



COMPARATIVE STUDY BETWEEN INTRATHECAL DEXMETETOMIDINE AND DEXAMETHASONE AS ADJUVANTS TO BUPIVACAINE FOR PREVENTION OF PERIOPERATIVE SHIVERING IN CAESAREAN SECTION

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Abstract

Background and aims: Perioperative shivering after spinal anaesthesia is common in caesarean section and increases oxygen consumption, carbon dioxide production and cardiac work load. Dexmedetomidine and dexamethasone are increasingly used intrathecally as adjuvants and may influence shivering, sedation and block characteristics. This study compared intrathecal dexmedetomidine and dexamethasone added to hyperbaric bupivacaine for prevention of shivering.

Methods: In this prospective, randomised, blind controlled trial, 60 ASA II parturients undergoing caesarean section under spinal anaesthesia were allocated to receive either dexmedetomidine 10 µg (Group D) or dexamethasone 4 mg (Group C) with 12.5 mg 0.5% hyperbaric bupivacaine. Shivering (Bedside Shivering Assessment Scale, Crossley-Mahajan scale), Ramsay sedation scores, Hemo dynamics, SpO₂, motor block duration and adverse events were recorded at predefined intervals.

Results: Demographic profile and surgery duration were comparable. Mean Ramsay score was higher with dexmedetomidine (3.5) than with dexamethasone (2.0, $P < 0.0001$). Shivering incidence and severity were low and similar in both groups at all time points. Heart rate, blood pressure and SpO₂ remained stable and comparable. Motor block duration was longer with dexamethasone (180.33 min) than with dexmedetomidine (161.33 min). Adverse events were infrequent and did not differ significantly ($P = 0.33$). **Conclusion:** Intrathecal dexmedetomidine 10 µg and dexamethasone 4 mg, as adjuvants to bupivacaine for caesarean section, are equally effective for shivering prophylaxis with good haemodynamic stability. Dexmedetomidine provides greater sedation, whereas dexamethasone prolongs motor block and may enhance postoperative analgesia.

Keywords: Dexmedetomidine, Dexamethasone, Spinal anaesthesia, Shivering, Caesarean section

Introduction

Perioperative shivering is a frequent and distressing complication after neuraxial anaesthesia, defined as repetitive, involuntary skeletal muscle activity triggered by perioperative heat loss, increased

sympathetic tone, pain and pyrogen release.¹ It increases metabolic rate, oxygen consumption and carbon dioxide production and may adversely affect haemodynamic status, especially in patients with limited cardiopulmonary reserve.^{2,3} In parturients undergoing caesarean section under regional anaesthesia, shivering also interferes with electrocardiographic and pulse oximetry monitoring and can negatively impact the birth experience.⁴

Spinal anaesthesia impairs thermoregulation by inhibiting tonic vasoconstriction and redistributing core heat from the trunk to peripheral tissues, leading to a fall in core temperature and a high incidence of shivering.^{4,5} Perioperative hypothermia and pain are the main contributors, whereas the exact role of sympathetic overactivity remains difficult to quantify.⁴ Non-pharmacological measures (forced-air warming, warmed IV fluids) and several drugs, including pethidine, tramadol, clonidine, ketamine, nefopam and 5-HT₃ antagonists, have been evaluated to prevent or treat shivering.^{2,3,6} However, these agents may cause oversedation, nausea, vomiting, respiratory depression or allergy, limiting their routine use in obstetric practice.^{2,3,6}

