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EFFECT OF DEXMEDETOMIDINE COMBINED WITH ROPIVACAINE IN ULTRASOUND-GUIDED TRANSVERSUS ABDOMINIS PLANE BLOCK IN PATIENTS UNDERGOING CAESARIAN SECTIONS

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ABSTRACT

Background: The Transversus Abdominis Plane (TAP) block is the most common peripheral nerve block that provides acceptable postoperative analgesia for a variety of abdominal surgeries. A long-acting local anesthetic called ropivacaine is used to relieve pain following surgery. The duration of analgesia may be extended by the adjuvant administration of dexmedetomidine.

Aim: The current study aimed to evaluate the effects of dexmedetomidine combined with Ropivacaine in ultrasound-guided Transversus Abdominis plane block on post-operative analgesia following cesarean section.

Materials and Method: A total of 70 patients scheduled for CS were divided randomly into two groups: $ (Ropivacaine) group, which received 3 mg/kg of Ropivacaine diluted to 40 mL in normal saline with 20 mL on each side, and B (dexmedetomidine) group, which received 3 mg/kg of Ropivacaine plus 0.5 µg/kg of dexmedetomidine diluted to 40 mL in normal saline with 20 mL on each side. The primary outcome was pain-free duration, with secondary outcomes included heart rate (HR) and mean blood pressure (MBP) readings, visual analogue scale (VAS) pain scores, number of patients requiring rescue analgesia, time to first seek analgesia, and patient satisfaction. Results were analysed using SPSS 20.0 version and the association was tested using the Student's t-test, Fisher's exact test or Pearson's χ^2 test.

Results: As compared to group A, group B experienced a significantly longer period of sensory block and analgesia ($p<0.05$). In comparison to Group A, group B showed longer pain-free duration (6.25±1.47 vs. 9.74±1.31 hours; $p<0.05$), a longer mean time to initial reporting of

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postoperative pain (5.12±1.23 vs. 7.07±1.48; p<0.05), a lower number of patients requiring rescue analgesic (27(77.14%) vs. 8(22.86%); p<0.05), a longer time to first request for analgesia (5.76±1.87 vs. 7.63±2.07 hours; p<0.05), and better patient satisfaction (3.5 vs. 4.5; p<0.05). Post-operative VAS pain scores in group B were considerably lower at 6, 8, and 10 hours than in group A. Bradycardia was noted in 1 (2.86%) and 3 (8.57%) of the patients in Groups A and B, respectively.

Conclusion: Extending the duration and improving the quality of analgesia without causing any notable side effects is possible with the adjuvant addition of dexmedetomidine to Ropivacaine for TAP block.

Keywords: Dexmedetomidine; Postoperative pain, Ropivacaine; Transversus abdominis plane block

INTRODUCTION:

One of the most commonly performed surgical procedures is the Caesarean section (CS).[1] The abdominal wall incision and soft tissue dissection involved with this technique may cause moderate to severe post-operative pain, which can interfere with early ambulation and nursing. After CS, effective post-operative pain management is essential to allowing patients to walk around as soon as possible, speed up their recovery, and have the best possible mother-neonatal bonding.[2]

Pain management after CS frequently involves the use of epidural analgesia as well as patient-controlled intravenous analgesia (PCIA). These techniques do have certain drawbacks, though. For instance, lower extremity weakness and numbness are frequently associated with epidural analgesia, delaying early ambulation and raising the risk of thrombotic events.[3] Furthermore, there are worries about opiate-related problems, such as drowsiness, nausea, vomiting, pruritus, respiratory depression, and urine retention, as opioids are the primary medications utilized in PCIA. Another cause for concern is the potential negative effects of opioids on a newborn through breast milk.[4]

Local analgesia may help to minimize the need for oral or IV analgesics while still providing adequate post-operative pain control.[5] Ultrasound-guided Transversus Abdominis Plane (TAP) block for abdominal surgery has been extensively investigated in clinical settings. It has

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been demonstrated that TAP block with ropivacaine lowers postoperative opiate consumption following C-section.[6]

Ropivacaine, an effective long-acting local anesthetic, is commonly used to relieve postoperative pain. Ropivacaine is used for regional anesthesia, which facilitates early ambulation, enhances sleep quality, lowers narcotic intake, and lessens gastrointestinal unpleasant responses. All of these benefits help patients recover after surgery. Nevertheless, ropivacaine by itself only lasts 9–14 hours for nerve blocks, and it plays a little part in postoperative analgesia. Ropivacaine exhibits a concentration-dependent local anesthetic nerve block with an enhanced sensory versus motor block profile at lower doses.[7]

