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STUDY OF COMPLICATIONS AND HEMODYNAMIC STABILITY DURING EPIDURAL ANAESTHESIA ASSOCIATED WITH DEXMEDETOMIDINE WITH BUPIVACAINE VS FENTANYL WITH BUPIVACAINE IN ORTHOPEDIC SURGERIES AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Epidural anaesthesia is widely used for lower limb orthopedic surgeries because it provides effective intraoperative anaesthesia and prolonged postoperative analgesia. Bupivacaine is commonly employed as the local anaesthetic agent, and the addition of adjuvants enhances block quality and analgesic duration. Opioids such as fentanyl are frequently used epidural adjuvants; however, their use is associated with opioid-related adverse effects including nausea, vomiting, pruritus, and respiratory depression. Dexmedetomidine, a highly selective α_2-adrenergic agonist, has emerged as a promising non-opioid alternative with analgesic, sedative, and sympatholytic properties. Evaluating its effects on hemodynamic stability and complication profile in comparison with fentanyl is clinically important in orthopedic surgical patients. **Aim:** To evaluate complications and hemodynamic stability during epidural anaesthesia associated with dexmedetomidine with bupivacaine vs fentanyl with bupivacaine in orthopedic surgeries at a tertiary care hospital. **Materials and Methods:** This prospective, randomized, double-blind comparative study was conducted on 68 adult patients (ASA physical status I–II) scheduled for elective orthopedic lower limb surgery under epidural anaesthesia at a tertiary care hospital. Patients were randomly allocated into two equal groups of 34 each. Group D received epidural bupivacaine with dexmedetomidine, while Group F received epidural bupivacaine with fentanyl. Hemodynamic parameters including heart rate, systolic and diastolic blood pressure, mean arterial pressure, and oxygen saturation were monitored intraoperatively. Block characteristics, duration of analgesia, sedation scores, and perioperative complications were recorded. Data were analyzed using SPSS version 26.0, and a p-value <0.05 was considered statistically significant. **Result:** Demographic variables and baseline clinical characteristics were comparable between the two groups. Group D showed a significantly faster onset of sensory and motor block and achieved maximum sensory level earlier than Group F ($p <0.05$). The duration of analgesia and time to first rescue analgesia were significantly longer in Group D ($p <0.001$). Hemodynamic parameters such as heart rate, systolic blood pressure, and mean arterial pressure were significantly lower yet stable in the dexmedetomidine group. Opioid-related complications including nausea, vomiting, and pruritus were significantly higher in Group F, while bradycardia was more frequent in Group D but clinically manageable. **Conclusion:** Dexmedetomidine as an epidural adjuvant to bupivacaine provides superior analgesia, better sedation, and improved hemodynamic stability with fewer opioid-related adverse effects compared to fentanyl. It is an effective and safe alternative to fentanyl for epidural anaesthesia in lower limb orthopedic surgeries.

