Al-Rafidain J Med Sci. 2025;9(2):16-21.
DOI: https://doi.org/10.54133/ajms.v9i2.2350

AJMS

Online ISSN (2789-3219)

Research Article

Dexamethasone versus Fentanyl as Adjuvants to Intrathecal Bupivacaine Anesthesia in Cesarean Section: Impacts on Analgesia Duration and Postoperative Outcomes

Mojgan Rahimi[1], Hayder Abbas Salman[2], Afzal Shamsi[2], Mohammed Jawad Kadhum[3], Elham Shahidi Delshad[2]*
[1]*Department of Anesthesiology and Intensive Care, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran;* [2]*Department of Anesthesia, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran;* [3]*Department of Anesthesiology, Al Hilla General Teaching Hospital, Babylon, Iraq*
Received: 10 July 2025; Revised: 19 August 2025; Accepted: 26 August 2025

Abstract

Background: Effective postoperative analgesia after cesarean section is essential to facilitate early maternal recovery and reduce opioid-related side effects. Although fentanyl is commonly used as an intrathecal adjuvant to bupivacaine, concerns about adverse effects such as pruritus and nausea have prompted exploration of alternatives like dexamethasone. ***Objective***: To compare the efficacy and safety of intrathecal dexamethasone versus fentanyl as adjuvants to 0.5% bupivacaine in spinal anesthesia for cesarean section. ***Methods***: In this quasi-randomized clinical study, 70 women undergoing elective cesarean section were allocated to receive spinal anesthesia with bupivacaine plus either fentanyl (10–25µg; Group F) or dexamethasone (2–4mg; Group D). Hemodynamic parameters, duration of postoperative analgesia, incidence of side effects, ambulation time, and patient satisfaction were assessed using validated instruments. ***Results***: Group D demonstrated significantly longer analgesia duration (median 5.0 h [IQR 4.0–6.0]) compared to Group F (3.0 h [IQR 2.0–4.0], $p<0.001$). Post-spinal systolic blood pressure and heart rate were significantly higher in the dexamethasone group but remained within physiological limits. Adverse events such as pruritus and postoperative nausea/vomiting were significantly more frequent in Group F, while back pain was reported only in Group D (20%, $p=0.011$). Patient satisfaction was higher in group F ($p<0.001$), potentially due to earlier ambulation. ***Conclusions***: Intrathecal dexamethasone is a safe and effective adjuvant to bupivacaine in cesarean section spinal anesthesia, offering prolonged analgesia and fewer opioid-related side effects compared to fentanyl. Further randomized trials with longer follow-up and neonatal outcomes are warranted.

Keywords: Analgesia, Bupivacaine, Cesarean section, Dexamethasone, Fentanyl.

ديكساميثازون مقابل الفنتانيل كمواد مساعدة للتخدير البوبيفاكائين داخل القراب في الولادة القيصرية: التأثيرات على مدة التسكين ونتائج ما بعد الجراحة

