

Original Research Article

ANALGESIC EFFICACY OF ROPIVACAINE VERSUS ROPIVACAINE-DEXMEDETOMIDINE FOR TRANSVERSUS ABDOMINIS PLANE BLOCK AFTER CAESAREAN SECTION

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ABSTRACT

Background: Postoperative pain following lower segment caesarean section (LSCS) can adversely affect maternal recovery, ambulation, breastfeeding, and overall well-being. Ultrasound-guided transversus abdominis plane (TAP) block provides effective somatic analgesia, but the duration of analgesia following single-shot ropivacaine remains limited. Dexmedetomidine, an α_2 -adrenergic receptor agonist, may enhance and prolong the analgesic effect of local anaesthetics. The objective is to compare the postoperative analgesic efficacy and safety of ultrasound-guided TAP block using 0.2% ropivacaine alone versus 0.2% ropivacaine combined with dexmedetomidine in women undergoing elective LSCS under spinal anaesthesia.

Materials and Methods: This prospective, randomized, double-blind, controlled study included 54 pregnant women aged 18–40 years with ASA physical status II undergoing elective LSCS. Participants were randomized equally into two groups of 27. Group RS received bilateral ultrasound-guided TAP block with 20 mL of 0.2% ropivacaine plus 1 mL normal saline on each side, while Group RD received 20 mL of 0.2% ropivacaine combined with dexmedetomidine 1 μ g/kg diluted to 1 mL on each side. Postoperative pain was assessed using the Visual Analogue Scale (VAS), and duration of analgesia, rescue tramadol consumption, haemodynamic parameters, Ramsay Sedation Score, and adverse events were recorded for 24 hours.

Results: Baseline demographic and anthropometric characteristics were comparable between the groups. VAS pain scores were significantly lower in Group RD at 2, 4, 6, and 12 hours after the block ($p < 0.001$). The mean pain-free duration was significantly longer with dexmedetomidine (8.67 ± 3.19 hours) compared with ropivacaine alone (4.59 ± 0.93 hours; $p < 0.001$). Total rescue tramadol consumption during the first 24 hours was significantly lower in Group RD than in Group RS (48.15 ± 9.62 mg vs. 100 mg; $p < 0.001$). Sedation scores were significantly higher in Group RD at 4, 8, and 12 hours, but no prolonged sedation was observed. Transient intergroup differences in haemodynamic parameters were noted, without clinically significant respiratory compromise or major block-related complications.

Conclusion: Addition of dexmedetomidine 1 μ g/kg to 0.2% ropivacaine for ultrasound-guided bilateral TAP block significantly prolongs postoperative analgesia, reduces pain intensity and rescue tramadol requirements, and provides effective postoperative analgesia following LSCS. The technique

appears to be a useful component of multimodal analgesia, although transient increases in sedation and haemodynamic differences warrant appropriate postoperative monitoring.

Keywords: LSCS, TAP block.

INTRODUCTION

The global and national rates of caesarean delivery have increased steadily over the past two decades, with the incidence in India exceeding the World Health Organization's recommended threshold of 15%.^[1] Adequate postoperative analgesia following lower segment caesarean section (LSCS) is an essential component of enhanced recovery because effective pain relief facilitates early ambulation, successful breastfeeding, maternal–infant bonding, and overall maternal satisfaction.^[2,3] Inadequately treated postoperative pain can delay functional recovery and adversely affect both maternal physical and psychological well-being.

Pain after LSCS has both somatic and visceral components, although the predominant source is the surgical incision involving the anterior abdominal wall. Conventional postoperative analgesia relies on systemic administration of opioids and non-opioid analgesics through oral or intravenous routes. While these agents provide satisfactory pain relief, their use may be associated with adverse effects such as nausea, vomiting, sedation, respiratory depression, and delayed recovery.^[4] Consequently, regional anaesthetic techniques have become an integral part of multimodal analgesia, reducing opioid consumption while improving postoperative comfort. The transversus abdominis plane (TAP) block is one of the most commonly employed fascial plane blocks for postoperative analgesia after lower abdominal surgery.^[5,6] It has demonstrated beneficial analgesic effects following several abdominal procedures, including hysterectomy, cholecystectomy, colectomy, prostatectomy, hernia repair, iliac crest bone graft harvesting, and caesarean section.^[7-14] Although a single-shot TAP block primarily alleviates somatic pain and has a limited duration of action, it remains a valuable component of multimodal postoperative analgesia following LSCS.^[15]

The TAP block was originally described by Rafi in 2001 as a landmark-guided technique using the triangle of Petit.^[16] The block involves deposition of local anaesthetic in the fascial plane between the internal oblique and transversus abdominis muscles, where the anterior rami of the thoracolumbar nerves (T6–L1) course before supplying the anterolateral abdominal wall.^[17] Spread of local anaesthetic within this plane interrupts transmission through these nerves, thereby providing effective analgesia for pain arising from the abdominal incision. Although the landmark technique was associated with occasional complications and variable block success, the introduction of ultrasound guidance has significantly improved the accuracy, efficacy, and safety of TAP

block, leading to its widespread clinical acceptance.^[18]

Several long-acting local anaesthetics, including bupivacaine, levobupivacaine, and ropivacaine, have been evaluated for TAP block. Ropivacaine is widely preferred because of its favourable safety profile, lower cardiotoxicity than bupivacaine, reduced motor blockade, and effective postoperative analgesia.^[19] Nevertheless, the duration of analgesia following a single injection remains limited, prompting investigation into adjuvants that may prolong its analgesic effect.

