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Original Research Article

Comparison of Intrathecal Dexmedetomidine and Fentanyl as Adjuvants to Bupivacaine for Spinal Anaesthesia: A Randomized Double-Blind Study

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Abstract

Background: Spinal anaesthesia with hyperbaric bupivacaine is widely used for lower abdominal and lower limb surgeries; however, limited duration of postoperative analgesia remains a major concern. Intrathecal adjuvants such as fentanyl and dexmedetomidine are used to improve block characteristics and prolong analgesia. This study aimed to compare the efficacy and safety of intrathecal dexmedetomidine and fentanyl as adjuvants to bupivacaine for spinal anaesthesia.

Methods: This randomized double-blind comparative study included 70 patients undergoing elective lower abdominal and lower limb surgeries under spinal anaesthesia. Patients were randomly allocated into two groups of 35 each. Group D received intrathecal dexmedetomidine with hyperbaric bupivacaine, whereas Group F received fentanyl with hyperbaric bupivacaine. Onset and duration of sensory and motor blockade, duration of postoperative analgesia, rescue analgesic requirement, haemodynamic changes, adverse effects, and patient satisfaction were assessed.

Results: The duration of sensory blockade was significantly longer in the dexmedetomidine group compared with fentanyl (287.6 ± 32.4 min vs 221.8 ± 28.7 min; $p<0.001$). Similarly, motor blockade duration was significantly prolonged with dexmedetomidine (241.5 ± 29.6 min vs 184.3 ± 24.8 min; $p<0.001$). Duration of postoperative analgesia was significantly greater in Group D (392.4 ± 45.6 min vs 276.5 ± 38.9 min; $p<0.001$), with lower rescue analgesic requirement (1.2 ± 0.5 vs 2.1 ± 0.7 doses; $p<0.001$). Haemodynamic parameters were comparable between groups. Pruritus was observed more frequently with fentanyl, while sedation was slightly higher with dexmedetomidine. Patient satisfaction was significantly higher in the dexmedetomidine group.

Conclusion: Intrathecal dexmedetomidine provides superior prolongation of spinal block and postoperative analgesia compared with fentanyl when combined with bupivacaine. It offers effective analgesia with acceptable haemodynamic stability and fewer opioid-related adverse effects.

Keywords: Dexmedetomidine; Fentanyl; Bupivacaine; Spinal anaesthesia; Intrathecal adjuvant; Postoperative analgesia.

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Introduction

Spinal anaesthesia is one of the most commonly used regional anaesthetic techniques for lower abdominal and lower limb surgeries due to its rapid onset, reliable sensory and motor blockade, technical simplicity, cost-effectiveness, and favourable safety profile[1]. Compared with general anaesthesia, spinal anaesthesia provides effective surgical anaesthesia with reduced perioperative opioid requirement, lower incidence of postoperative nausea and vomiting, and faster recovery. However, spinal anaesthesia using local anaesthetic agents alone has certain limitations, particularly the relatively shorter duration of postoperative analgesia and delayed recovery of motor function, which may affect early mobilization and patient satisfaction [2].Hyperbaric bupivacaine remains the most widely used intrathecal local anaesthetic because of its predictable spread, prolonged duration of action, and reliable surgical blockade[4]. However, increasing the dose of bupivacaine to extend analgesia may result in prolonged motor blockade and dose-related adverse effects such as hypotension, bradycardia, nausea, and vomiting. Therefore, the addition of intrathecal adjuvants has become an important approach to improve the

