

## **Analgesic Efficacy of IV Dexamethasone vs Intrathecal Dexamethasone as an Adjuvant to Spinal Anesthesia in Lower Abdominal Surgeries**

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### **Abstract**

**Background:** Dexamethasone, an adjuvant to spinal anesthesia, has been explored for its potential to prolong sensory block duration. However, the comparative efficacy of intravenous (IV) versus intrathecal administration remains unclear. **Objective:** To compare the analgesic efficacy and duration of sensory block between IV dexamethasone and intrathecal dexamethasone as adjuvants to spinal anesthesia in lower abdominal surgeries. **Patients and Methods:** This interventional clinical trial included 90 patients undergoing lower abdominal surgeries, randomized into two equal groups: Group IT (intrathecal dexamethasone 4 mg + bupivacaine) and Group IV (IV dexamethasone 8 mg + bupivacaine). The primary outcome was the duration of sensory block. Secondary outcomes included time to first rescue analgesia, total rescue analgesia, VAS scores, and incidence of complications. **Results:** The onset of sensory block was marginally faster in Group IV ( $28 \pm 4$  minutes) compared to Group IT ( $29 \pm 3$  minutes) ( $P = 0.046$ ). However, Group IT demonstrated a significantly longer duration of sensory block ( $177 \pm 17$  minutes) versus Group IV ( $120 \pm 16$  minutes) ( $P < 0.001$ ). Group IT also exhibited a longer time to first rescue analgesia ( $340 \pm 27$  minutes vs.  $255 \pm 27$  minutes,  $P < 0.001$ ) and lower VAS scores at 2, 4, and 24 hours postoperatively ( $P < 0.001$ ). **Conclusion:** Intrathecal dexamethasone significantly prolongs the duration of sensory block and analgesia compared to IV dexamethasone when used as an adjuvant to spinal anesthesia in lower abdominal surgeries. Both routes of administration were comparable in terms of safety.

**Keywords:** Dexamethasone; Spinal anesthesia; Sensory block; Analgesia; Lower abdominal surgery.

### **Introduction**

The growing preference for neuraxial anesthesia, particularly for infra-umbilical and lower abdominal surgeries, is due to its numerous advantages over general anesthesia. It offers greater safety, reliability, and fewer side effects, which consequently reduces hospital stay duration<sup>[1]</sup>.

As the significance of postoperative pain management becomes increasingly recognized for its impact on patient outcomes, the use of techniques that effectively lower pain scores had gained importance<sup>[2, 3]</sup>. This approach reduces the need for rescue analgesics and extends the interval before the first postoperative dose is necessary<sup>[4]</sup>.

In light of this, and the development of neuraxial anesthesia, extensive research has been conducted on various neuraxial adjuvants to prolong the time before rescue analgesics are required, in comparison to local anesthesia alone. These adjuvants include epinephrine, alpha-2 agonists (such as clonidine and dexmedetomidine), anesthetics (such as ketamine and midazolam), and newer, experimental options like butyl-amino-benzoate, charged molecules, adenosine, liposomal preparations, microspheres, and cyclodextrin systems<sup>[5, 6]</sup>.

A frequently used and accessible adjuvant, dexamethasone, presents a question regarding its mechanism of action. Does it function locally when injected intrathecally, or does it exert systemic effects upon absorption, similar to intravenous (IV) administration?<sup>[7]</sup>

Previous studies have compared various doses of intrathecal dexamethasone as an adjuvant to heavy bupivacaine, noting an extension in sensory block duration and delayed need for first rescue analgesia<sup>[8, 9]</sup>.

We propose that IV dexamethasone as an adjuvant in spinal anesthesia might provide analgesic effects comparable to the intrathecal route. Hence, this study aimed to compare the analgesic efficacy of IV dexamethasone versus intrathecal dexamethasone when used as an adjuvant to spinal anesthesia in lower abdominal surgeries.

### **Patients and Methods**

#### **Study Design and Participants:**

This interventional clinical trial was conducted over 10 months, involving 90 patients scheduled for lower abdominal surgeries at Benha University Hospital. Patients were randomized into two groups: 45 patients receiving intrathecal dexamethasone (Group IT) and 45 receiving IV dexamethasone (Group IV).

