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Original Research Article

Comparative Study of Intravenous Clonidine Versus Dexmedetomidine on Intraoperative and Postoperative Shivering and Ramsay Sedation Score in Patients Undergoing Lower Abdominal and Lower Limb Surgeries Under Intrathecal Bupivacaine

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Conflict of interest: Nil

Abstract

Background: Spinal anesthesia with intrathecal bupivacaine is widely used for lower abdominal and lower limb surgeries; however, its limited duration and associated complications such as shivering necessitate the use of adjuvants. Intravenous α2-adrenergic agonists, including clonidine and dexmedetomidine, have been shown to enhance anesthetic efficacy, improve sedation, and reduce perioperative shivering.

Aim: To compare intravenous clonidine and dexmedetomidine as premedication to intrathecal 0.5% hyperbaric bupivacaine with respect to intraoperative and postoperative shivering and Ramsay Sedation Score.

Methods: This prospective randomized double-blind study was conducted in 56 patients undergoing lower abdominal and lower limb surgeries under spinal anesthesia. Patients were allocated into two groups: Group C received intravenous clonidine (1 µg/kg), and Group D received intravenous dexmedetomidine (0.5 µg/kg) infused over 15 minutes prior to spinal anesthesia. Sensory and motor block characteristics, duration of analgesia, Ramsay Sedation Score, intraoperative and postoperative shivering, hemodynamic parameters, and adverse effects were recorded and analyzed.

Results: Dexmedetomidine group demonstrated a significantly faster onset of sensory (3.63 ± 0.37 min vs 4.07 ± 0.47 min) and motor block (4.06 ± 0.54 min vs 4.84 ± 0.28 min) compared to clonidine ($p < 0.001$). Duration of sensory block (168.86 min vs 147.21 min), motor block (167.04 min vs 159.64 min), and analgesia (251.79 ± 10.52 min vs 226.11 ± 13.33 min) were significantly prolonged in the dexmedetomidine group ($p < 0.001$). Ramsay Sedation Score was higher with dexmedetomidine (4.89 ± 0.68 vs 2.86 ± 0.70). Incidence of intraoperative and postoperative shivering was significantly lower in the dexmedetomidine group. Hemodynamic parameters were comparable between groups.

Conclusion: Intravenous dexmedetomidine is superior to clonidine as a premedicant to intrathecal bupivacaine, providing faster onset, prolonged anesthesia and analgesia, better sedation, and effective prevention of shivering without significant hemodynamic instability.

Keywords: Dexmedetomidine; Clonidine; Spinal anesthesia; Shivering; Ramsay Sedation Score; Bupivacaine.

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Introduction

Spinal anesthesia, first introduced into clinical practice by Karl August Bier in 1898, has evolved into a cornerstone technique in modern anesthesiology, particularly for lower abdominal and lower limb surgeries.[1] Its widespread acceptance is attributable to several advantages, including rapid onset, profound sensory and motor blockade, reduced systemic drug exposure, cost-effectiveness, and preservation of patient consciousness.[2] These characteristics render subarachnoid block (SAB) especially suitable for procedures requiring reliable regional anesthesia with minimal physiological disturbance.[3] Bupivacaine, a long-acting amide local anesthetic, remains one of the most frequently employed agents for spinal anesthesia due to its favorable pharmacokinetic profile and prolonged duration of action.[4] However, the intrinsic limitation of single-shot spinal anesthesia lies in its finite duration, which may be insufficient for prolonged surgical procedures or extended postoperative analgesia. Consequently, the incorporation of

adjuvants has become an established strategy to enhance block characteristics, prolong analgesia, and reduce the required dose of local anesthetics, thereby minimizing potential toxicity.[5]

Among various adjuvants, α2-adrenergic agonists have gained prominence owing to their sedative, analgesic, and sympatholytic properties. Clonidine, a partial α2-agonist, exerts its effects by inhibiting nociceptive transmission at both spinal and supraspinal levels, thereby prolonging sensory and motor blockade while providing hemodynamic stability.[6] Dexmedetomidine, a highly selective α2-adrenergic agonist, demonstrates superior receptor affinity and has been associated with enhanced analgesia, prolonged duration of spinal block, and improved sedation quality without significant respiratory depression.[7]