quality and duration of spinal anaesthesia while reducing the required dose of local anaesthetic agents and associated complications [2,3].Several pharmacological agents, including opioids, α2-adrenergic receptor agonists, magnesium sulphate, neostigmine, ketamine, and other agents, have been evaluated as intrathecal adjuvants. Among these, opioids and α2-adrenergic agonists are the most commonly used because of their effective analgesic properties and ability to enhance spinal block characteristics [4].Fentanyl, a highly lipid-soluble synthetic opioid, is one of the most frequently used intrathecal opioid adjuvants. It produces analgesia primarily through activation of spinal μ-opioid receptors and inhibition of nociceptive transmission in the dorsal horn. The addition of fentanyl to bupivacaine has been shown to improve the quality of sensory blockade, provide effective intraoperative analgesia, and prolong postoperative pain relief [5,6]. However, opioid-related adverse effects such as pruritus, nausea, vomiting, urinary retention, and respiratory depression remain important limitations associated with its use. Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, has emerged as an effective non-opioid intrathecal adjuvant for spinal anaesthesia. It produces analgesia by inhibiting norepinephrine release, reducing nociceptive signal transmission, and modulating spinal pain pathways. Clinical studies have demonstrated that intrathecal dexmedetomidine prolongs sensory and motor blockade, extends postoperative analgesia, decreases rescue analgesic requirements, and provides sedation without significant respiratory depression [7,8].Although both fentanyl and dexmedetomidine enhance the efficacy of spinal anaesthesia, their comparative advantages regarding onset and duration of sensory and motor blockade, postoperative analgesia, haemodynamic stability, sedation profile, and adverse effects remain incompletely established. [9] Therefore, direct comparison of these two agents is required to determine the optimal intrathecal adjuvant for spinal anaesthesia. Hence, the present randomized double-blind study was undertaken to compare intrathecal dexmedetomidine and fentanyl as adjuvants to bupivacaine for spinal anaesthesia, evaluating their effects on block characteristics, postoperative analgesia, haemodynamic changes, and adverse effects.[10]

Materials and Methods: This prospective, randomized, double-blind comparative clinical study was conducted in the Department of Anaesthesiology and included patients undergoing elective surgical procedures under spinal anaesthesia. Written informed consent was obtained from all participants before enrollment in the study.

Study Population: A total of 70 patients scheduled for elective lower abdominal and lower limb surgeries under spinal anaesthesia were enrolled in the study. Patients were randomly allocated into two equal groups of 35 patients each.

- **Group D (n=35):** Received intrathecal dexmedetomidine as an adjuvant to hyperbaric bupivacaine.
- **Group F (n=35):** Received intrathecal fentanyl as an adjuvant to hyperbaric bupivacaine.

Randomization was performed using a computer-generated random sequence. Allocation concealment was maintained using sealed opaque envelopes. The anaesthesiologist performing the spinal block and the investigator assessing the perioperative outcomes were blinded to the study group allocation.

Inclusion Criteria

Patients fulfilling the following criteria were included:

- Age between 18 and 60 years
- American Society of Anesthesiologists (ASA) physical status I and II
- Patients undergoing elective lower abdominal or lower limb surgical procedures
- Patients willing to participate and provide written informed consent
- Surgery expected to last less than 3 hours

Exclusion Criteria

Patients were excluded if they had:

- Patient refusal to participate
- Contraindication to spinal anaesthesia
- Allergy or hypersensitivity to study drugs
- Significant cardiovascular, respiratory, hepatic, or renal disease
- Coagulopathy or bleeding disorders
- Neurological disorders affecting sensory or motor assessment
- Pregnancy
- Chronic analgesic or opioid use
- Difficult spinal anaesthesia or failed block

Preoperative Assessment: All patients underwent detailed preoperative evaluation, including medical history, physical examination, airway assessment, systemic examination, and routine investigations. Baseline parameters including heart rate, non-invasive blood pressure, respiratory rate, oxygen saturation (SpO_2), and electrocardiogram were recorded before administration of spinal anaesthesia. Patients were kept nil per oral as per standard fasting guidelines and received intravenous access with appropriate fluid preload before the procedure.

Anaesthetic Technique: Standard monitoring including electrocardiography, non-invasive blood pressure monitoring, pulse oximetry, and respiratory monitoring was initiated before spinal anaesthesia. Under strict aseptic precautions, spinal anaesthesia was performed in the sitting position at the L3–L4 or L4–L5 intervertebral space using a suitable spinal needle.

Patients received intrathecal injection according to group allocation:

- **Group D:** Hyperbaric bupivacaine 0.5% (dose as per surgical requirement) combined with dexmedetomidine.
- **Group F:** Hyperbaric bupivacaine 0.5% (dose as per surgical requirement) combined with fentanyl.

The study drugs were prepared by an anaesthesiologist not involved in patient management or outcome assessment to maintain blinding.

Assessment of Sensory Block: Sensory blockade was assessed using the bilateral pinprick method at regular intervals after intrathecal injection. The following parameters were recorded:

- Time to onset of sensory block (time from intrathecal injection to achievement of T10 sensory level)
- Maximum sensory block level achieved
- Time to two-segment regression
- Duration of sensory blockade (time from onset of sensory block to regression to S1 dermatome)

Assessment of Motor Block: Motor blockade was assessed using the modified Bromage scale.

