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Dexamethasone vs. Alpha-2 Agonists in Cesarean Section Anesthesia: A Prospective Study from Sirte Teaching Hospital

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A B S T R A C T

Background: Effective postoperative pain control after cesarean section improves maternal recovery and reduces opioid use. This study compared intrathecal dexamethasone, dexmedetomidine, and clonidine as spinal anesthesia adjuvants.

Methods: In this prospective randomized study, 60 women undergoing elective cesarean section at Sirte Teaching Hospital, Libya, were allocated into three groups (n=20) receiving intrathecal bupivacaine with dexamethasone, dexmedetomidine, or clonidine. Outcomes included analgesia duration, sensory block onset, hemodynamics, sedation, PONV, opioid use, and satisfaction.

Results: Dexamethasone provided the longest analgesia and lowest PONV incidence with minimal side effects. Dexmedetomidine produced faster sensory block onset and greater opioid-sparing effects but increased bradycardia and sedation. Clonidine showed moderate analgesic prolongation with mild hypotension and sedation. Satisfaction was highest with dexmedetomidine.

Conclusion: Dexamethasone showed the best balance of efficacy and safety, while dexmedetomidine improved satisfaction but caused more sedation and bradycardia.

مقارنة الديكساميثازون ومحفزات ألفا–2 في تخدير العمليات القيصرية: دراسة مستقبلية من مستشفى سرت التعليمي

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الـمُخلص

الخلفية: يُعد التحكم الفعّال بالألم بعد العمليات القيصرية مهمًا لتحسين تعافي الأم وتقليل استخدام المواد الأفيونية. هدفت هذه الدراسة إلى مقارنة فعالية وسلامة الديكساميثازون، والديكسميديتوميدين، والكلونيدين كعوامل مساعدة للتخدير النخاعي.

المنهجية: أُجريت دراسة سريرية مستقبلية وعشوائية على 60 سيدة خضعن لعملية قيصرية اختيارية في مستشفى سرت التعليمي، وتم توزيعهن إلى ثلاث مجموعات (20 لكل مجموعة) لتلقي بوبيفاكايين مع الديكساميثازون أو الديكسميديتوميدين أو الكلونيدين. تم تقييم مدة التسكين بعد العملية القيصرية، بداية التخدير، التغيرات الديناميكية الدموية، التهدئة، الغثيان والقيء بعد العملية، استهلاك الأفيونات، ورضا المريضات.

النتائج: وفّر الديكساميثازون أطول مدة للتسكين مع أقل معدل للغثيان والقيء وآثار جانبية محدودة. أما الديكسميديتوميدين فقد أظهر بداية أسرع للتخدير وتأثيرًا أكبر في تقليل استخدام الأفيونات، لكنه ارتبط بزيادة بطء القلب والتهدئة. بينما أظهر الكلونيدين إطالة متوسطة للتسكين مع انخفاض ضغط الدم وتهدئة خفيفة. وكانت أعلى معدلات الرضا لدى مجموعة الديكسميديتوميدين.

الاستنتاج: أظهر الديكساميثازون أفضل توازن بين الفعالية والسلامة، بينما حقق الديكسميديتوميدين رضا أعلى للمريضات لكنه ارتبط بزيادة التهدئة وبطء القلب.

الكلمات المفتاحية :*التسكين بعد العملية القيصرية، التخدير النخاعي، عوامل مساعدة للتخدير، الديكساميثازون، الديكسميديتوميدين، الكلونيدين.*

1 Introduction

Cesarean section remains among the most frequently performed obstetric procedures worldwide, and its increasing incidence has drawn growing attention toward optimizing perioperative analgesia to enhance maternal recovery. Globally, the rate of cesarean delivery continues to rise in both developed and developing healthcare systems. Effective pain control during the perioperative period is essential to ensure maternal comfort, promote early mobilization, support successful breastfeeding, and reduce the risk of developing chronic postoperative pain syndromes (Betrán et al., 2016; Kainu et al., 2020). Spinal anesthesia is widely regarded as the preferred anesthetic technique for cesarean delivery due to its rapid onset, dense sensory and motor blockade, and improved maternal and neonatal safety profile compared with

general anesthesia (Hawkins, 2003). Despite these advantages, its main limitation lies in the relatively limited duration of analgesia, which may lead to intraoperative discomfort or insufficient postoperative pain control (Roofthooft & Van de Velde, 2008). To overcome this limitation, various adjuvant agents are commonly added to local anesthetics to prolong the duration and improve the quality of neuraxial blockade.