In addition to optimizing anesthetic efficacy, perioperative shivering remains a clinically significant concern during spinal anesthesia. Shivering increases oxygen consumption, carbon dioxide production, and cardiovascular stress, which may adversely affect patient outcomes, particularly in vulnerable populations. α2-agonists have been shown to reduce the incidence and severity of shivering by modulating thermoregulatory thresholds at the central level.[8]

Sedation is another critical parameter in regional anesthesia, as an optimal level contributes to patient comfort, anxiolysis, and procedural satisfaction without compromising airway reflexes or hemodynamic stability. The Ramsay Sedation Score (RSS) is widely utilized to quantify sedation levels in clinical practice and research settings.[9]

Although both clonidine and dexmedetomidine are extensively studied as adjuvants to spinal anesthesia, evidence comparing their intravenous administration as premedication particularly in relation to intraoperative and postoperative shivering and sedation profiles remains limited and heterogeneous.[10] Furthermore, variations in dosing, methodology, and outcome measures across studies necessitate well-structured comparative investigations.

Therefore, the present study was designed as a prospective randomized double-blind trial to compare the effects of intravenous clonidine and dexmedetomidine as premedication to intrathecal hyperbaric bupivacaine in patients undergoing lower abdominal and lower limb surgeries. The study specifically aims to evaluate intraoperative and postoperative shivering, sedation levels using the Ramsay Sedation Score, and associated anesthetic and analgesic outcomes, thereby contributing to evidence-based optimization of adjuvant selection in spinal anesthesia.

Aim: To compare intravenous clonidine and dexmedetomidine as premedication to intrathecal bupivacaine with respect to intraoperative and postoperative shivering and Ramsay Sedation Score in patients undergoing lower abdominal and lower limb surgeries.

Objectives

Primary

- To compare intraoperative and postoperative shivering.
- To compare sedation levels using Ramsay Sedation Score.

Secondary

- To compare onset and duration of sensory and motor block.
- To compare duration of analgesia.
- To assess hemodynamic parameters and adverse effects.

Materials and Methods

Study Design and Setting: This prospective, randomized, double-blind comparative study was conducted in the Department of Anaesthesiology at Chettinad Hospital and Research Institute over a period of 18 months.

Study Population: A total of 56 patients scheduled for lower abdominal and lower limb surgeries under spinal anesthesia were enrolled and randomly allocated into two equal groups (n = 28 each).

Inclusion Criteria

- Patients aged 18–60 years
- American Society of Anesthesiologists (ASA) physical status I and II
- Patients undergoing elective or emergency lower abdominal and lower limb surgeries

Exclusion Criteria

- Patient refusal
- Known allergy to study drugs
- Baseline bradycardia or tachycardia
- Significant systemic illness or contraindications to spinal anesthesia

Randomization and Blinding: Participants were randomized into two groups using a computer-generated sequence. The study was double-blinded, with both the patient and the investigator unaware of group allocation.

Study Groups

- **Group C (Clonidine group):** Intravenous clonidine 1 μg/kg diluted in 100 ml normal saline

- **Group D (Dexmedetomidine group):** Intravenous dexmedetomidine 0.5 µg/kg diluted in 100 ml normal saline

The study drug was administered as an infusion over 15 minutes prior to spinal anesthesia.

Preoperative Preparation: All patients underwent standard preanesthetic evaluation and were kept nil per oral according to guidelines. Baseline vital parameters including heart rate, non-invasive blood pressure, oxygen saturation, and Ramsay Sedation Score were recorded. Intravenous access was secured, and patients were preloaded with Ringer lactate solution (10 ml/kg).

Anaesthetic Technique: Under aseptic precautions, spinal anesthesia was performed in the sitting position at the L3–L4 interspace using a 25G Quincke needle.

After confirmation of free flow of cerebrospinal fluid, 3.5 ml of 0.5% hyperbaric bupivacaine was administered intrathecally.

Intraoperative Monitoring: Vital parameters (heart rate, blood pressure, SpO_2, ECG) were monitored at regular intervals. Oxygen was administered via face mask at 6 L/min throughout the procedure. Hemodynamic changes such as hypotension and bradycardia were managed according to standard protocols.

