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Original Research Article

# EVALUATION OF COMPLICATIONS AND HEMODYNAMIC STABILITY OF DEXMEDETOMIDINE WITH BUPIVACAINE VS FENTANYL WITH BUPIVACAINE USED FOR INTRATHECAL ANAESTHESIA IN PATIENTS UNDERGOING ORTHOPAEDIC LOWER LIMB SURGERIES

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## ABSTRACT

**Aim:** Regional anaesthesia offers significant advantages over general anaesthesia for lower abdominal and lower limb surgeries, with intrathecal and epidural techniques being the most commonly used. The aim of this study is to evaluate complications and hemodynamic stability of dexmedetomidine with bupivacaine vs fentanyl with bupivacaine used for intrathecal anaesthesia in patients undergoing orthopaedic lower limb surgeries.

**Materials and Methods:** The study cohort was categorised into two groups, each consisting of 20 participants. Group 1 received an injection of 2.5 mL of hyperbaric bupivacaine combined with 25 µg of fentanyl in 0.5 mL, while Group 2 was administered 2.5 mL of hyperbaric bupivacaine along with 5 µg of dexmedetomidine in 0.5 mL. A comprehensive pre-anaesthetic assessment, which included a general and systemic examination, was conducted the evening prior to the surgical procedure. Standardised investigations were performed on all subjects. Following the acquisition of informed written consent for both the study and the surgical intervention, each patient was prescribed 0.5 mg of alprazolam and 150 mg of ranitidine to be taken orally the night before surgery. Additionally, patients were instructed to refrain from oral intake from midnight on the day preceding the surgery. The intraoperative hemodynamic profiles of the two study groups were subsequently compared. All the statistical calculations were done through SPSS software.

**Results:** Mean age of the patients of group 1 and group 2 was 45.3 years and 42.9 years. Alterations in hemodynamic variables in group 1 occurred gradually, ultimately reaching a stable state that persisted throughout the duration of the surgical procedure. In contrast, group 2 exhibited more pronounced changes and declines in hemodynamic variables, which were found to be statistically significant. Complications were seen in 15 percent of the patients of group 1 and in 45 percent of the patients of group 2.

**Conclusion:** The addition of dexmedetomidine to intrathecal bupivacaine resulted in a more rapid onset and extended duration of the block when compared to intrathecal fentanyl. Both medications did not exhibit significant adverse effects, with the exception of transient abruptly decline in hemodynamic response with dexmedetomidine. The dexmedetomidine group demonstrated a more favourable profile regarding postoperative complications.

**Keywords:** Bupivacaine, Fentanyl, Dexmedetomidine.

## INTRODUCTION

Many beneficial aspects of Intrathecal anaesthesia have been reported, including better suppression of surgical stress, positive effect on postoperative nitrogen balance, more stable cardiovascular hemodynamic, reduced blood loss, better peripheral vascular circulation, and better postoperative pain control. Intrathecal anaesthesia effectively reduces surgical stress by blocking nociceptive impulses, leading to benefits such as reduced blood loss, improved respiratory and bowel function, and a lower incidence of deep vein thrombosis.[1-3]

To address these challenges, ongoing research focuses on finding an optimal adjuvant. An ideal adjuvant should provide sedation, stable hemodynamics, and prolonged postoperative analgesia. Various agents, including opioids, ketamine, midazolam, neostigmine, and α2-adrenergic agonists, have been explored for enhancing the duration of neuraxial block. Among them, dexmedetomidine, a highly selective α2-adrenergic agonist, stands out due to its analgesic, sedative, anxiolytic, and perioperative sympatholytic properties. It also contributes to prolonged postoperative pain relief, making it a promising adjuvant in Intrathecal anaesthesia.[5,6]

Dexmedetomidine, a highly selective α2-agonist, is emerging as a promising neuraxial adjuvant, providing stable hemodynamics, improved intraoperative conditions, and extended postoperative pain relief with minimal adverse effects. FDA-approved as a short-term sedative for ICU patients, dexmedetomidine has shown potential in anaesthesia when combined with hyperbaric bupivacaine. It is hypothesized that intrathecal dexmedetomidine (5 µg) could enhance postoperative analgesia more effectively than fentanyl, with fewer side effects.[7,8]

