Egyptian Journal of Anaesthesia

Vol. 41, 2025
ISSN: 1110-1849 (print))
ISSN: 1687-1804 (online)
DOI: 10.21608/EGJA.2025.386326.1088

# ORIGINAL ARTICLE

## Intrathecal Dexmedetomidine Allows Reduction of the Dose of Hyperbaric Bupivacaine for Patients Undergoing Lower Limb Orthopedic Surgery: Prospective Case-Control Comparative Study

**Mohamed G. Ayaad[1], Haitham AM. Osman[2], Mohsen M. Eissa[3]**

*Department of Anesthesia, Pain and Surgical ICU, Faculty of Medicine, [1]Tanta University, Tanta, [2]Al-Azhar University, Assiut Branch, Assiut, [3]Al-Azhar University, Cairo Branch, Cairo, Egypt*

**Correspondence to** *Haitham AM. Osman, MD; Department of Anesthesia, Pain and Surgical ICU, Faculty of Medicine, Al-Azhar University, Assiut Branch, Assiut, Cairo, Egypt*
*E-mail: haithamamosman@gmail.com*

**Background** Spinal anesthesia (SA) with rapid sensory and motor blockades and recovery helps to apply same-day surgeries. Intrathecal dexmedetomidine (IT-DEX) as an adjuvant for SA enhances blocks and minimizes the need for postoperative (PO) analgesia.

**Objectives** To evaluate the outcomes of IT injection of low-dose 0.5% hyperbaric bupivacaine (HBB) with DEX versus the usual dose of plain 0.5% HBB.

**Patients and Methods** Eighty study patients received 9mg of HBB 0.5% with 3µg IT-DEX (Group BD3) or 7mg of HBB with 5µg IT-DEX (Group BD5). Another 40 control patients received 12mg of 0.5% HBB without IT-DEX (Group BD0). The study outcomes included the ability of IT-DEX to reduce the dose of bupivacaine, the DEX dose-dependency of outcomes, the durations of blockade, PO analgesia, and the resultant complications.

**Results** IT-HBB with DEX provided rapid onset and longer block duration than plain HBB. Adding 3 and 5µg of DEX to IT-HBB allowed reducing its dose by 40% and 53.3%, respectively. The duration of PO analgesia was significantly ($P$<0.001, $P$= 0.033) longer in Group BD5 and BD3, respectively than in Group BD0. Also, the frequency of requesting PO morphine showed significant ($P$<0.001) intergroup difference in favor of BD5 group.

**Conclusion** IT injection of HBB with DEX reduced the HBB dose, minimized the duration to achieve complete spinal blockade and resolution, and prolonged the duration of PO analgesia. Further, these improvements were DEX dose-dependent and were associated with reduced incidence of SA-induced complications.

**Keywords** Dose-dependency, Durations of the blockade, Hyperbaric bupivacaine, Intrathecal dexmedetomidine.
**Received:** 18 May 2025, **Accepted:** 17 September 2025.

## INTRODUCTION

The spinal blocks (SBs) provide multiple advantages that make it the most commonly used anesthetic method for sub-umbilical surgeries. Still, local anesthetics (LA) vary in their time of start and fade of their effects[1]. Thus, the duration of action of SBs that could not be extended is considered one of its main disadvantages. The available policy to prolong the duration of action of the SB is the application of a catheter before the commencement of the anesthetic procedure[2].

The increasing application of ambulatory surgical procedures and same-day surgeries necessitated the provision of spinal anesthesia (SA) with rapid motor and sensory recovery[3]. In this setting, it is important to achieve

the desired block levels without the use of higher doses of the injected local anesthetic to guard against prolongation or deepening the blockade, which prolongs the durations of recovery and hospital stay after surgery[4].

Dexmedetomidine (DEX), which is a highly selective α2-adrenoceptor agonist, exerts profound analgesia with patients' calmness, thanks to its sedative properties[5]. In subanesthetic doses, DEX helps to maintain the blood-brain barrier, mitigates the activity of the locus coeruleus[6]. Additionally, the anti-inflammatory properties of DEX lessen the release of nociceptive inflammatory ytokines[7].

Intravenous DEX injection during transurethral prostatectomy under SA improves the block characteristics with remarkable prolongation of its durations[8]. Furthermore, the intrathecal (IT) administration of DEX during SA prolongs the duration of the sensory blockade with a reduction of the requirements for additional analgesia[9].

The usual IT dose of bupivacaine induces a higher incidence of hypotension than ropivacaine[10]. A recent retrospective study found that IT administration of low doses of 0.5% hyperbaric bupivacaine (HBB) provides an adequate duration of anesthesia for hip fracture surgery with reduced incidence of intraoperative hypotension[11].