Outcome Measures

Primary Outcomes

- Incidence and severity of intraoperative shivering
- Incidence and severity of postoperative shivering
- Sedation level assessed using Ramsay Sedation Score

Secondary Outcomes

- Onset and duration of sensory and motor block
- Duration of postoperative analgesia (time to first rescue analgesic)
- Hemodynamic parameters
- Adverse effects (hypotension, bradycardia, nausea, vomiting)

Assessment Methods

- Sensory block assessed using loss of cold sensation
- Motor block assessed using Modified Bromage Scale
- Pain assessed using Visual Analog Scale (VAS)
- Shivering graded using Crossley and Mahajan scale
- Sedation assessed using Ramsay Sedation Score

Statistical Analysis: Data were expressed as mean ± standard deviation for continuous variables and as frequencies and percentages for categorical variables. Statistical analysis was performed using appropriate tests (independent t-test and chi-square test), with a p-value <0.05 considered statistically significant.

Results and Findings

Table 1: Demographic Characteristics (Age)

Variable	Group C (Clonidine) Mean ± SD	Group D (Dexmedetomidine) Mean ± SD	P value
Age (years)	39.89 ± 13.38	43.86 ± 10.45	0.222

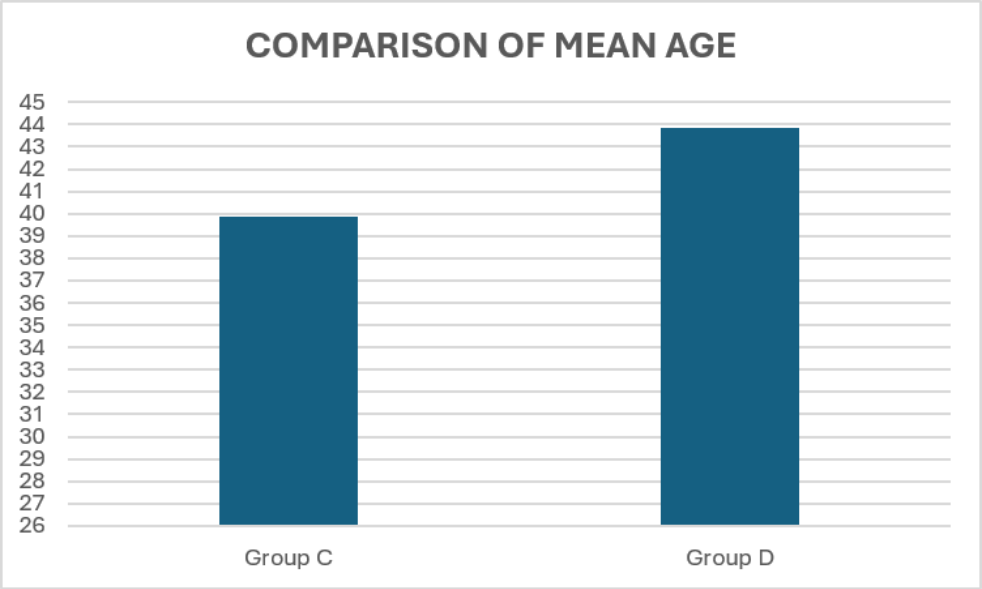

Figure 1: Demographic Characteristics (Age)

Interpretation: The mean age was comparable between both groups, with no statistically significant difference ($p > 0.05$), indicating appropriate baseline homogeneity.

Table 2: Sex Distribution

Sex	Group C (n=28)	Group D (n=28)	Total	P value
Male	14 (50%)	14 (50%)	28	1.00
Female	14 (50%)	14 (50%)	28	

