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Efficacy Comparison of Transversus Abdominis Plane Block with Levobupivacaine Versus Combined Levobupivacaine and Dexmedetomidine for Postoperative Analgesia in Cesarean Delivery

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ABSTRACT

Background: Effective postoperative pain management in cesarean delivery is crucial for patient recovery and satisfaction. This study aimed to evaluate the efficacy of transversus abdominis plane (TAP) block with levobupivacaine versus a combination of levobupivacaine with dexmedetomidine for postoperative analgesia in cesarean delivery.

Methods: In this double-blinded randomized control trial, 90 patients undergoing cesarean delivery under spinal anesthesia were divided into three groups: Group C (control), Group L (levobupivacaine), and Group LD (levobupivacaine with dexmedetomidine). The primary outcome was the time to the first request for rescue analgesia. Secondary outcomes included pain scores at rest and on movement, patient satisfaction, and the incidence of side effects.

Results: The time to first request for rescue analgesia was significantly longer in Group LD (600 minutes) compared to Group L (352.5 minutes) and Group C (90 minutes) ($p<0.05$). Pain scores at rest and on movement were lowest in Group LD at all time intervals, with significant differences observed when compared to both Group L and Group C ($p<0.05$). Patient satisfaction was highest in Group LD. The incidence of side effects such as nausea and pruritus was comparable across all groups.

Conclusion: The addition of dexmedetomidine to levobupivacaine in TAP blocks significantly enhances postoperative analgesia in cesarean delivery, with prolonged pain relief and higher patient satisfaction without increasing side effects. These findings support the use of dexmedetomidine as an adjunct in TAP blocks for improved pain management post-cesarean delivery.

Keywords*: Cesarean Delivery, Transversus Abdominis Plane Block, Levobupivacaine, Dexmedetomidine, Postoperative Analgesia, Randomized Controlled Trial.*

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INTRODUCTION:

Cesarean delivery, one of the most common surgical procedures worldwide, often presents a significant challenge in postoperative pain management [1]. Effective analgesia is crucial not only for maternal comfort but also for facilitating early ambulation and breastfeeding, thus enhancing overall recovery [2]. In recent years, the Transversus Abdominis Plane (TAP) block has emerged as a popular technique for providing post-cesarean analgesia due to its effectiveness in reducing the requirement for systemic opioids, which are associated with side effects such as nausea, vomiting, and respiratory depression [3].

The TAP block, a regional anesthesia technique, involves the injection of local anesthetics into the neurofascial plane between the internal oblique and transversus abdominis muscles to block afferent nerve transmission from the anterior abdominal wall [4]. Levobupivacaine, a long-acting local anesthetic, is commonly used for this purpose due to its favorable safety profile and efficacy [5]. However, to enhance the analgesic effects and duration of the block, adjuncts such as dexmedetomidine, a highly selective α2-adrenoceptor agonist, are increasingly being incorporated [6].

Dexmedetomidine, known for its analgesic, sedative, and anxiolytic properties, has been used as an adjuvant to local anesthetics in various regional blocks [7]. When combined with levobupivacaine in TAP blocks, dexmedetomidine has been reported to prolong the duration of analgesia and reduce opioid consumption postoperatively [8]. This synergistic combination could potentially optimize post-cesarean pain management, enhancing patient comfort and recovery outcomes.

Despite the promising advantages, the use of dexmedetomidine as an adjuvant to levobupivacaine in TAP blocks for cesarean delivery analgesia remains a topic of ongoing research. There are concerns regarding the optimal dosing, potential side effects, and overall efficacy and safety of this combination [9]. Therefore, it is crucial to assess and synthesize the current evidence to guide clinical practice.

Aims:

The primary aim of this prospective, randomized, double-blind, controlled trial is to evaluate and compare the efficacy of transversus abdominis plane (TAP) block using levobupivacaine alone versus a combination of levobupivacaine with dexmedetomidine for postoperative analgesia following cesarean delivery under spinal anesthesia. This study seeks to determine if the addition of dexmedetomidine to levobupivacaine in the TAP block enhances analgesic effectiveness, reduces the need for additional analgesia, and improves overall patient satisfaction and comfort.

Materials and Methods

This study was designed as a prospective double-blinded randomized control trial, conducted over a period from October 2015 to September 2017 at Kasturba Hospital, Manipal. The study population comprised pregnant females aged between 21 and 40 years who underwent cesarean delivery under spinal anesthesia.