Various additives, including tramadol, fentanyl, clonidine, and dexamethasone, have been combined with local anaesthetics to enhance the quality and duration of peripheral nerve blocks.^[20] Dexmedetomidine, a highly selective α_2 -adrenergic receptor agonist, possesses sedative, analgesic, sympatholytic, and opioid-sparing properties.^[21] Activation of presynaptic α_2 receptors inhibits norepinephrine release, thereby reducing nociceptive transmission, while postsynaptic receptor activation decreases sympathetic outflow, resulting in analgesia and sedation.^[22,23] Experimental and clinical studies have suggested that the addition of dexmedetomidine to ropivacaine in TAP block may prolong postoperative analgesia and reduce analgesic requirements.^[24]

However, evidence regarding the efficacy of dexmedetomidine as an adjuvant to low-concentration ropivacaine for ultrasound-guided TAP block in women undergoing LSCS remains limited. Therefore, the present study was designed to compare the postoperative analgesic efficacy of ultrasound-guided TAP block using 0.2% ropivacaine alone with that of 0.2% ropivacaine combined with dexmedetomidine in patients undergoing LSCS. Postoperative pain was evaluated using the Visual Analogue Scale (VAS),^[25] and sedation was assessed with the Ramsay Sedation Scale throughout the observation period.^[26]

MATERIALS AND METHODS

Study Design and Ethical Approval: This prospective, randomized, double-blind, controlled study was conducted in the Department of Anesthesiology, South Eastern Railway Central Hospital, Kolkata, India, between 2020 and 2022. The study protocol was approved by the Institutional Ethics Committee and the Scientific Research Committee before patient recruitment. Written informed consent was obtained from all participants after explaining the study objectives and procedures. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Participants: Fifty-four pregnant women aged 18–40 years with American Society of Anesthesiologists (ASA) physical status II, scheduled for elective lower segment cesarean section (LSCS) under spinal anaesthesia, were enrolled.

Inclusion Criteria

- Age 18–40 years
- ASA physical status II
- Elective LSCS under subarachnoid block
- Provision of written informed consent

Exclusion Criteria

Patients were excluded if they had:

- Refusal to participate
- Body mass index (BMI) >35 kg/m²
- ASA physical status III or higher
- Known hypersensitivity to the study medications
- Contraindications to spinal anesthesia, including infection at the puncture site, raised intracranial pressure, coagulopathy, severe spinal deformity, or systemic sepsis

Sample Size Calculation: The sample size was calculated using a two-sided significance level of 5% and a study power of 90%. Assuming a clinically significant difference of 2 units in postoperative Visual Analogue Scale (VAS) score between the study groups, the minimum calculated sample size was 27 patients per group. Accordingly, 54 participants were included.

Randomization and Blinding

Participants were randomly assigned in a 1:1 ratio using a computer-generated block-randomisation sequence into one of two study groups.

Group RS (Control group): Patients received bilateral ultrasound-guided TAP block using 20 mL of 0.2% ropivacaine mixed with 1 mL normal saline on each side (total volume 42 mL).

Group RD (Dexmedetomidine group): Patients received bilateral ultrasound-guided TAP block using 20 mL of 0.2% ropivacaine combined with dexmedetomidine 1 µg/kg diluted to 1 mL on each side (total volume 42 mL).

The study solutions were prepared by an anaesthesiologist who was not involved in patient management or data collection. Both the anaesthesiologist performing the TAP block and the investigator responsible for postoperative assessment remained blinded to group allocation throughout the study.

Preanesthetic Assessment: All patients underwent a comprehensive preanesthetic evaluation one day before surgery. Demographic characteristics, medical history, physical examination findings, and routine laboratory investigations were documented. The VAS scoring system was explained to each participant before surgery.

Perioperative Management: Patients observed standard fasting guidelines consisting of at least 6 hours for solid food and 2 hours for clear fluids.

After arrival in the operating room, standard monitoring was instituted, including electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO₂), and body

temperature monitoring. Baseline heart rate and blood pressure were recorded before induction of anaesthesia.

Spinal Anaesthesia: Spinal anaesthesia was administered with the patient in the sitting position under strict aseptic precautions. Following infiltration of the skin with 2 mL of 2% lignocaine, a 25-gauge Quincke spinal needle was introduced through the L3–L4 intervertebral space using a midline approach. After confirmation of free cerebrospinal fluid flow, 2 mL of 0.5% hyperbaric bupivacaine was injected intrathecally over 20–30 seconds.

Immediately after injection, patients were positioned supine with a 15° left lateral tilt to minimise aortocaval compression. Surgery commenced after achieving a sensory block up to at least the T6 dermatome.

Hypotension, defined as a systolic blood pressure decrease of more than 20% from baseline or an absolute systolic pressure below 90 mmHg, was managed with intravenous fluids and mephentermine. Bradycardia, defined as a heart rate below 50 beats/min, was treated with intravenous atropine.

Ultrasound-Guided Transversus Abdominis Plane Block

Following completion of the cesarean section and before transfer to the post-anaesthesia care unit (PACU), bilateral ultrasound-guided TAP blocks were performed under aseptic precautions.

A portable ultrasound machine equipped with a high-frequency linear transducer (6–13 MHz) was positioned transversely over the anterolateral abdominal wall between the iliac crest and the costal margin. The external oblique, internal oblique, and transversus abdominis muscles were identified sonographically.

A 21-gauge, 10-cm insulated Stimuplex needle was introduced using an in-plane technique through the anterior axillary line and advanced under continuous ultrasound visualisation until the needle tip reached the fascial plane between the internal oblique and transversus abdominis muscles.