The following parameters were recorded:

- Time to onset of motor blockade
- Maximum motor blockade achieved
- Duration of motor blockade (time from maximum motor block to complete regression)

Assessment of Postoperative Analgesia: The duration of postoperative analgesia was assessed using the Visual Analogue Scale (VAS), where 0 represented no pain and 10 represented worst imaginable pain.

The following parameters were recorded:

- Time to first rescue analgesic requirement
- Total analgesic consumption during the first 24 hours
- Postoperative pain scores at predefined intervals

Rescue analgesia was administered when the VAS score exceeded 4.

Haemodynamic Monitoring: Heart rate and blood pressure were recorded at baseline and at regular intervals after spinal anaesthesia. Episodes of hypotension and bradycardia were documented and managed according to standard protocols.

- Hypotension was defined as a decrease in systolic blood pressure >20% from baseline or systolic blood pressure <90 mmHg.
- Bradycardia was defined as heart rate <50 beats/min.

Sedation Assessment: Sedation level was assessed using a standardized sedation scoring system at regular intervals during the perioperative period.

Assessment of Adverse Effects: Patients were monitored for complications including:

- Hypotension
- Bradycardia
- Nausea and vomiting
- Pruritus
- Respiratory depression
- Urinary retention
- Excessive sedation

Statistical Analysis: Data were entered into Microsoft Excel and analysed using SPSS.25 statistical software. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage. Comparison between the two groups was performed using the independent sample t-test or Mann–Whitney U test for continuous variables depending on data distribution. Categorical variables were analysed using the Chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Outcome Measures

Primary Outcome

- Duration of postoperative analgesia following spinal anaesthesia.

Secondary Outcomes

- Onset and duration of sensory blockade
- Onset and duration of motor blockade
- Haemodynamic changes
- Sedation characteristics
- Requirement of rescue analgesics
- Incidence of adverse effects

Results

A total of 70 patients undergoing elective lower abdominal and lower limb surgeries under spinal anaesthesia were enrolled and randomly allocated into two groups of 35 patients each. Group D received intrathecal dexmedetomidine with hyperbaric bupivacaine, whereas Group F received intrathecal fentanyl with hyperbaric bupivacaine. All patients completed the study protocol and were

included in the final analysis. The baseline demographic and clinical characteristics of both groups are presented in Table 1.

The mean age was comparable between Group D and Group F (42.6 ± 10.8 years vs 43.1 ± 11.2 years; p=0.842). Gender distribution, BMI, ASA physical status, and duration of surgery were similar between the groups, with no statistically significant differences observed (p>0.05), confirming comparability of the study population (Table 1).

The characteristics of spinal blockade are shown in Table 2. The onset of sensory block (4.8 ± 0.9 min vs 4.5 ± 0.8 min; p=0.142) and onset of motor block (6.9 ± 1.1 min vs 6.5 ± 1.0 min; p=0.118) were comparable between Group D and Group F. The maximum sensory block level was also similar between both groups (p=0.918).However, the duration of sensory blockade was significantly prolonged in the dexmedetomidine group compared with fentanyl (287.6 ± 32.4 min vs 221.8 ± 28.7 min; p<0.001). Similarly, the duration of motor blockade was significantly longer with dexmedetomidine (241.5 ± 29.6 min vs 184.3 ± 24.8 min; p<0.001) (Table 2).Postoperative analgesic outcomes are presented in Table 3. Patients receiving dexmedetomidine had significantly longer duration of analgesia compared with fentanyl (392.4 ± 45.6 min vs 276.5 ± 38.9 min; p<0.001). The time to first rescue analgesia was also significantly delayed in Group D (405.2 ± 42.8 min vs 289.6 ± 40.1 min; p<0.001).The total rescue analgesic requirement during 24 hours was significantly lower in the dexmedetomidine group (1.2 ± 0.5 vs 2.1 ± 0.7 doses; p<0.001). The mean VAS score at 24 hours was significantly lower in Group D compared with Group F (2.4 ± 0.8 vs 4.1 ± 1.1; p<0.001) (Table 3). The comparison of postoperative analgesic outcomes is illustrated in Figure 1. Changes in heart rate and mean arterial pressure at different time intervals are presented in Table 4. Baseline haemodynamic parameters were comparable between groups. Both groups showed a gradual decrease in heart rate and mean arterial pressure following spinal anaesthesia; however, no significant difference was observed between groups at any time interval. Repeated measures analysis showed significant variation over time, but intergroup differences remained statistically insignificant (Table 4).The graphical representation of changes in heart rate and mean arterial pressure at different time intervals is shown in Figure 2.The comparison of sedation profile and adverse effects is presented in Table 5. Bradycardia occurred in 6 patients (17.1%) in Group D and 2 patients (5.7%) in Group F (p=0.134). Hypotension was observed in 5 patients (14.3%) in Group D and 4 patients (11.4%) in Group F (p=0.721).Nausea and vomiting were more frequent in the fentanyl group (22.9% vs 8.6%), although the difference was not statistically significant (p=0.108). Pruritus was observed only in the fentanyl group (14.3% vs 0%; p=0.021). Excessive sedation was slightly higher with dexmedetomidine (11.4% vs 2.9%; p=0.166). No respiratory depression was observed in either group. Patient satisfaction score was significantly higher in the dexmedetomidine group compared with fentanyl (4.6 ± 0.5 vs 4.1 ± 0.6; p<0.001) (Table 5).In Group D, duration of sensory block showed a strong positive correlation with duration of analgesia (r=0.86; p<0.001), while duration of motor block also demonstrated a significant positive correlation (r=0.79; p<0.001).