INTRODUCTION

Orthopedic lower limb surgeries are frequently associated with moderate-to-severe perioperative pain, marked sympathetic stress responses, and early postoperative functional limitation if analgesia is inadequate. Effective anesthesia for these procedures should therefore provide reliable intraoperative surgical conditions, maintain cardiovascular stability, and facilitate early postoperative mobilization with minimal adverse effects. In this context, neuraxial techniques—particularly epidural anesthesia—remain widely utilized because they can provide titratable segmental anesthesia, extendable postoperative analgesia through catheter techniques, and reduced systemic opioid requirements.[1] Epidural anesthesia is especially suited for lower limb orthopedic surgery as it allows graded dosing, prolonged analgesia, and the ability to adjust block height and intensity according to surgical duration and patient response. Compared with single-shot techniques, epidural catheterization offers an advantage when surgery is prolonged or when postoperative pain control is expected to be significant. By attenuating neuroendocrine and sympathetic responses, epidural anesthesia may also contribute to improved perioperative outcomes in selected populations.[1] Despite these advantages, the quality of epidural anesthesia depends greatly on the local anesthetic concentration, spread characteristics, and the choice of adjuvants used to optimize analgesia and minimize complications. Bupivacaine is a commonly used long-acting amide local anesthetic for epidural anesthesia because it provides dense sensory blockade suitable for lower limb orthopedic surgery. However, local anesthetic–only epidural regimens may require higher doses to achieve reliable surgical anesthesia, which can increase the likelihood of sympathetic blockade and hemodynamic instability, and may also produce more pronounced motor block that can delay early mobilization. These limitations have driven the routine use of epidural adjuvants aimed at accelerating block onset, improving block quality, and prolonging postoperative analgesia while allowing lower concentrations of local anesthetic to be used. Opioids, particularly fentanyl, are among the most widely used epidural adjuvants because of their rapid onset and ability to enhance analgesia through spinal opioid receptor mechanisms. Fentanyl's lipophilicity contributes to relatively rapid analgesic action and reduced rostral spread compared with hydrophilic opioids, which can be advantageous for intraoperative and immediate postoperative pain control.[2] However, opioid-based epidural regimens are associated with a characteristic adverse-effect profile that may limit patient comfort and safety, including nausea and vomiting, pruritus, urinary retention, and, less commonly but importantly, respiratory depression and excessive sedation.[2] These adverse effects can reduce satisfaction, prolong recovery, and increase the need for additional medications. Pruritus, in particular, is a well-recognized neuraxial opioid-related complication and can be distressing even when analgesia is otherwise satisfactory. The mechanism is multifactorial and not purely histamine-mediated, and clinical management often requires additional pharmacologic intervention.[3] Therefore, finding non-opioid alternatives that maintain or improve analgesic quality without increasing opioid-linked adverse effects is clinically relevant—especially in orthopedic patients where comfort, early ambulation, and prevention of postoperative complications are major priorities. Dexmedetomidine, a highly selective α_2-adrenergic agonist, has gained interest as an adjuvant in regional and neuraxial anesthesia because it produces analgesia and sedation while offering potential opioid-sparing benefits. Its sedative profile is distinctive in that it can provide cooperative sedation with minimal respiratory depression, which may be particularly useful during neuraxial anesthesia where patient interaction and airway independence are desired.[4] At the same time, α_2-agonism may lead to dose-dependent decreases in heart rate and blood pressure due to sympatholysis, making hemodynamic monitoring and careful titration essential.[4] This dual nature—analgesic and sedative advantages with possible bradycardia/hypotension—makes dexmedetomidine a compelling, yet safety-relevant, alternative to opioid adjuvants in epidural anesthesia. Evidence synthesis has suggested that adding dexmedetomidine to epidural local anesthetics can improve the sensory and analgesic profile and may reduce opioid consumption, with an overall acceptable safety profile in many clinical settings.[5] Importantly, however, the balance between improved analgesia and potential hemodynamic effects varies across populations, dosing strategies, and surgical contexts. Orthopedic lower limb surgery often involves patients in whom perioperative hemodynamic stability is critical, and where adverse effects such as nausea, pruritus, dizziness, or urinary retention can negatively influence early rehabilitation. Thus, comparisons focusing specifically on hemodynamic behavior and complication patterns are highly relevant. Clinical comparative studies in surgical settings have increasingly examined dexmedetomidine versus fentanyl as epidural adjuvants, reporting differences in onset, analgesic duration, sedation, and side-effect profiles.[6,7] Present study was conducted to evaluate complications and hemodynamic stability during epidural anaesthesia associated with dexmedetomidine with bupivacaine vs fentanyl with bupivacaine in orthopedic surgeries at a tertiary care hospital.

MATERIALS AND METHODS

Written informed consent was obtained from all participants prior to enrolment. A total of 68 adult

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patients of either sex, scheduled for elective orthopedic lower limb surgery under epidural anaesthesia and belonging to American Society of Anesthesiologists (ASA) physical status I–II, were included.