The effectiveness of TAP block in delivering post-operative analgesia after abdominal surgery has been shown in previous research studies. However, because the local anesthetics employed in TAP block have a brief half-life of action, one drawback of the procedure is its comparatively brief duration of analgesia. Local anesthetics have been combined with a variety of adjuvants, including fentanyl, dexamethasone, and clonidine, to address this problem.[8]

Dexmedetomidine is a selective α2 adrenergic receptor agonist. By reducing the release of substance P, epinephrine, and other neurotransmitters, enhancing the inhibition of local anaesthetics on sodium ion channels, and inhibiting the production of C and Aδ fiber action potentials, adjuvant dexmedetomidine use in regional anesthesia may prolong the duration of analgesia.[9]

Lower doses should produce analgesic effects from two anaesthetics that combine synergistically. Randomized controlled trials (RCTs) have been used to examine the safety and effectiveness of dexmedetomidine as an adjuvant to ropivacaine. When administered in conjunction with ropivacaine in TAP block, dexmedetomidine has been shown to extend analgesia following a variety of abdominal procedures. On the other hand, no study has been done on the effectiveness of ropivacaine and dexmedetomidine in TAP block for the treatment of post-CS pain in Southern India.

AIMS AND OBJECTIVES:

To evaluate the effects of dexmedetomidine combined with Ropivacaine in Ultrasound-guided Transversus abdominis plane block on post-operative analgesia in patients undergoing cesarean section.

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MATERIALS AND METHODS:

This was a prospective randomized controlled study conducted in the Department of Anaesthesiology, Sree Mookambika Institute of Medical Sciences, Kulasekharam for a period of 5 months from September 2023 to January 2024. A total of seventy patients, who were willing to participate in the study, were over the age of eighteen and undergoing a C-section under spinal anesthesia who had an American Society of Anaesthesiology (ASA) grade of 1 or 2, were able to interpret and rate their pain on the Visual Analog Scale (VAS; 0–10) and willing to participate in the study. The following patients were excluded from the study: those who did not want to take part, had a history of drug abuse, anaphylaxis from ropivacaine or dexmedetomidine use, coagulopathy, difficulty understanding VAS, history of allergy to any local anesthetics, and/or known contraindications for neuraxial anesthesia.

All patients provided written, informed consent. Details about the age, height, weight, BMI, and ASA scores of the patients were noted. Two groups of patients were assigned using a computer-generated series of random numbers. Group A (n=35) had a bilateral TAP block with 3 mg/kg of Ropivacaine diluted in normal saline to a total of 40 mL (20 mL on each side). Group B, consisting of 35 individuals, underwent bilateral TAP block with a combination of 3 mg/kg Ropivacaine and 0.5 µg/kg dexmedetomidine, diluted to a total of 40 mL in normal saline, with 20 mL administered to each side.

Routine ECG, non-invasive blood pressure (BP), pulse oxygen saturation, and heart rate (HR) monitoring were performed once the patient entered the operating room. A 20-gauge cannula was placed into the patient's hand dorsum, and Ringer's lactate was administered at 4-6 ml/min.

After aseptic preparation, patients were put into the left lateral decubitus position and 2% lidocaine was injected into the skin at the L3–4 interspace, the site of spinal anesthesia. A 25-gauge spinal needle was used to perform spinal anesthesia at the level of the L3–4 interspace utilizing a middle approach. Intrathecal injection of 10 mg 0.5% hyperbaric bupivacaine was performed over a 20–30 second period once the free flow of CSF fluid was confirmed. Patients were immediately placed in a supine position with a 15˚ left lateral tilt after anesthesia was induced in order to prevent aortocaval compression. Using a face mask, each patient received extra oxygen at a rate of 5 liters per minute.

When the sensory block level T6 or above was reached, a surgical incision was made. Following surgery, all study participants had a bilateral TAP block as soon as possible in the

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operating room, based on their coded group allocation. The US probe was positioned transversely to the abdomen (horizontal plane) in the mid-axillary line between the costal border and the iliac crest on one side. Using ultrasound, the transversus abdominis, internal oblique, and external oblique layers were located in every patient. A 100-mm short bevel needle was inserted into the ultrasonic probe and progressed until it reached the internal oblique and transversus abdominis muscles. Once at the plane, a small amount of local anesthetic (1 mL) was injected to make sure the needle was positioned correctly. Then, the remaining 19 mL of local anesthetic was administered. On the other side, the identical procedure was carried out again. Patients were moved to the post-anesthesia care unit (PACU) after the procedure.

Following a one-hour observation period, patients were allowed to leave the PACU after having their heart rate (HR) and mean blood pressure (MBP) measured every ten minutes. After surgery, at 2, 4, 6, 8, 10, 12, and 24 hours, pain scores (Visual Analogue Scale, VAS; 0 = no pain to 10 = worst imaginable agony) were measured. Intravenous tramadol 1 mg/kg was given as a rescue analgesic when VAS was ≥4. The number of patients who required rescue analgesics, as well as the time it took to make the first request, were noted.

