ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 10 | October - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EFFICACY OF DEXMEDETOMIDINE COMPARED TO FENTANYL AS INTRATHECAL ADJUVANT TO BUPIVACAINE: A DOUBLE-BLIND RANDOMIZED STUDY

Anaesthesiology

Dr. Shantanu Dey Department of Anaesthesiology, Shanti Mukand Hospital, New Delhi ORCID ID - 0009-0000-8876-2912

ABSTRACT

Background & Aims: Intrathecal adjuvants enhance spinal block quality and prolong postoperative analgesia. This study compared dexmedetomidine and fentanyl as intrathecal adjuvants to hyperbaric bupivacaine in lower limb orthopaedic surgeries. **Methods:** Sixty ASA I–II patients scheduled for lower limb surgery under spinal anaesthesia were randomized to receive either bupivacaine 0.5% 2 ml + dexmedetomidine 5 µg (Group D, n=30) or bupivacaine 0.5% 2 ml + fentanyl 25 µg (Group F, n=30). Onset and duration of sensory and motor block, haemodynamic changes, analgesia, and side effects were recorded. **Results:** Sensory block onset was faster in Group D (2.7 ± 0.5 vs. 4.4 ± 1.1 min; p<0.001) and lasted longer (186.8 ± 21.1 vs. 173.6 ± 7.9 min; p=0.003). Motor block onset was quicker in Group D (10.0 ± 2.0 vs. 11.2 ± 2.4 min; p=0.034) and duration was prolonged (144.6 ± 14.9 vs. 130.7 ± 12.9 min; p<0.001). Haemodynamic stability and side effects were comparable. **Conclusion:** Dexmedetomidine as intrathecal adjuvant provided superior block characteristics and prolonged analgesia compared to fentanyl, with stable haemodynamics and minimal side effects.

KEYWORDS

Dexmedetomidine, Fentanyl, Bupivacaine, Spinal anaesthesia, Postoperative analgesia, Intrathecal adjuvants

INTRODUCTION

Spinal anaesthesia is widely used for lower limb orthopaedic surgery. Intrathecal adjuvants are employed to enhance block characteristics and prolong analgesia. Fentanyl is effective but can be associated with opioid-related adverse effects. Dexmedetomidine, a highly selective α2-agonist, may improve sensory and motor block quality with fewer side effects. We conducted a randomized double-blind study to compare intrathecal dexmedetomidine and fentanyl as adjuvants to hyperbaric bupivacaine.

MATERIALS AND METHODS

Prospective, randomized, double-blind study in 60 ASA I–II adults undergoing lower limb orthopaedic surgery under spinal anaesthesia at a single centre. Group D received 0.5% hyperbaric bupivacaine 2 ml + dexmedetomidine 5 µg; Group F received 0.5% hyperbaric bupivacaine 2 ml + fentanyl 25 µg. Outcomes: onset and duration of sensory and motor block; haemodynamics (HR, SBP, DBP, SpO_2); adverse events. Statistics: t-test and chi-square; p<0.05 significant.

RESULTS

Table 1. Demographic Characteristics

Variable	Group D (Dex)	Group F (Fent)	p-value
Age (years)	36.83 ± 10.34	35.80 ± 8.70	0.677
Weight (kg)	72.47 ± 6.99	69.23 ± 7.95	0.100
Height (cm)	167.80 ± 4.81	165.70 ± 6.97	0.180
Sex (M/F)	25/5	21/9	0.222
ASA I/II (n)	20/10	24/6	0.243

Table 2. Onset Of Sensory And Motor Block

Variable	Group D (Dex)	Group F (Fent)	p-value
Sensory onset (min)	2.73 ± 0.52	4.40 ± 1.07	<0.001
Motor onset (min)	10.00 ± 1.95	11.23 ± 2.42	0.034

Table 3. Duration Of Sensory And Motor Block

Variable	Group D (Dex)	Group F (Fent)	p-value
Sensory duration (min)	186.77 ± 21.13	173.57 ± 7.94	0.003
Motor duration (min)	144.60 ± 14.86	130.67 ± 12.89	<0.001

Table 4. Adverse Events

Side Effect	Group D (Dex)	Group F (Fent)
Bradycardia	2	1
Hypotension	1	1
Pruritis	0	0

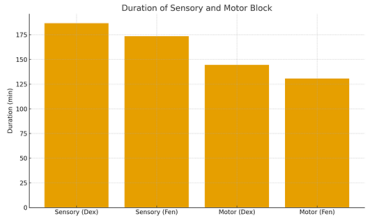

Figure 1. Duration of Sensory and Motor Block

DISCUSSION

The present randomized double-blind study demonstrates that adding dexmedetomidine (5 µg) to intrathecal hyperbaric bupivacaine results in a clinically meaningful improvement in block characteristics compared with fentanyl (25 µg). We observed a faster onset of both sensory and motor blockade, as well as a significantly longer duration of block and postoperative analgesia in the dexmedetomidine group. These findings are consistent with prior clinical work showing that α2-adrenoceptor agonists augment neuraxial anaesthesia by acting at the spinal cord level to inhibit nociceptive neurotransmission and to hyperpolarize dorsal horn neurons [3–5].

