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Original Research Article

Comparison of Ketamine and Dexmedetomidine for Post Spinal Shivering in Parturient Undergoing Caesarean Section

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Conflict of interest: Nil

Abstract

Background: Shivering is a common complication following spinal anaesthesia, particularly in parturients undergoing caesarean section. Uncontrolled shivering can increase oxygen consumption, metabolic demand, and patient discomfort. This study aimed to compare the efficacy of dexmedetomidine and ketamine in controlling post-spinal shivering in parturients undergoing elective caesarean section.

Methods: seventy two parturients scheduled for elective caesarean section under spinal anaesthesia were randomly assigned into Group D received 0.3mcg/kg Dexmedetomidine IV, while Group K received 0.2mg/kg ketamine IV upon the onset of shivering. Shivering intensity, onset time for the cessation of shivering, sedation levels and the need for rescue medication were recorded.

Results: Shivering reduction in 95% was significantly faster in Group D, with complete resolution by 15min, compared to 80% in Group K. The mean time for shivering resolution was significantly shorter in Group D (8.1 ± 1.2min) when compared to Group K (11.3 ± 2.1min) ($p < 0.001$). Group D required no rescue medication, whereas 22% in Group K required.

Conclusion: Dexmedetomidine was significantly more effective than ketamine in controlling post-spinal shivering with a faster onset and lower need for rescue medication. Given its superior efficacy and minimal adverse effects, dexmedetomidine can be recommended for shivering control in caesarean sections under spinal anaesthesia.

Keywords: Shivering, Dexmedetomidine, Ketamine, Spinal Anaesthesia, Caesarean Section.

Introduction

Shivering is a frequent and uncomfortable adverse effect following spinal anaesthesia, with an incidence reported between 40% and 60% in parturients undergoing caesarean section [1]. The physiological burden of shivering is particularly concerning in parturients, as it increases oxygen consumption, carbon dioxide production, and metabolic demand, while also causing distress and potential interference with neonatal bonding and breastfeeding immediately after delivery [2]. Effective prevention and treatment of post-spinal shivering therefore plays a vital role in optimizing maternal perioperative comfort and safety.

Multiple mechanisms contribute to shivering under neuraxial anaesthesia, including redistribution hypothermia, altered thermoregulation, vasodilation, and impaired afferent temperature regulation below the block level [3]. A range of pharmacological agents—such as opioids, magnesium sulfate, clonidine, ketamine, and dexmedetomidine—have been evaluated to attenuate these thermoregulatory disturbances [2]. Among these, ketamine and dexmedetomidine have emerged as promising options due to their distinct mechanisms, rapid onset, and favourable safety profiles in obstetric anaesthesia. Ketamine, an N-methyl-D-aspartate (NMDA) receptor antagonist, exerts antishivering effects by modulating thermoregulation through non-thermoregulatory pathways and increasing central catecholamine release [4]. It also provides analgesia and maintains hemodynamic stability, advantages that may be beneficial in parturients. Previous studies have demonstrated that low-dose ketamine effectively reduces the incidence and severity of shivering without significant neonatal compromise [5].

In contrast, dexmedetomidine, a highly selective α_2-adrenergic agonist, produces antishivering effects through inhibition of central thermoregulatory control and sympatholysis. It decreases the shivering threshold while providing sedation, anxiolysis, and analgesia with minimal

respiratory depression [6]. Several investigations have shown dexmedetomidine to be effective in preventing or treating neuraxial anaesthesia-induced shivering [7]. However, concerns regarding maternal bradycardia, hypotension, and transfer across the placenta necessitate careful evaluation in the obstetric population.

Although both ketamine and dexmedetomidine have demonstrated antishivering efficacy individually, direct comparative evidence in parturients undergoing caesarean section remains limited. Differences in mechanism of action, onset time, side-effect profiles and maternal hemodynamic response underscore the need for targeted comparative evaluation in this uniquely vulnerable group.

Therefore, the present study aims to compare the efficacy and safety of ketamine and dexmedetomidine for the treatment of post-spinal shivering in parturients undergoing caesarean section, with particular focus on onset of antishivering action, hemodynamic stability and maternal side effects.

Sample Size: Based on the study conducted by Lamontagne et al [8] Proportion of parturients without significant shivering after 5 min in Dexmeditomidine group, P1 = 72.5% = 0.725 and in Control group P2 = 17.5% = 0.175. P = P1 + P2 2 = 0.45. Z1-α=Standard normal variate at 99% confidence interval for the test = 2.576. Z1-β= Standard normal variate at 99 % power of the test = 2.326. After substituting in the formula, Total sample size was 72, so the minimum sample size in each group was 36.

