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" Post-operative Analgesic Effect of Dexmedetomidine and Dexamethasone as Adjunct in Transversus Abdominis Plane Block During Cesarean Section "

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ABSTRACT:

Background: Ultrasound-guided transversus abdominis plane (TAP) block is an established component of multimodal analgesia. Adjuvants such as dexmedetomidine or dexamethasone may enhance and prolong block duration. This study compared the postoperative analgesic efficacy and safety of these two agents when added to bupivacaine in TAP block during cesarean section.

Methods: In this randomized controlled trial, 42 patients undergoing elective caesarean section under spinal anaesthesia received transversus abdominis plane block in "Al-Hayah Port Fouad Hospital". Each participant will be placed at random into one of three equal groups: the first, or Control group, gets 40 ml of 0.25% bupivacaine plus 0.9% NS ; the second, or DMD group, receives 38 ml of the same bupivacaine and 2 ml (1 ml of dexmedetomidine dosed at 100 µg + 1 ml normal saline 0.9%); the third, or DEXA group, gets 38 ml of bupivacaine mixed with 2 ml of 8-milligram dexamethasone. The primary outcome was time to first request for rescue analgesia. Secondary outcomes included postoperative VAS scores, total rescue analgesic consumption, sedation scores, and adverse effects within 24 hours.

Results:
Dexmedetomidine significantly prolonged analgesia duration and lowered VAS scores in the first 18 hours (**p < 0.004)**, with reduced total rescue analgesic use compared with dexamethasone (**p < 0.001**). However, transient bradycardia and hypotension occurred more frequently in the dexmedetomidine group (**p < 0.001**) and no difference in RR between groups **(p >0.05).**

Conclusions: Dexmedetomidine, as an adjuvant to bupivacaine in TAP block, provided longer postoperative analgesia and reduced analgesic requirements compared with dexamethasone, but was associated with more hemodynamic side effects. Dexamethasone offered slightly shorter analgesia but a more favorable safety profile, making it preferable for patients with cardiovascular risk.

Keywords: Ultrasound-Guided TAP block, Spinal Anesthesia, cesarean section, adjuvant, bupivacaine, Dexmedetomidine, Dexamethasone,

Introduction:

Ultrasound guidance has increased its accuracy, safety, and efficacy. However, the duration of analgesia achieved with local anesthetics alone is often limited, leading to the use of adjuvants to prolong the block's effect.(1)

Multimodal analgesia aims to minimize opioid use, enhance recovery, and improve maternal satisfaction (2) Epidural analgesia with a catheter technique is still the most effective technique for analgesia after abdominal surgery. (3)

The transversus abdominis plane (TAP) block provides somatic analgesia to the anterior abdominal wall by targeting the lower thoracolumbar nerves between the internal oblique and transversus abdominis muscles (4) Ultrasound guidance has increased its accuracy, safety, and efficacy. However, the duration of analgesia achieved with local anesthetics alone is often limited, leading to the use of adjuvants to prolong the block's effect.(5)

Despite its benefits, TAP block with local anesthetic alone offers limited duration, necessitating adjuvants to prolong analgesia. Dexmedetomidine has been shown to enhance block duration and quality in various surgeries.(6,7) A recent review found that during cesarean sections, dexmedetomidine may contribute to the reduction of the initiation time of spinal anesthesia during cesarean surgeries.(8) whereas dexamethasone has also demonstrated efficacy in prolonging analgesia through its anti-inflammatory properties ,(9) while others report comparable effects or advantages for dexamethasone depending on dose, local anesthetic type, and patient factors.(10-11)

This study aimed to compare the postoperative analgesic effectiveness and safety profiles of dexmedetomidine versus dexamethasone as adjuvants to bupivacaine in ultrasound-guided TAP block during caesarean section.

Patients and Methods:

A prospective, randomized, double-blind clinical trial conducted with participation of 42 women scheduled for elective cesarean section under spinal anesthesia, American society of Anesthesiologists (ASA) physical status I–II, full-term pregnancy (≥ 37 weeks), age between 18–40 years.

The study drugs were prepared by an independent anesthesiologist not involved in patient care or data collection, using identical syringes labeled only with the patient code. Patient monitoring was performed by the attending anesthesiologist, while postoperative pain assessments and data collection were performed by a blinded research assistant.

Written informed consent was obtained from all participants, and the study adhered to the principles of the Declaration of Helsinki. Exclusion criteria were reported were allergy to study drugs, bleeding disorders, chronic opioid use, or any contraindication to regional anesthesia.

