

Comparison of Intrathecal Dexmedetomidine and Fentanyl as Adjuvants to 0.5% Hyperbaric Bupivacaine in Spinal Anaesthesia for Post-Traumatic Femur Fracture Repair Surgeries

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Abstract: **Background:** Hyperbaric bupivacaine is widely used for spinal anesthesia in orthopedic trauma surgery, but its duration is limited. Intrathecal adjuvants such as fentanyl and dexmedetomidine are used to improve block quality and extend postoperative analgesia. **Aim:** To compare the efficacy and safety of dexmedetomidine versus fentanyl as intrathecal adjuvants to 0.5% hyperbaric bupivacaine in patients undergoing post-traumatic femur fracture repair. **Methods:** A retrospective comparative study was conducted on 30 ASA I–II adults undergoing intramedullary nailing for post-traumatic femur fractures. Group D received intrathecal dexmedetomidine (3 µg) with hyperbaric bupivacaine, and Group F received intrathecal fentanyl (20 µg). Sensory and motor block onset, block duration, analgesic requirement, hemodynamics, and adverse effects were assessed. **Results:** Dexmedetomidine provided a faster onset of sensory block and significantly prolonged sensory and motor block duration compared with fentanyl. Postoperative analgesia lasted longer in Group D. Hemodynamics were more stable with dexmedetomidine, while fentanyl produced more opioid-related side effects such as pruritus and nausea. No major complications occurred. **Conclusion:** Dexmedetomidine is a superior intrathecal adjuvant to fentanyl for spinal anesthesia in femur fracture surgery, offering prolonged anesthesia, extended analgesia, greater hemodynamic stability, and fewer adverse effects.

Keywords: spinal anesthesia; dexmedetomidine; fentanyl; hyperbaric bupivacaine; postoperative analgesia; femur fracture

1. Introduction

Femur fracture fixation surgeries require anesthesia that provides rapid onset, dense sensory blockade, and sustained postoperative analgesia. Although 0.5% hyperbaric bupivacaine is a standard spinal anesthetic, its action is time-limited, often leading to early postoperative pain and the need for rescue analgesia.

Intrathecal adjuvants can enhance both the duration and quality of spinal anesthesia. Fentanyl, a synthetic μ -opioid agonist, enhances analgesia but is associated with adverse effects such as pruritus and nausea. Dexmedetomidine, a selective α_2 -adrenergic agonist, offers analgesia and sedation without opioid-related side effects and may prolong sensory and motor block through inhibition of nociceptive transmission.

This study compares the clinical effectiveness and safety of intrathecal dexmedetomidine and fentanyl when combined with hyperbaric bupivacaine for femur fracture repair.

2. Methodology

Study Design and Duration

A retrospective comparative study was performed over 12 months (February 2024 – February 2025) in the orthopedic trauma theatres of a tertiary care teaching hospital in India.

Participants

Inclusion criteria:

- Adults aged 18–60 years
- ASA physical status I–II
- Undergoing intramedullary nailing for post-traumatic femur fracture
- Provided informed consent

Exclusion criteria:

- Coagulopathy
- Spinal deformity
- Infection at puncture site
- Allergy to study drugs
- Severe cardiac, renal, or hepatic disease

Thirty eligible patients were included using purposive consecutive sampling.

Study Groups

- **Group D:** Hyperbaric bupivacaine + intrathecal dexmedetomidine (3 µg)
- **Group F:** Hyperbaric bupivacaine + intrathecal fentanyl (20 µg)

Procedure

Spinal anesthesia was administered at the L3–L4 interspace using a 25G Quincke needle under standard ASA monitoring. Parameters recorded included:

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- Sensory and motor block onset
- Time to highest sensory level
- Regression times (two dermatomes, S1, Bromage 0)
- Time to first analgesic request
- Hemodynamic trends (SBP, DBP, HR)
- Adverse effects

Statistical Analysis

Analysis was performed using SPSS v26. Continuous variables were compared using ANOVA, and categorical variables using chi-square tests. A p-value <0.05 was considered statistically significant.

3. Results and Discussion

Demographics

The mean patient age was 31.5 ± 8.2 years. Seventy percent of patients were male. ASA distribution and demographic variables were comparable between groups, minimizing confounding.

Block Characteristics

Dexmedetomidine produced a noticeably faster onset of sensory block. Motor block onset was similar in both groups. Block regression times were significantly longer in Group D, indicating more sustained anesthesia.

These findings correspond with earlier studies demonstrating that α_2 -agonists prolong spinal anesthesia by hyperpolarizing dorsal horn neurons and limiting nociceptive transmission.

Postoperative Analgesia

Group D experienced markedly longer analgesia duration. Pain scores at 6 hours were lower in Group D, emphasizing superior postoperative comfort and reduced opioid need.

Hemodynamic Stability

Hemodynamic parameters remained more stable in Group D throughout surgery. Group F showed higher fluctuations in SBP, DBP, and heart rate.

Adverse Effects

Fentanyl was associated with a higher incidence of pruritus and nausea—effects typically linked to μ -opioid receptor stimulation. Dexmedetomidine caused minimal side effects and no sedation-related complications. No major adverse events occurred in either group.

Discussion Summary

Dexmedetomidine demonstrated:

- Faster sensory onset
- Significantly longer sensory and motor block duration
- Extended postoperative analgesia
- More stable hemodynamics
- Fewer complications

These results align with published literature supporting the efficacy of dexmedetomidine as an intrathecal adjuvant with superior analgesic longevity compared with fentanyl.

4. Conclusion

Intrathecal dexmedetomidine, when used with 0.5% hyperbaric bupivacaine, provides longer sensory and motor block duration, superior postoperative analgesia, better hemodynamic stability, and fewer opioid-related side effects than fentanyl. It is an effective and safe adjuvant for spinal anesthesia in femur fracture repair surgeries.

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