**Hypothesis:**

The null hypothesis of this study is that using DEX as an adjuvant to IT bupivacaine can allow a reduction of the bupivacaine dose and its related effects without compromising its performance as an anesthetic block.

## OBJECTIVES

The current study aimed to evaluate the performance of low-dose 0.5% HBB with IT-DEX as an adjuvant in a dose-dependent manner, compared to plain 0.5% HBB during SA for adult patients undergoing lower limb orthopedic surgeries.

***Design:*** Multicenter prospective interventional study.

***Setting:*** Departments of Anesthesia, Pain nad Surgical ICU, Faculty of Medicine, Tanta, Benha, and Al-Azhar Universities.

**Ethical Considerations:**

The Anesthesia Departmental Committee accepted the study protocol, and the Local Ethics Committee at Tanta University approved it with the approval code: 36264PR1218/5/25. The study protocol was registered on ClinicalTrials.gov. with ID. The study protocol was discussed with patients, and those who agreed to participate and signed the written consent underwent evaluation.

## PATIENTS AND METHODS

All patients who were assigned for elective reduction and fixation of fractured long bones of the lower limb were eligible for evaluation. The evaluation process included the collection of demographic data, the ASA grade, the frequency of associated medical disorders, the side and laterality of the injured limb, contraindications for the SA, and the drugs used, and the presence of exclusion criteria.

**Inclusion criteria:**

Patients aged >18 years and assigned for elective reduction and fixation of fractured lower limb long bones, free of exclusion criteria, and accepted to participate, were enrolled in the study after signing a written patient consent.

**Exclusion criteria:**

The presence of spinal deformity, previous spinal surgery or trauma, obesity, habitual hypotension, history of post-dural puncture headache, headache for any cause, maintenance on antihypertensive therapy, ASA grade >II, and allergy to the used drugs, and the refusal to sign the consent were the exclusion criteria.

**Sample size calculation:**

Literature review for similar comparative study failed to detect similarly fashioned study, so considering an exploratory pilot study, 40 cases were included per group (total 120 cases).

**Randomization and Grouping:**

A computer-generated random sequence in a 1:1:1 ratio was obtained to allocate 120 patients into three groups ($n$= 40/ group). The study groups included the BD3 group that received 9mg of 0.5% HBB combined with 3µg of IT-DEX, and the BD5 group received 7mg of 0.5% HBB with 5µg of IT-DEX as an adjuvant. The control BD0 Group received 12mg of 0.5% HBB without IT-DEX. Allocation concealment was ensured using sequentially numbered, sealed envelopes that were prepared by an assistant, not an author. Both patients and the investigators responsible for intraoperative management and outcome assessment were blinded to group assignments to minimize performance and detection bias.

**Anesthetic procedure:**

No premedication was provided, and patients had received a preload with 500ml of lactated Ringer's solution. The patient is positioned in the setting or lateral decubitus position according to his comfort. The patient's

back was cleaned, sterilized, and draped. Then, the L3-4 spinal interspace was identified, LA was infiltrated, and a 27-G pencil-point spinal needle (Zibo Eastmed Healthcare Products Co., Ltd., China) was inserted, advanced until the resistance of the ligaments was felt, and was cautiously advanced through the epidural space until the cerebrospinal fluid was observed. The anesthetic assigned for each group was injected intrathecally; patients of Group BD0 received an IT injection of 12mg (2.4ml) of plain 0.5% HBB. For patients of Group BD3, HBB 0.5% in a dose of 9mg (1.8ml) with 3µg DEX was injected intrathecally. In the case of Group BD5, the dose of HBB was 7mg (1.4ml) mixed with 5µg DEX[12]. The injectable volume was completed to be 3ml with 0.9% saline for all patients. Following completion of the IT injections, patients were immediately turned to the supine position, and the block performance was checked.

**Evaluation parameters:**

***A- Spinal Block Performance***

Patients were assessed for the onset of sensory and motor block, time consumed to reach a sensory block (SB) at T10 and motor block (MB) at Bromage 0, and time till sensory and motor regression to S1 and Bromage 3.

***B- Intraoperative (IO) monitoring***

Patients were non-invasively monitored during surgery for heart rate (HR) and mean arterial pressure (MAP). Hypotension was defined as a decrease in MAP by >25% from baseline MAP and was treated with an intravenous bolus of 5mg ephedrine, which was repeated every 3 minutes until the hypotension resolved. Bradycardia was defined as an HR <40 beats per minute and was treated with atropine 0.5mg IV[13].

***C- PO monitoring***

Pain sensation was assessed using the pain Numeric Rating Scale (NRS), which is a 10-point scale with higher scores indicating severe pain. The NRS pain scores were determined every hour for 4 hours and then every two hours till hospital discharge. The duration of PO analgesia was defined as the time to the 1st request for PO analgesia that was provided at NRS ≥4. PO rescue analgesia was provided as IV morphine 5mg diluted to 10mL with normal saline and given as 2mL shots till pain resolution. The duration of PO analgesia till the first request for analgesia, the number of requests for rescue analgesia, and the total dose of morphine were recorded.