After negative aspiration, the allocated study solution was injected on each side with ultrasound confirmation of appropriate spread within the transversus abdominis plane.

Following completion of the block, patients were transferred to the PACU for postoperative monitoring.

Postoperative Assessment: Standard monitoring, including ECG, NIBP, heart rate, oxygen saturation, and body temperature, was continued in the PACU. Pain intensity was assessed using the Visual Analogue Scale (VAS) at 0, 2, 4, 6, 8, 12, and 24 hours after TAP block.

The duration of postoperative analgesia was defined as the interval between completion of the TAP block and administration of the first rescue analgesic.

Rescue analgesia was administered when the VAS score exceeded 4 or upon patient request. Intramuscular tramadol 50 mg was used as the rescue

analgesic. Total tramadol consumption during the first 24 postoperative hours was recorded.

Hemodynamic parameters, including heart rate, systolic blood pressure, and diastolic blood pressure, were recorded at the same postoperative time points. Sedation was evaluated using the Ramsay Sedation Scale, and adverse events such as hypotension, bradycardia, nausea, vomiting, or any block-related complications were documented throughout the study period.

Outcome Measures

Primary Outcome

- Duration of postoperative analgesia, defined as the time from completion of TAP block to administration of the first rescue analgesic.

Secondary Outcomes

- Postoperative VAS pain scores
- Time to first rescue analgesia
- Total tramadol consumption during the first 24 postoperative hours
- Hemodynamic variables
- Ramsay Sedation Score
- Incidence of adverse events, including hypotension, bradycardia, nausea, vomiting, and block-related complications

Statistical Analysis: Statistical analysis was performed using SPSS Statistics version 24.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation or median (interquartile range), as appropriate. Categorical variables were presented as frequencies and percentages.

Continuous variables were compared using the independent Student's *t*-test for normally distributed data and the Mann–Whitney *U*-test for non-normally distributed data. Categorical variables were analysed using the Chi-square test or Fisher's exact test, as appropriate. A two-tailed *P*-value of <0.05 was considered statistically significant.

Figure Legends (JOACP Style)

[Figure 1] Portable ultrasound machine used for ultrasound-guided transversus abdominis plane block.

[Figure 2] High-frequency linear ultrasound transducer (6–13 MHz) used to identify the abdominal wall muscle layers.

[Figure 3] Probe placement for ultrasound-guided transversus abdominis plane block along the anterolateral abdominal wall after cesarean delivery.

[Figure 4] Ultrasound image demonstrating the needle tip positioned between the internal oblique and transversus abdominis muscles with spread of local anaesthetic within the transversus abdominis plane.

RESULTS

There was no statistically significant difference in the mean age between Group RS and Group RD ($p = 0.594$), indicating that both groups were comparable with respect to age at baseline. Hence, age was

unlikely to influence the postoperative outcomes of the study.

The mean body weight of participants was similar in both groups, with no statistically significant difference ($p = 0.751$). This demonstrates successful randomization and baseline homogeneity regarding body weight. The average height was identical in both study groups (1.60 ± 0.02 m), and no statistically significant difference was observed ($p = 0.878$), confirming comparable baseline anthropometric characteristics.

Body Mass Index (BMI) Both groups had comparable BMI values, with no statistically significant difference ($p = 0.736$). Therefore, BMI was unlikely to act as a confounding factor affecting the study outcomes.

The duration of surgery was comparable between the two groups ($p = 0.054$), suggesting that surgical duration did not influence the postoperative analgesic or haemodynamic outcomes.

Baseline and 24-hour systolic blood pressure values were comparable between the groups. However, significant differences were observed at 2, 4, 6, 8, and 12 hours after the TAP block ($p < 0.05$), indicating that the intervention influenced postoperative haemodynamic responses during the early postoperative period. Diastolic Blood Pressure (DBP) remained comparable at baseline, 2, 6, and 24 hours, whereas significant intergroup differences were observed at 4, 8, and 12 hours ($p < 0.001$). These findings suggest transient postoperative haemodynamic differences between the treatment groups.

Heart rate was similar at baseline, 2, 6, and 24 hours, while statistically significant differences occurred at 4, 8, and 12 hours ($p < 0.001$). This indicates that the two treatment regimens produced different postoperative physiological responses during the intermediate postoperative period.

Peripheral oxygen saturation (SpO_2) remained within the normal range throughout the study in both groups. Except for a small but statistically significant difference at 12 hours ($p = 0.038$), SpO_2 values were comparable, indicating that both interventions maintained adequate oxygenation without clinically relevant respiratory compromise.

Postoperative Visual Analogue Scale (VAS) scores were significantly lower in Group RD than in Group RS at 2, 4, 6, and 12 hours ($p < 0.001$). Although pain scores were higher in Group RD at 8 hours, overall analgesic efficacy was superior in Group RD, with no significant difference remaining at 24 hours.

The requirement for rescue analgesia differed significantly between the two groups during the postoperative period. Group RD required no rescue analgesia during the initial 6 hours and demonstrated a significantly reduced analgesic requirement at 12 hours, indicating prolonged postoperative analgesia compared with Group RS. No significant difference was observed at 24 hours.

The total postoperative rescue analgesic consumption was significantly lower in Group RD (48.15 ± 9.62

mg) than in Group RS (100 mg) ($p < 0.001$), demonstrating that the addition of dexmedetomidine markedly reduced overall postoperative analgesic requirements.