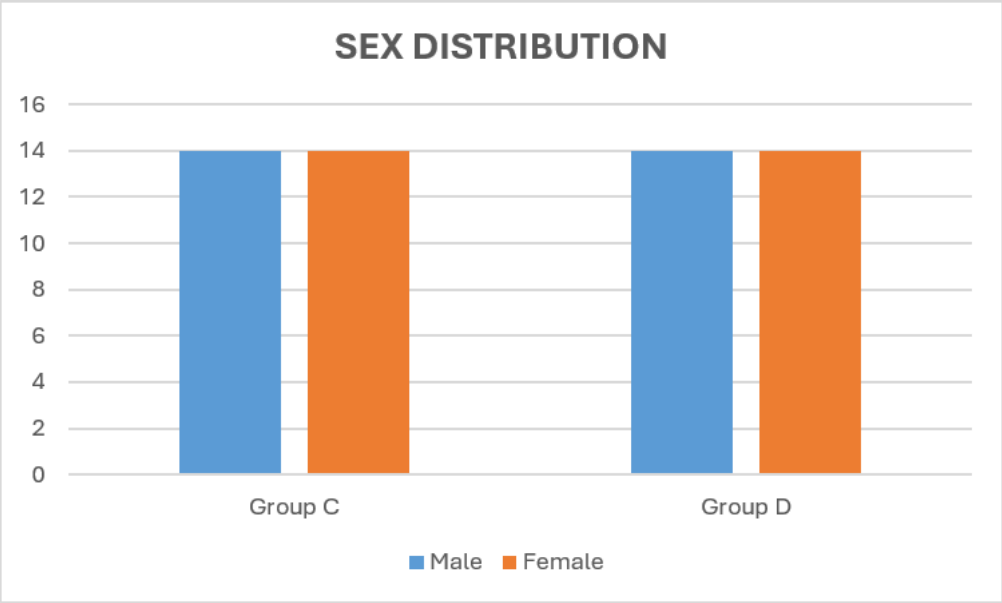

Figure 2: Sex Distribution

Interpretation: Sex distribution was identical in both groups, demonstrating effective randomization and eliminating gender-related confounding.

Table 3: ASA Physical Status

ASA Grade	Group C	Group D	Total	P value
I	15 (50%)	15 (50%)	30	1.00
II	13 (50%)	13 (50%)	26	

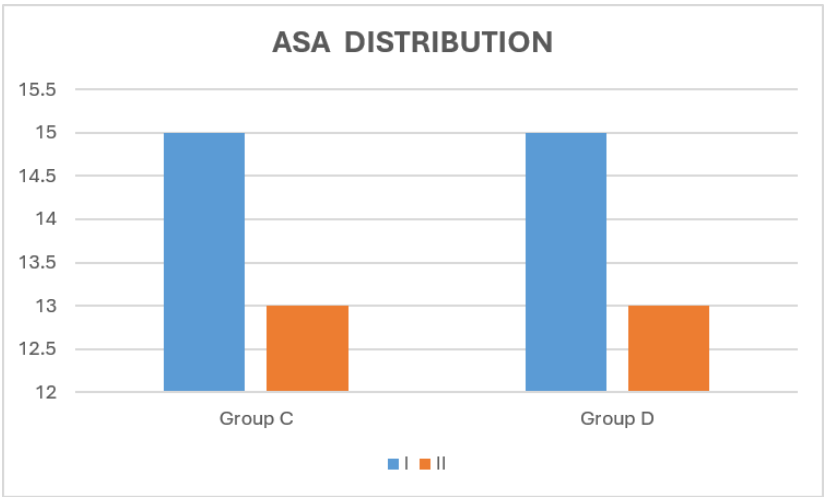

Figure 3: ASA Physical Status

Interpretation: ASA grading was evenly distributed between groups, confirming comparability in baseline clinical status.

Table 4: Onset of Sensory and Motor Block

Parameter	Group C Mean ± SD	Group D Mean ± SD	P value
Sensory onset (min)	4.07 ± 0.47	3.63 ± 0.37	<0.001
Motor onset (min)	4.84 ± 0.28	4.06 ± 0.54	<0.001