The frequency and severity of morphine-induced side effects, including postoperative nausea and vomiting (PONV), pruritus, and respiratory depression, were registered.

**Study Endpoints**:

1. The primary endpoint is the ability of IT-DEX to reduce the dose of IT bupivacaine.
2. The secondary outcomes included the DEX dose-dependency outcomes, the performance of SA with DEX as an adjuvant regarding the durations till complete sensory and motor blockade and resolution, PO analgesia, and the resultant complications.

Data are presented as means and standard deviations for continuous variables, and as frequencies with percentages for categorical variables.

**Statistical analysis:**

The Kolmogorov–Smirnov test and normal Q–Q plots were used to assess data normality. The intergroup variance was assessed using one-way ANOVA for continuous variables and the Chi-square test or Fisher's exact test for categorical variables. Pairwise comparisons were performed by Chi-square or Fisher's exact tests with Bonferroni correction for qualitative variables, and for quantitative variables, post-hoc Bonferroni analysis was conducted following ANOVA. Statistical analyses were performed using IBM® SPSS® Statistics, version 22 (IBM Corp., Armonk, NY, USA). A two-sided *P*-value <0.05 was considered statistically significant.

## RESULTS

Preliminary evaluation excluded five patients with BMI >30kg/m$^2$, three patients had ASA grade III, three patients had a history of postdural puncture headache after previous SA, two patients were always complaining of headache, two patients with coagulopathy, and one patient had a spinal deformity. Eighty patients were randomly divided as shown in Figure (1). Patients' enrolment data were comparable, as presented in Table (1).

Sensory block started remarkably earlier in BD5 than in BD0 ($P$= 0.0001) and BD3 ($P$= 0.032) groups. Still, the difference between the BD3 and BD0 groups was comparable. Similarly, motor block began noticeably more rapidly in BD5 than in BD0 ($P$<0.001) and BD3 ($P$= 0.034), with a significant ($P$= 0.032) difference in favor of BD3 than in the BD0 group. Time to sensory block at T10 was ($P$<0.001) shorter in BD5 than in other groups and in BD3 ($P$<0.001) than in the BD0 group. Time consumed till achieving the motor block of the Bromage score of 0 was remarkably ($P$<0.001) longer in BD0 compared to other groups, with an insignificant ($P$= 1) difference between groups BD3 and BD5. The duration till the start of fading of the sensory block down to S1 level and the motor to Bromage grade 3 was significantly ($P$<0.001) longer in BD5 than in other groups, with longer ($P$<0.001) times in BD3 than in BD0 Group (Table 2).