The study was done after approval from the Ethical Committee in at Al-Hayah Port Fouad Hospital, Faculty of Medicine, Port Said University, Port Said, Egypt, with the code number of Approval:

ERN: MED (1/4/2024) s.no (151) ANE 821_002

Randomization & Grouping:

Participants were randomly allocated into three equal groups (n = 14 per group): Group A (Control): TAP block with (38 mL of 0.25% Bupivacaine + 2 mL normal saline 0.9%). Group B (Dexmedetomidine): TAP block with (38 mL of 0.25% Bupivacaine + Dexmedetomidine 100 µg (1 ml diluted to 2 mL with normal saline 0.9%)). Group C (Dexamethasone): TAP block with (38 mL of 0.25% Bupivacaine + Dexamethasone 8 mg (2 ml))

Procedure:

All patients received spinal anesthesia, with the same dose of 2.8 mg bupivacaine, intraoperatively for cesarean section. TAP block was performed under ultrasound guidance after surgery using a linear probe and 22G needle. TAP Block performed bilaterally, targeting the fascial plane between the internal oblique and transversus abdominis muscles. under
ultrasound guidance by the same anesthesiologist.
The primary outcome was to compare the analgesic effects of bupivacaine + dexamethasone (DEXA) and bupivacaine + dexmedetomidine (DMD) on pain after cesarean section (CS) using the transversus abdominis plane (TAP) block as time from block completion to first rescue analgesic request, with using group A (TAP block with bupivacaine only) as control group. Secondary outcomes were to assess pain scores (VAS) at 0, 2, 4, 8, 16, and 24 hours, total consumption of rescue analgesia (Paracetamol 1 gm IV every 8 hours PRN – for mild/moderate pain (VAS 4-6)-, Ketolac 10 or 20 mg

IV PRN -for severe pain (VAS .6)-; higher dose for inadequate relief. Considering the hemodynamic variables (MAP, HR, RR), incidence of side effects (e.g., nausea, vomiting) and patient satisfaction at 24 hours.

Sample Size Calculation:

By using **Bhardwaj et al.,** [12] equation; the sample size was calculated based on a mean difference of 6.8 (cases) versus 5.4 (controls), assuming a standard deviation of 0.9, a power of 80%, and a significance level (α) of 0.05. Allowing for a 10% dropout rate, the required sample size was 14 patients per group. The calculation was performed using G*Power version 3.1.

Statistical analysis and Data interpretation:

Data was collected in Excel data sheet and analysis was performed by (Statistical Package for The Social Sciences) SPSS software, version ٢٦ (SPSS Inc., PASW statistics for windows version ٢٦. Chicago: SPSS Inc.). Qualitative data were described using number and percent. Quantitative data were described using mean± Standard deviation for normally distributed data after testing normality using Kolmogrov-Smirnov test. Significance of the obtained results was judged at the (0.05) level. Chi-Square, Monte Carlo tests were used to compare qualitative data between groups as appropriate (Categorical factors was presented as frequencies and percentages were compared). Student t test was used to compare 2 independent groups for normally distributed data. One Way ANOVA test was used to compare more than 2 independent groups with Post Hoc Tukey test to detect pair-wise comparison. The results were presented in the appropriate form of tables and graphs using Microsoft Excel.

Results:

A total of 42 patients completed the study without protocol deviations. Demographic and perioperative characteristics were comparable between groups **(Table 1).**
The mean time to first rescue analgesic request was significantly longer in Group B (dexmedetomidine) compared with Group C (dexamethasone) ($p < 0.001$) **(Figure 1).**

Table (1): Comparison of demographic data of the patients among the studied groups

	Group A (Control group)	Group B (dexametomidine group)	Group C (dexamethasone group)	Test of significance	Within group significance
Age / years	28.07±3.73	29.28±2.84	28.29±2.76	F=0.596 P=0.556	P1=0.313 P2=0.858 P3=0.405
Weight (kg)	79.5±6.90	80.21±5.85	79.21±7.72	F=0.079 P=0.924	P1=0.785 P2=0.913 P3=0.702

F:One Way ANOVA test , *statistically significant , P1: difference among group A versus B , P2:difference among group A versus C , P3: difference among group C versus B