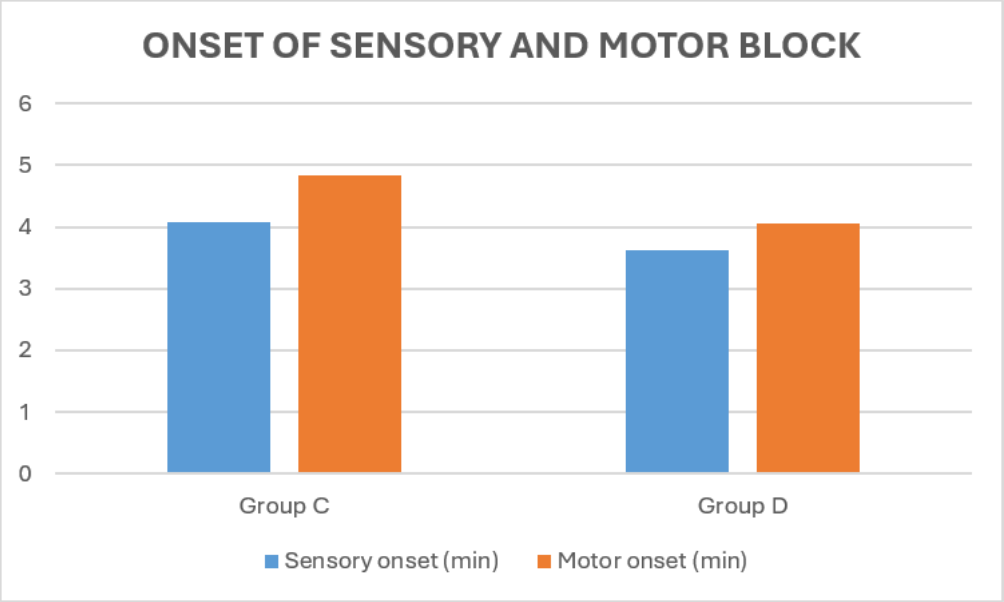

Figure 4: Onset of Sensory and Motor Block

Interpretation: Dexmedetomidine demonstrated a significantly faster onset of both sensory and motor block compared to clonidine ($p < 0.001$).

Table 5: Time to Peak Sensory Level

Parameter	Group C	Group D	P value
Time to peak level (min)	8.37 ± 0.54	6.05 ± 0.68	<0.001

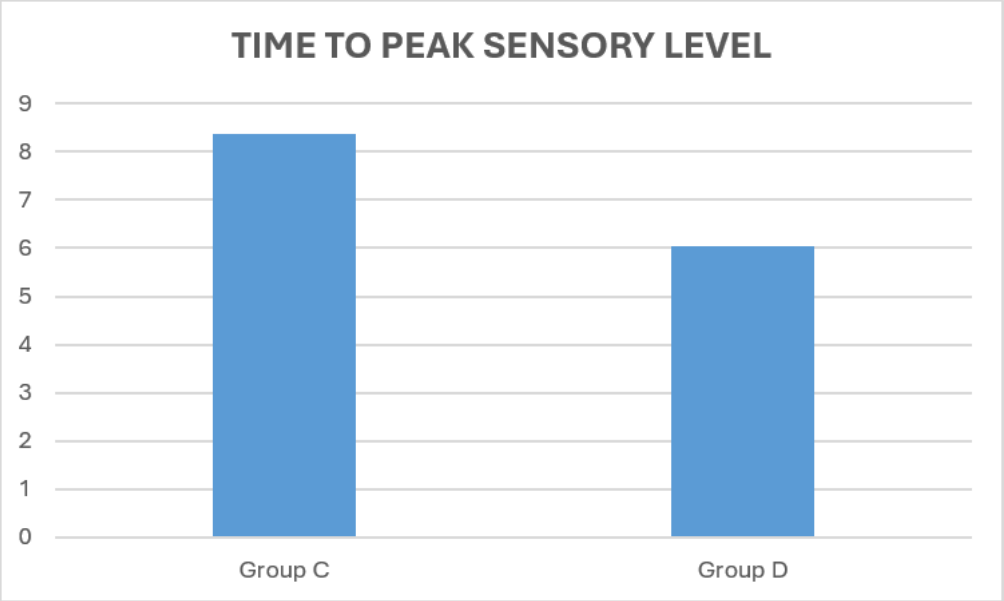

Figure 5: Time to peak sensory level

Interpretation: Time to achieve peak sensory level was significantly shorter in the dexmedetomidine group.

Table 6: Duration of Block

Parameter	Group C	Group D	P value
Sensory regression (min)	147.21 ± —	168.86 ± —	<0.001
Motor regression (min)	159.64 ± —	167.04 ± —	<0.001

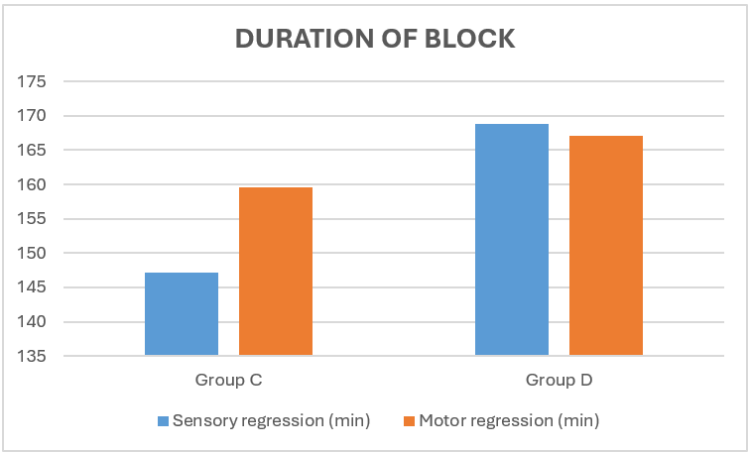

Figure 6: Duration of Block

Interpretation: Dexmedetomidine significantly prolonged both sensory and motor block duration compared to clonidine.