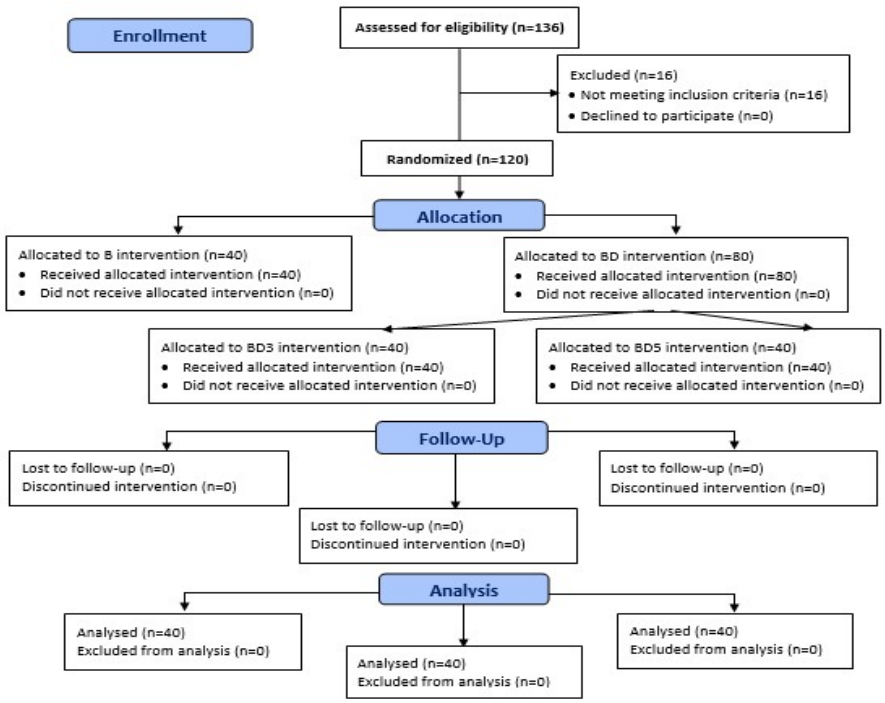


**Fig. 1:** Consort flowchart.

**Table 1:** Demographic and clinical data:

| Variables | Group | Control (BD0) | Study | | *P* |
|---|---|---|---|---|---|
| | | | BD3 | BD5 | |
| Age (years) | | 50.3±5.4 | 49.3±5.5 | 50.5±3.4 | 0.885‡ |
| Gender | Male | 17(42.5%) | 21(52.5%) | 15(37.5%) | 0.388* |
| | Female | 23(57.5%) | 19 (47.5%) | 25 (62.5%) | |
| Body mass index | | 30.94±1.5 | 31.8±1.8 | 31.46±1.6 | 0.073† |
| Fractured bone | Femur | 36(90%) | 38(95%) | 37(82.5%) | 0.908** |
| | Tibia | 4(10%) | 2(5%) | 3(7.5%) | |
| Side | Rt | 30(75%) | 27(67.5%) | 31(77.5%) | 0.575* |
| | Lt | 10(25%) | 13(32.5%) | 9(22.5%) | |
| ASA grade | I | 32(80%) | 30(75%) | 33(92.5%) | 0.702* |
| | II | 8(20%) | 10(25%) | 7(7.5%) | |
| Medical diseases | No | 32(80%) | 30(75%) | 33(92.5%) | 0.702* |
| | DM | 5(12.5%) | 6(15%) | 3(7.5%) | 0.679** |
| | HTN | 2(5%) | 3(7.5%) | 3(7.5%) | 1.0** |
| | Cardiac | 1(2.5%) | 1(2.5%) | 1(2.5%) | 1.0** |

*P*: Indicates the significance of the overall group differences as judged by *: Chi-square test; **: Fisher Exact Test; †: ANOVA test.

During surgery, 16 patients (13.3%) developed hypotension that required ephedrine injections. The differences between the three groups regarding the frequency of IO hypotension, the number of ephedrine doses, and the received doses of ephedrine were insignificant. IO bradycardia was reported in 10 patients (8.3%) with insignificant intergroup differences (Table 3).

Fifty-eight patients (48.3%) did not require PO analgesia, with a significant ($P$<0.001) intergroup difference. The frequency of patients who did not request PO morphine was significantly ($P$<0.05) higher in Groups BD3 and BD5 than in Group BD0, with a significantly ($P$<0.05) higher frequency of needing PO morphine by patients of Group BD3 than in Group BD5.

**Table 2:** Spinal block data:

| Variables | Group | Control (BD0) | Study | | *P** |
|---|---|---|---|---|---|
| | | | BD3 | BD5 | |
| Onset of sensory block (min) | | 2.65±0.32 | 2.55±0.28 | 2.38±0.24 | <0.001[a] |
| Onset of motor block (min) | | 9.52±1.2 | 8.88±1 | 8.24±1.15 | <0.001[b] |
| Time to sensory block at T10 (min) | | 8.4±1.34 | 6.5±1.4 | 5±1 | <0.001[c] |
| Time to reach Bromage 0(min) | | 12.8±1.86 | 11.6±1.6 | 11.3±1.38 | <0.001[d] |
| Time till regression of sensory block to S1 (h) | | 2.8±0.6 | 5.76±0.7 | 6.58±0.9 | <0.001[c] |
| Time till regression of motor block to Bromage 3 (h) | | 2.33±0.5 | 5±0.71 | 5.92±0.81 | <0.001[c] |

**P*: indicates the significance of the overall group differences as judged by the ANOVA test; a. BD0 vs. BD5 (Significant), BD3 vs. BD5 (Highly Significant) by Bonferroni corrected post hoc test; b. BD0 vs. BD3 (Significant), BD0 vs. BD5 (Highly Significant), BD3 vs. BD5 (Significant) by Bonferroni corrected post hoc test; c. BD0 vs. BD3 (Highly Significant), BD0 vs. BD5 (Highly Significant), BD3 vs. BD5 (Highly Significant) by Bonferroni corrected post hoc test; d. BD0 vs. BD3 (Significant), BD0 vs. BD5 (Significant), BD3 vs. BD5 (Non-Significant) by Bonferroni corrected post hoc test.