Sedation Scores were significantly different between the groups at 4, 8, and 12 hours ($p < 0.001$), while no significant differences were observed at baseline, 2, 6, or 24 hours. This suggests that dexmedetomidine influenced postoperative sedation during the

intermediate postoperative period without causing prolonged sedation.

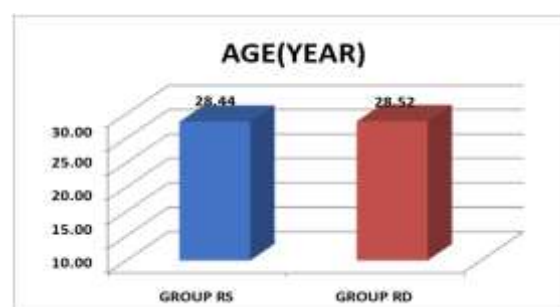
The pain-free period was significantly longer in Group RD (8.67 ± 3.19 hours) than in Group RS (4.59 ± 0.93 hours) ($p < 0.001$), indicating that dexmedetomidine as an adjuvant to ropivacaine in TAP block substantially prolonged the duration of postoperative analgesia.

Table 1: Age distribution in the study population(n=54)

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation	P Value	Significance
AGEYEAR	28.44	0.51	28.52	0.51	0.594	Not Significant

P value < 0.05 considered as significant

The average age of the participants in Group RS was 28.44 ± 0.51 years. Majority of the participants were of the age of 28 and 29 years only. While in the RD group, where average age of the participants was 28.52 ± 0.51 and majority of the participants were of the age of 28 or 29. No significant difference was seen in the mean age of the two-study group. ($p > 0.05$)



Graph 1: Category wise age distribution in the study population.

Table 2: Weight distribution in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
WEIGHT	64.04	0.90	63.96	0.81	0.751	Not Significant

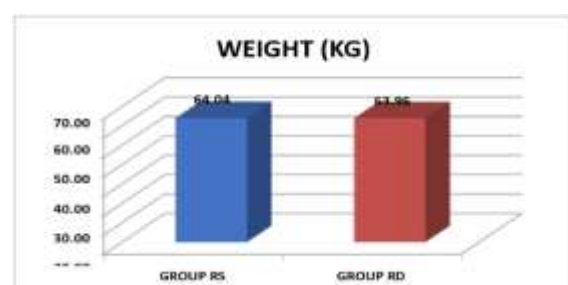
Weight distribution of the study participants showed. The mean weight of the participating females in the RS Group was 64.04 ± 0.90 kg while that of the RD

group was 63.96 ± 0.81 kg. No significant difference in the weight distribution of the study group was seen ($p > 0.05$).

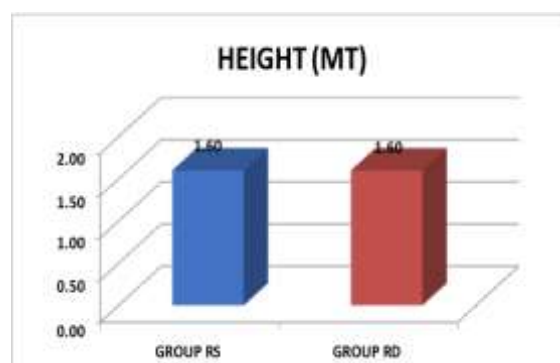
Table 3: Height distribution in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
HEIGHT	1.60	0.02	1.60	0.02	0.878	Not Significant

The average height of the participants in both group RS and RD was 1.60 ± 0.02 metre. No significant difference was seen in the mean height of the two-study group ($p > 0.05$).



Graph 2: Category wise distribution of weight.

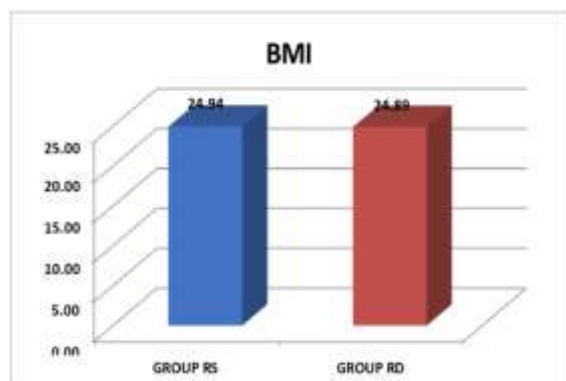


Graph 3: Category wise height distribution in the study population.

Table 4: The average BMI (Body Mass Index) of the study population

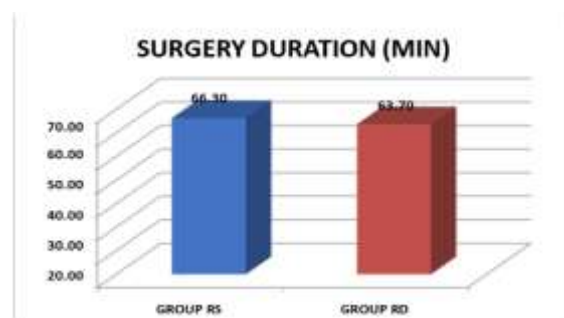
	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation	p Value	Significance
BMI	24.94	0.46	24.89	0.58	0.736	Not Significant

The average BMI in RS group was 24.94 ± 0.46 kg/m² while the mean BMI value in Group RD Was 24.89 ± 0.58 kg/m². No significance was seen in the mean BMI of the two-study group ($p > 0.05$).