The study was done after being accepted by the Research Ethics Committee, Benha University. All patients provided written informed consents prior to their enrolment. The consent form explicitly outlined their agreement to participate in the study and for the publication of data, ensuring protection of their confidentiality and privacy. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

#### **Inclusion and Exclusion Criteria:**

Inclusion criteria were adults aged 18-60 years with BMI 20-29.9 kg/m<sup>2</sup>, non-smokers, with no history of bleeding tendency. Exclusion criteria included refusal to participate, contraindications to spinal anesthesia or corticosteroids, steroid use within one week before surgery, chronic pain or daily analgesic use, and psychiatric illness affecting communication or VAS score use.

**Randomization and Blinding:**

Patients were randomized using a computer-based random number generator. Allocation was concealed in sealed, opaque envelopes, ensuring double blinding (participant and care provider). Medications were prepared and administered by an independent anesthesiologist.

**Interventions:**

**Group IT:** Intrathecal dexamethasone 4 mg (1 ml) + heavy bupivacaine (4 ml), IV placebo (2 ml 0.9% saline). **Group IV:** Intrathecal placebo (1 ml 0.9% saline) + heavy bupivacaine (4 ml), IV dexamethasone 8 mg (2 ml).

**Anesthesia and Monitoring:**

Standard monitoring (non-invasive blood pressure, ECG, pulse oximetry) was applied. Each patient received 10 ml/kg IV 0.9% saline as preload. Spinal anesthesia was administered at L4-L5 or L5-S1 using a 25G pencil-point spinal needle. Sensory block level was assessed every 30 seconds for 20 minutes, then evaluated until 4 dermatome regression or end of surgery.

**Outcomes and Assessments:**

Primary outcome was the duration of sensory block. Secondary outcomes included time to first rescue analgesia, total rescue analgesia, and incidence of complications. Sensory block was assessed using loss of sensation to pinprick, and motor block using the Modified Bromage Scale (MBS) 1-6. VAS scores for pain were recorded postoperatively at specific intervals [10].

**Data Management:**

Data management and statistical analysis were conducted using SPSS version 28 (IBM, Armonk, New York, USA). The Shapiro-Wilk test and visual assessment methods were employed to evaluate the normality of quantitative data. Based on the normality results, quantitative data were summarized as means and standard deviations or as medians and ranges. Categorical data were presented as frequencies and percentages. For comparisons between groups, the independent t-test was used for normally distributed quantitative variables, while the Mann-Whitney U test was applied for non-normally distributed variables. Categorical variables were compared using the Chi-square test or Fisher's exact test. Multivariate linear regression analyses were performed to predict various outcomes, and regression coefficients with 95% confidence intervals were calculated. All statistical tests were two-sided, and a P-value of less than 0.05 was considered statistically significant.

**Results**

The studied groups were comparable in terms of age (P = 0.444), gender (P = 0.673), BMI (P = 0.258), comorbidities (P = 0.057), and ASA classification (P = 0.057). The onset of sensory block was slightly faster in Group IV (28 ± 4 minutes) compared to Group IT (29 ± 3 minutes), reaching statistical significance (P = 0.046). The duration of the sensory block was significantly longer in Group IT (177 ± 17 minutes) compared to Group IV (120 ± 16 minutes) (P < 0.001). Additionally, surgeries lasted longer in Group IT, averaging 96 ± 25 minutes, compared to 84 ± 25 minutes in Group IV (P = 0.032). **Table 1**

**Table (1)** Demographic characteristics, onset and type and duration of sensory block, and type of surgery of the studied groups

		Group IV (n = 45)	Group IT (n = 45)	P-value
<b>Age (years)</b>	Mean ±SD	36 ±10	37 ±8	0.444
<b>Gender</b>				
Males	n (%)	23 (51.1)	25 (55.6)	0.673
Females	n (%)	22 (48.9)	20 (44.4)	
<b>BMI</b>		26.5 ±1.5	26.1 ±1.8	0.258
<b>Comorbidity</b>	n (%)	8 (17.8)	16 (35.6)	0.057
<b>ASA</b>				
ASA I	n (%)	37 (82.2)	29 (64.4)	0.057
ASA II	n (%)	8 (17.8)	16 (35.6)	
<b>Onset of sensory block (min)</b>	Mean ±SD	28 ±4	29 ±3	0.046*
Duration of sensory block (min)	Mean ±SD	120 ±16	177 ±17	<0.001*
Surgery duration (min)	Mean ±SD	84 ±25	96 ±25	0.032*
<b>Type of surgery</b>				
Appendectomy	n (%)	10 (22.2)	6 (13.3)	0.578
Fracture penis	n (%)	0 (0)	1 (2.2)	
Hernia repair	n (%)	20 (44.4)	25 (55.6)	
Hydrocelectomy	n (%)	3 (6.7)	1 (2.2)	
Radical prostatectomy	n (%)	0 (0)	2 (4.4)	
TAH	n (%)	5 (11.1)	3 (6.7)	
Testicular torsion	n (%)	2 (4.4)	1 (2.2)	
Uterine myomectomy	n (%)	3 (6.7)	2 (4.4)	
Varicocelectomy	n (%)	2 (4.4)	4 (8.9)	

