ($p<0.001$).

Table No.4: Time to onset of shivering

Variable	Group D (n=71)	Group T (n=71)	p-value
Time to shivering (minutes) Mean ± SD	24.6 ± 5.3	18.2 ± 6.1	<0.001

The dexmedetomidine group recorded higher scores on the sedation scale, which is indicative of the established sedative quality of the medication. The majority of patients in Group D reported a Ramsay sedation of 2-3, which is a sign of calm and cooperative sedation, but the patients in the tramadol group tended to be completely awake.

Table No.5: Ramsay sedation score distribution

Sedation Score	Group D (n=71)	Group T (n=71)	p-value
Score 1	14 (19.7%)	39 (54.9%)	
Score 2	33 (46.5%)	23 (32.4%)	
Score 3	18 (25.4%)	7 (9.9%)	
Score ≥4	6 (8.4%)	2 (2.8%)	0.001

DISCUSSION

The demographic profile of the study population was widely similar to other studies of obstetric anesthesia that were previously published. The average age of 29.4 +/- 4.8 years was also similar to the population of parturients in the study by Yaakop et al, which investigated women undergoing a caesarean section under spinal anesthesia with an average age of 30.2 +/- 5.2 years (10). In our study, the internal validity of the comparative results is supported by the similarity in baseline hemodynamics of the two groups of treatment. The frequency of post-spinal shivering in our cohort was 27.5 percent compared to 40-80 percent of incidence described in the literature[2,14]. But, published obstetric data indicate that shivering is frequent during caesarean section, with the rates ranging about 50 in most institutions[3,11]. The relatively lower rate in our research could be due to the differences in the institutional temperature control, intraoperative warming, patient factors, or local anesthesia. We find that dexmedetomidine was more effective than tramadol in the control of post-spinal shivering, most episodes of shivering were mild in nature in the dexmedetomidine group, and the incidence of shivering is significantly lower in Group D than in Group T (16.9% vs 38.0% p=0.006). The meta-analysis of Wang et al. findings is in agreement with these findings as these results indicated that dexmedetomidine had a

much higher effective rate of shivering control and shorter time to shivering cessation than tramadol in randomized controlled trials[15]. Better prevention of intraoperative shivering was also reported by Kumar and Ammu in patients under surgery under subarachnoid blockade by dexmedetomidine as compared to tramadol[16]. On the same note, Venkatraman et al. discovered that dexmedetomidine was more effective at providing speed in shivering control and reducing recurrence compared to tramadol[17]. All these studies added up to support the higher anti-shivering efficacy of dexmedetomidine that we found in our patients. The fact that shivering in the dexmedetomidine group was greatly delayed also indicates that a stronger prophylactic thermoregulatory effect was likely to be present. According to Zhang, dexmedetomidine pretreatment decreased the rate of shivering during caesarean section and augmented the anti-shivering impact of tramadol when administered as having rescue treatment[18]. Jayaraj et al. also reported that tramadol is also a successful prophylaxis agent in caesarean surgery under spinal anesthesia[7]. Moreover, Mades et al. also have reported successful shivering and constant hemodynamic conditions using tramadol in patients under spinal anesthesia[6]. Such results point to the fact that tramadol can still be used as an option in the case where dexmedetomidine is not either available or contraindicated. The increased scores in Ramsay sedation scale in dexmedetomidine group are in line with its pharmacological characteristics of an alpha 2 adrenergic agonist. According to Wang et al., dexmedetomidine sedation was much more frequent than tramadol[15]. Kawsar et al. also reported a better sedation score of patients undergoing dexmedetomidine in order to prevent the occurrence of post-spinal shivering[4]. Sedation in our study was not excessive in any way and no patient became excessively or unarousable. The majority of the patients were peaceful and cooperative which can be a better experience during spinal anesthesia. Observation of the increased rate of nausea and vomiting in the tramadol group is congruent with the earlier published results. According to Wang et al., dexmedetomidine showed significantly reduced cases of nausea and vomiting as opposed to tramadol[15]. Yu et al. also noted decreased gastrointestinal adverse effects using dexmedetomidine in patients undergoing caesarean section[5]. These results were in favor of dexmedetomidine with regards to its gastrointestinal tolerance profile. The incidence of bradycardia was higher in the dexmedetomidine group though this was not significant. This finding is in line with the meta-analysis carried out by Wang et al. which indicated that dexmedetomidine had a higher risk of causing bradycardia[15]. Patel and Halvadia also found that dexmedetomidine was an effective control of intraoperative shivering but hemodynamic monitoring was necessary[19]. Thus, dexmedetomidine seems to be an excellent candidate in controlling shivering, but clinicians are to be aware of possible cardiovascular consequences.

CONCLUSION

A single intravenous dose of dexmedetomidine seems to be more effective than tramadol to decrease the incidence and severity of post-spinal shivering among patients undergoing cesarean section with acceptable safety and sedation profiles. Its application can help to enhance intraoperative comfort and perioperative in obstetric anesthesia.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Sana Bahadur, Saira Sadaf
Drafting or Revising Critically:	Sana Bahadur, Maira Ambreen
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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