Patients were excluded if they refused epidural anaesthesia, had coagulopathy or anticoagulant therapy, infection at the puncture site, spine deformity, raised intracranial pressure, known allergy to study drugs, significant cardiac conduction abnormalities, uncontrolled systemic disease (e.g., severe hypertension/diabetes), pregnancy, chronic opioid use, or any neurological deficit affecting sensory or motor assessment.

Methodology

Patients were randomized into two equal groups (n = 34 each) using a computer-generated random sequence. Group allocation was concealed using sequentially numbered, opaque, sealed envelopes opened just before drug preparation. Study solutions were prepared by an anaesthesiologist not involved in patient management or data collection. Both the patient and the observing anaesthesiologist assessing outcomes were blinded to group allocation.

Pre-anaesthetic assessment and standardization

All patients underwent a pre-anaesthetic evaluation including detailed history, general and systemic examination, airway assessment, and review of routine investigations as per institutional protocol. Patients were kept nil per oral as per standard guidelines. On arrival in the operating room, baseline vital parameters were recorded and intravenous access was secured.

All patients received standard monitoring with electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_2), and respiratory rate, and were preloaded with crystalloid solution as per body weight and clinical status. Oxygen was administered by face mask or nasal prongs when indicated.

Epidural technique and study drug administration

Under aseptic precautions, epidural catheterization was performed in the sitting or lateral position at the L2–L3 or L3–L4 interspace using an 18G Tuohy needle and loss-of-resistance technique. After catheter placement (3–5 cm in the epidural space), a test dose of 3 mL of 2% lignocaine with adrenaline (1:200,000) was administered to rule out intrathecal or intravascular placement.

Following confirmation, the study drug mixture was given epidurally. Group D received bupivacaine with dexmedetomidine, and Group F received bupivacaine with fentanyl; the total injectate volume was kept identical in both groups by dilution with normal saline to maintain blinding. The top-up regimen, if required intraoperatively, was standardized using incremental doses of local anaesthetic based on clinical need and surgeon request, while ensuring uniform criteria across both groups.

Outcome measures and assessment parameters

Hemodynamic stability was assessed using heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and SpO_2. Measurements were recorded at baseline (pre-epidural), immediately after epidural dosing, every 5 minutes for the first 20 minutes, every 10 minutes thereafter until the end of surgery, and postoperatively at regular intervals in the recovery area. Sensory block onset was assessed by loss of pinprick sensation in bilateral dermatomes, and the highest sensory level achieved was documented. Motor block was evaluated using the Modified Bromage scale (0–3). Time to onset of sensory block, time to achieve adequate surgical anaesthesia, onset of motor block, and duration of analgesia (time from epidural dosing to first request for rescue analgesic) were recorded. Sedation was assessed using the Ramsay Sedation Scale at predefined intervals intraoperatively and postoperatively. Postoperative pain was evaluated using a Visual Analogue Scale (VAS; 0–10), and rescue analgesia was administered when VAS $\geq$ 4 or on patient request, using a standardized institutional analgesic protocol.

Definition and management of complications

Complications were actively monitored intraoperatively and postoperatively, including hypotension, bradycardia, nausea/vomiting, pruritus, shivering, respiratory depression, urinary retention, excessive sedation, dizziness, and dry mouth. Hypotension was defined as a fall in SBP >20% from baseline or SBP <90 mmHg and was treated with intravenous fluid bolus and vasopressor (e.g., ephedrine/mephentermine) as per protocol. Bradycardia was defined as HR <50 beats/min and was treated with intravenous atropine if clinically indicated. Respiratory depression was defined as respiratory rate <10/min and/or SpO_2 <92% on room air, and was managed with supplemental oxygen and supportive measures; naloxone was reserved for clinically significant opioid-related respiratory depression. Nausea/vomiting was treated with antiemetics, and shivering with warming measures and standard pharmacologic therapy if required. Any need for conversion to general anaesthesia, patchy block, failed epidural, or catheter-related issues were documented and managed according to institutional practice.