Dexmedetomidine, a highly selective α_2 -adrenergic agonist, provides sedation, analgesia and anti-shivering effects via neuraxial and intravenous routes.^{7,16-19} Its anti-shivering action is attributed to central modulation of hypothalamic thermoregulation and reduction in vasoconstriction and shivering thresholds.¹⁶⁻¹⁹ Dexamethasone, a long-acting corticosteroid, reduces inflammatory mediator release and the core-peripheral temperature gradient, and has been used systemically to attenuate shivering and intrathecally to prolong spinal block and reduce opioid requirements.^{8,12,13} Recent trials have examined dexmedetomidine and dexamethasone as intrathecal adjuvants to bupivacaine. Atri et al. and Ismaiel et al. reported that both drugs reduce shivering in caesarean section, with dexmedetomidine producing greater sedation and dexamethasone prolonging motor block.^{9,11} Moeen et al. found intrathecal dexamethasone comparable to meperidine for shivering prevention, and Usta et al. showed that intravenous dexmedetomidine reduced shivering during spinal anaesthesia.^{7,16} However, comparative data in obstetric patients remain limited, and the optimal intrathecal adjuvant for balancing shivering control, block characteristics and maternal safety is unclear.^{9,11}

This study was designed to compare intrathecal dexmedetomidine 10 µg and dexamethasone 4 mg, as adjuvants to 0.5% hyperbaric bupivacaine, with respect to perioperative shivering, sedation, haemodynamic parameters, block characteristics and adverse events in parturients undergoing caesarean section under spinal anaesthesia.

Methods

After approval from the Institutional Ethics Committee and written informed consent from all participants, this prospective, blind randomised controlled study was conducted in 60 parturients scheduled for caesarean section under spinal anaesthesia. Pregnant women aged 18-40 years, ASA physical status II, with gestational age ≥ 37 weeks and expected surgical duration < 4 hours were included.

Exclusion criteria were refusal to participate, coagulopathy or anticoagulant therapy, presence of significant comorbidities, known hypersensitivity to study drugs, history of allergy and age < 18 or > 40 years.

Patients were randomly allocated into two equal groups ($n = 30$ each) using a computer-generated random number table. Group D received intrathecal dexmedetomidine 10 µg as adjuvant to 12.5 mg 0.5% hyperbaric bupivacaine; Group C received intrathecal dexamethasone 4 mg with the same dose of bupivacaine. Study solutions were prepared in identical 5-ml syringes by an anaesthesiologist not involved in patient care or data collection, ensuring blinding of both patients and observers.

In the operating room, standard monitoring (non-invasive blood pressure, heart rate, ECG and SpO₂) was instituted, and intravenous access secured with lactated Ringer's infusion at 6–8 ml/kg. Spinal anaesthesia was performed at L3-L4 or L4-L5 interspace with a 25-G spinal needle under aseptic precautions, and the allocated study drug with bupivacaine was injected intrathecally.

Onset of sensory block was assessed by pinprick using a three-point scale (2 = sharp pain, 1 = blunt pain, 0 = no pain), and time from completion of injection to loss of pinprick sensation at T10 was recorded as onset of sensory block. Time to maximum sensory level, onset and maximum degree of motor block (modified Bromage scale), and duration of motor block (time to Bromage 0) were recorded.

Shivering was evaluated at baseline and at 5, 15, 30, 45, 60, 90, 120, 180 and 240 min using the Bedside Shivering Assessment Scale (0-3) and Crossley and Mahajan scale (grades 0-4). Sedation was assessed using the Ramsay Sedation Scale, aiming for scores 2-3 as the target range. Heart rate, systolic, diastolic and mean blood pressures and SpO₂ were documented at the same time points.

Non-pharmacological measures such as warm blankets and warmed intravenous fluids were used as rescue for shivering when needed. Hypotension (systolic blood pressure <80 mmHg or >30% fall from baseline) was treated with crystalloid boluses and Mephentermine 3 mg IV; bradycardia (heart rate <50/min) was treated with atropine 0.6 mg IV. Adverse events including nausea, vomiting, bradycardia, hypotension and any neurological symptoms were recorded.

Statistical analysis

Data were compiled in Microsoft Excel and analysed using IBM SPSS version 21. Continuous variables were expressed as mean $\pm$ standard deviation and compared using Student's t-test; categorical variables were analysed using chi-square or Fisher's exact test as appropriate. A P value <0.05 was considered statistically significant.