**Table 3:** IO Hemodynamic Complications:

| Variables | Group | Control (BD0) | Study | | *P* |
|---|---|---|---|---|---|
| | | | BD3 | BD5 | |
| Frequency of IO hypotension | Yes | 7(17.5%) | 4(10%) | 5(12.5%) | 0.604* |
| | No | 33(82.5%) | 36(90%) | 35(87.5%) | |
| Number of ephedrine doses for cases that developed hypotension | One | 4(10%) | 3(7.5%) | 4(10%) | 0.808** |
| | Two | 3(7.5%) | 1(2.5%) | 1(2.5%) | |
| Dose of ephedrine (mg)* | | 4.3±1.6 | 3.75±1.5 | 3.6±1.3 | 0.715† |
| Frequency of IO bradycardia | Yes | 4(10%) | 2(5%) | 4(10%) | 0.769** |
| | No | 36(90%) | 38(95%) | 36(90%) | |

IO: Intraoperative; *P*: Indicates the significance of the overall group differences as judged by *: Chi-square test; **: Fisher Exact Test; †: ANOVA test.

All patients who received IT-DEX and required PO analgesia requested it once with insignificant ($P>0.05$) intergroup differences, while 13 patients in Group BD0 required PO morphine twice with significant ($P<0.05$) differences versus both BD3 and BD5. Moreover, the duration until the first request for PO analgesia was noticeably longer ($P<0.001$) in BD5 than in the other groups, and in BD3 compared to BD0 Group. Among patients who requested PO analgesia, the total morphine dose used was significantly lower ($P<0.001$) in groups BD5 and BD3 compared to Group BD0 but was insignificantly ($P= 0.157$) lower in Group BD5 compared to Group BD3 (Table 4). The frequencies of PO side effects showed insignificant intergroup differences, despite being lower in BD5 (Table 5).

**Table 4:** PO analgesia requirement data:

| Variables | Group | Control (BD0) | Study | | *P* |
|---|---|---|---|---|---|
| | | | BD3 | BD5 | |
| Frequency of requesting rescue analgesia | No | 5(12.5%)[a] | 22(55%)[b] | 31(77.5%)[c] | <0.001* |
| | Once | 22(55%)[a] | 18(45%)[a, b] | 9(22.5%)[b] | |
| | Two | 13(32.5%)[a] | 0(0%)[b] | 0(0%)[b] | |
| Duration till requesting rescue analgesia (h) | | 3.43±0.72 | 5.5±1.17 | 7.9±0.93 | <0.001**[d] |
| The total dose of morphine (mg) received by patients who required PO analgesia | | 3.9±1.2 | 2.6±0.6 | 1.8±0.7 | <0.001**[e] |

*P*: Indicates the significance of the overall group differences as judged by *: Fisher's Exact Test; **: ANOVA test; d. BD0 vs. BD3 (Highly Significant), BD0 vs. BD5 (Highly Significant), BD3 vs. BD5 (Highly Significant) by Bonferroni corrected post hoc test; e. BD0 vs. BD3 (Highly Significant), BD0 vs. BD5 (Highly Significant), BD3 vs. BD5 (non- Significant) by Bonferroni corrected post hoc test.

**Table 5:** PO complications:

| Variables | Group | Control (BD0) | Study | | *P** |
|---|---|---|---|---|---|
| | | | BD3 | BD5 | |
| Postoperative nausea and vomiting | No | 33(82.5%) | 38(95%) | 39(97.5%) | 0.096 |
| | Nausea | 6(15%) | 2(5%) | 1(2.5%) | |
| | Vomiting | 1(2.5%) | 0(0%) | 0(0%) | |
| Respiratory depression | No | 38(95%) | 40(100%) | 40(100%) | 0.328 |
| | Yes | 2(5%) | 0(0%) | 0(0%) | |
| Postdural puncture headache | No | 36(90%) | 38(95%) | 39(97.5%) | 0.5 |
| | Yes | 4(10%) | 2(5%) | 1(2.5%) | |

**P*: Indicates the significance of the overall group differences as judged by the **: Fisher Exact Test.

## DISCUSSION

The study rationale was to use an intrathecal (IT) adjuvant to IT 0.5% hyperbaric bupivacaine (HBB) to reduce its dose. This significantly improved the performance of SA and PO analgesia and minimized SA-related complications. In line with the trial to reduce the dose of HBB, Benjhawaleemas *et al.,*[14] found that an HBB dose of >11mg is a risk factor for developing a high spinal block. Also, Hatter *et al.,*[15] found that IT morphine in a dose of 50µg as an adjuvant to HBB (12mg) with fentanyl 50µg for SA was not inferior to adding 100µg of morphine as regards the duration till the need for and the dose of opioid rescue analgesia.