الخلاصة

الخلفية: التسكين الفعال بعد جراحة الولادة القيصرية ضروري لتسهيل الشفاء المبكر للأمهات وتقليل الآثار الجانبية المرتبطة بالمواد الأفيونية. على الرغم من أن الفنتانيل يستخدم بشكل شائع كعامل مساعد داخل القراب للبوبيفاكايين، إلا أن المخاوف بشأن الآثار الضارة مثل الحكة والغثيان دفعت إلى استكشاف بدائل مثل ديكساميثازون. **الهدف**: مقارنة فعالية ومأمونية ديكساميثازون داخل القراب مقابل الفنتانيل كمواد مساعدة مع 0.5٪ بوبيفاكائين في التخدير النخاعي للولادة القيصرية. **الطرائق**: في هذه الدراسة السريرية شبه العشوائية، تم تخصيص 70 امرأة خضعين لعملية قيصرية اختيارية لتلقي التخدير النخاعي مع بوبيفاكائين بالإضافة إلى الفنتانيل (10-25 ميكروغرام ؛ المجموعة F) أو ديكساميثازون (2-4 ملغ; المجموعة د). تم تقييم المعلمات الديناميكية الدموية، ومدة التسكين بعد الجراحة، وحدوث الآثار الجانبية، ووقت التنزه، ورضا المريض باستخدام أدوات تم التحقق من صحتها. **النتائج**: أظهرت المجموعة D مدة تسكين أطول بشكل ملحوظ (متوسط 5.0 ساعة [IQR 4.0-6.0]) مقارنة بالمجموعة F (3.0 ساعات [IQR 2.0-4.0] ، ص <0.001). كان ضغط الدم الانقباضي بعد العمود الفقري ومعدل ضربات القلب أعلى بشكل ملحوظ في مجموعة الديكساميثازون ولكنهما ظلوا ضمن الحدود الفسيولوجية. كانت الأحداث الضائرة مثل الحكة والغثيان/القيء بعد الجراحة أكثر تواترا بشكل ملحوظ في المجموعة واو، بينما تم الإبلاغ عن آلام الظهر فقط في المجموعة D (20٪، قيمة الاحتمال = 0.011). كان رضا المرضى أعلى في المجموعة F (p<0.001)، ربما بسبب التجوال المبكر. **الاستنتاجات**: ديكساميثازون داخل القراب هو عامل مساعد آمن وفعال للبوبيفاكائين في التخدير النخاعي القيصري، مما يوفر تسكين طويل الأمد وآثارا جانبية أقل مرتبطة بالمواد الأفيونية مقارنة بالفنتانيل. هناك ما يبرر إجراء المزيد من التجارب المعشاة ذات المتابعة الأطول والحصائل الوليدية.

* ***Corresponding author***: Elham S. Delshad, Department of Anesthesia, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran; Email: eshahididelshad@tums.ac.ir
Article citation: Rahimi M, Salman HA, Shamsi A, Kadhum MJ, Delshad ES. Dexamethasone versus Fentanyl as Adjuvants to Intrathecal Bupivacaine Anesthesia in Cesarean Section: Impacts on Analgesia Duration and Postoperative Outcomes. *Al-Rafidain J Med Sci*. 2025;9(2):16-21. doi: https://doi.org/10.54133/ajms.v9i2.2350

INTRODUCTION

Cesarean section remains a highly prevalent surgical procedure worldwide, emphasizing the need for efficient postoperative pain management to support early maternal mobilization and neonatal care [1]. Optimal analgesia not only enhances patient comfort but also facilitates breastfeeding and reduces stress-related hormonal activation [2]. Intrathecal adjuvants added to 0.5% bupivacaine spinal anesthesia are increasingly used to extend analgesic duration while maintaining

safety profile yet choosing the most effective and least harmful additive remains a critical clinical decision [3]. Traditionally, local anesthetics such as bupivacaine have been employed for this purpose, often in combination with opioids like fentanyl to prolong analgesic effects. Recent studies have demonstrated that the addition of fentanyl to bupivacaine can significantly extend the duration of postoperative analgesia, with findings indicating that the combination can lead to a mean duration of analgesia of approximately 360 minutes compared to 220 minutes with bupivacaine alone [4]. However, the use of opioids is not without drawbacks, including potential side effects such as respiratory depression and increased sedation, which necessitate the exploration of alternative adjuncts to enhance analgesia without these adverse effects [5]. Dexamethasone, a corticosteroid, has emerged as a promising alternative adjunct to local anesthetics [6]. Its anti-inflammatory properties may contribute to prolonged analgesia when combined with bupivacaine [7]. Studies have shown that the addition of dexamethasone can significantly increase the duration of analgesia in various surgical settings, including cesarean sections. For instance, one study reported a mean duration of analgesia of 466 minutes with bupivacaine plus dexamethasone, compared to 268 minutes with bupivacaine alone [8]. This suggests that dexamethasone may provide a viable option for enhancing postoperative pain control while minimizing the reliance on opioids. Although both fentanyl and dexamethasone have shown beneficial effects when combined with bupivacaine, direct head-to-head comparisons (especially in cesarean section) are sparse. Limited trials suggest that dexamethasone may be as effective as fentanyl in prolonging analgesia while mitigating opioid-related side effects in a mixed surgical population [9,10]. Furthermore, adjuvant combinations involving dexmedetomidine, fentanyl, and dexamethasone explored in some cesarean anesthesia studies found dexmedetomidine superior, but dexamethasone and fentanyl similarly outperformed control regimens [11]. However, standardized evaluation in the context of bupivacaine-only spinal anesthesia during elective cesarean delivery remains limited. In summary, while evidence supports the efficacy of both intrathecal fentanyl and dexamethasone in prolonging postoperative analgesia when combined with bupivacaine, there is a notable absence of well-controlled comparative studies in cesarean section settings. The existing literature lacks conclusive data on which adjuvant better optimizes analgesia duration, side-effect profile, and recovery milestones in this specific patient population. Therefore, this study seeks to fill this gap by rigorously comparing 0.5% bupivacaine plus fentanyl versus 0.5% bupivacaine plus dexamethasone in women undergoing elective cesarean section, with a primary focus on the duration of postoperative analgesia and secondary evaluation of hemodynamic stability and recovery-related outcomes.