All perioperative observations and outcomes were recorded in a structured proforma by a blinded investigator. Patient confidentiality was maintained, and all procedures were performed in accordance with ethical standards for human research.

Statistical Analysis

Data were entered into a spreadsheet and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range) based on distribution, and categorical variables as frequencies and percentages. Intergroup comparison of continuous variables was performed using the independent

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samples t-test for normally distributed data or the Mann–Whitney U test for non-normal data. Categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate. Hemodynamic trends over time were analyzed using repeated measures analysis of variance (ANOVA) (or an equivalent non-parametric approach where applicable). A p-value <0.05 was considered statistically significant.

RESULTS

A total of 68 patients were included in the final analysis, with 34 patients in each group. Group D received epidural dexmedetomidine with bupivacaine, while Group F received epidural fentanyl with bupivacaine. All enrolled patients completed the study successfully, and no protocol deviations or exclusions were recorded after randomization.

Demographic characteristics and baseline clinical variables (Table 1)

The demographic profile and baseline clinical characteristics of patients in both groups were comparable. The mean age in Group D was 46.82 ± 9.14 years, while in Group F it was 47.35 ± 8.76 years, with no statistically significant difference ($p = 0.801$). Gender distribution was similar between the groups, with males constituting 64.71% in Group D and 61.76% in Group F ($p = 0.804$). Mean body weight was also comparable, being 63.94 ± 7.86 kg in Group D and 64.41 ± 8.12 kg in Group F ($p = 0.801$). The distribution of ASA physical status showed no significant difference, with ASA I patients accounting for 58.82% in Group D and 55.88% in Group F ($p = 0.808$). These findings indicate that both groups were well matched at baseline, allowing valid comparison of outcomes.

Characteristics of sensory and motor block (Table 2)

Patients receiving dexmedetomidine demonstrated a significantly faster onset of sensory block compared to those receiving fentanyl. The mean onset time of sensory block was 7.42 ± 1.31 minutes in Group D versus 9.18 ± 1.56 minutes in Group F ($p < 0.001$). Similarly, the time to achieve maximum sensory level was significantly shorter in Group D (12.26 ± 2.04 minutes) compared to Group F (14.91 ± 2.38 minutes), with a highly significant difference ($p < 0.001$). The onset of motor block was also faster in Group D (15.84 ± 2.91 minutes) than in Group F (17.62 ± 3.08 minutes), and this difference was statistically significant ($p = 0.012$). However, the proportion of patients achieving maximum motor block (Bromage score 3) was comparable between the groups, with 91.18% in Group D and 85.29% in Group F ($p = 0.448$). These results suggest that dexmedetomidine enhances the speed of onset of both sensory and motor block without affecting the overall depth of motor blockade.

Duration of analgesia and sedation scores (Table 3)

The duration of postoperative analgesia was significantly prolonged in the dexmedetomidine group. Group D had a mean analgesia duration of 324.76 ± 38.42 minutes, compared to 247.53 ± 34.61 minutes in Group F ($p < 0.001$). Correspondingly, the time to first request for rescue analgesia was significantly longer in Group D (332.18 ± 40.05 minutes) than in Group F (256.71 ± 36.88 minutes), again showing a highly significant difference ($p < 0.001$). In terms of sedation, a Ramsay Sedation Score ≥ 3 was observed in 70.59% of patients in Group D, compared to 29.41% in Group F, and this difference was statistically significant ($p = 0.001$). These findings indicate that dexmedetomidine provides superior and longer-lasting analgesia along with better intraoperative sedation compared to fentanyl.