Time to two-segment regression showed a similar positive correlation (r=0.74; p<0.001). Rescue analgesic requirement (r=-0.76; p<0.001) and VAS score at 24 hours (r=-0.71; p<0.001) showed significant negative correlations with duration of analgesia (Table 6). In Group F, sensory block duration (r=0.78; p<0.001), motor block duration (r=0.69; p<0.001), and time to two-segment regression (r=0.64; p<0.001) showed significant positive correlations with analgesia duration. Rescue analgesic requirement (r=-0.68; p<0.001) and VAS score at 24 hours (r=-0.59; p<0.001) showed significant negative correlations (Table 6).The graphical representation of correlation between duration of analgesia and block characteristics in both groups is shown in Figure 3.

The strength of correlation between block characteristics and analgesic duration was greater in the dexmedetomidine group compared with the fentanyl group (Table 6; Figure 3).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants

Parameter	Group D (Dexmedetomidine) (n=35)	Group F (Fentanyl) (n=35)	p-value
Age (years), Mean ± SD	42.6 ± 10.8	43.1 ± 11.2	0.842
Male sex, n (%)	22 (62.9)	23 (65.7)	0.801
Female sex, n (%)	13 (37.1)	12 (34.3)	
BMI (kg/m²), Mean ± SD	24.7 ± 3.1	24.9 ± 3.4	0.794
ASA I, n (%)	21 (60.0)	20 (57.1)	0.806
ASA II, n (%)	14 (40.0)	15 (42.9)	
Duration of surgery (min)	96.5 ± 18.4	94.8 ± 17.9	0.701

Statistical test used: Independent sample t-test Chi-square test

Table 2: Comparison of Characteristics of Spinal Anaesthesia between Groups

Parameter	Group D	Group F	p-value
Onset of sensory block (min)	4.8 ± 0.9	4.5 ± 0.8	0.142
Time to achieve maximum sensory level (min)	12.6 ± 2.4	11.9 ± 2.1	0.204
Maximum sensory block level	T6 (T4–T8)	T6 (T4–T8)	0.918
Onset of motor block (min)	6.9 ± 1.1	6.5 ± 1.0	0.118
Duration of sensory block (min)	287.6 ± 32.4	221.8 ± 28.7	<0.001
Duration of motor block (min)	241.5 ± 29.6	184.3 ± 24.8	<0.001

Statistical test used: Independent sample t-test. Mann–Whitney U test was used for comparison of

Table 3: Comparison of Postoperative Analgesic Outcomes

Parameter	Group D	Group F	p-value
Duration of analgesia (min)	392.4 ± 45.6	276.5 ± 38.9	<0.001
Time to first rescue analgesia (min)	405.2 ± 42.8	289.6 ± 40.1	<0.001
Total rescue analgesic doses (24 h)	1.2 ± 0.5	2.1 ± 0.7	<0.001
VAS score at 24 hours	2.4 ± 0.8	4.1 ± 1.1	<0.001