METHODS

Study design and setting

This study was a quasi-randomized clinical trial conducted at Al-Imam Al-Sadiq Teaching Hospital, Babylon, Iraq, from January 15 to May 15, 2025. Systematic assignment by admission order was implemented: even-numbered participants received bupivacaine with fentanyl (Group F), and odd-numbered participants received bupivacaine with dexamethasone (Group D).

Participants and sample size

Convenience sampling was employed to recruit pregnant adults presenting for elective cesarean section under spinal anesthesia at admission to the operating suite.

Inclusion criteria

Age <45 years at enrollment. Body mass index (BMI) 20.0–29.9 kg/m², measured at admission. Scheduled for elective cesarean section with planned spinal anesthesia. No known hypersensitivity or allergy to bupivacaine, fentanyl, or dexamethasone (study drugs). No obstetric complications, such as preeclampsia or placental abnormalities (e.g., previa, abruption). Ability to provide informed consent and complete study assessments.

Exclusion criteria

Contraindications to spinal anesthesia, including coagulation disorder or infection at the puncture site. Any obstetric complication identified preoperatively (e.g., preeclampsia, placental abnormalities). Known hypersensitivity to bupivacaine, fentanyl, or dexamethasone identified after screening. Incomplete follow-up data or withdrawal from the study after randomization.

Sample size and power

An a priori power analysis indicated that 35 patients per group were required to detect a 20% difference in postoperative analgesia duration with $\alpha = 0.05$ and 80% power. To accommodate potential attrition, we recruited 70 participants in total.

Interventions and outcomes measurement

Written informed consent was obtained from each participant after a thorough explanation of study objectives and procedures. Upon admission, patients received 500 mL of normal saline preload. Under aseptic conditions and local skin infiltration, a 25-gauge spinal needle was introduced at the L3–L4 or L4–L5 interspace until cerebrospinal fluid return was confirmed. According to group allocation, intrathecal injections were administered over 10–15 seconds. Group F