The IT-DEX did favorably, irrespective of the used dose, as manifested by a significantly rapid onset and approaching peak sensory and motor blocks with prolonged duration of block and PO analgesia. In evidence for the efficacy of IT-DEX as a neuraxial adjuvant, Alam *et al.,* [16] found IT-DEX 10µg as an adjuvant to 10mg of 0.5% HBB significantly fastened the blocks to achieve the desired levels, with extended time till fading away, reduction of the requests of rescue analgesia, and minimal adverse effects in comparison to 0.5% HBB alone. Also, Farmawy *et al.,*[17] reported the superiority of adding DEX to epidural bupivacaine over nalbuphine with regard to the time of block start and end and duration of PO analgesia, and patient satisfaction. Further, Manoharan *et al.,*[18] in a comparative study of IT-DEX versus IT clonidine documented that DEX was superior and provided long blockade duration, with extended duration of PO analgesia with mitigation of using additional analgesics, and indifferent minor hemodynamic variability. Additionally, Modir *et al.,*[19] found that IT-DEX as an adjuvant to ropivacaine SA significantly shortened the time till the onset of blockade. Still, they prolonged its durations compared with IT fentanyl and IT magnesium sulfate as adjuvants to local anesthetic (LA).

The use of IT-DEX as an adjuvant to IT-bupivacaine allowed reductions of the injected dose of bupivacaine by 40% and 53.3% by adding 3 and 5µg of DEX, respectively. These findings align with Shafqat *et al.,*[20] who compared SA using 7.5mg of 0.5% HBB alone versus 6mg of 0.5% HBB with 3µg DEX and documented that IT-DEX combined with low-dose HBB resulted in a rapid onset and longer duration of spinal blockades with reduced consumption of analgesia.

The reported improvements in the performance of SA despite the dose reduction of HBB were DEX dose-dependent. These data indicated the study's null hypothesis that the use of IT-DEX as an adjuvant to IT-HBB allows a reduction of the dose of bupivacaine with the improvement of its anesthetic performance and reduction of its onset of action and complications. In line with the dose-dependent effect of IT-DEX, Nallam *et al.,*[21] tried increasing doses (5,7.5 and 10µg) of IT-DEX with a fixed 15mg dose of IT hyperbaric ropivacaine (0.75%) and reported that increasing doses of DEX reduced the time of the start of blockade with a dose-dependent prolongation of the duration of analgesia. Per, higher dose induced higher incidence of side effects. Wan *et al.,*[22] also found that DEX as an adjuvant to epidural ropivacaine reduced its EC50 for motor block and shortened its onset time of action, and documented that the optimal dose of DEX was 0.5µg/kg.

In support of the dose-dependence of the effect of DEX as an adjuvant to neuroaxial anesthetic techniques, Kurhekar *et al.,*[23] tried DEX in doses of 0.5 and 1µg/kg/24h with 0.1% ropivacaine as an epidural infusion for PO analgesia and found that continuous epidural infusion of ropivacaine with 1µg DEX provided better PO analgesia with a safe hemodynamic profile. Sundararajan *et al.,*[24] also found that intravenous DEX (0.75 and 1µg) during SA prolonged the SA regression-time with extension of the duration of the motor block relative to a 0.5µg DEX while maintaining hemodynamic stability without adverse effects. Recently, Bai *et al.,*[25] found that combined spinal-epidural anesthesia for the elderly had intertrochanteric femoral fracture using

ropivacaine with low or high doses of DEX shortened the time of onset of anesthesia, maintained perioperative hemodynamic stability, and reduced the incidence of delirium and cognitive dysfunction than ropivacaine alone, with a dose-dependent effect for DEX.

In line with the efficacy of DEX in a dose of 5µg, Shukla *et al.,*[26] found that sequential IT-DEX administration in a dose of 5µg as an adjuvant with 15mg of hyperbaric bupivacaine enhanced the block characteristics with prolonged analgesia, reduced analgesic demands, increased patient satisfaction, and maintained stable hemodynamics compared to fentanyl. The prolonged PO analgesia and better outcomes after neuroaxial anesthesia with the use of IT-DEX as an adjuvant to LA were attributed by Bia *et al.,*[25] to the reported significant reduction of levels of PO pain mediator release and to the anti-inflammatory effect of DEX that was evidenced by the significant reduction of PO neutrophil-to-lymphocyte ratio in comparison to local anesthetic alone.

## CONCLUSIONS

Spinal anesthesia with IT-DEX as an adjuvant allowed dose reduction of HBB and improved the block characteristics, the duration to achieve complete sensory and motor blocks and their resolution, and the duration of postoperative analgesia. These improvements were DEX dose-dependent and associated with reduced incidence of IO hypotension and other complications.

## RECOMMENDATIONS

Multicenter, wider-scale studies were required to define the optimal minimum dose of 0.5% HBB and DEX.

## CONFLICT OF INTERESTS

There are no conflicts of interest.

## REFERENCES

1. Gupta P, Chouhan R, Jangir K, Rathore V, Audichya P, Goyal S: A Comparison of Intrathecal Dexmedetomidine and Fentanyl as Adjuvants to 0.5% Hyperbaric Levobupivacaine for Lower Abdominal Surgeries: A Prospective, Double-Blinded, Randomized Controlled Trial. Cureus. 2024 Dec 23;16(12): e76292. Doi: 10.7759/cureus.76292.