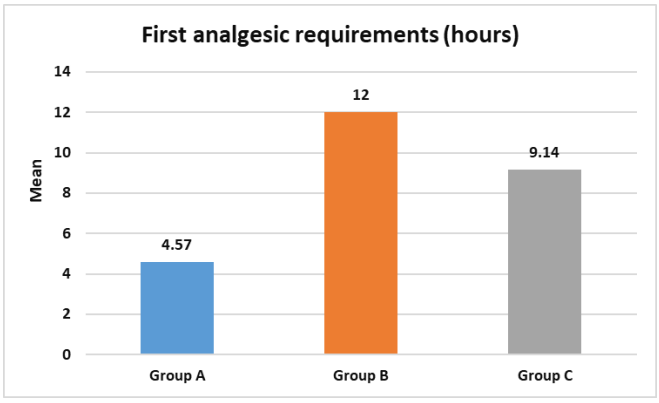

Figure (1): Comparison of Time of first analgesic requirements among studied groups

VAS scores at rest and on movement were significantly the lowest in Group B at 2, 6, 12, and 18 hours postoperatively, with no significant difference at 24 hours **(Figures 2 and 3).**

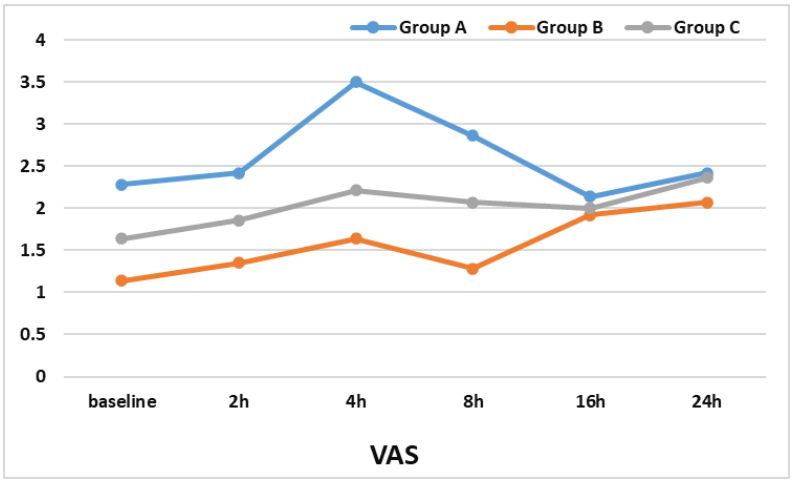

Figure (2): Comparison of visual analogue scale change among studied groups

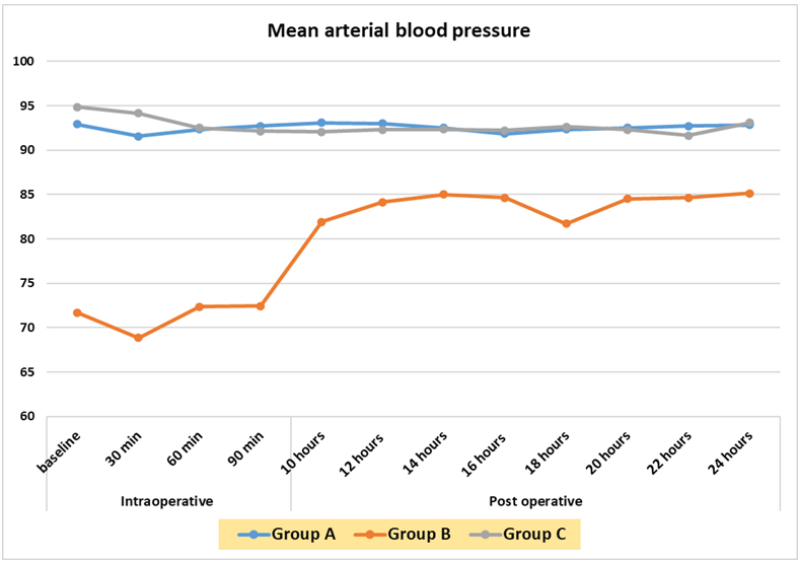

Figure (3): Comparison of mean arterial blood pressure (MAP) change among studied groups.

(Figure 4) illustrate heart rate changes across the study groups. Group B exhibited significantly lower heart rates than Groups A and C at all assessed time points, except at 18, 20, 22 and 24 hours postoperatively (P <0.05 for significant differences).