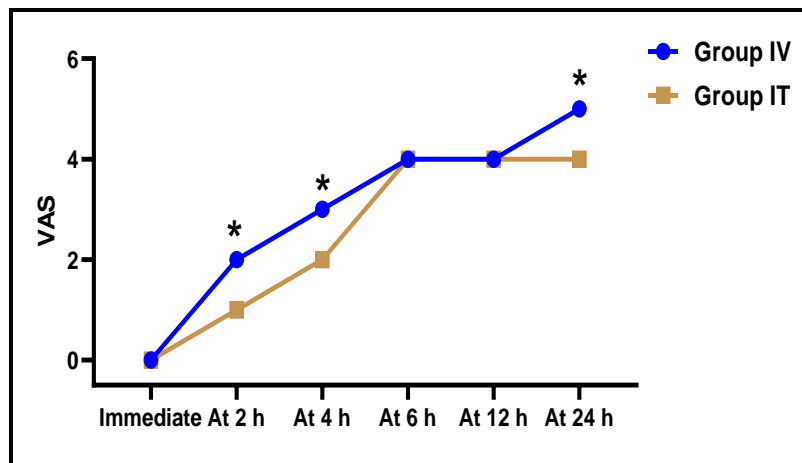
SD: Standard deviation; IV: Intravenous group; IT: Intrathecal group; BMI: Body mass index; ASA: American Society of Anesthesiologists.

**VAS score**

In the study, postoperative VAS scores for pain were assessed at multiple time points between Group IV and Group IT. Immediately post-operation, the median VAS scores were similar, with Group IV at 0 (range 0-1) and Group IT at 0 (range 0-0) ( $P = 0.155$ ). At 6- and 12-hours post-operation, both groups had median VAS scores of 4, showing no significant difference ( $P = 0.366$  and  $P = 0.432$ , respectively). However, at 2 hours, Group IV had a higher median VAS score of 2 (range 1-3) compared to Group IT's 1 (range 0-2) ( $P < 0.001$ ). At 4 hours, Group IV reported a median score of 3 (range 2-7), while Group IT had a median of 2 (range 0-5) ( $P < 0.001$ ). At 24 hours, Group IV's median VAS score was 5 (range 3-8) compared to Group IT's 4 (range 2-6) ( $P < 0.001$ ).