Table 7: Duration of Analgesia

Parameter	Group C	Group D	P value
Duration (min)	226.11 ± 13.33	251.79 ± 10.52	<0.001

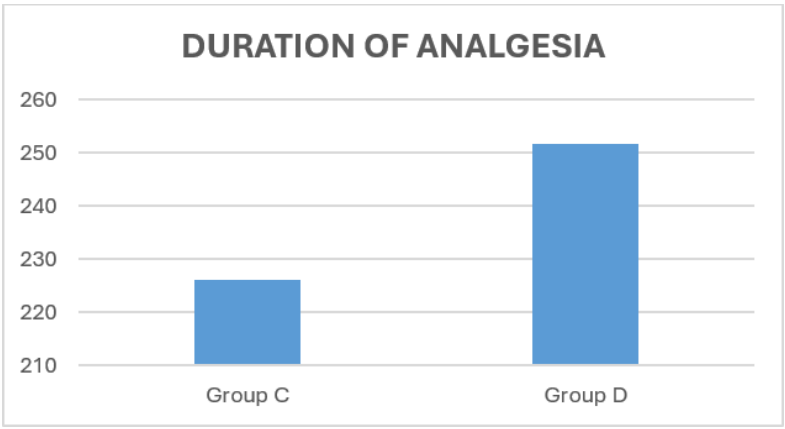

Figure 7: Duration of Analgesia

Interpretation: Postoperative analgesia lasted significantly longer in the dexmedetomidine group.

Table 8: Ramsay Sedation Score

Parameter	Group C	Group D	P value
Mean RSS	2.86 ± 0.70	4.89 ± 0.68	<0.001

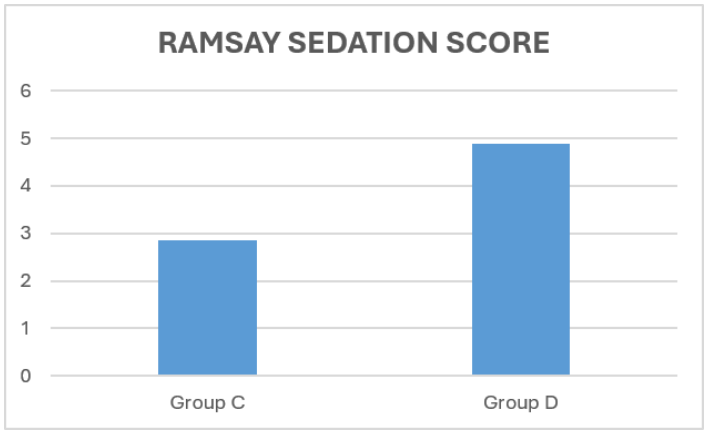

Figure 8: Ramsay Sedation Score

Interpretation: Dexmedetomidine produced significantly higher sedation levels compared to clonidine, indicating superior sedative efficacy.

Table 9: Association between Intraoperative Shivering and Study Groups

Intraoperative Shivering	Group C (n=28)	Group D (n=28)	Total (n=56)	P value
Yes	10 (83.3%)	2 (16.7%)	12 (100%)	0.009*
No	18 (40.9%)	26 (59.1%)	44 (100%)	
Total	28 (50%)	28 (50%)	56 (100%)	