2. Sai Krishna A, Agarwal J, Khanuja S, Kumar S, Khan A, Butt K: Comparison of intravenous dexmedetomidine versus ketamine-dexmedetomidine combination on spinal block characteristics in patients undergoing lower limb orthopaedic surgery - A randomised clinical trial. Indian J Anaesth. 2024 Sep;68(9):795-800. Doi: 10.4103/ija.ija_14_24.

3. Layson J, Jackson M, Wells A, Mabee K, DeClaire J, Frisch N: Administration of Low-dose Hyperbaric Bupivacaine for Spinal Anesthesia in the Setting of Outpatient Arthroplasty. J Am Acad Orthop Surg Glob Res Rev. 2024 May 9;8(5): e23.00240. Doi: 10.5435/JAAOSGlobal-D-23-00240.

4. Tan J, Wang W, Yoshida T, Abdullah S, Chowdhury J, Chin K: The anesthetic and recovery profiles of low-dose hypobaric mepivacaine and bupivacaine for spinal anesthesia in total hip and knee arthroplasty: a prospective observational study. Can J Anaesth. 2024 Dec 10. Doi: 10.1007/s12630-024-02887-y.

5. Li H, Wang L, Shi C, Zhou B, Yao L: Impact of Dexmedetomidine Dosing and Timing on Acute Kidney Injury and Renal Outcomes After Cardiac Surgery: A Meta-Analytic Approach. Ann Pharmacother. 2025 Apr;59(4):319-329. Doi: 10.1177/10600280241271098.

6. Gao W, Lv X, Li H, Yan X, Huo D, Yang Z, Zhang Z, Jia J: Dexmedetomidine pretreatment alleviates brain injury in middle cerebral artery occlusion (MCAO) model rats by activating PI3K/AKT/NF-κB signaling pathway. J Toxicol Environ Health A. 2025 Feb 24:1-11. Doi: 10.1080/15287394.2025.2469088.

7. Hu X, RLuo R, Lei F, Li X, Luo Y, Li Q, Yi L, Zhang L, Polyak A, Tao Y, Jiang R: Therapeutic Potential of Dexmedetomidine in Neuropsychiatric Disorders: From the Bench to the Clinic. Curr Neuropharmacol. 2025 Jan 2. Doi: 10.2174/011570159X349530241123140415.

8. Sangkum L, Termpornlert S, Tunprasit C, Rathanasutthajohn C, Komonhirun R, Dusitkasem S: Effect of low-dose dexmedetomidine to prolong spinal anesthesia in elderly patients: a prospective randomized controlled study. BMC Anesthesiol. 2024 Nov 26;24(1):427. Doi: 10.1186/s12871-024-02815-z.

9. Cansian J, Giampaoli A, Immich L, Schmidt A, Dias A: The efficacy of buprenorphine compared with dexmedetomidine in spinal anesthesia: a systematic review and meta-analysis. Braz J Anesthesiol. 2024 Nov-Dec;74(6):844557. Doi: 10.1016/j.bjane.2024.844557.

10. Hashemian M, Barouni M, Honarvar Z, Alidousti K, Mohajerani S, Rezaeizadeh L: Comparison of Ropivacaine versus Bupivacaine in Spinal-Induced Hypotension in Preeclampsia Patients: A Randomized Control Trial. Anesth Pain Med. 2024 Feb 29;14(1): e142646. Doi: 10.5812/aapm-142646.

11. White SM: A retrospective, observational, single-centre, cohort database analysis of the haemodynamic effects of low-dose spinal anaesthesia for hip fracture surgery. BJA Open. 2024 Feb 17:9:100261. Doi: 10.1016/j.bjao.2024.100261.

12. Mohamed T, Susheela I, Balakrishnan B, Kaniyil S: Dexmedetomidine as Adjuvant to Lower Doses of Intrathecal Bupivacaine for Lower Limb Orthopedic Surgeries. Anesth Essays Res. 2017 Jul-Sep;11(3):681-685. Doi: 10.4103/aer.AER_243_16.

13. Hofhuizen C, Lemson J, Snoeck M, Scheffer G: Spinal anesthesia-induced hypotension is caused by a decrease in stroke volume in elderly patients. Local Reg Anesth. 2019 Mar 4;12:19–26. Doi: 10.2147/LRA.S193925.

14. Benjhawaleemas P, Sakolnagara B, Tanasansuttiporn J, Chatmongkolchart S, Oofuvong M: Risk prediction score for high spinal block in patients undergoing cesarean delivery: a retrospective cohort study. BMC Anesthesiol. 2024 Nov 11;24(1):406. Doi: 10.1186/s12871-024-02799-w.