Hemodynamic parameters (Table 4)

Intraoperative hemodynamic parameters revealed greater stability in patients receiving dexmedetomidine. The mean heart rate was significantly lower in Group D (68.24 ± 6.12 beats/min) compared to Group F (74.91 ± 7.48 beats/min), with a highly significant difference ($p < 0.001$). Mean systolic blood pressure was also significantly lower in Group D (112.36 ± 9.84 mmHg) than in Group F (118.94 ± 10.21 mmHg) ($p = 0.008$). Mean arterial pressure followed a similar trend, being significantly lower in Group D (85.34 ± 7.26 mmHg) compared to Group F (89.40 ± 7.68 mmHg) ($p = 0.021$). Although mean diastolic blood pressure was slightly lower in Group D, the difference was not statistically significant ($p = 0.094$). Oxygen saturation remained comparable and within normal limits in both groups throughout the procedure ($p = 0.654$). Overall, these results demonstrate that dexmedetomidine provides better control of heart rate and blood pressure without compromising oxygenation.

Incidence of complications (Table 5)

The overall incidence of complications differed between the two groups. Hypotension occurred in 17.65% of patients in Group D and 8.82% in Group F, but this difference was not statistically significant ($p = 0.285$). Bradycardia was more frequently observed in Group D (20.59%) than in Group F (5.88%), although this difference did not reach statistical significance ($p = 0.071$). Opioid-related side effects were significantly more common in the fentanyl group. Nausea and vomiting occurred in 26.47% of patients in Group F compared to 8.82% in Group D, with a statistically significant difference ($p = 0.047$). Pruritus was observed in 23.53% of patients in Group F, while no patient in Group D experienced pruritus, and this difference was highly significant ($p = 0.002$). The incidence of shivering, respiratory depression, and excessive sedation was low and comparable between groups, with no statistically significant differences. These findings suggest that dexmedetomidine is associated with fewer opioid-

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related adverse effects, while maintaining an acceptable safety profile.

Table 1: Demographic characteristics and baseline clinical variables

Variable	Group D (n = 34)	Group F (n = 34)	p-value
Age (years), mean ± SD	46.82 ± 9.14	47.35 ± 8.76	0.801
Gender (Male), n (%)	22 (64.71%)	21 (61.76%)	0.804
Gender (Female), n (%)	12 (35.29%)	13 (38.24%)	0.804
Weight (kg), mean ± SD	63.94 ± 7.86	64.41 ± 8.12	0.801
ASA I, n (%)	20 (58.82%)	19 (55.88%)	0.808
ASA II, n (%)	14 (41.18%)	15 (44.12%)	0.808

Table 2: Characteristics of sensory and motor block

Parameter	Group D (n = 34)	Group F (n = 34)	p-value
Onset of sensory block (min), mean ± SD	7.42 ± 1.31	9.18 ± 1.56	<0.001*
Time to maximum sensory level (min), mean ± SD	12.26 ± 2.04	14.91 ± 2.38	<0.001*
Onset of motor block (min), mean ± SD	15.84 ± 2.91	17.62 ± 3.08	0.012*
Maximum Bromage score (3), n (%)	31 (91.18%)	29 (85.29%)	0.448

Table 3: Duration of analgesia and sedation scores

Parameter	Group D (n = 34)	Group F (n = 34)	p-value
Duration of analgesia (min), mean ± SD	324.76 ± 38.42	247.53 ± 34.61	<0.001*
Time to first rescue analgesia (min), mean ± SD	332.18 ± 40.05	256.71 ± 36.88	<0.001*
Ramsay Sedation Score ≥ 3, n (%)	24 (70.59%)	10 (29.41%)	0.001*

Table 4: Hemodynamic parameters (intraoperative mean values)

Parameter	Group D (n = 34)	Group F (n = 34)	p-value
Mean HR (beats/min), mean ± SD	68.24 ± 6.12	74.91 ± 7.48	<0.001*
Mean SBP (mmHg), mean ± SD	112.36 ± 9.84	118.94 ± 10.21	0.008*
Mean DBP (mmHg), mean ± SD	71.82 ± 6.91	74.63 ± 7.14	0.094
Mean MAP (mmHg), mean ± SD	85.34 ± 7.26	89.40 ± 7.68	0.021*
Mean SpO_2 (%), mean ± SD	98.21 ± 0.84	98.12 ± 0.91	0.654