Mechanistically, dexmedetomidine has presynaptic effects on C-fibres and postsynaptic effects on dorsal horn neurons, which reduce the release of substance P and glutamate and enhance inhibitory descending pathways. This translates into earlier establishment of a dense block and prolongation of sensory and motor blockade without the pruritus, nausea, and respiratory depression that may accompany intrathecal opioids such as fentanyl or morphine [1,2]. In our cohort, haemodynamic variables remained comparable between groups throughout the intraoperative and early postoperative period, and the incidence of bradycardia and hypotension was low and similar across groups, aligning with previous reports that small intrathecal doses of dexmedetomidine are generally well tolerated [3–5].

Our results complement the observations by Kanazi et al., who reported that low-dose dexmedetomidine added to bupivacaine improved the quality of spinal anaesthesia and extended block duration compared with clonidine [3]. Indian data by Gupta et al. and Bajwa et al. similarly support the use of dexmedetomidine as an intrathecal adjuvant to prolong postoperative analgesia and improve patient comfort without increasing adverse effects [4,5]. Narrative and scoping reviews have since summarized these advantages—earlier onset, longer block, opioid-sparing effect, and acceptable safety profile—positioning dexmedetomidine as a useful alternative to neuraxial opioids in appropriate patients [6,7].

A pragmatic consideration is dose selection. We chose 5 µg of dexmedetomidine to balance efficacy and safety based on prior literature and pilot experience. Although higher doses may further prolong analgesia, incremental haemodynamic effects and sedation can occur; therefore, many authors recommend using the lowest dose that reliably improves block quality [3–5]. Similarly, we used 25 µg fentanyl, a commonly adopted dose that improves the quality of surgical anaesthesia but is limited by shorter duration of action and opioid-related adverse effects in some settings [2]. Future trials comparing multiple dexmedetomidine doses, as well as head-to-head comparisons with other adjuvants (e.g., clonidine, magnesium), would better define the optimal strategy for different procedures and patient profiles.

Clinical implications are two-fold. First, in lower limb orthopaedic surgery, where predictable surgical conditions and early mobilization are both desirable, dexmedetomidine may help achieve a dense block with prolonged analgesia while preserving haemodynamic stability, potentially reducing the need for early rescue analgesics. Second, in resource-constrained settings, a single intrathecal injection that extends postoperative pain relief may translate into fewer nursing interventions and improved patient satisfaction. Nevertheless, our single-centre sample limits generalizability, and we did not evaluate longer-term outcomes (e.g., urinary retention beyond PACU, chronic pain, or neurological sequelae). A multicentre randomized trial with standardized outcome definitions and patient-reported measures would help validate these findings and inform practice guidelines.

In summary, our data add to a growing body of evidence favoring dexmedetomidine over fentanyl as an intrathecal adjuvant to hyperbaric bupivacaine for lower limb surgery: onset is faster, block and analgesia last longer, and safety is comparable. Within the limitations noted, dexmedetomidine appears a reasonable first-line adjuvant when prolonged postoperative analgesia is desired and opioid-related adverse effects are a concern [3–7].

Lacunae Of The Study

This single-centre randomized trial enrolled a modest sample (n=60) of ASA I–II adults undergoing lower-limb orthopaedic surgery, which may limit external validity and the ability to detect uncommon adverse events. Fixed doses were used (dexmedetomidine 5 µg; fentanyl 25 µg) without a dose–response evaluation or weight-adjusted dosing. Analgesia was inferred mainly from block duration; standardized postoperative pain/sedation scores and patient satisfaction were not systematically captured.

CONCLUSION

Intrathecal dexmedetomidine (5 µg) with bupivacaine provides superior block characteristics and prolonged analgesia compared to fentanyl (25 µg), with minimal adverse effects.

Conflict of Interest

The authors declare no conflict of interest.

Funding

No external funding was received.

REFERENCES

1. Wang JK, Nauss LA, Thomas JE. Pain relief by intrathecally applied morphine in man. Anesthesiology. 1979;50(2):149–51.
2. Kang FC, Tsai YC, Chang PJ, Chen TY, Lin CR. Intrathecal fentanyl with small-dose bupivacaine improves spinal anesthesia for cesarean delivery. Anesth Analg. 1998;87(6):1360–3.
3. Kanazi GE, Aouad MT, Jabbour-Khoury SI, et al. Effect of low-dose dexmedetomidine or clonidine on characteristics of bupivacaine spinal block. Acta Anaesthesiol Scand. 2006;50(2):222–7.
4. Gupta R, Bogra J, Verma R, et al. Dexmedetomidine as an intrathecal adjuvant for postoperative analgesia. Indian J Anaesth. 2011;55(4):347–51.
5. Bajwa SJ, Arora V, Kaur J, et al. Comparative evaluation of dexmedetomidine and clonidine with bupivacaine in spinal anesthesia. Saudi J Anaesth. 2011;5(4):365–70.
6. Naaz S, Ozair E. Dexmedetomidine in anaesthesia practice: A wonder drug? Indian J Anaesth. 2014;58(2):119–22.
7. Kaur M, Singh PM. Current role of dexmedetomidine in clinical anaesthesia and intensive care. Anaesth Essays Res. 2011;5(2):128–33.