

Original Research Article

ANALYSIS OF COMPLICATIONS AND HEMODYNAMIC STABILITY DURING EPIDURAL ANAESTHESIA BY DEXMEDETOMIDINE WITH BUPIVACAINE V/S FENTANYL WITH BUPIVACAINE IN ORTHOPEDIC LOWER LIMB SURGERIES

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ABSTRACT

Background: Multinodal strategies used in postoperative pain relief in surgical patients such as opioids, NSAIDS, local infiltration and epidural analgesia among them epidural analgesia provide superior outcomes with fewer complications. This study was conducted to analyze complications and hemodynamic stability during epidural anaesthesia by dexmedetomidine with bupivacaine v/s fentanyl with bupivacaine in orthopedic lower limb surgeries.

Materials and Methods: The study included 40 ASA I–II patients aged 20–50 years, randomized into two groups: Group A received bupivacaine with dexmedetomidine, and Group B received bupivacaine with fentanyl epidurally. Standard preoperative preparation and intraoperative monitoring were performed, with hemodynamic parameters recorded at baseline and regular intervals. Postoperative pain was assessed using VAS, and data were analyzed statistically using SPSS.

Results: Both groups were demographically comparable with similar age, gender, and ASA grading distribution. Group A showed significantly faster onset and regression of sensory and motor block compared to Group B. It indicate that group A has superior block characteristics. Hemodynamic parameters were largely stable, with Group B showing transient reductions in heart rate, SBP, and DBP at 20–25 minutes, while complication rates remained similar across both groups.

Conclusion: Dexmedetomidine with bupivacaine proved more effective than fentanyl with bupivacaine, offering faster block onset and stable hemodynamics with similar complication rates.

Keywords: Dexmedetomidine, Bupivacaine, Fentanyl, Bupivacaine.

INTRODUCTION

Clinical evidence indicates that fewer than 50% of surgical patients achieve satisfactory postoperative pain relief. Inadequately managed pain exerts a profound impact on patient well-being, compromising quality of life, delaying functional recovery, and predisposing to a spectrum of postoperative complications. Poorly controlled pain has also been strongly associated with the transition to persistent postsurgical pain syndromes, thereby imposing both individual and healthcare burdens.^[1,2]

Findings from randomized controlled trials have consistently demonstrated that multimodal analgesia, which integrates multiple pharmacological and interventional strategies, is more effective than reliance on a single agent or technique. This approach not only enhances analgesic efficacy but also reduces opioid requirements, thereby minimizing the risk of opioid-related adverse effects such as nausea, vomiting, respiratory depression, and dependence.^[3-5]

Among the available modalities, epidural analgesia remains the gold standard for major surgical

procedures. When appropriately employed, it provides profound analgesia with minimal systemic side effects, while significantly improving patient satisfaction. Beyond symptom control, epidural analgesia plays a mechanistic role in blunting central sensitization—a key process in the chronification of pain—and attenuating the cascade of pain-induced physiological disturbances such as sympathetic overactivity, immunosuppression, and organ dysfunction. By reducing these maladaptive responses, epidural techniques contribute to improved postoperative outcomes, accelerated rehabilitation, and decreased morbidity.^[6,7] Dexmedetomidine is widely utilized in anesthetic practice, primarily as an agent for procedural sedation across a broad range of surgical and diagnostic interventions. It is also frequently administered to facilitate patient comfort and cooperation during awake intubation procedures.^[8] Fentanyl is a highly potent synthetic opioid that shares structural and pharmacological similarities with morphine but exhibits a much stronger analgesic effect. Therapeutically, fentanyl is most commonly employed as a sedative agent in mechanically intubated patients and for the management of severe pain, particularly in individuals with renal impairment, since its metabolism occurs predominantly via hepatic pathways rather than renal clearance.^[9] Hence; the present study was conducted to analyze complications and hemodynamic stability during epidural anaesthesia by dexmedetomidine with bupivacaine v/s fentanyl with bupivacaine in orthopedic lower limb surgeries.