Results

All 60 patients completed the study and were included in the analysis.

Demographic characteristics and surgery duration

The two groups were comparable with respect to age and duration of surgery. Mean age was 25.10 years in Group C and 25.50 years in Group D, with no statistically significant difference. Mean duration of surgery was 112 min in Group C and 113.17 min in Group D, which was also not significantly different.

Sedation

According to the Ramsay Sedation Scale, all patients in Group C had a score of 2, whereas in Group D, 1 patient had a score of 2, 17 patients had a score of 3, 10 patients had a score of 4 and 2 patients had a score of 5. Mean Ramsay score was 2.0 in Group C and 3.5 in Group D, indicating significantly deeper sedation with dexmedetomidine ($P < 0.0001$).

Motor block

Mean duration of motor block was 180.33 min in Group C (dexamethasone) and 161.33 min in Group D (dexmedetomidine), showing a statistically significant prolongation of motor block with dexamethasone.

Shivering

On the Bedside Shivering Assessment Scale, the majority of patients in both groups had no shivering at all time points. At 15 min, all 30 patients in Group C had no shivering, whereas in Group D, 27 had no shivering, 2 had moderate shivering and 1 had mild shivering; this difference was not statistically significant. At 30 and 45 min, isolated instances of mild or moderate shivering occurred in both groups, but there were no significant inter-group differences.

On the Crossley and Mahajan scale, most patients in both groups remained at grade 0, with a few cases at grades 1-3 at 5, 15 and 30 min; again, there was no statistically significant difference between groups.

Haemodynamic parameters and oxygen saturation

Baseline mean heart rate was 82.90 beats/min in Group C and 88.77 beats/min in Group D, with no significant difference at any interval during the study. Mean systolic blood pressure was 112.82 mmHg in Group C and 111.92 mmHg in Group D, mean diastolic blood pressure was 74.96 and 74.43 mmHg, respectively and mean arterial pressure was 88.7 and 88.3 mmHg, respectively, with no significant inter-group differences at any time.

Baseline SpO₂ was 98% in both groups; after initiation of spinal anaesthesia and throughout the observation period up to 240 min, SpO₂ remained at 100% in all patients without any difference between groups.

Adverse effects

In Group C, 10% of patients experienced nausea, 6.67% had bradycardia and 3.33% had vomiting. In Group D, 16.67% had bradycardia and 3.33% each had nausea and vomiting. There was no statistically significant association in overall adverse effects between the two groups ($P = 0.33$). No serious complications were observed.