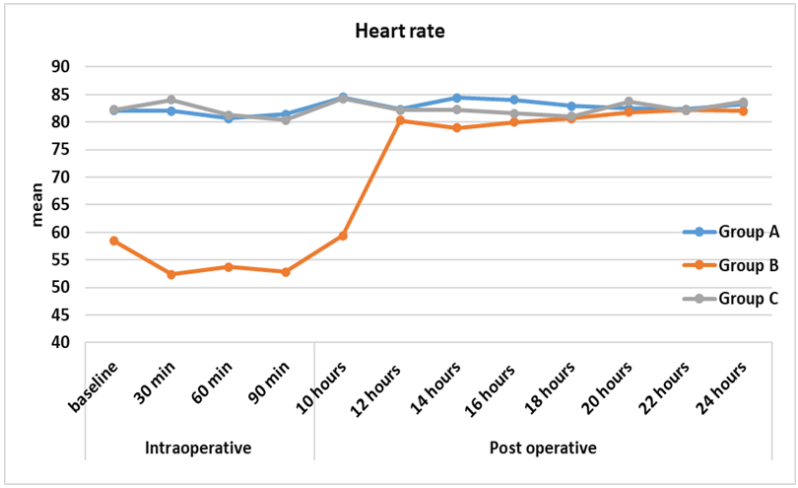

Figure (4): Comparison of heart rate change among studied groups

(Figure 5) reveals no statistically significant differences in respiratory rate between the groups at baseline or during all follow-up intervals (P > 0.05).

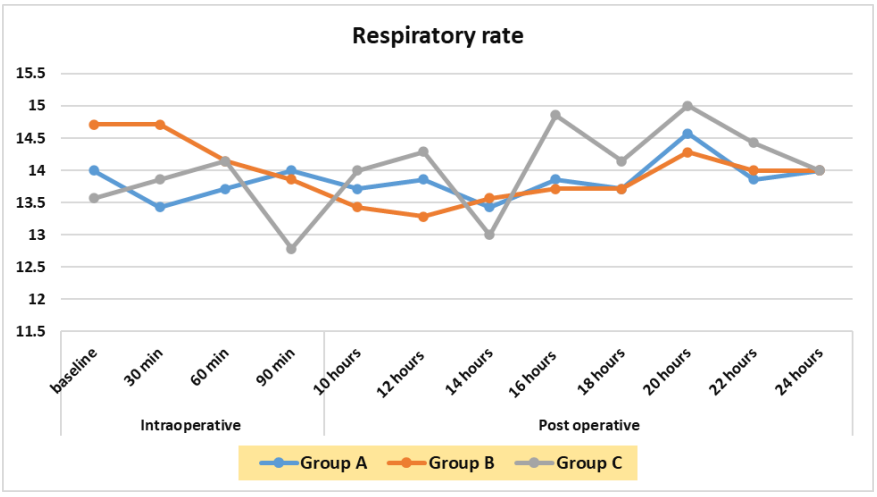

Figure (5): Comparison of respiratory rate change among studied groups

(Figure 6) demonstrates a statistically significant difference in the incidence of nausea and vomiting among the study groups (P < 0.001), with the highest incidence observed in the control group (Group A) compared with Groups B and C. No other complications were reported in any of the groups.

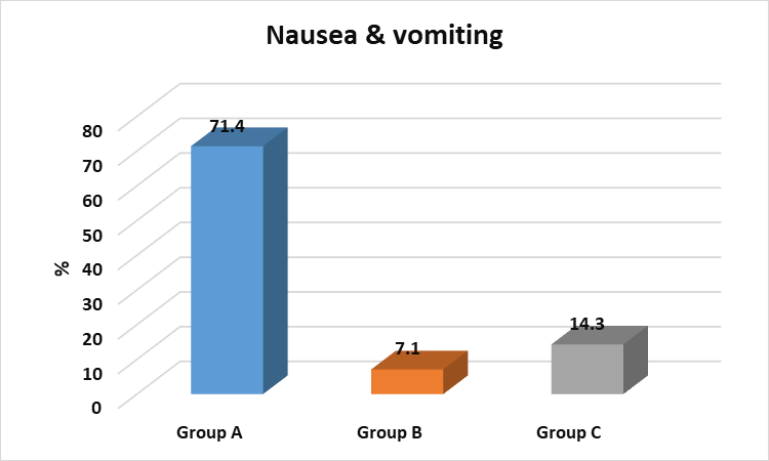

Figure (6): Comparison of incidence of complications among studied groups

(Figure 7) shows a highly significant difference in total analgesic consumption during the first 24 hours postoperatively (P < 0.001), with the greatest consumption recorded in Group A, followed by Group C and Group B. Choosing among the listed rescue agents (Paracetamol 1 gm IV every 8 hours PRN – for mild/moderate pain (VAS 4-6)-, Ketolac 10 or 20 mg IV PRN - for severe pain (VAS .6)-; higher dose for inadequate relief.