Additionally, data was collected on patient satisfaction with the quality of analgesia 48 hours after surgery (using the Number rating scale (NRS) 1–5, with 1 representing very dissatisfied, 2 dissatisfied, 3 slightly dissatisfied, 4 quite satisfied, and 5 completely satisfied), as well as pain-free duration (the amount of time between the end of surgery and the patient complaining of pain). Patients who reported no postoperative discomfort completed the study after being observed for the first 24 hours.

The SPSS 20.0 version has been used for doing statistical analysis. The standard deviation ± mean was used to express continuous numerical data. Frequencies and percentages are used to express categorical data. Student's t-test was used to compare normally distributed numerical data between groups, whereas Fisher's exact test or Pearson's $\chi 2$ test was used to study categorical variables. A p value <0.05 was considered to indicate a statistically significant difference.

OBSERVATION AND RESULTS

There were no significant differences in the demographic characteristics of the patients and surgery duration between the two groups with p value > 0.05 (Table 1)

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Variable	Group A (n=35)	Group B (n=35)	p value
Age (years)	25.9±3.8	27.3±4.4	0.238
Height (cm)	161.8±5.2	162.8±4.8	0.513
Weight (kg)	73.1±6.5	75.2±5.9	0.749
BMI (kg/m^2)	27.9±2.5	28.2±2.3	0.685
ASA score, I/II	26/9	28/7	0.322

Table 1: Comparison of demographics among both groups

Furthermore, during the procedure, hemodynamic variables were similar in the two groups. In both groups, the BP and HR decreased modestly after the induction of anesthesia. After TAP block, group B also showed a drop in HR, but there was no statistically significant difference between the two groups.

When comparing group B to group A, there was a significant increase in the duration of sensory block and analgesia ($p<0.05$). The maximum degree of sensory block attained, though, was comparable for both groups. However, no significant difference was found in sedation levels between the two groups at T6 and T10. The majority of participants in the current study had a sedation grade ≤3. (Table 2)

	Group A	Group B	p value
Mean duration of sensory block	9.2±3.2	12.7±4.5	0.001
Mean duration of Analgesia	6.3±2.8	9.9±4.1	0.002

Table 2: Comparison of mean duration of sensory block and analgesia

The group that received Dexmedetomidine with Ropivacaine (Dex-R) had significantly longer initial reporting of postoperative pain, pain-free period, and first request for analgesia compared to group A, which received Ropivacaine. Additionally, compared to group A, the proportion of patients in group B who needed rescue analgesics was much lower. (Table 3)

Variable	Group A	Group B	p value
Surgery duration (min)	64.7±11.7	66.9±12.9	0.327

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Variable	Group A	Group B	p value
Mean time to initial reporting of postoperative pain (hours)	5.12±1.23	7.07±1.48	0.001
Pain-free duration (hours)	6.25±1.47	9.74±1.31	<0.001
No. of patients who required rescue analgesic	27(77.14%)	8(22.86%)	0.010
Mean time to first rescue analgesia (hours)	5.76±1.87	7.63±2.07	0.041

Table 3: Comparison of post-operative variables between group A and B

Post-operative VAS pain scores were significantly lower in group B at 6, 8 and 10 hours compared with those in group A. However, there was no significant difference in scores between groups at 2, 4, 12 and 24 h. (Table 4)

Time post-surgery, hrs	Group A	Group B	p value
2	0 (0.00-0.00)	0 (0.00-0.00)	1.000
4	0 (0.00-0.00)	0 (0.00-0.00)	1.000
6	2 (1.00-2.00)	0 (0.00-0.25)	<0.001
8	2 (2.00-3.00)	0 (0.00-1.00)	<0.001
10	2 (1.25-3.00)	0 (0.00-1.00)	<0.001
12	2 (1.75-2.00)	2 (0.75-2.00)	0.413
24	1 (0.00-1.00)	1 (0.25-1.00)	0.269

Table 4: Comparison of VAS scores between group A and B.

Both groups reported no postoperative adverse effects such as respiratory depression, hypoxemia, hypotension, or somnolence. There were no adverse effects, including bleeding, peritoneum penetration, or toxicity from local anesthetics. Within the first 6 hours postoperatively, Group B experienced more bradycardia cases than Group A ($p = 0.03$).

Bradycardia was detected in 3 (8.57%) of the individuals in Group B and did not require any therapy. In group A, one patient (2.86%) had bradycardia and did not need therapy. In addition, during the first 48 hours following surgery, patient satisfaction scores in group B were

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significantly higher than in group B. Groups A and B had mean patient satisfaction scores of 3.5 and 4.5, respectively. ($p<0.05$).