Statistical test used: Independent sample t-test

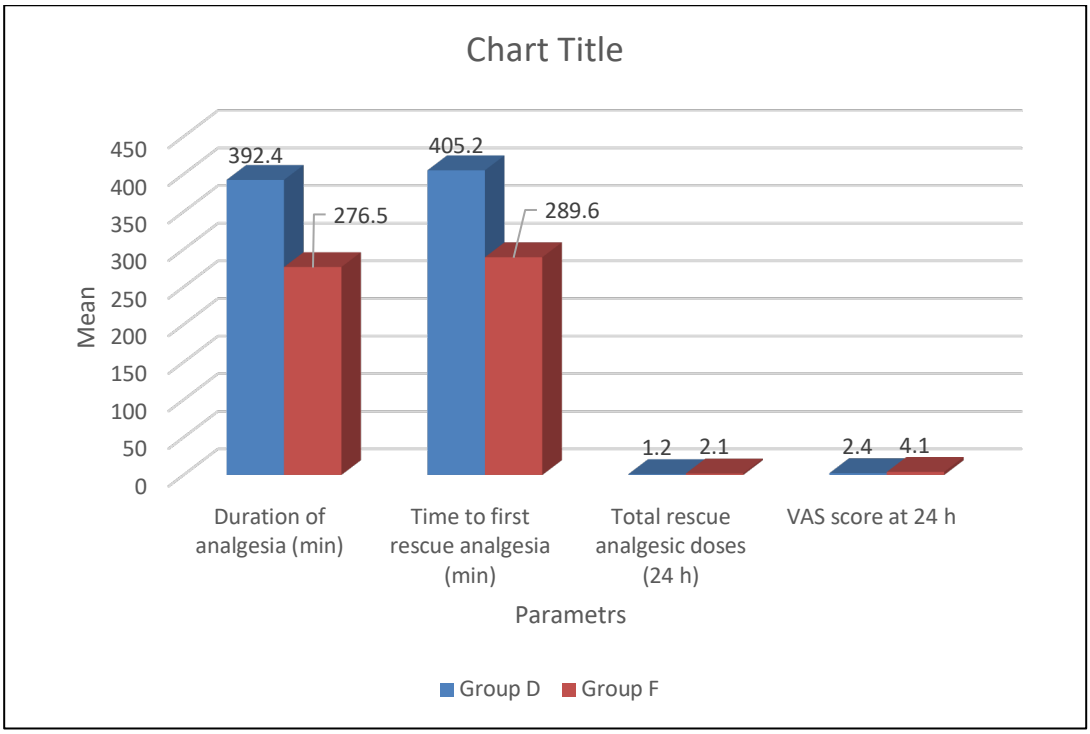

Figure 1: Comparison of Postoperative Analgesic Outcomes

Table 4: Comparison of Haemodynamic Parameters at Different Time Intervals

Time interval	Heart Rate (beats/min)		Mean Arterial Pressure (mmHg)	
	Group D	Group F	Group D	Group F
Baseline	84.6 ± 9.8	85.2 ± 10.1	91.4 ± 8.2	90.8 ± 7.9
15 min	78.5 ± 8.7	81.6 ± 9.4	82.8 ± 7.5	84.6 ± 7.8
30 min	76.9 ± 8.5	80.2 ± 9.1	80.6 ± 7.2	83.1 ± 7.4
60 min	78.1 ± 8.8	81.3 ± 9.6	82.4 ± 7.6	84.0 ± 7.9
120 min	80.4 ± 9.2	82.6 ± 9.8	85.2 ± 7.8	86.3 ± 8.1