Graph 4: Mean BMI in the study population

The average duration of surgery in Group RS And RD were 66.30 ± 4.92 and 63.70 ± 4.72 minutes Respectively. There was no significant difference seen in the surgery duration in both the groups (p value > 0.05).



Graph 5: Mean surgery duration in the study population.

Table 5: The average duration of the surgery in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
SURGERY DURATION	66.30	4.92	63.70	4.72	0.054	Not Significant

Table 6: Mean Systolic Blood Pressure at different time duration in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
SBP: 0 HOUR	117.19	4.44	117.26	3.32	0.945	Not Significant
SBP: 2HOUR	117.33	4.27	121.33	5.53	0.004	Significant
SBP: 4HOUR	129.04	7.17	117.41	3.21	<0.001	Significant
SBP: 6 HOUR	122.78	9.25	118.59	3.09	0.030	Significant
SBP: 8 HOUR	120.78	5.81	130.85	5.76	<0.001	Significant
SBP: 12 HOUR	131.30	6.23	119.74	5.97	<0.001	Significant
SBP: 24 HOUR	117.37	4.27	118.74	4.48	0.255	Not Significant

Group wise mean of the systolic blood pressure of the study participants showed as different time duration started after the point of TAP (Transversus Abdominis Plane Block) and recording were done at 0 hr(after TAP block), 2hr, 4hr, 6hr, 8hr, 12hr and 24 hour. Significant difference in mean systolic BP was observed after 2hr, 4hr, 6hr, 8hr and 12hr (p value < 0.05) in the studied groups.



Graph 6: Mean systolic pressure at different time duration in the study population.

Table 7: Mean diastolic pressure at different time duration in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation	P Value	Significance
DBP: 0 HOUR	76.67	4.56	75.56	4.26	0.359	Not Significant
DBP: 2HOUR	76.48	4.27	77.93	4.04	0.207	Not Significant
DBP: 4HOUR	83.33	3.77	75.81	4.10	<0.001	Significant
DBP: 6 HOUR	79.15	5.86	76.59	3.78	0.062	Not Significant

DBP: 8 HOUR	78.74	4.51	84.15	3.70	<0.001	Significant
DBP: 12 HOUR	84.26	3.59	76.56	5.45	<0.001	Significant
DBP: 24 HOUR	76.37	4.15	76.67	4.09	0.793	Not Significant

Group wise mean of the diastolic blood pressure of the study participants showed as different time duration started after the point of TAP (Transversus Abdominis Plane Block) and recording were done at 0 hr(after TAP block), 2hr, 4hr, 6hr, 8hr, 12hr and 24 hour. When baseline MAP was noted down, then it was found that significant difference in the rise of mean diastolic BP was observed after 4hr, 8hr and 12 hours (p-value <0.05) of TAP Block in the group RS while in Group RD it was observed after 8hr. When the trend was compared in both the group it was found that rise in mean DBP was more in Group RD after 4hr, 8hr and 12hr.



Graph 7: Mean systolic pressure at different time duration in the study population

Table 8: Mean heart rate at different time duration in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation	P Value	Significance
HR: 0 HOUR	69.22	3.03	70.07	3.81	0.368	Not Significant
HR: 2HOUR	69.22	3.04	70.67	3.86	0.133	Not Significant
HR: 4HOUR	85.48	10.11	70.67	4.06	<0.001	Significant
HR: 6 HOUR	76.04	10.21	72.26	3.85	0.078	Not Significant
HR: 8 HOUR	74.04	7.77	86.22	6.03	<0.001	Significant
HR: 12 HOUR	87.15	7.94	73.56	7.18	<0.001	Significant
HR: 24 HOUR	70.22	3.58	72.44	5.81	0.096	Not Significant

Group wise mean of the heart rate of the study participants showed as different time duration started after the point of TAP (Transversus Abdominis Plane Block) and recording were done at 0 hr (after TAP block), 2hr, 4hr, 6hr, 8hr, 12hr and 24 hour. Significant difference in mean heart rate was observed after 4hr, 8hr and 12 hours (p-value <0.05) in the studied groups.



Graph 8: Mean heart rate at different time duration in the study population.

Table 9: Mean blood oxygen saturation levels at different time duration in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
SPO2 : 0 HOUR	99.89	0.32	99.78	0.58	0.386	Not Significant
SPO2: 2HOUR	99.89	0.32	99.89	0.32	1.000	Not Significant
SPO2: 4HOUR	99.96	0.19	99.96	0.19	1.000	Not Significant
SPO2: 6 HOUR	100.00	0.00	100.00	0.00	NA	NA
SPO2: 8 HOUR	100.00	0.00	100.00	0.00	NA	NA
SPO2: 12 HOUR	100.00	0.00	99.85	0.36	0.038	Significant
SPO2: 24 HOUR	100.00	0.00	100.00	0.00	NA	NA

Group wise mean of the blood oxygen saturation of the study participants showed as different time duration started after the point of TAP (Transversus Abdominis Plane Block) and recording were done at 0 hr (after TAP block), 2hr, 4hr, 6hr, 8hr, 12hr and 24 hours. Significant difference in blood oxygen saturation was observed after 12 hours (p-value <0.05) in the studied groups



Graph 9: Mean blood oxygen saturation levels at different time duration in the study population

Table 10: Mean VAS(Visual Analogue Scale) score at different time duration in the study population