OBSERVATIONS AND RESULTS

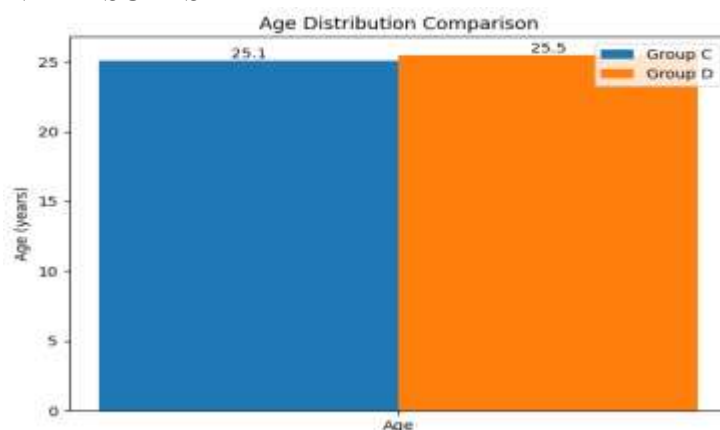


Chart 1: age distribution amongst group C and group D

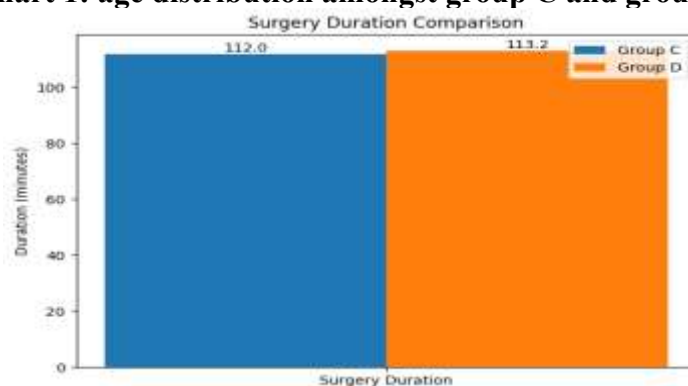


Chart 2: mean surgery duration among group C and group D

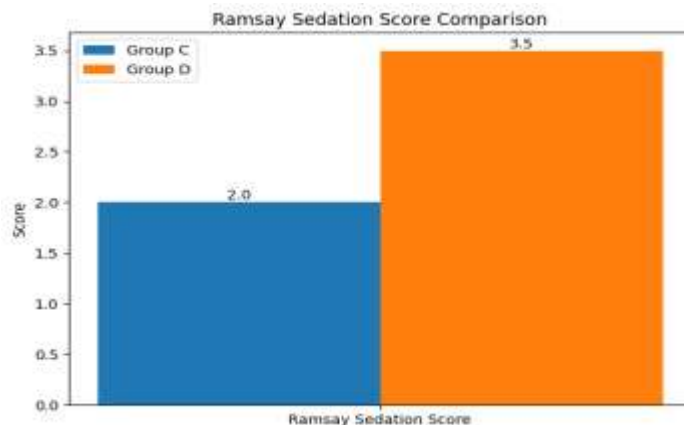


Chart 3: Ramsay sedation score among group C and group D

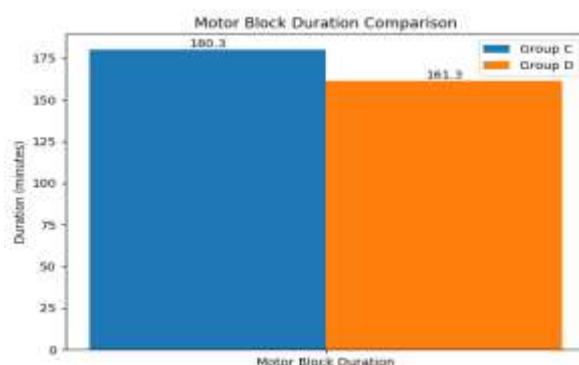


Chart 4: motor duration block in group C and group D

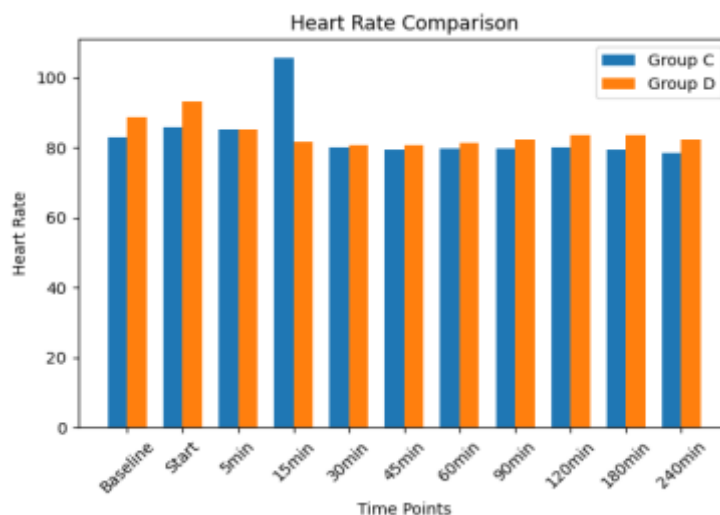


Chart 5: heart rate at various interval in group C and group D.