Statistical test used: Repeated measures ANOVA, Independent sample t-test

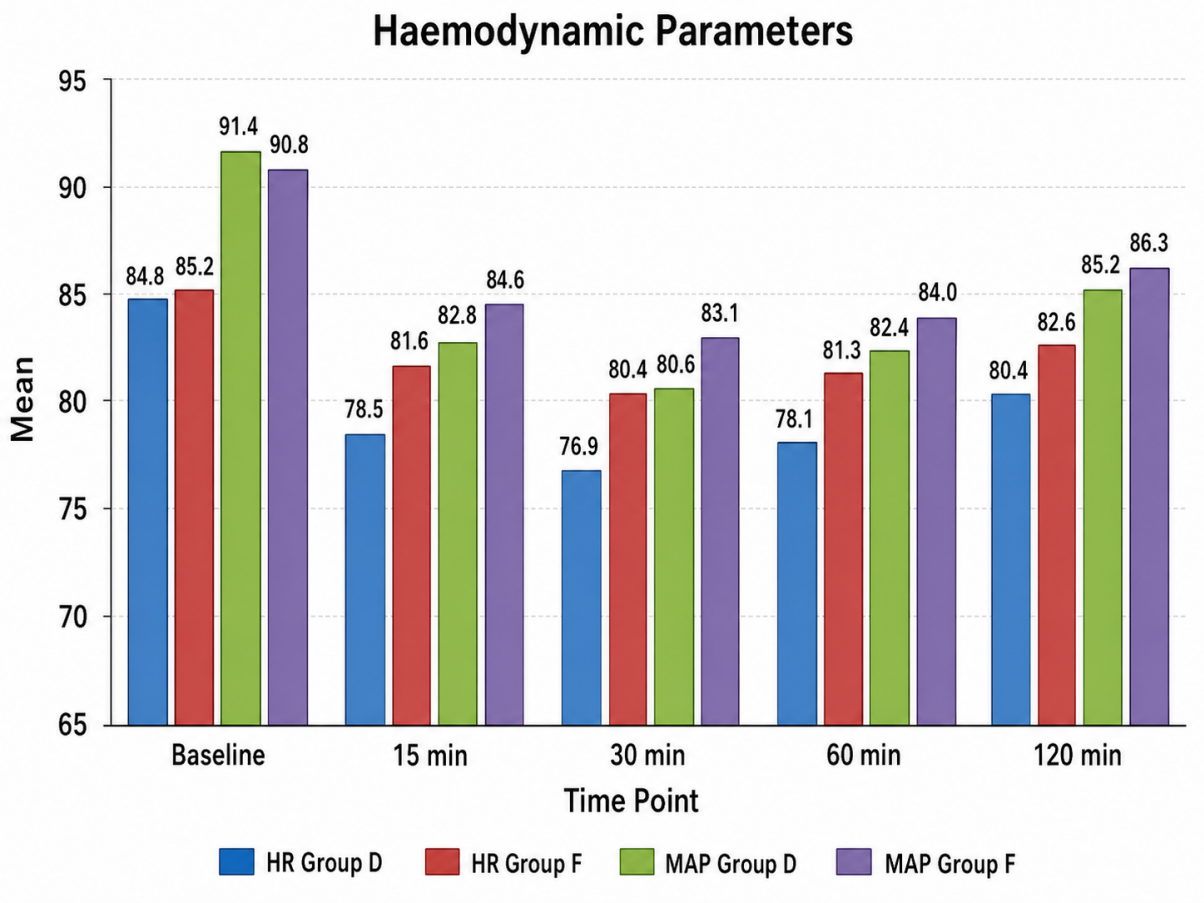

Figure 2: Comparison of Haemodynamic Parameters at Different Time Intervals

Table 5. Comparison of Sedation and Adverse Effects between Groups

Parameter	Group D n (%)	Group F n (%)	p-value
Bradycardia	6 (17.1)	2 (5.7)	0.134
Hypotension	5 (14.3)	4 (11.4)	0.721
Nausea/vomiting	3 (8.6)	8 (22.9)	0.108
Pruritus	0 (0.0)	5 (14.3)	0.021
Excessive sedation	4 (11.4)	1 (2.9)	0.166
Respiratory depression	0 (0.0)	0 (0.0)	—
Patient satisfaction score	4.6 ± 0.5	4.1 ± 0.6	<0.001

Statistical test used: Chi-square test/Fisher's exact test

Table 6: Correlation between Duration of Analgesia and Block Characteristics in Both Study Groups

Variable	Group D (Dexmedetomidine) (n=35)		Group F (Fentanyl) (n=35)	
	Correlation coefficient (r)	p-value	Correlation coefficient (r)	p-value
Duration of sensory block vs Duration of analgesia	0.86	<0.001	0.78	<0.001
Duration of motor block vs Duration of analgesia	0.79	<0.001	0.69	<0.001
Time to two-segment regression vs Duration of analgesia	0.74	<0.001	0.64	<0.001
Rescue analgesic requirement vs Duration of analgesia	-0.76	<0.001	-0.68	<0.001
VAS score at 24 hours vs Duration of analgesia	-0.71	<0.001	-0.59	<0.001