**Figure 1**

Table

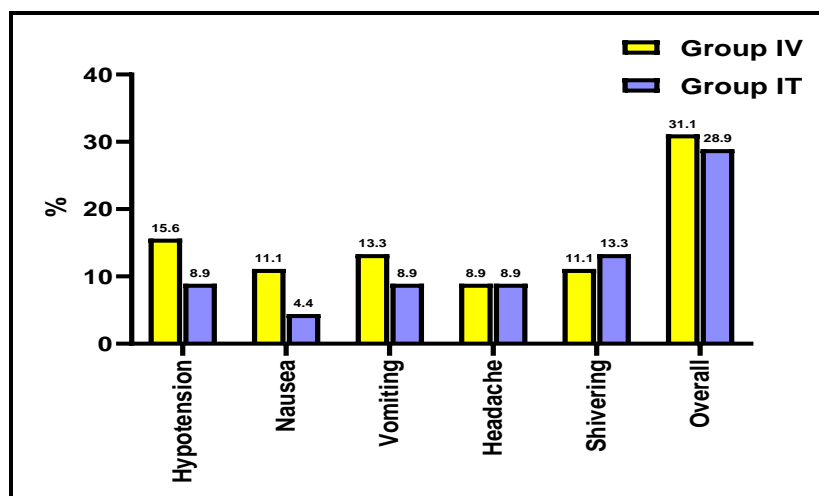


**Fig. (1)** VAS score in the studied groups at different follow-up times.

**Table (1)** Time to 1st rescue analgesia and total rescue analgesia in the studied groups

		Group IV (n = 45)	Group IT (n = 45)	P-value
<b>Time to 1st rescue analgesia (min)</b>	Mean ±SD	255 ±27	340 ±27	<0.001*
<b>Total rescue analgesia (mg)</b>	Mean ±SD	630 ±202	563 ±126	0.065

\*Significant P-value; SD: Standard deviation; IV: IV: Intra venous group; IT: Intrathecal group.



**Fig. (2)** Frequency of complications in the studied groups.

**Time to 1st rescue analgesia and total rescue analgesia**

The time to first rescue analgesia was significantly longer in Group IT, with a mean time of  $340 \pm 27$  minutes, compared to  $255 \pm 27$  minutes in Group IV ( $P < 0.001$ ). Additionally, the total amount of rescue analgesia administered was higher in the IV Group ( $630 \pm 202$  mg) compared to the IT group ( $563 \pm 126$  mg) but with borderline statistical significance ( $P = 0.065$ ).

**Complications**

No significant differences were reported between the studied groups regarding complications, including hypotension ( $P = 0.334$ ), nausea ( $P = 0.434$ ), vomiting ( $P = 0.502$ ), headache ( $P = 1.0$ ), shivering ( $P = 0.748$ ), and overall complications ( $P = 0.818$ ).

**Figure 2**

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**Table (3)** Multivariate linear regression analysis to predict duration of sensory block

	<b>B (95% CI)</b>	<b>P-value</b>
<b>Age (years)</b>	-0.373 (-0.919 - 0.173)	0.178
<b>Gender</b>	-0.997 (-7.982 - 5.989)	0.777
<b>BMI</b>	0.081 (-2.048 - 2.211)	0.94
<b>Comorbidity</b>	-5.368 (-15.269 - 4.532)	0.284
<b>Surgery duration (min)</b>	0.133 (-0.026 - 0.291)	0.099
<b>IT dexamethasone</b>	57.626 (50.31 - 64.942)	<b>&lt;0.001*</b>

\*Significant P-value; B: Regression coefficient; CI: Confidence Interval; BMI: Body Mass Index; IT: Intrathecal group.

**Table (4)** Multivariate linear regression analysis to predict 24-hour pain score

	<b>B (95% CI)</b>	<b>P-value</b>
<b>Age (years)</b>	0.019 (-0.021 - 0.058)	0.348
<b>Gender</b>	-0.302 (-0.801 - 0.196)	0.231
<b>BMI</b>	0.027 (-0.125 - 0.179)	0.721
<b>Comorbidity</b>	0.11 (-0.597 - 0.817)	0.757
<b>Surgery duration (min)</b>	-0.015 (-0.026 - -0.004)	0.009
<b>IT dexamethasone</b>	-0.942 (-1.465 - -0.419)	<b>&lt;0.001*</b>

\*Significant P-value; B: Regression coefficient; CI: Confidence Interval; BMI: Body Mass Index; IT: Intrathecal group.

**Table (5)** Multivariate linear regression analysis to predict time to 1st rescue analgesia

	<b>B (95% CI)</b>	<b>P-value</b>
<b>Age (years)</b>	-0.907 (-1.801 - -0.013)	0.047
<b>Gender</b>	-0.403 (-11.834 - 11.029)	0.944
<b>BMI</b>	-0.294 (-3.778 - 3.19)	0.867
<b>Comorbidity</b>	9.513 (-6.688 - 25.714)	0.246
<b>Surgery duration (min)</b>	0.146 (-0.113 - 0.405)	0.266
<b>IT dexamethasone</b>	82.998 (71.026 - 94.97)	<b>&lt;0.001*</b>

\*Significant P-value; B: Regression coefficient; CI: Confidence Interval; BMI: Body Mass Index; IT: Intrathecal group.