Table 5: Incidence of complications

Complication	Group D (n = 34)	Group F (n = 34)	p-value
Hypotension, n (%)	6 (17.65%)	3 (8.82%)	0.285
Bradycardia, n (%)	7 (20.59%)	2 (5.88%)	0.071
Nausea/Vomiting, n (%)	3 (8.82%)	9 (26.47%)	0.047*
Pruritus, n (%)	0 (0.00%)	8 (23.53%)	0.002*
Shivering, n (%)	2 (5.88%)	5 (14.71%)	0.233
Respiratory depression, n (%)	0 (0.00%)	1 (2.94%)	0.313
Excessive sedation, n (%)	4 (11.76%)	1 (2.94%)	0.164

DISCUSSION

In the present study, both groups were comparable at baseline (mean age 46.82 ± 9.14 vs 47.35 ± 8.76 years; ASA I 58.82% vs 55.88%), minimizing selection bias and allowing outcome differences to be attributed to the epidural adjuvant. A similar "well-matched baseline" pattern has been reported in orthopedic epidural trials; for example, Gousheh et al (2019) found no significant intergroup differences in demographic variables (e.g., age 39.5 ± 2.0 vs 34.3 ± 1.7 years; p = 0.868) before comparing epidural bupivacaine–dexmedetomidine with bupivacaine–morphine.[8]

Dexmedetomidine produced a faster establishment of neuraxial anesthesia in our cohort, with a significantly shorter onset of sensory block (7.42 ± 1.31 vs 9.18 ± 1.56 min; p < 0.001) and quicker attainment of maximal sensory level (12.26 ± 2.04 vs 14.91 ± 2.38 min; p < 0.001) compared with fentanyl. These findings closely align with Sarkar et al (2018), who demonstrated markedly earlier achievement of T10 sensory level with dexmedetomidine compared with fentanyl (8.10 ± 1.03 vs 15.03 ± 1.67 min) and earlier motor onset (15.10 ± 1.49 vs 22.77 ± 1.41 min) in lower-limb orthopedic surgery under epidural block.[9]

The earlier onset of motor block in our study (15.84 ± 2.91 vs 17.62 ± 3.08 min; p = 0.012) occurred without a significant difference in the proportion reaching Bromage 3 (91.18% vs 85.29%; p = 0.448), suggesting that dexmedetomidine primarily accelerated block development rather than increasing final motor block intensity. Bajwa et al (2011) reported a similar acceleration with dexmedetomidine compared with fentanyl when added to epidural ropivacaine, showing earlier onset at T10 (7.12 ± 2.44 vs 9.14 ± 2.94 min) and earlier complete motor blockade (18.16 ± 4.52 vs 22.98 ± 4.78 min).[10]

Analgesic quality was superior with dexmedetomidine in our study, reflected by longer analgesia duration (324.76 ± 38.42 vs 247.53 ± 34.61 min; p < 0.001) and delayed first rescue analgesia request (332.18 ± 40.05 vs 256.71 ± 36.88 min; p <

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0.001). Comparable trends were observed by Kiran et al (2018), where the mean time to rescue analgesia was longer in the dexmedetomidine group than the fentanyl group (312.4 ± 30.2 vs 243.0 ± 29.7 min; p < 0.001), supporting a consistent analgesia-prolonging effect of epidural dexmedetomidine across different surgical populations and local anesthetic regimens.[11]

The magnitude of analgesia prolongation in our study is also consistent with work comparing dexmedetomidine against local anesthetic alone. Kaur et al (2014) found that adding dexmedetomidine (1 µg/kg) to epidural ropivacaine increased postoperative analgesia duration to 496.56 ± 16.08 min versus 312.64 ± 16.21 min with ropivacaine alone, along with longer sensory and motor block durations. While our absolute analgesia times were lower (likely reflecting differences in drug concentrations/volumes and surgical stimulus), the direction and clinical relevance of improvement match the broader evidence base.[12]