(n = 35) received 10 mg of 0.5% bupivacaine combined with 10–25 µg fentanyl. The intrathecal fentanyl dose range (10–25 µg) was determined based on randomized controlled trials and systematic reviews in cesarean delivery, which reported effective analgesia at 10–25 µg, with 15 µg frequently identified as an optimal compromise between analgesic efficacy and side effects [10,12]. Group D (n = 35) received 10 mg of 0.5% bupivacaine combined with 2–4 mg preservative-free dexamethasone in accordance with recent randomized data indicating that 4 mg prolongs analgesia comparably to 8 mg, alongside reports supporting efficacy at 2 mg in cesarean delivery; prior studies using 8 mg informed the upper boundary of historical practice [13, 14]. To eliminate any confounding effect of injected volume, the total intrathecal volume was standardized to 3.0 mL in both groups. Bupivacaine 0.5% (10 mg; 2.0 mL) was combined with the assigned adjuvant, and preservative-free normal saline was added to reach 3.0 mL. In group F, fentanyl 10–25 µg (drawn from a 0.5 mg/mL preservative-free vial; volume 0.02–0.05 mL) was used; in Group D, preservative-free dexamethasone 2–4 mg (5 mg/mL; volume 0.40–0.80 mL) was used. For accuracy of measurement and improved blinding, fentanyl was pre-diluted 1:10 with preservative-free saline to 50 µg/mL prior to preparation, and the final mixture in each case was made up to 3.0 mL with saline. Intrathecal injections were administered over 10–15 seconds using identical syringes by an anesthesiologist not involved in outcome assessment. The exact dose of intrathecal adjuvant within the specified range (fentanyl 10–25 µg, dexamethasone 2–4 mg) was determined by the attending anesthesiologist based on clinical judgment, considering patient factors such as age, body weight, and expected analgesic requirement. Patients were then positioned supine with a left lateral tilt, and standard monitoring continued throughout surgery and recovery. Systolic and diastolic blood pressure and heart rate were recorded noninvasively using calibrated automated monitors at baseline (pre-spinal), and at 5, 10, 30, and 60 minutes, as well as at 2 and 4 hours after spinal injection. Duration of spinal anesthesia was defined as the time from intrathecal injection until regression of sensory block to the T12 dermatome, as assessed by pinprick testing every 15 minutes in the postoperative recovery room. This was documented by a blinded research nurse. Duration of postoperative analgesia was defined as the interval from completion of intrathecal injection to the patient's first verbal request for additional analgesic, documented by the blinded research nurse. A checklist was used to record the presence or absence of back pain, pruritus, postoperative nausea and vomiting (PONV), and time to independent ambulation. The research staff marked each item immediately upon occurrence. Patient satisfaction was evaluated at 4 hours post–spinal injection by a trained research nurse, who directly asked each participant to rate her satisfaction using a structured checklist based on a 5-point Likert scale (1 = very dissatisfied to 5 = very satisfied) and recorded the responses immediately. This approach has been previously adopted in perioperative anesthesia research using similar Likert-type measures [15].

Ethical Considerations

The study protocol was approved by the Ethical Committee of Tehran University of Medical Sciences (Approval No. IR.TUMS.SPH.REC.1403.302). All participants provided written informed consent. The study conducted adhered to the Declaration of Helsinki.

Statistical analysis

Data analysis was performed in SPSS v26. Normality of continuous variables was assessed using the Shapiro–Wilk test. Between-group comparisons for continuous outcomes employed independent-samples t-tests or Mann–Whitney U tests as appropriate. Repeated measures ANOVA (or Friedman's test) evaluated within-subject changes in hemodynamics over time. Categorical variables, including adverse event rates, were compared using chi-square or Fisher's exact tests. A two-tailed p-value < 0.05 was considered significant.

RESULTS

Seventy participants (35 in each group) completed the trial. The overall mean age was 29.3 ± 5.2 years, and the mean BMI was 26.1 ± 2.8 kg/m², with no significant intergroup differences ($p > 0.05$). Average height was comparable between group D and group F (162.5 ± 5.1 cm *vs*. 159.7 ± 5.1 cm; $p = 0.022$) (Table 1).

Table 1: Demographic Characteristics of (n=70, 35 in each group)

Characteristic	Dexamethasone group	Fentanyl group	*p*-value*
Age (years)	29 (7)	31 (6)	0.323
Height (cm)	162.5 (5.1)	159.7 (5.1)	0.022

Values were expressed as mean±SD. * Independent samples t-test.

Baseline systolic blood pressure (SBP) did not differ significantly between group D and group F (median 131 mmHg [IQR 122–138] vs. 134 mmHg [IQR 128–139]; $p = 0.169$). Post-spinal SBP was consistently higher in group D at 5, 10, 30, and 60 minutes and at 2 and 4 hours (all $p < 0.001$) (Table 2). Both cohorts exhibited significant changes over time (Friedman test $p < 0.001$). Heart rate (HR) trends demonstrated no baseline difference (96 ± 10 bpm *vs*. 99 ± 10 bpm; $p = 0.190$), but group D maintained higher HR values at 10 and 60 minutes and at 2 and 4 hours post-spinal ($p < 0.01$) (Table 3). Within-group HR variations were significant across all time points (Friedman test, $p < 0.001$). The median duration of postoperative analgesia was significantly longer in group D (5.0 hours [IQR 4.0–6.0]) compared to group F (3.0 hours [IQR 2.0–4.0]; $p < 0.001$).