MATERIALS AND METHODS

The study population consisted of 40 adult patients, aged between 20 and 50 years, with ASA physical status I or II. Patients with significant systemic illnesses, neuromuscular or bleeding disorders, obesity, infections, or a history of drug allergy were excluded from participation. Eligible patients were randomly divided into two groups of 20 each: Group A received 15 ml of 0.5% bupivacaine with 1 µg/kg of dexmedetomidine epidurally, while Group B received 15 ml of 0.5% bupivacaine with 1 µg/kg of fentanyl. Standard preoperative evaluation and preparation were carried out, including fasting guidelines, preanesthetic check-up, and written informed consent. On the day of surgery, routine monitoring with pulse oximeter, NIBP, and ECG was applied, intravenous access was secured, and baseline hemodynamic parameters were recorded. Hemodynamic parameters were observed at baseline,

immediately after drug administration, and at regular intervals intraoperatively and postoperatively. Postoperative pain was assessed using a 10-point visual analog scale (VAS), where VAS >4 was considered, significant pain requiring rescue analgesia. All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software.

RESULTS

The mean age of participants was comparable between the two groups, with 44.8 years in Group A and 46.1 years in Group B. Gender distribution was also similar, with males comprising 65% in Group A and 60% in Group B, while females constituted 35% and 40%, respectively. Most patients in both groups belonged to ASA Grade II (80% in Group A and 75% in Group B), with a minority in ASA Grade I. Thus, the demographic profile was well-matched and statistically comparable across the two groups. Group A demonstrated a faster onset of sensory and motor block compared to Group B. The mean time to achieve T10 sensory block was 9.2 minutes in Group A versus 12.7 minutes in Group B ($p = 0.001$, significant). Similarly, onset of motor block occurred earlier in Group A (17.8 minutes) than in Group B (23.8 minutes, $p = 0.002$). The time to complete motor block was also significantly shorter in Group A (18.6 minutes) compared to Group B (24.1 minutes, $p < 0.001$). These findings indicate superior block characteristics in Group A. Baseline and early intraoperative heart rates were comparable between groups. However, at 20 minutes and 25 minutes, Group B exhibited significantly lower heart rates than Group A ($p = 0.00^*$ at both intervals). Beyond 25 minutes, heart rate values remained largely similar between groups with no statistically significant differences. Both groups showed comparable baseline and subsequent SBP trends up to 15 minutes. At 20 and 25 minutes, Group B demonstrated significantly lower SBP values compared to Group A ($p = 0.00^*$ at both time points). Thereafter, SBP measurements between groups remained stable and statistically nonsignificant. DBP values were initially similar between both groups. Significant differences were noted at 20 minutes and 25 minutes, where Group B exhibited lower DBP values compared to Group A ($p = 0.00^*$ for both). At later intervals, DBP trends were comparable, with no significant intergroup variation. Complications rate was similar in both the study groups (Group A: 20 percent, Group B: 30 percent).

Table 1: Demographic data

Variable	Group A N (%)	Group B N (%)
Mean age (years)	44.8	46.1
Males	13 (65%)	12 (60%)
Females	7 (35%)	8 (40%)
ASA Grade I	4 (20%)	5 (25%)
ASA Grade II	16 (80%)	15 (75%)

Table 2: Block Characteristics in Both Groups

Variables	Group A	Group B	P-value
Time to achieve T10 sensory block (min)	9.2	12.7	0.001 (Significant)
Onset of motor block (min)	17.8	23.8	0.002 (Significant)
Complete motor block (min)	18.6	24.1	0.000 (Significant)

Table 3: Comparison of heart rate

Heart rate	Group A	Group B	p-value
0 mins	78.6	79.1	0.18
5 mins	77.9	78.4	0.22
10 mins	82.4	80.4	0.98
15 mins	80.9	79.8	0.28
20 mins	83.3	76.8	0.00*
25 mins	80.1	77.1	0.00*
50 mins	82.1	81.3	0.46
75 mins	83.9	83.9	0.38
100 mins	82.4	82.4	0.66
150 mins	82.8	80.4	0.52
180 mins	83.7	81.6	0.59
240 mins	82.9	80.9	0.17