### Prediction of duration of sensory block

Multivariate linear regression analysis was done to predict the duration of the sensory block. The model revealed that using intrathecal dexamethasone was significantly associated with increased duration of sensory block by about 58 minutes (B = 57.626, 95% CI = 50.31 – 64.942, P < 0.001), controlling for age, gender, BMI, comorbidity, and surgery duration. **Table3.**

### Prediction of the duration of 24-hour pain score

Multivariate linear regression analysis was done to predict the 24-hour pain score. The model revealed that using intrathecal dexamethasone was significantly associated with a decline in the 24-hour pain score by about 1 degree (B = -10.942, 95% CI = -1.465 - -0.419, P < 0.001), controlling for age, gender, BMI, comorbidity, and surgery duration. **Table 4**

### Prediction of the duration of time to 1<sup>st</sup> rescue analgesia

Multivariate linear regression analysis was done to predict the time to 1st rescue analgesia. The model revealed that using intrathecal dexamethasone was significantly associated with increased time to 1st rescue analgesia by 82.998 minutes (B = 82.998, 95% CI = 71.026 – 94.97, P < 0.001), controlling for age,

gender, BMI, comorbidity, and surgery duration. **Table5.**

### Discussion

Up to our knowledge, this study is among the first to directly compare the analgesic efficacy of intrathecal versus intravenous dexamethasone as adjuvants to spinal anesthesia in lower abdominal surgeries.

The demographic data of the studied groups were comparable in terms of age, gender, BMI, comorbidities, and ASA classification. **Abd Ellal et al.** conducted a randomized study comparing intrathecal versus IV dexamethasone on spinal anesthesia quality in lower limb orthopedic surgeries, finding no significant demographic differences among the groups <sup>[11]</sup>. Similarly, **Hassan et al.** evaluated the efficacy of intrathecal dexmedetomidine versus dexamethasone in prolonging spinal anesthesia, noting comparable baseline characteristics among their groups <sup>[12]</sup>. **Kaur et al.** also found no significant demographic differences in their study on intrathecal dexamethasone with fentanyl and normal saline as adjuvants to hyperbaric bupivacaine in lower limb surgeries <sup>[13]</sup>.

According to our findings, the onset of sensory block was slightly faster in the IV group, averaging 28 ± 4 minutes compared to 29 ± 3 minutes in the IT

group, with statistical significance. Notably, the duration of the sensory block differed substantially; the IV group had a shorter duration of  $120 \pm 16$  minutes, while the IT group experienced a significantly longer duration of  $177 \pm 17$  minutes. In line with our results, **Abd Ellal et al.** found that intrathecal dexamethasone significantly prolongs the sensory block duration compared to IV administration, reporting durations of  $191.43 \pm 25.94$  minutes for the IT group and  $110.67 \pm 11.14$  minutes for the IV group<sup>[11]</sup>. Similarly, **Kaur et al.** demonstrated that intrathecal dexamethasone significantly extended the sensory block duration to  $311.43 \pm 13.59$  minutes compared to IV administration<sup>[13]</sup>.

Supporting our findings, **El-Shourbagy et al.** showed that adding dexamethasone to bupivacaine for spinal anesthesia in cesarean sections significantly prolonged sensory block duration to  $122.4 \pm 7.9$  minutes compared to  $91.8 \pm 10.8$  minutes in the control group<sup>[14]</sup>. **Bani-Hashem et al.** also found that intrathecal dexamethasone significantly extends sensory block duration, reporting  $119 \pm 10.69$  minutes compared to  $89.44 \pm 8.37$  minutes in the control group<sup>[9]</sup>. **Hassan et al.** observed a sensory block duration of  $199.75 \pm 18.22$  minutes with dexamethasone versus  $149.55 \pm 10.83$  minutes for the control group<sup>[12]</sup>. **Movafegh et al.** demonstrated that intrathecal dexamethasone significantly prolonged sensory block in orthopedic surgeries<sup>[15]</sup>. Conversely, **Manohar et al.** reported that IV dexamethasone did not significantly extend sensory block duration in lower-segment cesarean sections, highlighting the importance of the administration route in our study's focus on lower abdominal surgeries<sup>[16]</sup>.

Regarding our findings, a statistically significant difference was found in the duration of surgery, with Group IT experiencing longer surgeries, averaging  $96 \pm 25$  minutes compared to  $84 \pm 25$  minutes in Group IV.