Materials and Methods

This randomized prospective comparative study was conducted at the tertiary care hospital between June 2024 and January 2025 with approval from Institutional ethics committee.

ASA II physical status participants Aged between 20 to 40 years with Gestational age > 37 weeks who were scheduled for elective caesarean section under spinal anaesthesia were included in the study after providing written informed consent. Parturients with known allergy to the study drug, who had coagulopathies or were taking anticoagulant drugs, who had any associated conditions like cerebrovascular insufficiency, neuromuscular diseases, severe preeclampsia, cardiopulmonary disease, hyperthyroidism, spinal deformities were excluded from the study.

Study Procedure: The study included 72 parturients who fulfil all the points in the inclusion and exclusion criteria were randomized into 2 equal groups, each consisting of 36 parturients, namely Group D (dexmedetomidine group) and Group K (ketamine group). All parturients were randomized to one of the two groups (36 each) by using a computer-generated random number of table and group allocation was done with the sealed envelope method by an anaesthesiologist who was not involved in data collection. Parturients belonging to Group D received 0.3 mcg/kg dexmedetomidine IV, while Group K received 0.2 mg/kg ketamine IV upon the onset of shivering. The study drugs were prepared in coded 5ml syringes and conferred to the responsible anaesthesiologist, who was not a part of the study. Anaesthetic management was standardized. Operating room temperature was maintained at 24°C. IV fluids at room temperature were used and parturients were draped intraoperatively and covered with a cotton blanket postoperatively. No active warming devices were used. All parturients received 10 ml/kg of lactated Ringer's pre-spinal, followed by 6 ml/kg/hr or depending on the haemodynamics. Standard monitoring included NIBP, ECG, temperature, and SpO_2.

Shivering was graded by Tsai and Chu [9] as, 0 = No shivering, 1 = piloerection or peripheral vasoconstriction but no visible shivering, 2 = muscular activity in more than one muscle group but not generalised and 4 = involving the whole body. Shivering with grade 2 and above were given the study drug. The time at which a significant reduction in shivering was noticed and recorded. The intensity of shivering was also noted at 5min, 10min, and 15 min after the bolus injection to evaluate the evolution of shivering over time. Hemodynamic parameters, sedation levels, adverse effects, and the need for rescue medication (tramadol 50mg IV) were also recorded. Regarding Intraoperative fluids administered and total blood loss there was no significant difference between the groups.

Adverse effects such as hypotension (20% drop from the baseline mean arterial blood pressure) and bradycardia (<50 beats/ min) were noted as they occurred from the time of administration of the bolus until the end of the surgery. The Ramsay sedation score 1 = Anxious and agitated, 2 = cooperative and tranquil, 3 = responds to commands only, 4 = brisk response to glabellar tap or loud sound, 5 = sluggish response to stimulus, 6 = no response to stimulus was recorded every five minutes after the administration of the study drug. Where hypotension arose, it was treated with a bolus of 100-200 mcg of phenylephrine IV and/or 5-10 mg IV ephedrine as needed.

Statistical Analysis: Results obtained was analyzed with descriptive statistics, namely mean, median, standard deviation, and percentage wherever applicable. Chi-Square test was used to assess categorical data, paired t test was used to assess quantitative data.

SPSS version 25.0 was used for calculation and P<0.05 was considered significant.

Results

Seventy-two parturients who matched all inclusion criteria were randomly assigned to one of the two groups, Group D or Group K, each with thirty-six participants.

Demographics & Baseline Characteristics: Each parturients age, weight, height, and gestational age were noted at the start of the trial, and Table 1 displays the statistical comparison of these data. The mean age of participants in Group D was 27.9 ± 3.5 years, while in Group K, it was 28.4 ± 3.7 years. The average weight was comparable across both groups (Group D: 69.3 ± 4.2 kg, Group K: 70.1 ± 4.5 kg). In terms of demographic information, there was no statistically significant difference between the two groups.