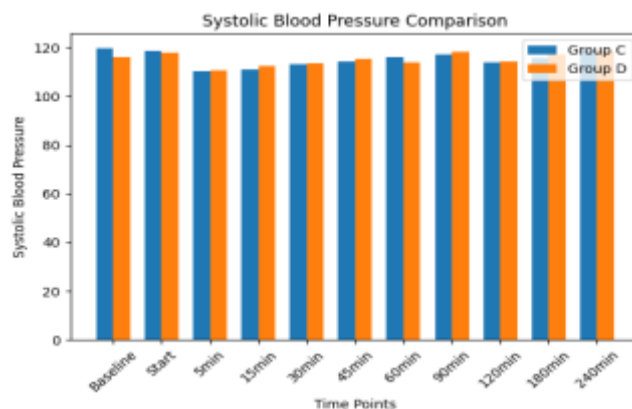


Chart 6: systolic blood pressure at various intervals among group C and group D

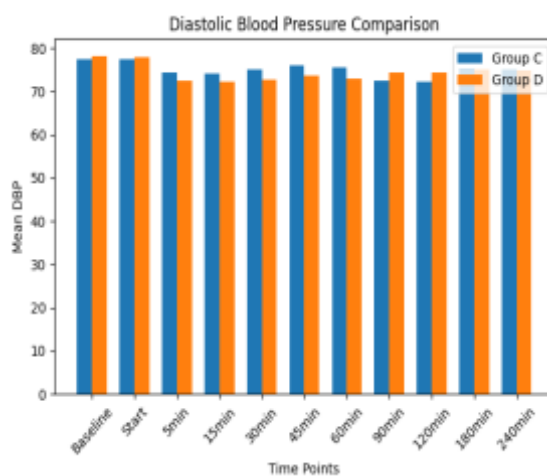


Chart 7: Diastolic blood pressure at various intervals among group C and group D

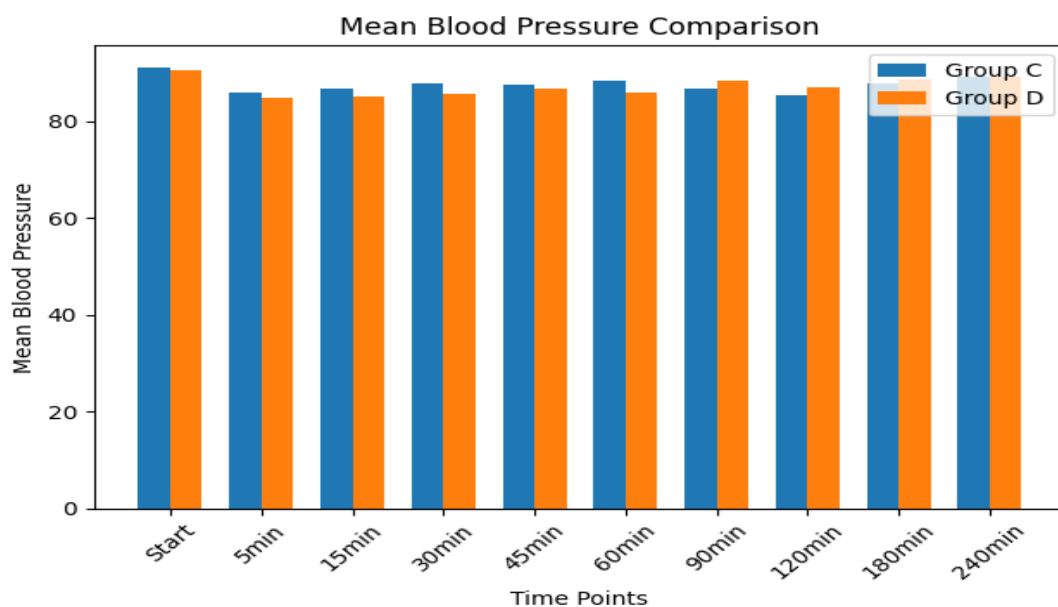


Chart 8: Mean blood pressure at various intervals among group C and group D

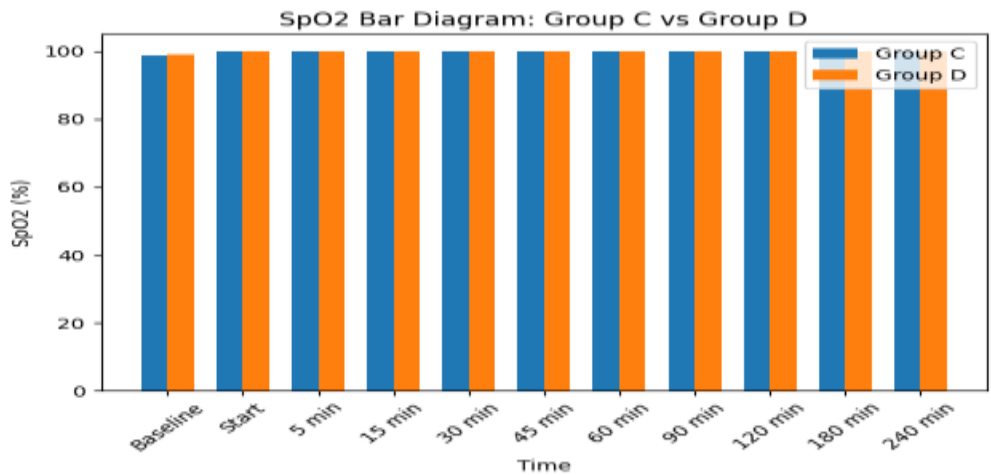


Chart 9: SPO2 among group C and Group D

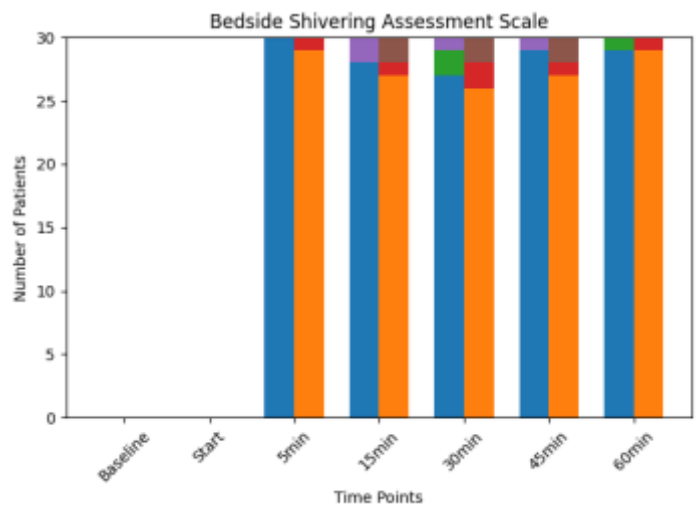


Chart 10: Bedside shivering assessment scale

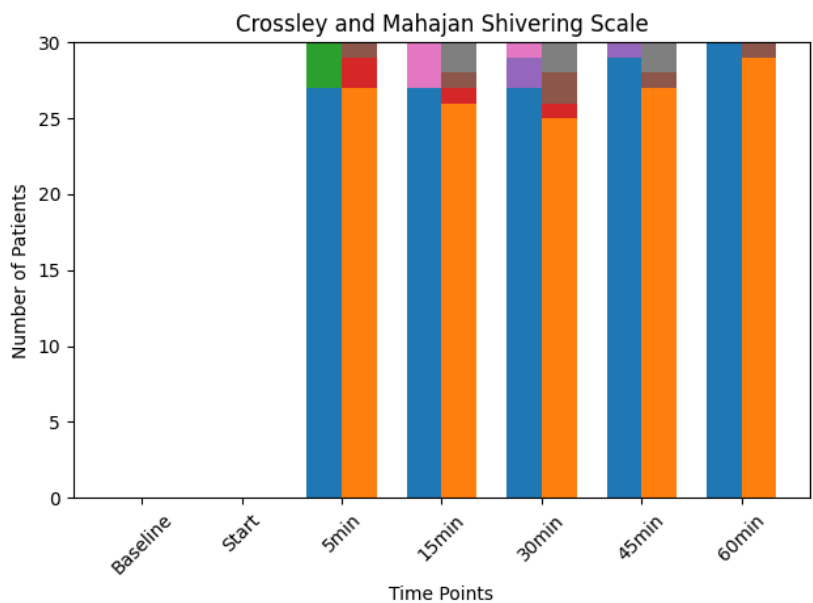


Chart 11: Crossley and Mahajan shivering assessment scale

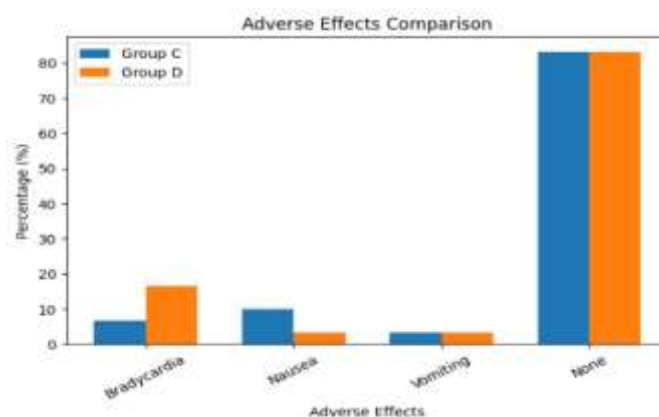


Chart 12: comparison of adverse effects amongst group C and group D

Discussion

In this randomised, blind controlled trial, intrathecal dexmedetomidine 10 µg and dexamethasone 4 mg, added to hyperbaric bupivacaine for caesarean section, provided comparable prevention of perioperative shivering with stable haemodynamics and acceptable safety. Dexamethasone significantly prolonged motor block, whereas dexmedetomidine produced deeper sedation without respiratory compromise.