In contrast, **Abd Ellal et al.** reported that the duration of surgery was insignificantly different between the studied groups. This discrepancy could be attributed to differences in patient populations, sample size, surgical procedures, or study methodologies<sup>[11]</sup>. This was also reported in **Hassan et al.'s** study<sup>[12]</sup>.

In terms of the pain assessment, supporting our results, **Abd Ellal et al.** found that the VAS scores for pain were lower in the intrathecal group at multiple postoperative time points with significant differences were noted in VAS scores at 1, 3, and 6 hours postoperatively, with lower pain levels in the intrathecal group compared to the IV group<sup>[11]</sup>.

Conforming our results, **El-Shourbagy et al.** reported that the VAS scores for pain were significantly lower in the intrathecal dexamethasone group compared to the control group at various postoperative time points. Specifically, they found lower VAS scores at 30, 60, and 120 minutes post-operation in the dexamethasone group ( $1.4 \pm 0.5$ ,  $1.9 \pm 0.6$ , and  $2.5 \pm 0.7$ , respectively) compared to the

control group ( $1.1 \pm 0.6$ ,  $1.4 \pm 0.5$ , and  $1.9 \pm 0.6$ , respectively), with all differences being statistically significant<sup>[14]</sup>.

In the present study, the time to first rescue analgesia was significantly longer in Group IT, averaging  $340 \pm 27$  minutes compared to  $255 \pm 27$  minutes in Group IV. Additionally, the total amount of rescue analgesia administered was higher in Group IV ( $630 \pm 202$  mg) compared to Group IT ( $563 \pm 126$  mg), though with borderline statistical significance. Similarly, **Abd Ellal et al.** found that the control group required more analgesia than the intrathecal group, supporting our observation of lower analgesic requirements in the intrathecal group<sup>[11]</sup>.

**Hassan et al.** also found that the time to first analgesic request was significantly longer in the intrathecal dexamethasone group ( $178.4 \pm 19.26$  minutes) compared to the control group ( $125.0 \pm 17.47$  minutes)<sup>[12]</sup>. **Kaur et al.** reported a significantly longer duration of postoperative analgesia in the intrathecal dexamethasone group ( $400 \pm 29.13$  minutes) compared to the control group and the fentanyl group, with no patients in the intrathecal group requiring analgesia within the first four hours postoperatively<sup>[13]</sup>. **El-Shourbagy et al.** also observed a significant extension of the pain-free period, with the dexamethasone group experiencing  $434.3 \pm 43.8$  minutes of analgesia versus  $215.3 \pm 40.3$  minutes in the control group ( $P < 0.001$ )<sup>[14]</sup>. Consistently, **Bani-Hashem et al.** reported a significantly longer duration of analgesia in the dexamethasone group ( $401.92 \pm 72.44$  minutes) compared to the control group ( $202.24 \pm 43.67$  minutes)<sup>[9]</sup>. However, **Manohar et al.** found no significant difference in the duration of postoperative analgesia between groups<sup>[16]</sup>.

Regarding complications, no significant differences were reported between the studied groups regarding complications, including hypotension, nausea, vomiting, headache, shivering, and overall complications.

Interestingly, **Abd Ellal et al.** observed a significant difference in intraoperative complications, with fewer complications in both the IV and intrathecal dexamethasone groups compared to the control group. However, no significant differences were observed between both IV and intrathecal dexamethasone groups<sup>[11]</sup>.

Also, **Kaur et al.** noted minimal side effects and stable hemodynamic profiles with the use of intrathecal dexamethasone, indicating its safety as an adjuvant to spinal anesthesia. They reported only two instances of hypotension in the intrathecal dexamethasone group<sup>[13]</sup>.

Further, **El-Shourbagy et al.** found no significant differences in the incidence of hypotension, bradycardia, nausea, vomiting, and other adverse effects, indicating that adding intrathecal dexamethasone does not increase the risk of complications<sup>[14]</sup>.

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In addition, **Bani-hashem *et al.*** found no significant differences between the groups in terms of nausea, vomiting, hypotension, bradycardia, or shivering [9]. Furthermore, **Hassan *et al.*** observed no significant differences in the incidence of hypotension, bradycardia, or other adverse events between the groups [12].