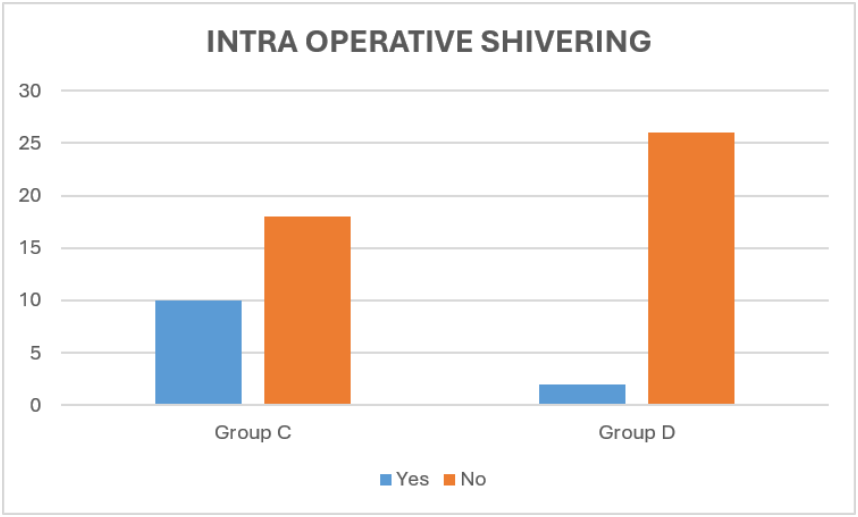

Figure 9: Intraoperative shivering

Interpretation: Intraoperative shivering was observed in a significantly higher proportion of patients in Group C (83.3%) compared to Group D (16.7%). The difference was statistically significant (p = 0.009), indicating that dexmedetomidine is more effective than clonidine in reducing intraoperative shivering.

Table 10: Association between Postoperative Shivering and Study Groups

Postoperative Shivering	Group C (n=28)	Group D (n=28)	Total (n=56)	P value
Yes	13 (81.3%)	3 (18.8%)	16 (100%)	0.003*
No	15 (37.5%)	25 (62.5%)	40 (100%)	
Total	28 (50%)	28 (50%)	56 (100%)	

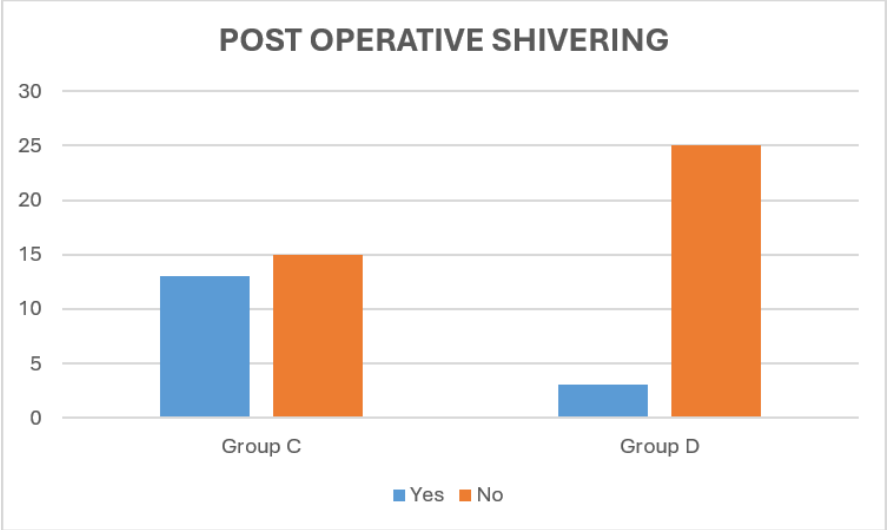

Figure 10: Association between Postoperative Shivering and Study Groups

Interpretation: Postoperative shivering occurred significantly more frequently in Group C (81.3%) than in Group D (18.8%). This difference was statistically significant (p = 0.003), further supporting the superior anti-shivering efficacy of dexmedetomidine in the postoperative period.

Table 11: Hemodynamic Parameters

Parameter	Observation
Heart Rate	Comparable between groups
Blood Pressure	No significant difference
SpO_2	Stable in both groups

Interpretation: Both drugs maintained hemodynamic stability with no clinically significant differences.

Table 12: Adverse Effects

Adverse Effect	Group C	Group D
Hypotension	Mild	Mild
Bradycardia	Occasional	Slightly higher
Nausea/Vomiting	Minimal	Minimal

Interpretation: Both groups exhibited minimal and manageable adverse effects, with no major complications.

Major Findings of the Study

- Dexmedetomidine provided faster onset of sensory and motor block.
- It resulted in prolonged duration of anesthesia and analgesia.
- Sedation levels were significantly higher with dexmedetomidine.
- Marked reduction in intraoperative and postoperative shivering was observed with dexmedetomidine.
- Both drugs maintained hemodynamic stability with minimal side effects.