Table 1: Comparison of Demographic Characteristics

Demographics Characteristics			
Characteristics	Group D (n=36)	Group K (n=36)	p-value
Age (years)	27.9 ± 3.5 years	28.4 ± 3.7 years	0.0613
Weight (kg)	69.3 ± 4.2 kg	70.1 ± 4.5 kg	0.1631
Duration of surgery (min)	58± 15	51± 16	0.090

Assessment of Hemodynamics During and After Surgery

Table 2: Comparison of Mean MAP

Mean MAP			
Characteristics	Group D (n=36)	Group K (n=36)	p-value
Preoperative	99.13 ± 4.5	97.86 ± 3.47	0.229
Induction of spinal	98.3 ± 4.9	97.5 ± 2.93	0.432
Intra op - 5 (min)	71.9 ± 2.76	73.43 ± 4.3	0.101
10	70.43 ± 4.1	71.23 ± 3. 45	0.415
15	72.23 ± 3. 65	73.73 ± 4. 18	0. 114
20	75.1 ± 3.75	76.4 ± 3.29	0.13
25	75.5 ± 4.83	77.4 ± 4.33	0.141
30	75.67 ± 4.46	76.17 ± 2.8	0.607
35	76.4 ± 3.32	76.8 ± 4.58	0.7
40	76.9 ± 3.95	78.28 ± 3.2	0.13
45	78 ± 3.16	78.59 ± 3.81	0.736
Postop - 15 (min)	78.2 ± 3.52	79.6 ± 3.4	0.119
30	77.7 ± 3.65	78.9 ± 3.69	0.211
45	78.9 ± 3.77	79 ± 4.16	0.974
60	80.4 ± 3.3	81.1 ± 3.66	0.456

There was no statistical difference in Mean MAP between the two groups.

Shivering Incidence and Severity:

Baseline Shivering: Group D had lower initial shivering scores, with 66.7% of parturients experiencing mild to moderate shivering (Grade 1 or 2), while Group K had a higher proportion of severe shivering (Grade 3 or 4) at 72.2%.