Sedation was significantly more frequent with dexmedetomidine in our cohort (Ramsay ≥3: 70.59% vs 29.41%; p = 0.001), which is clinically useful in cooperative regional anesthesia when not excessive. Dose-dependent improvement in neuraxial analgesia and sedation has been demonstrated in epidural dexmedetomidine studies; Chakole et al (2016) reported progressively longer pain-free duration with higher epidural dexmedetomidine dosing (e.g., ~9.33 ± 0.25 h and ~10.89 ± 0.39 h in dexmedetomidine groups vs ~5.53 ± 0.17 h in control), supporting the concept that α2-agonist adjuvants can enhance analgesia and sedation in a graded manner.[13]

Hemodynamic behavior in our study favored "lower but acceptable" intraoperative values with dexmedetomidine—mean HR (68.24 ± 6.12 vs 74.91 ± 7.48 bpm; p < 0.001), mean SBP (112.36 ± 9.84 vs 118.94 ± 10.21 mmHg; p = 0.008), and MAP (85.34 ± 7.26 vs 89.40 ± 7.68 mmHg; p = 0.021)—with a non-significant increase in bradycardia (20.59% vs 5.88%; p = 0.071) and hypotension (17.65% vs 8.82%; p = 0.285). This pattern is biologically plausible given sympatholysis from α2-agonism and is echoed in neuraxial literature; Rahimzadeh et al (2018) showed that dexmedetomidine as a neuraxial adjuvant produced longer analgesia than fentanyl (time to first analgesic request 496.63 ± 138.86 vs 296.33 ± 89.74 min) with generally comparable side-effect profiles, emphasizing that improved analgesia can coexist with manageable hemodynamic effects under protocolized monitoring and treatment.[14]

Opioid-related adverse effects were clearly reduced with dexmedetomidine in our study: nausea/vomiting occurred in 8.82% with dexmedetomidine versus 26.47% with fentanyl (p = 0.047), and pruritus occurred in 0.00% versus 23.53% (p = 0.002). This mirrors the broader understanding that epidural opioids—especially lipophilic agents like fentanyl—commonly contribute to pruritus and nausea/vomiting, whereas non-opioid adjuvants can reduce such events while preserving epidural analgesic efficacy. Wheatley et al (2001) highlighted these opioid-linked complications as key safety considerations in postoperative epidural practice, supporting the clinical relevance of the lower pruritus/PONV burden seen with dexmedetomidine in our cohort.[15]

From a clinical-impact perspective, optimizing epidural adjuvants matters because epidural analgesia itself is a strong modality for postoperative pain control. In a large meta-analysis, Block et al (2003) reported better postoperative pain scores with epidural analgesia compared with parenteral opioids (mean VAS 19.40 vs 29.40 mm; p < 0.001), reinforcing the value of refining epidural techniques and drug combinations. In this context, our findings suggest that substituting fentanyl with dexmedetomidine as an epidural adjuvant can further improve block kinetics, prolong analgesia, increase useful sedation, and reduce opioid-related side effects—while requiring continued vigilance for bradycardia/hypotension.[16]

CONCLUSION

Epidural dexmedetomidine used as an adjuvant to bupivacaine in lower limb orthopedic surgery provided faster onset of sensory and motor block, prolonged duration of analgesia, and better intraoperative sedation compared to fentanyl. Dexmedetomidine was associated with improved hemodynamic stability and significantly fewer opioid-related adverse effects such as pruritus and nausea/vomiting. Although a higher incidence of bradycardia was observed with dexmedetomidine, it was clinically manageable and did not compromise patient safety. Overall, dexmedetomidine appears to be an effective and safe alternative to fentanyl as an epidural adjuvant in orthopedic lower limb surgeries.

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