The low and similar shivering scores in both groups support the anti-shivering efficacy of each adjuvant when combined with intrathecal bupivacaine. These results are consistent with those of Ismaiel et al., who reported reduced shivering incidence and intensity with both intrathecal dexmedetomidine and dexamethasone in caesarean section¹¹ Atri et al. likewise found that both adjuvants effectively controlled shivering, with no significant difference in anti-shivering efficacy⁹ Dexmedetomidine's role as a highly selective α_2 -adrenergic agonist explains the deeper sedation observed in our study.^{7,17-19} The higher Ramsay scores in the dexmedetomidine group mirror the patterns reported by Atri et al. and Ismaiel et al., who also documented greater sedation with dexmedetomidine than with dexamethasone.^{9,11} Moeen et al. further demonstrated that intrathecal dexmedetomidine significantly reduced the incidence and intensity of shivering compared with saline, with acceptable sedation.¹⁶

Dexamethasone likely attenuates shivering through anti-inflammatory effects and modulation of the core-peripheral temperature gradient.^{8,12,13} In our study, dexamethasone prolonged motor block duration compared with dexmedetomidine, in line with the findings of Ismaiel et al. and Bani-Hashem et al., who showed longer spinal block and reduced postoperative opioid use when dexamethasone was added intrathecally.^{11,12} Abdelhady et al. also reported that dexamethasone, used as an adjuvant in transversus abdominis plane block, prolonged analgesia more than dexmedetomidine, supporting a broader role for dexamethasone as an analgesia-extending agent.¹⁰

Haemodynamic stability in both groups is reassuring in obstetric practice. Our data parallel the observations of Atri et al. and Ismaiel et al., who did not find significant differences in heart rate or blood pressure between dexmedetomidine and dexamethasone groups when used intrathecally.^{9,11} Nasser et al. similarly showed that intrathecal dexmedetomidine added to bupivacaine for caesarean section did not increase hypotension or bradycardia compared with bupivacaine alone.¹⁴ In the present study, episodes of bradycardia and hypotension were few, easily treated and comparable between groups.