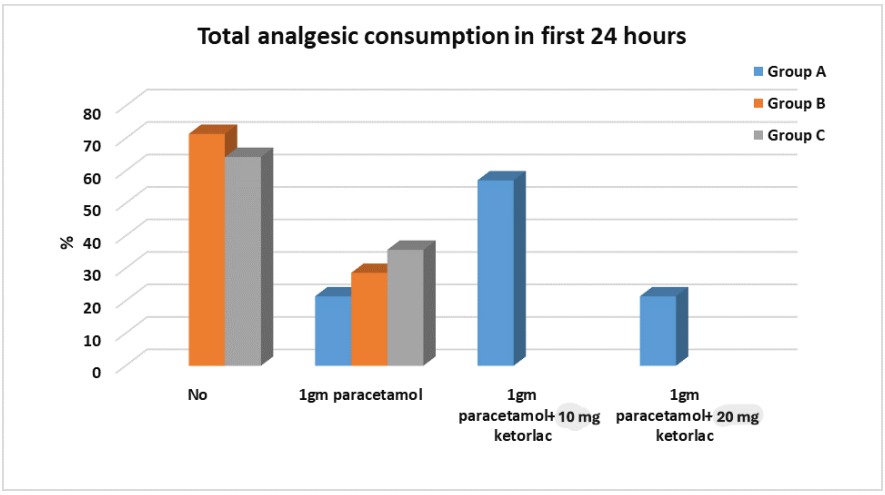

Figure (7): Comparison of Total analgesic consumption in first 24 hours among studied groups

(Table 2) shows a highly statistically significant difference in patient satisfaction among the studied groups (P < 0.001). The highest satisfaction level was observed in Group B (dexmedetomidine group), followed by Group C (dexamethasone group), and lastly Group A (control group).

Table (2): Patient satisfaction among studied groups

Patient satisfaction	Group A (Control group)	Group B (dexametomidine group)	Group C (dexamethasone group)	Test of significance	Within group significance
	N(%)	N(%)	N(%)		
Neutral	11(78.6)	0	0		P1= 0.001*
satisfied	3(21.4)	4(28.6)	9(64.3)	MC=35.88	P2= 0.001* P3= 0.058
strongly satisfied	0	10(71.4)	5(35.7)	P<0.001*	

Data expressed as number (%) . MC: Monte Carlo test , *statistically significant

Discussion

A research team at Al-Hayah Port Fouad Hospital conducted a randomized, controlled, parallel-group trial involving 42 patients scheduled for elective cesarean delivery under spinal anesthesia with a TAP block for postoperative analgesia. Participants were randomly allocated into three equal groups (n = 14 each): Group A received standard care (bupivacaine) only, Group B received dexamethasone, and Group C received dexmedetomidine as an adjuvant to the TAP block. Postoperatively, patients were closely monitored for heart rate, blood pressure, respiratory rate, and any adverse events, and the number of rescue analgesic doses administered was recorded. In this study, the addition of dexmedetomidine to bupivacaine in ultrasound-guided TAP block for cesarean section significantly prolonged postoperative analgesia compared with dexamethasone. Patients in the dexmedetomidine group also had lower VAS pain scores during the first 18 hours and required less rescue analgesia in the first 24 hours. However, this benefit was associated with a higher incidence of transient bradycardia and hypotension. Similarly, Sobhy et al. [10] reported superior analgesic efficacy for both dexmedetomidine and dexamethasone compared with bupivacaine alone, although the effect became evident only at six hours postoperatively. In our findings, the addition of dexmedetomidine to bilateral 0.25% bupivacaine prolonged pain-free duration more than bupivacaine with dexamethasone.