Discussion

The present prospective randomized double-blind study evaluated the comparative efficacy of intravenous clonidine and dexmedetomidine as premedication to intrathecal hyperbaric bupivacaine, with particular emphasis on shivering, sedation, block characteristics, and hemodynamic stability.

Baseline demographic parameters, including age, sex distribution, and ASA physical status, were comparable between the two groups, indicating appropriate randomization and eliminating potential confounding factors. Such homogeneity strengthens the internal validity of the study and ensures that observed differences in outcomes can be attributed primarily to the pharmacological effects of the study drugs.

A principal finding of this study was the significantly faster onset of both sensory and motor blockade in the dexmedetomidine group compared to the clonidine group (3.63 vs 4.07 minutes for sensory onset; 4.06 vs 4.84 minutes for motor onset). These findings are consistent with previous investigations, such as those by Ganesh et al.[11] and Kanazi et al.[12], which demonstrated that α2-adrenergic agonists, particularly dexmedetomidine, enhance the quality and rapidity of neuraxial blockade. The superior receptor selectivity of dexmedetomidine (α2:α1 ratio of 1600:1) likely contributes to its more pronounced facilitation of spinal anesthesia.

The duration of sensory and motor blockade was significantly prolonged in the dexmedetomidine group (168.86 vs 147.21 minutes for sensory block; 167.04 vs 159.64 minutes for motor block). These findings align with studies by Mahendru et al. and Liu et al.[13], which reported prolonged blockade and delayed regression with dexmedetomidine when used as an adjuvant. The mechanism underlying this effect is attributed to inhibition of substance P release and hyperpolarization of interneurons in the dorsal horn, thereby augmenting and sustaining the anesthetic effect.

Similarly, the duration of postoperative analgesia was significantly longer in the dexmedetomidine group (251.79 vs 226.11 minutes), corroborating findings from Al-Mustafa et al.[14] and Paramasivan et al.[15], who demonstrated enhanced analgesic duration and reduced requirement for rescue analgesics with dexmedetomidine. This prolonged analgesia has substantial clinical implications, particularly in reducing opioid consumption and improving postoperative recovery profiles.

Sedation, assessed using the Ramsay Sedation Score, was significantly higher in the dexmedetomidine group (mean RSS 4.89 vs 2.86). This observation is consistent with the known central sympatholytic and sedative effects of dexmedetomidine mediated via locus coeruleus inhibition. Comparable findings have been reported in studies by Agarwal et al.[16] and Marhofer et al.[17], which emphasize that dexmedetomidine provides cooperative sedation without respiratory depression, a desirable characteristic in regional anesthesia. A critical outcome of this study was the marked reduction in both intraoperative and postoperative shivering in the dexmedetomidine group compared to clonidine. These findings are supported by meta-analyses and randomized trials indicating that dexmedetomidine effectively lowers the shivering threshold through central thermoregulatory modulation. Paramasivan et

al.[18] and recent clinical studies have similarly demonstrated reduced incidence of shivering with dexmedetomidine, highlighting its superiority as an anti-shivering agent.

Hemodynamic parameters remained stable in both groups, with no statistically significant differences in heart rate, blood pressure, or oxygen saturation. Although mild bradycardia and hypotension were observed, these were clinically manageable and did not necessitate major interventions. These findings agree with previous studies, including those by Manoharan et al.[19], which reported minimal hemodynamic disturbances with both α2-agonists when used in appropriate doses. The findings of the present study indicate that dexmedetomidine is superior to clonidine in terms of faster onset, prolonged duration of blockade and analgesia, enhanced sedation, and more effective prevention of shivering, without compromising hemodynamic stability. These results are consistent with a growing body of literature supporting the preferential use of dexmedetomidine as an adjuvant in spinal anesthesia.

Conclusion

Intravenous dexmedetomidine, when used as premedication to intrathecal hyperbaric bupivacaine, demonstrates superior clinical efficacy compared to clonidine by providing a faster onset and prolonged duration of sensory and motor blockade, extended postoperative analgesia, significantly higher sedation levels, and a marked reduction in both intraoperative and postoperative shivering, while maintaining comparable hemodynamic stability and an acceptable safety profile; therefore, dexmedetomidine may be considered a more effective adjuvant than clonidine in patients undergoing lower abdominal and lower limb surgeries under spinal anesthesia.

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