	GROUP				P Value	Significance
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
VAS: 0 HOUR	0.00	0.00	0.00	0.00	NA	NA
VAS: 2HOUR	2.00	0.00	0.22	0.42	<0.001	Significant
VAS: 4HOUR	5.56	2.12	1.22	0.85	<0.001	Significant
VAS: 6 HOUR	3.81	2.30	2.07	0.38	<0.001	Significant
VAS: 8 HOUR	3.89	1.58	6.19	1.39	<0.001	Significant
VAS: 12 HOUR	6.37	2.02	2.52	1.81	<0.001	Significant
VAS: 24 HOUR	2.07	0.96	2.04	1.60	0.918	Not Significant

4 hours, 2.07 ± 0.38 at 6hours, 6.19 ± 1.39 at 8 hours, 2.52 ± 1.81 at 12 hours. All participants in group RD had a lower VAS score at 2 hours, 4 hours, 6 hours, and 12 hours compared with the group RS. But, at 6th hour VAS score of the group RD was higher than the group RS. VAS score between both the groups was statistically significant (P value < 0.001) after 2 hours, 4 hours, 6 hours, 8 hours & 12 hours



Graph 10: Mean VAS (Visual Analogue Scale) score at different time duration in the study population.

Table 11: Average amount of rescue analgesia administered to the study participants at different time duration after TAP block

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation	P Value	Significance
RESCUE ANALGESIA: 0 HOUR	0.00	0.00	0.00	0.00	NA	NA
RESCUE ANALGESIA: 2HOUR	0.00	0.00	0.00	0.00	NA	NA
RESCUE ANALGESIA: 4HOUR	33.33	24.02	0.00	0.00	<0.001	Significant
RESCUE ANALGESIA: 6 HOUR	16.67	24.02	0.00	0.00	<0.001	Significant
RESCUE ANALGESIA: 8 HOUR	7.41	18.10	40.74	19.79	<0.001	Significant
RESCUE ANALGESIA: 12 HOUR	42.59	18.10	5.56	16.01	<0.001	Significant
RESCUE ANALGESIA: 24 HOUR	0.00	0.00	1.85	9.62	0.322	Not Significant

Amount of Rescue analgesic given to the participants in both the groups were compared at different time intervals post operatively, the trend was noted, and it was found out that just after and 2 hours later of TAP Block no rescue analgesic was administered to any participants in both group RS and RD.

After 4 hours and 6 hours of TAP Block, a significant difference was seen in the amount of rescue analgesia given to group RS while no rescue analgesia was required by the group RD.

After 8 hours, 4 of the participants in group RS ($7.41 \pm 18.10\text{mg}$) while 22 of the 27 participants in the group RD ($40.74 \pm 19.79 \text{ mg}$) required rescue analgesia respectively.

A statistically significant amount of rescue analgesia administered in group RS ($42.59 \pm 18.10\text{mg}$) was administered compared to ($5.56 \pm 16.01\text{mg}$) in group RD after 12 hours.

Rescue analgesia administered to both groups was statistically insignificant after 24 hours.



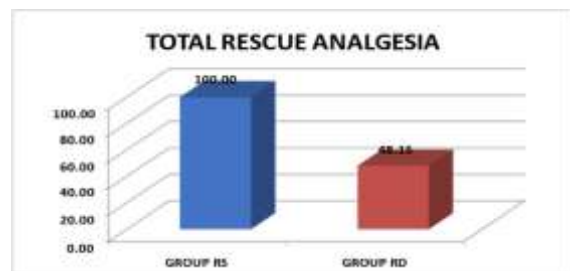
Graph 11: Average amount of rescue analgesia administered to the study participants at different time duration after TAP block

Table 12: Average total amount of rescue analgesia administered to the study participants

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation	P Value	Significance
TOTAL RESCUE ANALGESIA	100.00	0.00	48.15	9.62	<0.001	Significant

The average total amount of rescue analgesia administered to the Group RS was higher (100mg) than that administered to the participants of Group RD (48.15 ± 9.62 mg).

A statistically significant lower amount of Rescue analgesic was needed in the Group RD (pvalue<0.001) after 24 hours of TAP Block.



Graph 12: Average total amount of rescue analgesia administered to the study participants.

Table 13: The average sedation score in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation	P Value	Significance
SEDATION SCORE: 0 HOUR	2.00	0.00	2.00	0.00	NA	NA
SEDATION SCORE: 2HOUR	2.00	0.00	2.00	0.00	NA	NA
SEDATION SCORE: 4HOUR	1.33	0.48	2.00	0.00	<0.001	Significant
SEDATION SCORE: 6 HOUR	1.67	0.48	1.85	0.36	0.116	Not Significant
SEDATION SCORE: 8 HOUR	1.85	0.36	1.19	0.40	<0.001	Significant
SEDATION SCORE: 12 HOUR	1.15	0.36	1.89	0.32	<0.001	Significant
SEDATION SCORE: 24 HOUR	2.00	0.00	1.96	0.19	0.322	Not Significant

P-value <0.05 considered as significant

A statistically significant difference was seen in average sedation score after 4 hours, 8 hours and 12 hours between Group RS and Group RD. After 4 hours and 12 hours, sedation score was lower in Group RS compared to Group RD suggesting agitation or anxiety among participants of Group RS due to pain. In the same way, after 8 hours participants of the Group RD had lower Sedation score compared to Group RS due to the same reason of Pain.