The most frequently used intrathecal adjuvants include opioids, alpha-2 adrenergic agonists such as clonidine and dexmedetomidine, and corticosteroids such as dexamethasone (Al-Ghanem et al., 2009; Movafegh et al., 2006; Bajwa et al., 2011). Each of these agents has distinct pharmacological properties that influence both the quality of anesthesia and the overall clinical outcome Dexamethasone, a potent synthetic glucocorticoid, has gained increasing attention as an adjuvant due to its anti-inflammatory, antiemetic, and analgesic effects. Evidence suggests that when administered intrathecally or perineurally, it can prolong sensory blockade and significantly reduce postoperative nausea and vomiting (PONV) (Elsharkawy et al., 2014; Wang et al., 2018; Choi et al., 2014). Unlike opioid or sedative-based adjuvants, dexamethasone has been reported to enhance postoperative analgesia after cesarean delivery without producing clinically relevant sedation (Hong et al., 2016). Dexmedetomidine is a highly selective α2-adrenergic receptor agonist with sedative, anxiolytic, and analgesic properties. When used as an adjuvant in spinal anesthesia, it improves block characteristics by prolonging both the intensity and duration of neuraxial anesthesia, while also reducing postoperative opioid consumption (Kanazi et al., 2006; Gupta et al., 2011). However, its clinical use may be limited by dose-related adverse effects, including hypotension, bradycardia, and increased sedation, which reflect its strong sympatholytic action (Al-Mustafa et al., 2009). Clonidine, another α2-adrenergic agonist, shares a similar mechanism of action but has lower receptor selectivity compared with dexmedetomidine. It is also capable of prolonging analgesia; however, it is associated with dose-dependent hypotension and bradycardia (Filos et al., 1994; Dobrydnjov et al., 2003; Abdelhamid et al., 2014). Although these agents have been individually investigated in several studies, direct comparative evidence in the context of cesarean delivery remains relatively limited. Pregnancy-related physiological changes including increased cardiac output, altered pharmacokinetics, and enhanced sensitivity to neuraxial blockade further complicate the selection of appropriate adjuvant agents (Santos et al., 2017). Therefore, maternal safety, neonatal well-being, hemodynamic stability, and patient satisfaction remain central considerations in obstetric anesthesia practice. In Libya, spinal anesthesia is the standard anesthetic technique for cesarean delivery across most teaching hospitals, including Sirte Teaching Hospital. However, there remains limited local evidence comparing commonly used intrathecal adjuvants in this clinical setting. This gap highlights the need for region-specific data to support evidence-based anesthetic decision-making and improve maternal outcomes. Accordingly, the present study was designed to evaluate and compare the efficacy and adverse effect profiles of dexamethasone, dexmedetomidine, and clonidine when used as adjuvants to intrathecal bupivacaine in women undergoing cesarean section at Sirte Teaching Hospital. The assessed outcomes included duration of analgesia, onset of sensory block, sedation level, hemodynamic changes, opioid consumption, incidence of PONV, and maternal satisfaction. Recent comparative reviews have highlighted the evolving role of intrathecal adjuvants in expanding the pharmacological options for spinal anesthesia (Lotfi et al., 2020). Moreover, meta-analytical evidence focusing on cesarean delivery suggests that appropriate selection of these agents can significantly enhance the balance between surgical anesthesia and postoperative recovery (Mirkheshti et al., 2021). Collectively, these findings provide a structured framework for understanding how corticosteroids and α2-adrenergic agonists influence the overall quality of neuraxial anesthesia in obstetric populations (Lotfi et al., 2020; Mirkheshti et al., 2021).

2. Materials and Methods

This prospective randomized controlled clinical trial was conducted in the Department of Anesthesia at Sirte Teaching Hospital, Libya, from September to October 2024 following ethical approval and written informed consent. A total of 60 multiparous women undergoing elective cesarean section under spinal anesthesia were enrolled and randomly assigned into three equal groups (n=20 each): Group D received bupivacaine with dexamethasone, Group A received bupivacaine with dexmedetomidine, and Group B received bupivacaine with clonidine. The study was conducted by Jadalla Emhalhel and Jomaa F. Alrjael, Department of Anesthesia, Faculty of Medicine, University of Sirte, Libya. Eligible participants were women aged 20–40 years with ASA physical status I–II and singleton term pregnancies, while patients with drug hypersensitivity, hypertensive pregnancy disorders, coagulation abnormalities, chronic opioid use, neurological disorders, or contraindications to regional anesthesia were excluded. Randomization was performed using a computer-generated sequence, and postoperative assessments were conducted by a blinded independent investigator. Standard monitoring and spinal anesthesia procedures were applied using hyperbaric bupivacaine (10–12.5 mg) combined with dexamethasone (8 mg), dexmedetomidine (5 µg), or clonidine (30 µg). Outcomes included sensory and motor block characteristics, duration of analgesia, hemodynamic changes, sedation, postoperative nausea and vomiting (PONV), opioid consumption, adverse effects, and maternal satisfaction. All patients received standardized postoperative multimodal analgesia. Data were analyzed using SPSS version 26, with $p < 0.05$ considered statistically significant.

3. Results

Table 1. Comparative analysis of block characteristics and analgesic duration among study groups

Parameter	Dexa	Dexmed	Clonidine
Analgesia	Prolonged	Markedly prolonged	Prolonged (< Dexa)
Onset	Minimal	Faster	Slight delay
Opioids	Reduced	Markedly reduced	Moderately reduced

Footnotes
[a] Dexamethasone group
[b] Dexmedetomidine group
[c] Clonidine group
Note: Data are presented as qualitative comparative outcomes across study groups. No statistical significance values (p-values) are provided in this table.
Abbreviations: Dexa = Dexamethasone; Dexmed = Dexmedetomidine.