*: Significant

Table 4: Comparison of SBP

SBP	Group A	Group B	p-value
0 mins	120.3	121.2	0.23
5 mins	122.6	120.3	0.27
10 mins	122.7	122.7	0.39
15 mins	120.9	120.9	0.81
20 mins	118.9	114.7	0.00*
25 mins	119.1	115.9	0.00*
50 mins	120.9	120.7	0.71
75 mins	122.5	121.8	0.53
100 mins	121.6	122.9	0.33
150 mins	122.3	121.8	0.29
180 mins	121.7	122.8	0.81
240 mins	122.9	123.8	0.32

Table 5: Comparison of DBP

DBP	Group A	Group B	p-value
0 mins	81.3	80.6	0.75
5 mins	80.9	81.9	0.65
10 mins	82.6	81.2	0.19
15 mins	80.7	82.7	0.88
20 mins	82.9	77.9	0.00*
25 mins	80.1	75.2	0.00*
50 mins	79.2	80.1	0.61
75 mins	80.8	81.3	0.29
100 mins	80.2	80.9	0.15
150 mins	81.9	82.7	0.55
180 mins	80.3	82.9	0.37
240 mins	81.5	82.2	0.46

DISCUSSION

Large volumes of local anesthetics often used perioperatively increase the risk of systemic toxicity and adverse hemodynamic effects. While using local anaesthetic with opioids like fentanyl enhance analgesia but carry risks of pruritus, urinary retention, nausea, vomiting, and respiratory depression. The combination of local anesthetics with opioids may also delay rehabilitation due to motor block. Dexmedetomidine, an α_2 -adrenergic agonist, provides analgesic, sedative, and sympatholytic benefits via epidural route without opioid-related adverse effects, though hypotension and bradycardia may occur.^[6-8] This study was conducted to analyze complications and hemodynamic stability during

epidural anaesthesia by dexmedetomidine with bupivacaine v/s fentanyl with bupivacaine in orthopedic lower limb surgeries.

In the present study, both groups were demographically comparable with similar age, gender, and ASA grading distribution. Group A showed significantly faster onset and regression of sensory and motor block compared to Group B, indicating superior block characteristics. Hemodynamic parameters were largely stable, with Group B showing transient reductions in heart rate, SBP, and DBP at 20–25 minutes, while complication rates remained similar across both group. Sarkar A et al. in a randomized double-blind study on 70 ASA I–II patients compared epidural bupivacaine with dexmedetomidine versus fentanyl for postoperative

analgesia. Dexmedetomidine showed earlier onset of sensory and motor block, prolonged analgesia, and reduced rescue analgesic requirement. The study concluded dexmedetomidine to be a superior epidural adjuvant compared to fentanyl.^[9] Bajwa JS et al. compared epidural dexmedetomidine and fentanyl as adjuvants to ropivacaine in 100 ASA I–II patients undergoing lower limb orthopedic surgery. The dexmedetomidine group showed earlier onset of sensory block (7.12 vs 9.14 min) and motor block (18.16 vs 22.98 min), with significantly prolonged postoperative analgesia and reduced local anesthetic requirement. Sedation scores were superior with dexmedetomidine, while nausea and vomiting were more frequent with fentanyl, and dry mouth was slightly higher with dexmedetomidine. Overall, dexmedetomidine proved a more effective epidural adjuvant, offering stable hemodynamics, better sedation, and longer analgesia.^[10] Kaur et al. in a randomized double-blind study on 100 ASA I–II patients compared epidural ropivacaine alone versus ropivacaine with dexmedetomidine for lower limb surgeries. The dexmedetomidine group showed significantly longer sensory and motor block durations, prolonged postoperative analgesia, and reduced rescue analgesic use. Better sedation scores and stable hemodynamics further established dexmedetomidine as a superior adjuvant to ropivacaine.^[11]

CONCLUSION

Epidural bupivacaine with dexmedetomidine provided faster onset and superior block characteristics compared to bupivacaine with fentanyl. Both regimens maintained stable hemodynamics with comparable complication rates, making dexmedetomidine a more effective adjuvant for epidural anesthesia in lower limb surgeries.

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