Bupivacaine discovered in 1957, is widely used for intrathecal anaesthesia. It blocks action potential generation by inhibiting sodium channels, affecting nerve function in a specific order: pain, temperature, touch, proprioception, and muscle tone. Its potency, duration, and onset are influenced by lipid solubility and ionization constant. Bupivacaine is used in various procedures, including nerve blocks and epidural anaesthesia, often with adjuvants like dexmedetomidine or dexamethasone to prolong effects. Adverse effects range from mild (nausea, dizziness) to severe cardio toxicity, CNS toxicity, with overdose potentially leading to seizures and cardiovascular collapse. Toxicity is managed with lipid emulsion therapy, now a first-line treatment, alongside supportive care. Proper monitoring, dosage control, and emergency preparedness are crucial to ensure safe administration, requiring a coordinated approach among healthcare professionals.[9,10]

Fentanyl is a potent synthetic opioid, 50 to 100 times stronger than morphine, primarily used for sedation in intubated patients, severe pain management, and chronic pain in opioid-tolerant patients. It acts as a Mu-selective opioid agonist, increasing dopamine in the brain's reward system, contributing to its high addiction potential. Metabolized via CYP3A4 with a 3 to 7-hour half-life, it is administered IV, IM, transdermally, intranasally, intrathecally, or buccally. While effective for pain relief and anaesthesia, it carries serious risks, including respiratory depression, euphoria, confusion, addiction, and potential fatality, especially when mixed with alcohol or other depressants. Misuse is a major concern, as illicit fentanyl is often mixed with heroin, causing overdoses. Contraindications include respiratory diseases, liver failure, hypersensitivity, and interactions with CYP3A4 inhibitors or MAOIs. Monitoring vital signs, ECG, and dose adjustments is crucial, and overdose requires naloxone administration and respiratory support. Given the opioid crisis, healthcare professionals must carefully monitor fentanyl use, ensuring proper dosing and compliance with prescription laws.[11-13]

In this study we aim to evaluate complications and hemodynamic stability of dexmedetomidine with bupivacaine vs fentanyl with bupivacaine used for intrathecal anaesthesia in patients undergoing orthopaedic lower limb surgeries.

## MATERIALS AND METHODS

The study cohort was categorised into two groups, each consisting of 20 participants. Group 1 received an injection of 2.5 mL of hyperbaric bupivacaine combined with 25 µg of fentanyl in 0.5 mL, while Group 2 was administered 2.5 mL of hyperbaric bupivacaine along with 5 µg of dexmedetomidine in 0.5 mL.

A comprehensive pre-anaesthetic assessment, which included a general and systemic examination, was conducted the evening prior to the surgical procedure. Standardised investigations were carried out on all subjects.

Following the acquisition of informed written consent for both the study and the surgical intervention, each patient was prescribed 0.5 mg of alprazolam and 150 mg of ranitidine to be taken orally the night before surgery. Additionally, patients were instructed to refrain from oral intake from midnight on the day preceding the surgery. The intraoperative hemodynamic profiles of the two study groups were subsequently compared. All the statistical calculations were done through SPSS software; P-values of less than 0.05 were considered statistically significant.

## RESULTS

The mean age of the patients of group 1 and group 2 was 45.3 years and 42.9 years. Time from injection to onset of sensory block was 3.9 mins in group 1

and 1.6 minutes in group 2. Significant results were obtained while comparing Time from injection to onset of sensory block among two study groups. Onset of motor block was 4.9 mins in group 1 and 2.8 minutes in group 2. Significant results were obtained while comparing onset of motor block among two study groups. Alterations in hemodynamic variables in group 1 occurred gradually, ultimately reaching a stable state that persisted throughout the duration of the surgical procedure. In contrast, group 2 exhibited more pronounced changes and declines in hemodynamic variables, which were found to be statistically significant. Complications were seen in 15 percent of the patients of group 1 and in 45 percent of the patients of group 2.

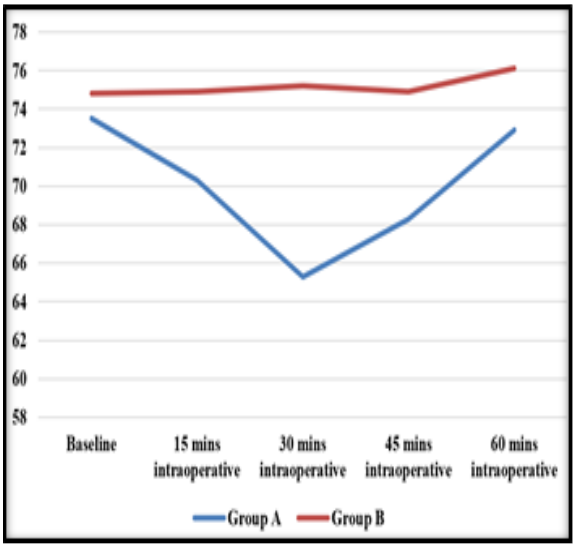


**Figure 1: Heart rate**

**Table 1: Demographic and anaesthetic variables**

| Variable | Group 1 | Group 2 | p-value |
|---|---|---|---|
| **Mean age (years)** | 45.3 | 42.9 | 0.25 |
| **Males** | 13 | 15 | 0.73 |
| **Females** | 7 | 5 | |
| **Time from injection to onset of sensory block (mins)** | 3.9 | 1.6 | 0.001 (Significant) |
| **Onset of motor block (mins)** | 4.9 | 2.8 | 0.001 (Significant) |
| **Duration of postoperative analgesia (mins)** | 236.8 | 398.1 | 0.000 (Significant) |