Table 2. Side effect profile and hemodynamic changes associated with adjuvants

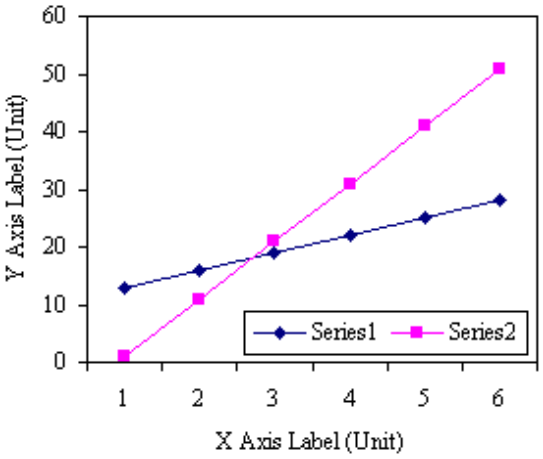
Parameter	Dexam[a]	Dexmed[b]	Clonidine[c]
PONV	↓	No change	↓
Sedation	None	Moderate	Mild
Hemodynamics	Stable	Bradycardia, hypotension	Mild hypotension, bradycardia
Side effects	Minimal	Sedation + bradycardia	Sedation + hypotension

Footnotes
[a] Dexamethasone group
[b] Dexmedetomidine group
[c] Clonidine group
Note: Data are presented as qualitative clinical observations across study groups. No statistical testing values are included in this table.
Abbreviations: PONV = postoperative nausea and vomiting.

Table 3. Patient satisfaction outcomes following administration of Dexamethasone, Dexmedetomidine, and Clonidine as adjuvants in spinal anesthesia

Parameter	Dexamethasone[a]	Dexmedetomidine[b]	Clonidine[c]
Patient satisfaction	High	Very high	High

Note: Patient satisfaction reflects overall subjective postoperative experience including analgesia quality and recovery profile.
[a] Dexamethasone group
[b] Dexmedetomidine group
[c] Clonidine group



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4. Discussion

This study explored the clinical significance of dexamethasone, dexmedetomidine, and clonidine as intrathecal adjuvants to bupivacaine during cesarean section anesthesia. The findings suggest that each agent provides distinct pharmacological advantages and limitations, highlighting the importance of individualized adjuvant selection in obstetric anesthesia. Optimizing postoperative analgesia is essential not only for pain control but also for enhancing maternal recovery, early mobilization, breastfeeding, and overall patient experience. The favorable profile of dexamethasone observed in this study may be explained by its anti-inflammatory and antiemetic properties. Previous studies by El-Rahmany et al. (2018), Kaur et al. (2017), and Chakraborty et al. (2015) similarly demonstrated that dexamethasone improves postoperative analgesic quality without causing clinically relevant sedation. Its mechanism, involving suppression of inflammatory mediators and peripheral nociceptor sensitization, may contribute to prolonged analgesia while maintaining cardiovascular stability. The antiemetic benefits reported by Wang et al. (2000) are particularly relevant in cesarean patients, as reducing postoperative nausea and vomiting may enhance maternal comfort and facilitate early mother–infant interaction.

Dexmedetomidine demonstrated characteristics consistent with previous reports describing its strong α2-adrenergic activity. Kanazi et al. (2006) and Abdallah and Brull (2013) and Niu et al. (2013) reported that dexmedetomidine improves neuraxial block quality and reduces opioid requirements. Although these effects may improve the overall anesthetic experience and

explain higher patient satisfaction, the associated sympatholytic effects can increase the risk of bradycardia, hypotension, and sedation. Such hemodynamic changes are particularly important in obstetric patients because physiological adaptations of pregnancy may increase sensitivity to alterations in sympathetic tone (Santos et al., 2017). The moderate effects observed with clonidine align with findings from Elia et al. (2011) and Dobrydnjov et al. (2003), who reported that clonidine prolongs neuraxial analgesia but has lower efficacy compared with more selective α2 agonists. Its reduced receptor selectivity may explain the less pronounced analgesic benefits and persistence of cardiovascular adverse effects. While clonidine remains clinically useful, its overall profile appears less favorable compared with dexmedetomidine and dexamethasone in this setting.

Hemodynamic stability remains a major consideration during cesarean delivery because maternal hypotension may adversely affect both maternal and fetal outcomes. Previous reports similarly demonstrated that α2 agonists may reduce sympathetic tone and contribute to cardiovascular depression (Al-Mustafa et al., 2009; Niu et al., 2013; Filos et al., 1994). Therefore, balancing analgesic efficacy with safety is essential when selecting intrathecal adjuvants in obstetric practice. This study has several limitations, including its single-center design, relatively small sample size, and lack of neonatal outcome assessment. These factors may limit generalizability. Future multicenter randomized studies with larger populations and neonatal safety endpoints are recommended to further clarify the optimal intrathecal adjuvant for cesarean section anesthesia.

Conclusions

The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section

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Conflict of interest: The authors declare that there are no conflicts of interest

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