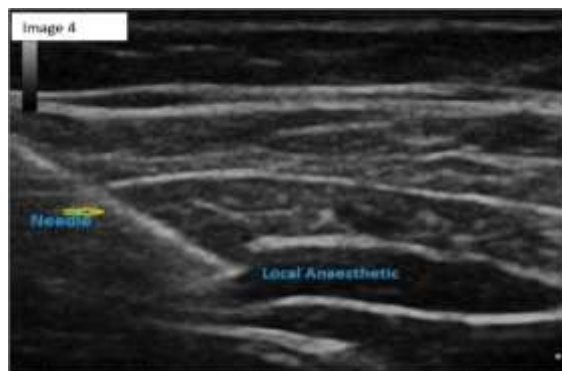
Graph 13: The average sedation score in the study population

Table 14: The average pain free duration in the study population

	GROUP					
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
PAIN FREE PERIOD (Hours)	4.59	0.93	8.67	3.19	<0.001	Significant

A statistically significant difference in the pain free duration (VAS ≤ 4) was observed in the study group. The average amount of time in the pain free duration

was significantly higher in the group RD i.e. 8.67 ± 3.19 hours when compared to group RS i.e. 4.59 ± 0.93 hours.



DISCUSSION

Transversus abdominis plane block has a major role in abdominal surgeries as an analgesic regimen, but it is not fully defined. In the study that we conducted, the analysis of the effect of dexmedetomidine when combined with ropivacaine in TAP block for postoperative pain relief among the patients who underwent LSCS was done. The probable efficacy of adding dexmedetomidine to ropivacaine in the patients who underwent LSCS was analysed in terms of reduced pain (VAS score) and opioid usage (Tramadol via intramuscular route) for the first 24 hours. TAP block was done under Ultrasound guidance.

In our study, the demographic profile was comparable with respect to mean age, body weight and ASA physical status. The total number of patients in our study was 54, which were divided equally into group RS and group RD, with 27 study patients in each group. Bilateral transversus abdominis plane block was performed in group RS with 0.2% ropivacaine plus normal saline in group RS and group RD with 0.2% ropivacaine plus dexmedetomidine. All the patients received USG-guided TAP block on each side. We found that the addition of dexmedetomidine with ropivacaine improves the efficacy of TAP block, prolongs the duration of analgesia, reduces the amount of analgesics required post-operatively, and reduces the post-operative pain in these post-LSCS patients.

A randomised, blinded, controlled study was done in 2011 by Brummett et al³⁴ to see the analgesic effects of peripheral nerve blocks using 0.5% ropivacaine alone or 0.5% ropivacaine plus dexmedetomidine, and it was observed that adding dexmedetomidine to ropivacaine caused approximately a 75% increase in the duration of analgesia. After that, numerous studies were conducted that indicated that adding dexmedetomidine to local anaesthetics prolongs the analgesic duration provided by the local anaesthetics in brachial plexus nerve block³⁵, ulnar nerve block³⁶, and TAP block^{33,37,38}. Just like the other studies^{33,37,38}, the results of this study have also suggested that adding dexmedetomidine with ropivacaine prolongs the action of the latter and increases its analgesic effects without increasing associated complications.

The optimal dosing of dexmedetomidine as an adjunct to TAP blockade has remained to be determined despite promising results from previous studies. Xu et al³⁷ in their study on elderly patients undergoing emergency laparotomy of combining 0.5% dexmedetomidine with ropivacaine in TAP block and rectus sheath block reported prolonged duration of analgesia and reduced post-operative pain. Luan et al³⁸ indicated that 0.5 mcg/kg dexmedetomidine can potentiate the analgesic properties of ropivacaine in TAP block after hysterectomy surgery. Kiplinger et al³⁹ in their study, suggested that dexmedetomidine in different dosages, i.e., 50, 100 or 150 mcg, when mixed with 0.75%, increased the duration of sensory blockade in a dose-dependent manner in ulnar nerve block. Junget al⁴⁰ mixed different doses i.e., 1, 1.5 and 2 mcg/kg of dexmedetomidine with ropivacaine in interscalene brachial plexus block and observed that there was not much difference in the duration of analgesia between the group treated with 1 and 1.5 mcg/kg dexmedetomidine while the group treated with 2 mcg/kg of dexmedetomidine showed some side effects like hypotension with no added advantages over the other groups. Based on the above studies, the dose of 1 mcg/kg was chosen for the current study to see the effects of adding dexmedetomidine with ropivacaine in TAP block after caesarean section. Regular gynaecologic incisions were performed around 2 cm above the pubic symphysis. The results from the current study as well as the other studies mentioned above have indicated that the TAP block provided good-quality blocking from T8 to T12. In our study, all the patients who received the local anaesthetic alone, that is, 0.2% ropivacaine with saline, did not have sufficient duration to provide analgesia above 4 hours. By contrast, at 24 hours post-operation, the pain score in the group RS was significantly higher than the group RD. The analgesic effect of the TAP block appeared to be increased when dexmedetomidine was added with ropivacaine, and overall the VAS pain score was lower compared to the group RS. The result of the present study suggested that the addition of dexmedetomidine to 0.2% Ropivacaine for TAP blockade improved the quality and duration of analgesia as well as reduced the overall requirement of opioids postoperatively. In our study, the overall pain score was lower in group RD and they required a lesser amount of tramadol (48.15 ± 9.62 mg) vs group RS (100 mg) after the 24-hour interval of our study. Also, the group that received dexmedetomidine as an adjuvant required a longer time to first tramadol use, i.e., 8 hours in 12 of the participants and 10 hours in 7 of the participants after LSCS surgery. The sedation score of group RD was higher compared with the group RS. No major changes in vitals were observed after the administration of local anaesthetic and dexmedetomidine in the TAP block. The pain-free duration that we achieved in our study was 8.67 ± 3.19 hours after adding dexmedetomidine to 0.2% ropivacaine which is much higher than 0.2%

Ropivacaine given alone, i.e., 4.59 ± 0.93 hours in TAP block. TAP block with dexmedetomidine plus ropivacaine additionally provided approximately 4 hours of analgesia compared with ropivacaine alone, with no significant differences in patients' vitals after the surgery.