**Table 2: Complications**

| Variable | Group 1 | Group 2 |
|---|---|---|
| **No complication** | 17 | 11 |
| **Hypotension** | 1 | 3 |
| **Bradycardia** | 1 | 4 |
| **Nausea/vomiting** | 1 | 2 |

## DISCUSSION

Intrathecal anaesthesia is widely used for lower limb orthopaedic surgeries due to its effective pain control, reduced systemic opioid requirement, and improved postoperative recovery. Adjuvants such as dexmedetomidine and fentanyl are commonly added to Intrathecal bupivacaine to enhance analgesic efficacy and prolong the duration of anaesthesia. Dexmedetomidine, an α2-adrenergic agonist, provides sedation, analgesia, with transient hemodynamics instability, while fentanyl, a potent opioid, enhances analgesia but carries risks of respiratory depression. Comparing these two adjuvants is essential to determine their impact on hemodynamic stability, analgesic effectiveness, and perioperative complications in patients undergoing lower limb orthopaedic procedures.[15]

Mean age of the patients of group 1 and group 2 was 45.3 years and 42.9 years. Time from injection to onset of sensory block was 3.9 mins in group 1 and 1.6 minutes in group 2. Significant results were obtained while comparing Time from injection to onset of sensory block among two study groups. Onset of motor block was 4.9 mins in group 1 and 2.8 minutes in group 2. Significant results were obtained while comparing onset of motor block among two study groups. Alterations in hemodynamic variables in group 1 occurred gradually, ultimately reaching a stable state that persisted throughout the duration of the surgical procedure. The study by Guneet Sodhi,[16] explored the impact of adjuvants in epidural anaesthesia for lower limb orthopaedic surgeries, highlighting their role in hemodynamic stability, analgesic efficacy, and complications. Dexmedetomidine and fentanyl, when combined with bupivacaine, enhance pain relief and prolong anaesthesia, but their effects on cardiovascular parameters and side effects vary. Dexmedetomidine is valued for its sedative and stabilizing properties, whereas fentanyl offers potent analgesia with a quicker onset. Comparing these combinations helps determine the safer and more effective option, ultimately improving patient outcomes and minimising anaesthesia-related risks. Jai PT et al,[17] aimed to assess complications and hemodynamic stability with dexmedetomidine and bupivacaine in epidural anaesthesia. The study enrolled 30 patients (15 per group), with a mean age of 39.22±4.67 years. Preoperative blood pressure was 94.67±8.22 in Group I and 91.52±5.38 in Group II, showing no significant difference. One patient in each group experienced nausea and shivering, respectively. The study concluded that there were no

significant alterations in hemodynamic stability or side effects between subjects receiving bupivacaine alone versus bupivacaine with dexmedetomidine.

In the present study, group 2 exhibited more pronounced changes and declines in hemodynamic variables, which were found to be statistically significant. Complications were seen in 15 percent of the patients of group 1 and in 45 percent of the patients of group 2. A study by Shefa Set al,[18] investigated the effects of dexmedetomidine with and without bupivacaine on hemodynamic stability and pain in patients undergoing lower limb orthopaedic surgery. Results showed significantly lower systolic blood pressure in the dexmedetomidine group at 30, 45, 60, 90, and 120 minutes post-anaesthesia and outside recovery ($P<0.05$). Pain was lower in this group at 6 hours but higher at 12 hours post-surgery compared to bupivacaine alone. While dexmedetomidine proved effective in stabilising hemodynamics, no significant difference in overall pain control was observed, suggesting its potential use primarily for hemodynamic management in orthopaedic surgeries.

## CONCLUSION

The addition of dexmedetomidine to intrathecal bupivacaine resulted in a more rapid onset and extended duration of the block when compared to intrathecal fentanyl. Both medications did not exhibit significant adverse effects, with the exception of transient abruptly decline in hemodynamic response with dexmedetomidine. The dexmedetomidine group demonstrated a more favourable profile regarding postoperative complications.

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