Table 2: Systolic Blood Pressure Trends in Dexamethasone and Fentanyl Groups (n=70, 35 in each group)

Systolic Blood Pressure	Dexamethasone group	Fentanylgroup	*p*-value*
Bassline SBP	131 (122, 138)	134 (128, 139)	0.169
SBP (after 5 min)	124±12	111 ±15	<0.001
SBP (after 10 min)	123±11	99±10	<0.001
SBP (after 30 min)	125±9	110±9	<0.001
SBP (after 60 min)	131 (120, 135)	113 (110, 120)	<0.001
SBP (after 2 hrs)	131 (126, 132)	116 (111, 121)	<0.001
SBP (after 4 hrs)	126 (122, 130)	116 (112, 120)	<0.001
p-value**	<0.001	<0.001	

Values were expressed as mean±SD, and median (Q1, Q3). *Independent samples T test; Mann-Whitney test. ** Friedman's test.

Table 3: Heart rate trends in dexamethasone and fentanyl groups (n=70; 35 in each group)

Variable	Dexamethasone group	Fentanyl group	*p*-value*
Bassline HR	96±10	99±10	0.190
HR (after 5 min.)	90±8	88±11	0.226
HR (after 10 min.)	90 (80, 91)	77 (70, 82)	<0.001
HR (after 30 min.)	83 (74, 88)	83 (78, 85)	0.805
HR (after 60 min.)	80±8	85±9	0.006
HR (after 2 hrs.)	79±7	86±7	<0.001
HR (after 4 hrs.)	81±7	87±7	0.002
p-value**	<0.001	<0.001	

Values were expressed as mean±SD and Median (Q1, Q3).* Independent samples t-test; Mann-Whitney test. ** Friedman's test.

There was no difference in surgical duration (58 ± 9 min vs. 61 ± 8 min; $p = 0.231$). Ambulation time was delayed in group D (195 min [IQR 185–200]) versus group F (145 min [IQR 115–180]; $p < 0.001$). Adverse events differed markedly: back pain occurred in 20.0% of group D and none in group F ($p = 0.011$); PONV was absent in group D but reported by 17.1% of group F ($p = 0.025$); and pruritus was present only in group F (17.1%; $p = 0.025$) (Table 4). Patient satisfaction scores favored group F (median 2 [IQR 1–3] *vs*. 1 [IQR 0–1]; Mann–Whitney U test, $p < 0.001$).

Table 4: Analgesia duration, recovery metrics, and adverse events between groups (n=70; 35 in each group)

Variable	Dexamethasone group	Fentanyl group	*p*-value*
Duration of spinal block (min)	166±14	144±16	<0.001
Surgery time (min)	58±9	61±8	0.231
Analgesia time (hr)	5.0 (4.0, 6.0)	3.0 (2.0, 4.0)	<0.001
Back pain			
No	28(80)	35(100)	0.011
Yes	7(20)	0(0.0)	
PONV			
N+V	0(0.0)	6(17.1)	0.025
No	35(100)	29(82.9)	
Ambulation time (min)	195 (185, 200)	145 (115, 180)	<0.001
Pruritus			
No	35(100)	29(82.9)	0.025
Yes	0(0.0)	6(17.1)	
Patients' satisfaction	2.0 (1.0, 3.0)	1.0 (0.0, 1.0)	<0.001

Values were expressed as mean±SD, median (Q1, Q3), and n (%).* Independent samples t-test, Mann-Whitney test, and Fisher's exact test.