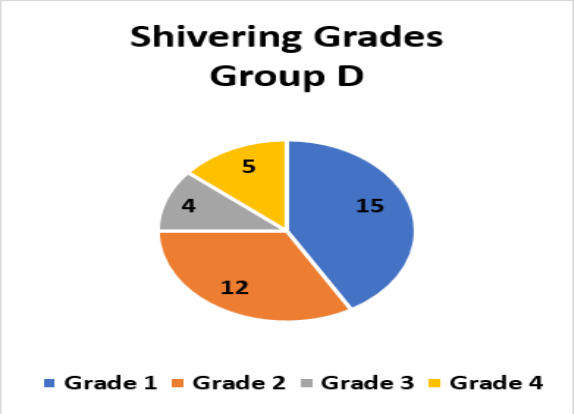

Figure 1: Comparison of Shivering Grading

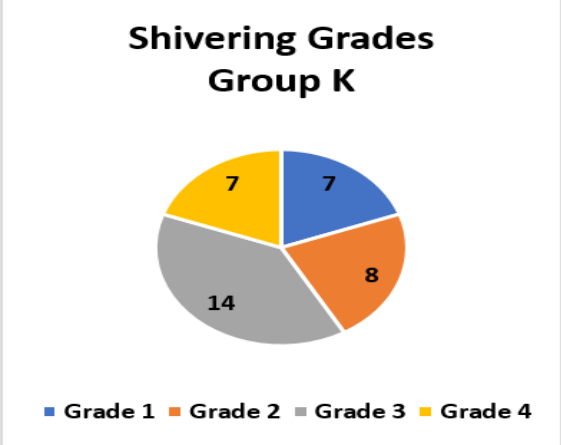

Figure 2: Comparison of Shivering Reduction Over Time

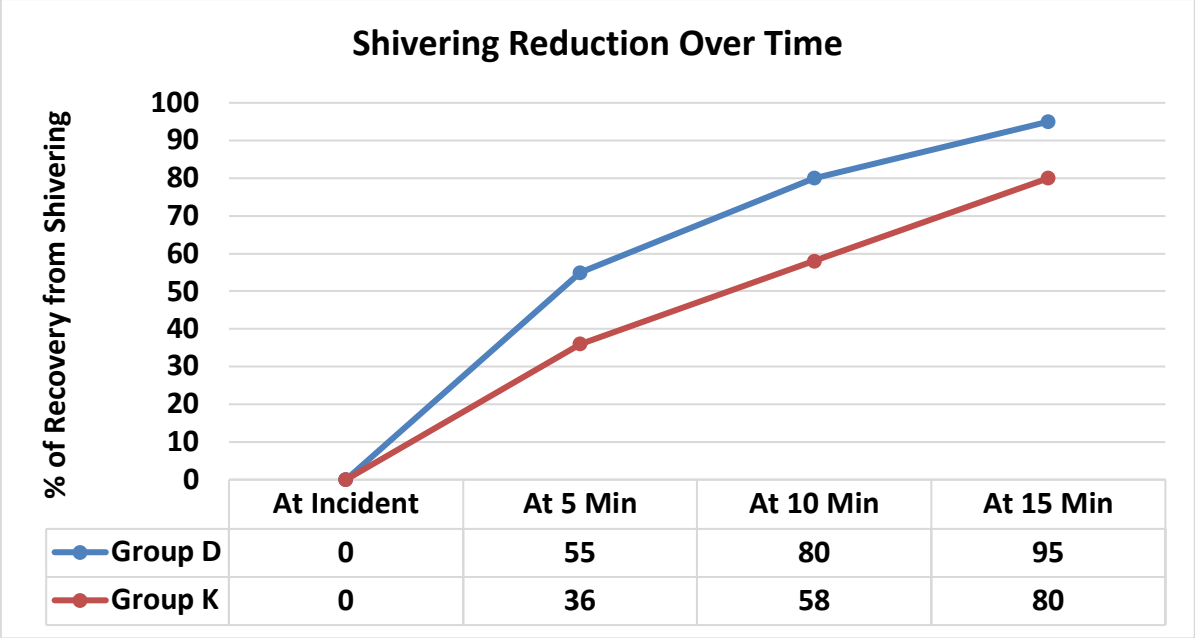

Figure 3: Shivering Reduction Over Time

Table 3: Comparison of Shivering Reduction Over Time

Comparison of Shivering Reduction Over Time		
	Group D	**Group K**
At Incident	**0**	**0**
At 5 Min	**20 (55%)**	**13 (36%)**
At 10 Min	**29 (80%)**	**21 (58%)**
At 15 Min	**34 (95%)**	**29 (80%)**

At 5 minutes: Reduction in shivering was more pronounced in Group D, with 55% achieving Grade 1 or 0, while only 35% in Group K showed similar improvement. At 10 minutes: 80% of Group D had no or mild shivering (Grade 0 or 1), compared to 58% in Group K. At 15 minutes: Almost complete resolution of shivering (95%) was observed in Group D, whereas in Group K, 20% of participants still had moderate to severe shivering (Grade 2 or higher).

Table 4: Comparison of Mean Time to Complete Resolution of shivering

Comparison of Mean Time to Complete Resolution		
Group	**Time to Complete Resolution**	**p-Value**
Group D	8.1 ± 1.2 min	0.000*
Group K	11.3 ± 2.1 min	

Time for Complete Shivering Resolution was faster in Group D when compared to Group K

Statistical Analysis: A two-sample independent t-test was performed to compare the time to complete shivering resolution between the two groups.

- **T-statistic:** -8.76
- **P-value:** 5.34×10^{-12}

Since the p-value is highly significant ($p < 0.05$), the difference in shivering resolution time between the two groups is statistically significant, confirming that dexmedetomidine acts significantly faster than ketamine in reducing shivering.

Use of Rescue Medication: No patients in Group D required rescue medication. In Group K, 8 (22%) of parturients required tramadol 50mg IV due to persistent Grade 3-4 shivering.

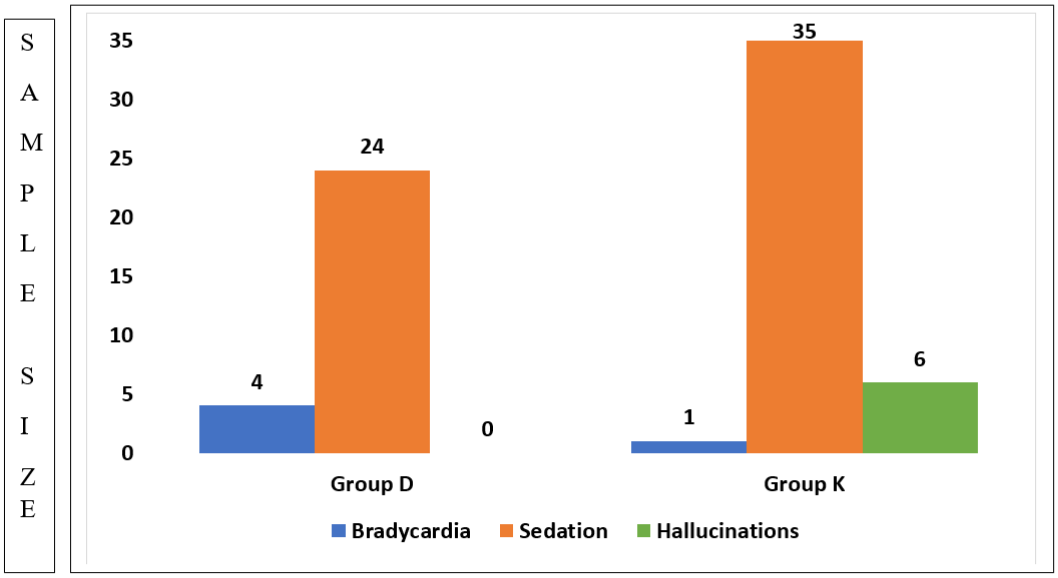

Figure 4:

Hemodynamic Parameters & Adverse Effects:
Bradycardia: Group D had a slightly higher incidence (11%) than Group K (3%).

No interventions were required for bradycardia in either group.

- **Sedation Levels:** Group D showed mild to moderate sedation (Sedation Score 2) in 66.67% of cases, whereas Group K had minimal sedation (Sedation Score 1) in 83.3% of cases.
- **Hallucinations:** 16.7% of participants in Group K reported hallucinations, while none in Group D experienced this side effect.

Discussion

In this comparative study evaluating intravenous dexmedetomidine (0.3 µg/kg) and ketamine (0.2 mg/kg) for the management of post-spinal shivering in parturients undergoing caesarean section, our findings demonstrates that dexmedetomidine provides a significantly faster onset of shivering cessation and a higher overall efficacy, with minimal adverse effects. These results align with the pharmacological profile of dexmedetomidine, a selective α2-adrenergic agonist known for its thermoregulatory modulation and central sympatholytic properties. The faster action of dexmedetomidine observed in our study is consistent with previous literature, which reports that low-dose dexmedetomidine effectively reduces the shivering threshold and facilitates rapid cessation of established shivering. Studies by Elvan et al [7]. and Bajwa et al [10] have similarly shown dexmedetomidine to produce rapid symptomatic relief, typically within a few minutes of administration, owing to its potent central antishivering mechanism. In contrast, ketamine exerts its effects primarily through NMDA receptor antagonism, which, although effective, may not suppress the thermoregulatory response as rapidly or consistently. Study by Hala Saad et al [11] out of 3 different doses of dexmedetomidine (0.5, 0.3 and 0.2µg/kg) 0.3µg/kg effectively treated shivering associated with spinal anaesthesia with minimal hemodynamic and sedation effects. With reference to this study our study dose of 0.3µg/kg was choosen. Their study showed shivering cessation time of 96.86±40sec when compared to our study of 8.1±1.2min. Study by shivangi Ganjoo et al [12] the shivering cessation time was 6.74±1.3min with dexmedetomidine 0.5µg/kg faster in onset when compared to our study which could be attributed to smaller dose used in our study. According to study by Pradeep Kumar Dash [13] time taken for complete control of shivering was 3.86±1.6min

with ketamine 0.5mg/kg when compared to our study with 0.2mg/kg which was 11.3±2.1min, difference could be again due to the small dose used in our study.

Our results also indicate that dexmedetomidine achieves a higher rate of complete shivering cessation compared with ketamine. These findings are comparable to observations from previous randomized trials that reported greater success rates and lower recurrence of shivering with dexmedetomidine compared to ketamine, clonidine, or tramadol. Additionally, the sedative properties of dexmedetomidine appeared beneficial, providing anxiolysis without significant respiratory depression, an advantage in obstetric anaesthesia. Adverse effects in the dexmedetomidine group were minimal and predominantly limited to mild bradycardia and sedation, which did not require clinical intervention. This is in accordance with prior studies noting that low-dose dexmedetomidine maintains stable hemodynamics. In comparison, ketamine was associated with a slightly higher incidence of hallucinations, dysphoria, and increased secretions, consistent with its known side-effect profile, although these remained manageable and did not result in study withdrawal.

Limitations

Future studies with larger sample sizes and multicentric design may help further validate the optimal dosing strategies and maternal–fetal safety considerations. Study was confined in parturients with no major blood loss or fluid shift. Core temperature were not monitored as parturients were awake.

Conclusions

Overall, the findings suggest that dexmedetomidine at 0.3 µg/kg is superior to ketamine 0.2 mg/kg in terms of onset and efficacy and for treating post-spinal shivering in caesarean section. Its favourable safety profile, rapid thermoregulatory control, and smoother recovery experience make it a more suitable agent in obstetric anaesthesia where maternal well-being and hemodynamic stability are paramount.

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