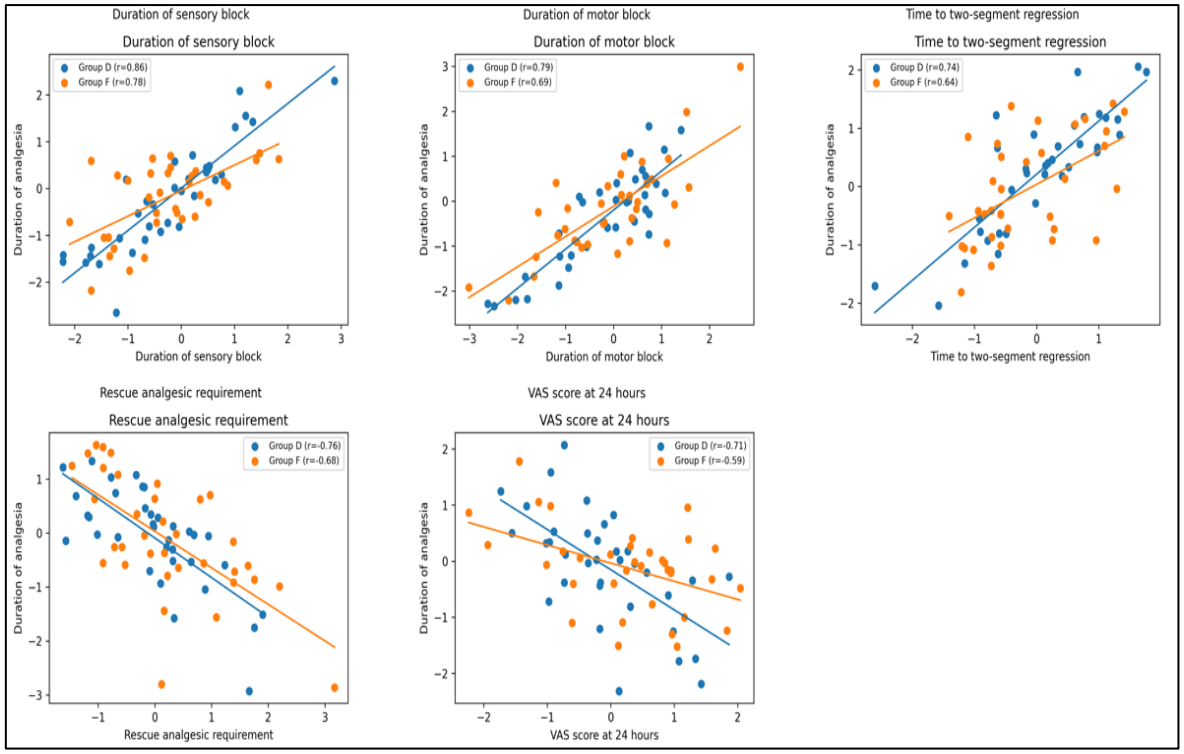

Figure 3: Correlation between Duration of Analgesia and Block Characteristics in Both Study Groups

Discussion

The present randomized double-blind study compared intrathecal dexmedetomidine and fentanyl as adjuvants to bupivacaine for spinal anaesthesia in 70 patients. The findings demonstrated that dexmedetomidine significantly prolonged sensory and motor blockade, increased the duration of postoperative analgesia, reduced rescue analgesic requirement, and improved patient satisfaction compared with fentanyl. Both groups showed comparable haemodynamic stability and acceptable safety profiles. In the present study, dexmedetomidine produced significantly longer sensory and motor blockade compared with fentanyl. The duration of sensory block was 287.6 ± 32.4 min in the dexmedetomidine group compared with 221.8 ± 28.7 min in the fentanyl group ($p<0.001$), while motor block duration was 241.5 ± 29.6 min vs 184.3 ± 24.8 min ($p<0.001$), respectively.