Qiet al³², conducted a study on 100 patients who underwent gynaecological surgeries and divided the patients randomly into 4 groups with 25 study patients in each group. TAP block was performed on 3 groups which were divided as Group R, who received only 0.375% ropivacaine; Group R-dex, who received 0.375% ropivacaine along with dexmedetomidine 1 mcg/kg and Group R-fen, who was administered 0.375% ropivacaine along with 1 mcg/kg of fentanyl. The fourth group was kept as the control group, which received PCA (patient-controlled analgesia) of sufentanil. Time to first rescue analgesia was 1.56 hours in the control group, while in group R it was 7.86 hours, in group R-dex 9.86 hours and in group R-fen 8.79 hours. The results that we found in our study were 8.67 hours, which was approximately 1 hour less than what was observed in this study conducted by Qi et al. PCA boluses were lower in the group R-dex than any other group, which indicates that the efficacy of analgesia was enhanced by adding dexmedetomidine to ropivacaine in TAP block.

A study was conducted by Zenget al³³ on 100 patients who underwent laparotomy, where the patients were divided into four groups, in which one group was administered 50 ml of 0.3% ropivacaine while the other three groups were administered 50 ml of 0.3% ropivacaine along with 0.5 mcg/kg, 1 mcg/kg and 2 mcg/kg of dexmedetomidine, respectively, in TAP block. Pain was assessed on the NRS scale where a lower NRS score was observed in the first 12 hours after TAP block in the group that received dexmedetomidine. The PCA boluses administered to the patients were also lower in this group who received dexmedetomidine plus ropivacaine than the group who received ropivacaine alone. Time to first rescue analgesia was 510 minutes in the group who received just ropivacaine, while the duration was 595 min, 682 min and 776 minutes in the groups who received dexmedetomidine 0.5 mcg/kg, 1 mcg/kg and 2 mcg/kg respectively as supplement to ropivacaine in TAP block. The duration of time to first rescue analgesia with 50 mL 0.3% ropivacaine with 1 mcg/kg was 682 minutes which is higher than what we have achieved in our study i.e., 520 minutes. The difference could be due to the difference in the dosage of ropivacaine used (i.e., 50 mL 0.3% vs 40 mL 0.2%).

However, the patients in the group that received higher i.e., 2 mcg/kg of dexmedetomidine had a way higher time to rescue analgesia (776 min) but these patients had a higher PACU stay after the procedure. Xu et al³⁷ conducted a prospective randomised double-blind study trial on 60 patients to compare the analgesic efficacy of dexmedetomidine when it is added to ropivacaine in combined TAP and rectus

sheath block. The patients were divided equally into 2 groups of 30 patients in each group. Group R received only ropivacaine, while group RD received 0.5mcg/kg dexmedetomidine mixed with ropivacaine. Bilateral TAP plus rectus sheath was performed, and 10 ml of ropivacaine was administered at each of the 4 sites in group R, while in group RD 0.5mcg/kg dexmedetomidine was added. In their results, they found that a lower dose of rescue analgesia in the form of sufentanil was needed in 24-hour duration after the block in group RD compared to group R. Time to first rescue analgesia after the block was 248 minutes in group RD vs 157 min in group R, which is lesser if compared to the results that we obtained in our study, i.e., 520 minutes. The VAS score was lower for the first 12 hours after the block, which is like the effect that we saw in our study after adding dexmedetomidine.

The study done by Luan et al [38] on 50 patients divided equally into two groups, i.e., one that received ropivacaine while the other received dexmedetomidine with ropivacaine in TAP block after hysterectomy. It showed that ultrasound-guided TAP block with ropivacaine and dexmedetomidine reduced the use of patient-controlled analgesia after hysterectomy. Ropivacaine in the dose of 20ml 0.3% concentration was used, and dexmedetomidine in the concentration of 0.5mcg/kg was used. Better analgesic results were seen in the group that received dexmedetomidine in addition to ropivacaine.

However, in the study by Ding et al. [41], performed in gastrectomy-undergoing patients, the addition of dexmedetomidine to ropivacaine for TAP block did not yield better results than ropivacaine alone. Another study, conducted by Bansal et al [42] with 40 study subjects divided into 2 groups of 20 patients each, where one group was administered dexmedetomidine plus ropivacaine while the other group of patients were administered ropivacaine alone in TAP block. The pain-free duration of 6.6 ± 2.01 hours was observed in the former group, while in the latter it was only 5.03 ± 1.34 hours. Time to first rescue analgesia in the group that received dexmedetomidine with ropivacaine was 7.8 hours. Compared to these results, the results that we obtained showed more time to rescue analgesia i.e., 8.67 hours after the addition of dexmedetomidine to ropivacaine. In our study as well as in the above-mentioned surgeries, it can be suggested that the addition of dexmedetomidine to ropivacaine prolongs the pain-free duration as well as the overall usage of rescue analgesics and improvement of overall VAS or pain score for the first 24 hours after TAP block.

Limitations to our study

There were a few limitations in our study:

- We did not estimate the plasma concentration of dexmedetomidine to determine whether its action was related to local effects or systemic effects.

- We were unable to measure the onset time of TAP block because the patient did not fully recover from the subarachnoid block effects.

CONCLUSION

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