15. Hatter K, Shugart N, Paladugu N, Nitchie H, Wolf B, Hebbar L: Low dose intrathecal morphine for post-cesarean analgesia with scheduled multimodal pain regimen: a prospective, randomized, open blinded end-point study. Int J Obstet Anesth. 2025 Mar 27:62:104361. Doi: 10.1016/j.ijoa.2025.104361.

16. Alam S, Abbas N, Asgher A, Rafique M, Anees-ur-Rehman, Abid K: Effectiveness of intrathecal dexmedetomidine in combination with hyperbaric bupivacaine for lower abdominal surgeries and its postoperative analgesic characteristic. J Ayub Med Coll Abbottabad. 2022 Oct-Dec;34 (Suppl 1) (4):S936-S939. Doi: 10.55519/JAMC-04-S4-10179.

17. Farmawy MSE, Mowafy S, Wahdan R: Epidural nalbuphine versus dexmedetomidine as adjuvants to bupivacaine in lower limb orthopedic surgeries for postoperative analgesia: a randomized controlled trial. BMC Anesthesiol. 2023 Dec 6;23(1):401. Doi: 10.1186/s12871-023-02348-x.

18. Manoharan MM, Paneer M, Elavarasan K, Punniyakoti K: Dexmedetomidine Versus Clonidine as Additives for Spinal Anesthesia: A Comparative Study. Anesth Pain Med. 2023 Aug 6;13(4): e138274. Doi: 10.5812/aapm-138274.

19. Modir H, Hafez-Alsehe N, Almasi-Hashiani A, Kamali A: Effects of dexmedetomidine, fentanyl and magnesium sulfate added to ropivacaine on sensory and motor blocks in lower abdominal surgery: a randomized clinical trial. Med Gas Res. 2024 Sep 1;14(3):102-107. Doi: 10.4103/2045-9912.385947.

20. Shafqat N, Abbas S, Abbas M, Farooq M, Siddique M, Malik S: Intrathecal Dexmedetomidine as an Adjuvant to Low Dose Hyperbaric 0.5% Bupivacaine on Haemodynamic Parameters in Patients Undergoing Transurethral Resection of Prostate. J Coll Physicians Surg Pak. 2024 Sep;34(9):1014-1018. Doi: 10.29271/jcpsp.2024.09.1014.

21. Nallam S, Kandala S, Kanipakam S, Bathini V, Chiruvella S, Sesham S: Cesarean Sections Under Spinal Anaesthesia: Comparison of Varying Doses of Dexmedetomidine Combined with 0.75% Hyperbaric Ropivacaine: A Double-Blind Randomized Trial. Turk J Anaesthesiol Reanim. 2024 Sep 17;52(4):134-141. Doi: 10.4274/TJAR.2024.241619.

22. Wan J, Lin C, Wu Z, Feng D, Wang Y, Wang F: The median effective concentration of epidural ropivacaine with different doses of dexmedetomidine for motor blockade: an up-down sequential allocation study. Front Med (Lausanne). 2024 Aug 5:11:1413191. Doi: 10.3389/fmed.2024.1413191.

23. Kurhekar P, Sheba S, Meenakshisundaram S, Sethuraman R, Parlikar N: Comparison of two different doses of dexmedetomidine for continuous epidural analgesia for lower limb surgeries: A randomized double-blind study. J Anaesthesiol Clin Pharmacol. 2024 Jul-Sep;40(3):451-456. Doi: 10.4103/joacp.joacp_88_23.

24. Sundararajan C, Singaravelu G, Selvaraj K, Meenakshisundaram S, Sethuraman R, Moni A: The Effects of Premedication With Three Different Doses of Intravenous Dexmedetomidine on Spinal Anesthesia: A Randomized Comparative Study. Cureus. 2024 Jan 17;16(1): e52459. Doi: 10.7759/cureus.52459.

25. Bai L, Zhao L, Jia F, Liu Y, Li P: Effects of dexmedetomidine-ropivacaine assisted combined spinal-epidural anesthesia on neutrophil-lymphocyte ratio and postoperative delirium in elderly patients with intertrochanteric femoral fracture. Front Pharmacol. 2025 Jan 30:15:1454452. Doi: 10.3389/fphar.2024.1454452.

26. Shukla U, Singh R, Mishra K, Rathore V: A Comparative Study of Intrathecal Hyperbaric Bupivacaine With Fentanyl Versus Intrathecal Hyperbaric Bupivacaine With Dexmedetomidine Administered Sequentially for Lower Limb Orthopaedic Surgeries: A Prospective Randomised Double-Blind Study. Cureus. 2024 Nov 14;16(11): e73672. Doi: 10.7759/cureus.73672.