DISCUSSION

In this study, intrathecal dexamethasone produced a notably longer duration of sensory and motor blockade and postoperative analgesia than fentanyl when added to 0.5% bupivacaine for cesarean section. For example, previous cesarean studies report that adding 8–10 mg intrathecal dexamethasone extended analgesia to ~430–473 min *vs*. ~200 min without dexamethasone [16,17]. By contrast, intrathecal fentanyl (25–50 µg) typically adds only about 60–90 minutes of analgesia [10]. Consistent with these data, we observed that the dexamethasone group had a significantly longer pain-free interval than the fentanyl group. Both groups maintained stable hemodynamics, though dexamethasone is reported to mitigate spinal anesthesia–induced hypotension [13]. Indeed, meta-analytic evidence shows fewer episodes of hypotension, nausea, and vomiting with intrathecal dexamethasone [13]. whereas fentanyl does not alter blood pressure but is well known to cause pruritus (RR ~5.9) [10]. In this study, pruritus occurred only in the fentanyl group, while neither group had respiratory depression. The prolonged effect of dexamethasone likely reflects its anti-inflammatory action and suppression of C-fiber nociception [18], whereas fentanyl's lipophilic µ-agonist effect has a rapid onset but shorter duration [19]. The findings of this study align with several high-quality trials in obstetric anesthesia. Multiple randomized studies have demonstrated that adding intrathecal dexamethasone to bupivacaine in cesarean sections

significantly prolongs analgesia duration without increasing adverse events [16,17]. This is consistent with the prolonged pain-free interval observed in our dexamethasone group. By contrast, while intrathecal fentanyl is known to improve intraoperative comfort and delay analgesic demand by roughly 60–90 minutes, it is frequently associated with pruritus and PONV [20]. These adverse effects were also evident in the fentanyl group, underscoring dexamethasone's more favorable safety profile.

Study limitations

This study, however, has limitations. Quasi- rather than blinded randomized allocation may have introduced selection bias. The lack of an opioid-free control arm, single-center setting, short follow-up period, and relatively small sample size also restrict the generalizability and depth of our conclusions.

Conclusion

Intrathecal dexamethasone appears to be a safe and effective adjuvant to bupivacaine in spinal anesthesia for cesarean section, providing extended postoperative analgesia and fewer opioid-related side effects compared to fentanyl. However, potential drawbacks such as the limited availability of long-term safety data, possible risks of neurotoxicity with corticosteroid use, and variability in patient response should be considered. Further randomized, multicenter studies with longer follow-up and comprehensive maternal-neonatal outcome assessments are warranted before recommending its routine clinical use.

ACKNOWLEDGMENTS

The authors thank the staff of Al-Imam Al-Sadiq Teaching Hospital, Babylon, Iraq, and the research team at Tehran University of Medical Sciences for their invaluable support in data collection and ethical oversight. We also thank all participants for their cooperation.

Conflict of interests

The authors declared no conflict of interest.

Funding source

The authors did not receive any source of funds.

Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

REFERENCES

1. Pan PH. Post cesarean delivery pain management: multimodal approach. *Int J Obstet Anesthesia*. 2006;15(3):185-188. doi: 10.1016/j.ijoa.2006.04.004.
2. Elfaragy MS, Ahmad AR, Elbadry DH. Neonatal pain management: Is there an endocrinal response? Endocr *Metab Immune Disord Drug Targets*. 2025. doi: 10.2174/0118715303325556241127080237.
3. Nasr IA, Elokda SA. Safety and efficacy of intrathecal adjuvants for cesarean section: bupivacaine, sufentanil, or dexmedetomidine. *Ain Shams J Anesthesiol*. 2015;8(3).
4. Cooper DW, Turner G. Patient-controlled extradural analgesia to compare bupivacaine, fentanyl and bupivacaine with fentanyl in the treatment of postoperative pain. *Br J Anaesth*. 1993;70(5):503-507. doi: 10.1093/bja/70.5.503.
5. Paul AK, Smith CM, Rahmatullah M, Nissapatorn V, Wilairatana P, Spetea M, et al. Opioid analgesia and opioid-induced adverse effects: A review. *Pharmaceuticals (Basel)*. 2021;14(11):1091. doi: 10.3390/ph14111091.
6. Desai N, Kirkham KR, Albrecht E. Local anaesthetic adjuncts for peripheral regional anaesthesia: a narrative review. *Anaesthesia*. 2021;76 Suppl 1:100-109. doi: 10.1111/anae.15245.
7. Abebe M, Alemu B, Teku G, Eshetu O, Wale E, Besha A, et al. Effectiveness of single intravenous dexamethasone in prolongation of spinal anesthesia for postoperative analgesia in elective cesarean section: A systematic review of randomized controlled trials. *J Pain Res*. 2024;17:1361-1368. doi: 10.2147/JPR.S451595.
8. Jagdale S, Kakade AS, Wagh G: Comparison of the efficacy of bupivacaine versus bupivacaine plus dexamethasone during surgical TAP block for post operative analgesia after caesarean section. *Indian J Obstet Gynecol Res*. 2019;6(4):492-494. doi: 10.18231/j.ijogr.2019.106.
9. Khafagy HF, Refaat AI, El-Sabae HH, Youssif MA. Efficacy of epidural dexamethasone versus fentanyl on postoperative analgesia. *J Anesth*. 2010;24(4):531-536. doi: 10.1007/s00540-010-0949-7.
10. Uppal V, Retter S, Casey M, Sancheti S, Matheson K, McKeen DM. Efficacy of intrathecal fentanyl for cesarean delivery: A systematic review and meta-analysis of randomized controlled trials with trial sequential analysis. *Anesth Analg*. 2020;130(1):111-125. doi: 10.1213/ANE.0000000000003975.
11. Li Z, Tian M, Zhang CY, Li AZ, Huang AJ, Shi CX, et al. A randomised controlled trial to evaluate the effectiveness of intrathecal bupivacaine combined with different adjuvants (fentanyl, clonidine and dexmedetomidine) in caesarean section. *Drug Res (Stuttg)*. 2015;65(11):581-586. doi: 10.1055/s-0034-1395614.
12. Ali MA, Ismail S, Sohaib M, Aman A. A double-blind randomized control trial to compare the effect of varying doses of intrathecal fentanyl on clinical efficacy and side effects in parturients undergoing cesarean section. *J Anaesthesiol Clin Pharmacol*. 2018;34(2):221-226. doi: 10.4103/joacp.JOACP_271_16.
13. Tantry TP, Shetty V, Deepak A, Murali S, Golitadka MSB, Menon SK, et al. Efficacy and safety of adjuvant intrathecal dexamethasone during spinal anesthesia: A systematic review and meta-analysis. *Saudi J Anaesth*. 2024;18(3):417-428. doi: 10.4103/sja.sja_112_24.
14. Mohamed RT, Hammad RA, Kamar NM, Mohamed MM. Intravenous dexamethasone versus intrathecal dexamethasone in prolonging the duration of spinal anesthesia and postoperative analgesia in elective cesarean section. *QJM Inte J Med*. 2024;117(Supplement_1):hcae070. 030. doi: 10.1093/qjmed/hcae070.030.
15. Fetene MB, Bayable SD, Wendimu ES, Belehu KD, Almaw AA, Dula PK, et al. Perioperative patient satisfaction and its predictors following surgery and anesthesia services in North Shewa, Ethiopia. A multicenter prospective cross-sectional study. *Ann Med Surg*. 2022;76:103478. doi: 10.1016/j.amsu.2022.103478.
16. Nasiri A, Abutorabi SM, Sane S. Intrathecal dexamethasone-bupivacaine combination with bupivacaine alone in spinal anesthesia for cesarean delivery. *Caspian J Intern Med*. 2024;15(3):414-420. doi: 10.22088/cjim.15.3.414.
17. El-Shourbagy MA, Mammdouh AM, Shawky ME, Mohamed HA. Addition of intrathecal dexamethasone to bupivacaine for

spinal anesthesia in cesarean section. *Evid Based Women's Health J*. 2019;9(2):416-424. doi: 10.21608/ebwhj.2019.33474.
18. Ahmed SA, Lotfy HA, Mostafa TAH. The effect of adding dexmedetomidine or dexamethasone to bupivacaine-fentanyl mixture in spinal anesthesia for cesarean section. *J Anaesthesiol Clin Pharmacol*. 2024;40(1):82-89. doi: 10.4103/joacp.joacp_396_22.
19. Comer SD, Cahill CM. Fentanyl: Receptor pharmacology, abuse potential, and implications for treatment. *Neurosci Biobehav Rev*. 2019;106:49-57. doi: 10.1016/j.neubiorev.2018.12.005.
20. Bhuyan S, Chandak AV. Intrathecal fentanyl: A comprehensive review of the pharmacological and clinical profile in anaesthesia. *Res J Pharm Technol*. 2024;17(6):2959-2966. doi: 10.52711/0974-360X.2024.00463.