### Conclusions

Intrathecal dexamethasone significantly prolongs the duration of sensory block and reduces postoperative pain compared to intravenous dexamethasone when used as an adjuvant to spinal anesthesia in lower abdominal surgeries. Intrathecal dexamethasone also extends the time to first rescue analgesia, indicating a more prolonged analgesic effect. Both routes of administration are safe, with no significant differences in complications.

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### References

- [1] D. Verma, U. Naithani, C. Gokula, Harsha. Spinal anesthesia in infants and children: A one year prospective audit. *Anesth Essays Res*;8:324-9. 2014
- [2] V. Garimella, C. Cellini. Postoperative pain control. *Clin Colon Rectal Surg*;26:191-6. 2013
- [3] J. Luo, S. Min. Postoperative pain management in the postanesthesia care unit: an update. *J Pain Res*;10:2687-98. 2017
- [4] F. Puntillo, M. Giglio, G. Varrassi. The Routes of Administration for Acute Postoperative Pain Medication. *Pain Ther*;10:909-25. 2021
- [5] A. Swain, D. Nag, S. Sahu, D. Samaddar. Adjuvants to local anesthetics: Current understanding and future trends. *World J Clin Cases*;5:307-23. 2017
- [6] J. Giovannitti, S. Thoms, J. Crawford. Alpha-2 adrenergic receptor agonists: a review of current clinical applications. *Anesth Prog*;62:31-9. 2015
- [7] K. An, N. Elkassabany, J. Liu. Dexamethasone as adjuvant to bupivacaine prolongs the duration of thermal antinociception and prevents bupivacaine-induced rebound hyperalgesia via regional mechanism in a mouse sciatic nerve block model. *PLoS One*;10:e0123459. 2015
- [8] S. Iyengar, A. Pangothra, K. Abhishek, N. Sinha, N.S. Rao, V.K. Singh, et al. The Comparison of Dexmedetomidine to Dexamethasone as Adjuvants to Bupivacaine in Ultrasound-Guided Infraclavicular Brachial Plexus Block in Upper Limb Surgeries. *Cureus*;15:e41668. 2023
- [9] N. Bani-Hashem, B. Hassan-Nasab, E. Pour, P.A. Maleh, A. Nabavi, A. Jabbari. Addition of intrathecal Dexamethasone to Bupivacaine for spinal anesthesia in orthopedic surgery. *Saudi J Anaesth*;5:382-6. 2011
- [10] M. Qu, J. Zhao, Y. Zhang, Z. Xu, C. Ma, H. Cui. Utilizing the visual analogue scale (VAS) to monitor and manage pain in post-operative skin wounds after thoracic surgery. *Int Wound J*;21:e14503. 2023
- [11] Abd Ellal, B. Ahmed, Z.M. Attia, A.A. Aly, A. Mosallem. Effect of Intrathecal versus Intravenous Dexamethasone on Quality of Spinal Anesthesia in Lower Limb Orthopedic Surgery. *Zagazig University Medical Journal*;30:105-14. 2024
- [12] A. Hassan, A. Abd-Allah Al-Kumity, A. El-Deen Mahmoud Sayed Ahmed, I. Abd El-Latif Shabaiek. Clinical comparative study between intrathecal dexmedetomidine and dexamethasone on prolonging the duration of intrathecal blockade in lower limb orthopedic surgery. *Al-Azhar Medical Journal*;50:1467-78. 2021
- [13] H. Kaur, R. Misra, S. Mittal, G. Sidhu. Prospective Randomized Control Trial Comparing Effect of Dexamethasone Versus Fentanyl as Adjuvants to Intrathecal Bupivacaine for Orthopedic Surgery. *Cureus*;13:e13949. 2021
- [14] M.A. El-Shourbagy, A.M. Mammdouh, M.E. Shawky, H.A. Mohamed. Addition of intrathecal dexamethasone to bupivacaine for spinal anesthesia in cesarean section. *Evidence Based Women's Health Journal*;9:416-24. 2019
- [15] A. Movafegh, M. Ghafari. A comparison of the sensory and motor blockade duration of intrathecal lidocaine 5% plus epinephrine and lidocaine 5% plus dexamethasone. *Int J pharmacol*;1:346-9. 2005
- [16] M. Manohar, S. Singhal, N. Goyal. Evaluation of the Effect of Intravenous Dexamethasone on the Duration of Spinal Anaesthesia in Parturients Undergoing Lower Segment Caesarean Section. *Cureus*;15:e37549. 2023