Patients in the dexamethasone group requested rescue analgesia sooner than those in the dexmedetomidine group. Yoshitomi et al. [13] attributed dexmedetomidine's prolongation of analgesia to α2-adrenoceptor–mediated vasoconstriction at the injection site, slowing systemic absorption of the local anesthetic, along with inhibition of norepinephrine release and enhanced potassium conductance in C-fibres and A-delta neurons, reducing nociceptive transmission. Consistently, Singla et al. [11] observed lower initial pain scores in the dexmedetomidine group, aligning with our results. Jamshidi et al. [14] found that, when combined with ropivacaine in TAP block after cesarean section, dexmedetomidine provided significantly better pain control and prolonged analgesia compared with dexamethasone. However, their data also indicated lower pain intensity and reduced analgesic requirements in the dexamethasone group. Similar benefits of dexmedetomidine in delaying pain onset and prolonging rescue

analgesia have been reported by Bansal et al. [15], Qian et al. [16], Ramya et al. [17],Thakur et al. [18] and Varshney et al. [19].

Conversely, Ding et al. [20] reported no difference in pain scores or morphine consumption between ropivacaine with dexmedetomidine and ropivacaine alone in gastrectomy patients. In contrast, Ozalp et al. [21] demonstrated significant intraoperative and early postoperative hemodynamic changes with dexmedetomidine addition. Dexmedetomidine, at higher doses, can induce hypotension, bradycardia, and sedation via central α2-adrenoceptor activation. Singla et al. [22] noted these effects in ~10% of patients, whereas dexamethasone maintained more stable hemodynamics, likely due to differences in sympathetic modulation. This difference happens because dexmedetomidine reduces the release of noradrenaline, a key signal in the sympathetic nervous system, by acting on 2A receptors located in the brainstem.

Zhang et al. [23] reported reduced postoperative pain and fewer adverse effects, including nausea, vomiting, and shivering, with dexmedetomidine—findings consistent with ours. Similarly, Aga et al. [24] found lower postoperative nausea incidence with dexmedetomidine TAP block compared to saline ($p = 0.04$), corroborated by Sachdeva [25] and Ammar [26]. However, Jamshidi et al. [14] observed fewer hemodynamic side effects with dexmedetomidine versus dexamethasone only in the first three hours, with no difference in nausea/vomiting at multiple postoperative intervals. Variations in bradycardia definition and dosing, as noted by Qian et al. [27], may explain discrepancies.

Abdallah et al. [28] acknowledged ongoing debate regarding TAP block efficacy after cesarean delivery but supported its opioid-sparing and satisfaction-enhancing potential when performed optimally. Our data align, showing that dexmedetomidine addition prolongs analgesia and lowers visual analogue scores. Similar results have been reported by Sachdeva [25], Deshpande [29], and Fouad [30], who found ~24% less analgesic use in dexmedetomidine TAP block patients versus saline. Conversely, Huang [31] found no difference, possibly due to block timing differences (after general vs. spinal anesthesia). Hetta et al. [29] demonstrated that epidural dexmedetomidine with bupivacaine reduced morphine use and prolonged analgesia, consistent with Ganesh and Krishnamurthy [32] using intrathecal administration. Aksu et al. [4] also reported lower pain scores, reduced opioid use, and improved satisfaction with dexmedetomidine in TAP block. Collectively, these findings support dexmedetomidine's role in enhancing and prolonging local anesthetic analgesia, although conflicting evidence (e.g., Ding et al. [20]) suggests that differences in drug concentration, dose, and perioperative analgesic regimens may influence outcomes.

Limitations:

The current study was conducted at a single center with a relatively small sample size, limiting generalizability. Psychological variables such as stress, depression, and sleep quality, as well as baseline pain intensity, were not assessed despite their established influence on postoperative pain perception. the follow-up period was limited to 24 hours, and long-term analgesic outcomes were not assessed.

Future research:
Further large-scale, multicenter trials are recommended to confirm these findings and optimize dosing regimens. Studies should also explore the potential benefits of combining dexmedetomidine and dexamethasone in TAP block, as well as evaluating outcomes in high-risk obstetric populations.

Conclusion:

The incorporation of dexmedetomidine or dexamethasone into bupivacaine for ultrasound-guided transversus abdominis plane (TAP) block enhances postoperative analgesia and patient satisfaction following cesarean section. Dexmedetomidine demonstrated superior efficacy over dexamethasone, providing prolonged analgesia, lower pain scores, and reduced analgesic requirements. Although dexmedetomidine is associated with certain cardiovascular effects, dexamethasone offers a more stable hemodynamic profile and remains a safe and effective alternative.

Financial support and sponsorship: Nil

Conflict of Interest: Nil

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