DISCUSSION:

Ultrasound-guided TAP block targets the T9 to L1 nerve roots and is suggested for use in lower abdominal surgeries. After CS, it has also been presented as a useful part of multimodal analgesia.[10]

Ropivacaine belongs to the aminoamide class of local anaesthetics. Because ropivacaine has a larger safety margin and lower levels of cardiac toxicity, it was employed as the local anesthetic for TAP block in this investigation. In many localized blocks, dexmedetomidine, a highly selective α2 adrenoreceptor agonist, works well as an adjuvant to local anesthetics. When used in conjunction with local anesthetics, dexmedetomidine has been shown in prior research to improve analgesic efficacy and extend the duration of analgesic effects. Combination of Dexmedetomidine to Ropivacaine for TAP blocks has also yielded inconsistent results in different studies.[11]

In the current study, on comparing group B (Dex-R) to group A (ropivacaine alone), there was a significant increase in the duration of sensory block and analgesia ($p<0.05$). The group that got Ropivacaine in addition to dexmedetomidine experienced significantly longer initial reporting of postoperative pain, pain-free duration, and first request for analgesia as compared to the patients who received Ropivacaine alone. There were also noticeably fewer patients in group B who needed rescue analgesics than patients in group A.

Gupta KK et al.[12] examined the effectiveness of Dex-R as an analgesic in TAP block for unilateral infra-umbilical operations performed while under spinal anesthesia. Patients who got 20 mL of 0.25% Ropivacaine with 0.5 μg/kg (1 mL) dexmedetomidine experienced a considerably longer mean duration of analgesia (842.50 ± 38.74 min and 435.17 ± 25.75 min, respectively) than patients who received 20 mL of 0.25% Ropivacaine with 1 mL of normal saline.

The effectiveness of TAP block in conjunction with a dexmedetomidine adjunct for gynecological laparoscopy was assessed by Xue Y et al.[13] The study found that the use of dexmedetomidine as an adjuvant in conjunction with ultrasound-guided TAP block may enhance anesthesia recovery and minimize post-operative pain.

In their study Garg K et al.[14] examined the difference in analgesic impact of ropivacaine alone and ropivacaine plus dexmedetomidine for TAP block in pediatric laparoscopic patients. The

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study revealed that although the total amount of analgesics consumed in the first 24 hours was comparable, the first rescue analgesic demand was substantially longer (P = 0.001) in the 0.2% Ropivacaine with 1 g/kg dexmedetomidine group (474.8 min) than in the 0.5 ml/kg of 0.2% Ropivacaine group (240.9 min).

Similar study was done by Pan W et al.[15] on patients who had laparoscopic colectomy; the results showed that the Dex-R group experienced analgesia for a considerably longer period of time than the Ropivacaine group (P<0.05).

Qin Z et al.[16] found that the addition of Dexmedetomidine to Ropivacaine for TAP block significantly decreased serum levels of cortisol, epinephrine, norepinephrine, blood glucose, MAP, and HR in a dose-dependent manner ($p < 0.05$). This was accompanied by a decrease in the amount of anesthetic and opioid used during the procedure ($p < 0.05$). However, the high dose of Dexmedetomidine caused more instances of Bradycardia than the low or medium dose. ($p < 0.05$).

In the current study, patients who received Dex-R had considerably decreased post-operative VAS pain scores. Among patients who received Dex-R in the first six hours after surgery, bradycardia was more common 3(8.57%) ($p = 0.03$). This was similar to the study conducted by Garg K et al.[14] Similar findings were made by Zhang X et al.[17], who noted that the Dex-R group had a decreased incidence of POD on the first postoperative day and lower VAS scores at rest and during movement at 8 and 12 hours after surgery. The Dex-R group had transient bradycardia more frequently. The research additionally discovered that a lower VAS score 12 hours following surgery was linked to TAP block in conjunction with Dex-R.

Similar to the study by Qian H et al.[18] in the present study, during the first 48 hours following surgery, patient satisfaction scores were considerably greater in the Dex-R group compared to the Ropuvacaine group. ($p<0.05$).

CONCLUSION:

In conclusion, the current study demonstrated that the addition of 3 mg/kg of Ropivacaine plus 0.5 µg/kg of Dexmedetomidine in TAP block in patients undergoing CS increased pain-free duration, decreased the number of patients who required rescue analgesia, decreased VAS pain scores, prolonged the time of first request for analgesia, and improved patient satisfaction without serious side effects.

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Nil.

CONFLICTS OF INTEREST:

There are no conflicts of interest

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