However, the onset of sensory and motor block was comparable between both groups. The prolonged block duration with dexmedetomidine may be due to its selective α2-adrenergic receptor activation, which inhibits norepinephrine release, suppresses nociceptive transmission, and enhances the effect of local anaesthetics. Gupta et al. [9] reported significantly prolonged sensory and motor block duration with dexmedetomidine compared with fentanyl when used as adjuvants to bupivacaine for lower limb surgery, supporting the findings of the present study. Similarly, Al-Ghanem et al. [11] demonstrated significantly longer sensory regression (274 ± 73 min vs 179 ± 47 min; $p<0.001$) and motor recovery time (240 ± 60 min vs 155 ± 46 min; $p<0.001$) with dexmedetomidine compared with fentanyl in gynaecological procedures. Mahendru et al. [12] also reported prolonged sensory and motor blockade with dexmedetomidine compared with fentanyl when used with hyperbaric bupivacaine for lower limb surgery. The present study showed significantly prolonged postoperative analgesia with dexmedetomidine. The duration of analgesia was 392.4 ± 45.6 min in Group D compared with 276.5 ± 38.9 min in Group F ($p<0.001$). The time to first rescue analgesia was also significantly delayed (405.2 ± 42.8 min vs 289.6 ± 40.1 min; $p<0.001$), with lower rescue analgesic consumption in the dexmedetomidine group (1.2 ± 0.5 vs 2.1 ± 0.7 doses; $p<0.001$). The prolonged analgesic effect of dexmedetomidine may be attributed to spinal α2-receptor stimulation, which reduces pain transmission and enhances the analgesic effect of bupivacaine. Gupta et al. [9] observed longer postoperative analgesia with dexmedetomidine compared with fentanyl, with reduced requirement for rescue analgesics. Sun et al. [13] compared bupivacaine alone, bupivacaine-fentanyl, and bupivacaine-dexmedetomidine during caesarean section and reported significantly prolonged analgesia and reduced analgesic requirement with dexmedetomidine. Nayagam et al. [10] also demonstrated superior analgesic duration with dexmedetomidine compared with fentanyl when added to low-dose bupivacaine for spinal anaesthesia. In the present study, duration of

sensory blockade showed a strong positive correlation with duration of analgesia in both groups, with a stronger association in the dexmedetomidine group ($r=0.86$, $p<0.001$) compared with fentanyl ($r=0.78$, $p<0.001$). Similarly, motor block duration correlated positively with analgesic duration ($r=0.79$ in Group D and $r=0.69$ in Group F; $p<0.001$). These findings indicate that prolonged sensory and motor blockade contributes to improved postoperative analgesia. The stronger correlation in the dexmedetomidine group may be related to its additional intrinsic spinal analgesic properties.In the present study, both groups maintained comparable haemodynamic stability. Hypotension occurred in 14.3% of patients in Group D and 11.4% in Group F, while bradycardia was observed in 17.1% and 5.7%, respectively, with no statistically significant difference. Al- Ghanem et al. [11] reported that intrathecal dexmedetomidine significantly prolonged spinal block characteristics without causing significant haemodynamic instability. Similarly, Kim et al. [14] demonstrated that intrathecal dexmedetomidine enhanced spinal anaesthesia duration in elderly patients undergoing transurethral prostatectomy without clinically significant cardiovascular complications.

The present study showed fewer opioid-related adverse effects with dexmedetomidine. Pruritus occurred only in the fentanyl group (14.3% vs 0%; $p=0.021$), while nausea and vomiting were more frequent with fentanyl (22.9% vs 8.6%). Erdil et al. [15] reported that excessive sedation was slightly higher with dexmedetomidine but was clinically acceptable. Sun et al. [13] also reported reduced opioid-related side effects and improved postoperative analgesic outcomes with dexmedetomidine compared with fentanyl. Patient satisfaction was significantly higher in the dexmedetomidine group (4.6 ± 0.5 vs 4.1 ± 0.6; $p<0.001$), likely due to prolonged analgesia, reduced rescue analgesic requirement, and improved postoperative comfort.

Conclusion

Intrathecal dexmedetomidine as an adjuvant to bupivacaine provided significantly prolonged sensory and motor blockade, extended postoperative analgesia, reduced rescue analgesic requirement, and improved patient satisfaction compared with fentanyl. Both dexmedetomidine and fentanyl demonstrated comparable haemodynamic stability; however, dexmedetomidine showed superior analgesic efficacy with fewer opioid-related adverse effects. Dexmedetomidine may be considered a valuable alternative to fentanyl for enhancing the quality and duration of spinal anaesthesia.

Limitations

The study was conducted with a relatively small sample size and limited to a single centre, which may restrict the generalizability of the findings. Long-term outcomes, cost-effectiveness, and comparison of different doses of dexmedetomidine and fentanyl were not evaluated.

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