The deeper sedation with dexmedetomidine may benefit anxious parturients but could interfere with early mother-infant interaction if excessive. Ismaiel et al. and Atri et al. both reported higher sedation grades with dexmedetomidine than with dexamethasone, similar to our findings^{9,11} Dexamethasone maintained an awake but comfortable Ramsay 2 level in all patients in our study and may therefore be preferred when active maternal participation is prioritised.

Our results regarding motor block duration corroborate earlier studies showing that intrathecal dexamethasone prolongs spinal anaesthesia and may reduce postoperative analgesic requirements.

^{11,12} While this is desirable from an analgesia perspective, prolonged motor block may delay ambulation and should be balanced against institutional protocols and patient expectations. Additional evidence supports the anti-shivering effect of dexmedetomidine across various settings. Usta et al. reported that intravenous dexmedetomidine significantly reduced shivering during spinal anaesthesia compared with placebo⁷ Nasser et al. showed reduced incidence and intensity of shivering with intrathecal dexmedetomidine in caesarean section¹⁴ Qi et al. found a markedly lower shivering incidence with intrathecal dexmedetomidine than with morphine or bupivacaine alone, further confirming its anti-shivering efficacy¹⁷

Strengths of the study

The strengths of this study include its prospective randomised, blind controlled design and the use of a homogeneous obstetric population (ASA II parturients undergoing caesarean section under spinal anaesthesia), which reduces confounding from mixed surgical profiles. A direct head-to-head comparison of intrathecal dexmedetomidine and dexamethasone as adjuvants to the same dose of bupivacaine provides clinically relevant information that is lacking in much of the existing literature. Objective, repeated measurement of shivering (Bedside Shivering Assessment Scale and Crossley-Mahajan scales), sedation and haemodynamic variables, along with systematic recording of adverse events, strengthens the internal validity of our findings.

Limitations and future directions

Limitations include the relatively small sample size from a single centre, which may limit generalisability beyond similar practice settings. Core temperature was not monitored using invasive methods, and shivering scores were used as clinical surrogates, so subclinical hypothermia may have been missed. Only one dose each of dexmedetomidine (10 µg) and dexamethasone (4 mg) was evaluated, and neonatal outcomes were not assessed, which may be relevant in obstetric practice. Future studies with larger, multicentre cohorts should explore different intrathecal dose regimens and combinations of dexmedetomidine and dexamethasone, incorporate core temperature monitoring and include maternal satisfaction and neonatal outcomes. Such work could help define the optimal adjuvant and dosing strategy for high-risk subgroups, such as women with cardiac disease or pre-eclampsia.

Conclusion

Intrathecal dexmedetomidine 10 µg and dexamethasone 4 mg, when used as adjuvants to 0.5% hyperbaric bupivacaine for caesarean section, are both effective in reducing the incidence and severity of perioperative shivering without adversely affecting maternal haemodynamics or oxygenation. Dexamethasone significantly prolongs motor block and is likely to reduce postoperative rescue analgesia requirements, whereas dexmedetomidine provides deeper intraoperative sedation, which may be beneficial in selected parturients. Both agents appear to be safe options in this setting, and future dose-finding and multicentre trials are warranted to refine their role in obstetric anaesthesia.

Conflict of interest

The authors declare that there is **no conflict of interest** related to this study.

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