Inclusion and Exclusion Criteria:

Participants included in the study were within the age group of 21 – 40 years, classified as ASA physical status II, undergoing elective cesarean delivery under spinal anesthesia, and had a Body Mass Index (BMI) of 18.5 – 34.9 kg/m^2. Exclusion criteria involved patient refusal, contraindications for spinal anesthesia, psychological disorders, allergy to study medications, chronic use of pain medications or adrenoreceptors agonists or antagonists, and a history of tolerance to opiates.

Approvals:

The study received approval from the Departmental Dissertation Committee, Department of Anesthesiology, Kasturba Medical College, Manipal, and the Institutional Ethics Committee, KMC & Kasturba Hospital, Manipal University.

Observers:

Three observers were involved in the study. Observer 1, an anesthesiology postgraduate and the investigator, was blinded to the study. They were responsible for preoperative evaluation, obtaining informed consent, and conducting all postoperative assessments. Observer 2, a consultant anesthesiologist, performed the ultrasound-guided transversus abdominis plane (TAP) block. Observer 3, also a consultant anesthesiologist, handled patient randomization using a computer-generated table and ensured the appropriate intervention for each patient.

Methods:

Preoperative Visit:

On the evening before surgery, Observer 1 evaluated the patients, ensuring all inclusion criteria were met. Detailed explanations of the procedure were provided, and written informed consent was obtained. Patients received standard preoperative instructions and premedication. Observer 3 conducted the randomization into three groups: Group C, Group L, or Group LD. Patients were instructed to be nil per oral for 6 hours for solids and 2 hours for clear fluids, and oral premedication including ranitidine 150mg and metoclopramide 10mg was administered the night before and on the morning of the procedure.

On the Day of Surgery:

In the preoperative holding area, nil per oral status was confirmed. In the operation room, Observer 2 ensured the setup of necessary monitors, including a pulse oximeter, non-invasive blood pressure, and ECG monitor. Baseline vitals were recorded, and IV access was secured. Preparations for the TAP block included an ultrasound machine with a 5-12 MHz linear array ultrasound probe, a block needle, 0.25% levobupivacaine, and dexmedetomidine. Spinal anesthesia was administered with hyperbaric bupivacaine and fentanyl, and standard intraoperative management followed, including the insertion of a diclofenac rectal suppository at surgery's end.

Immediately Following Delivery:

An opaque screen was used to maintain blinding. Depending on the group allocation by Observer 3, Group C underwent an ultrasound scan but no TAP block, Group L received a bilateral TAP block with levobupivacaine, and Group LD received the same with the addition of dexmedetomidine. The TAP block was performed using an ultrasound-guided approach to identify the transversus abdominis plane, followed by the administration of the local anesthetic with or without dexmedetomidine.

Postoperatively:

Patients were moved to the recovery area for 24-hour monitoring. Observer 1 recorded the time to the first request for rescue analgesia and performed assessments at specified intervals. These assessments included pain at rest and during movement using the Visual Analogue Scale (VAS), sedation scoring using the Ramsay Sedation Score, and monitoring for side effects like nausea and pruritus using a categorical scale. Patient satisfaction with analgesia was also recorded using the VAS scale at the 24-hour mark.

Visual Analogue Scale (VAS):

The VAS, a standard tool for measuring pain intensity, was used in this study. It consisted of a 10 cm line with verbal descriptors at each end, representing 'no pain' and 'worst imaginable pain'. The distance in mm from the 'no pain' end to the patient's mark was measured to obtain a pain score.

Ramsay Sedation Score:

The Ramsay Sedation Score, ranging from 1 (patient anxious and agitated) to 6 (no response), was used to assess sedation levels.

Side Effects Assessment:

Nausea and pruritus were evaluated using a categorical scale ranging from 0 (none) to 3 (severe).

Sample Size:

The pilot study included 9 patients per group. The sample size was determined using standard formulas considering the level of significance, power of the study, estimated standard deviation, and effect size, resulting in a requirement of 30 patients per group.

This comprehensive approach ensured a thorough and systematic evaluation of the efficacy and safety of the TAP block with levobupivacaine alone versus levobupivacaine with dexmedetomidine in providing postoperative analgesia following cesarean delivery.

Results

This double-blinded randomized controlled study evaluated a total of 90 patients, with 30 individuals assigned to each of the three study groups.

Demographic Data: The demographic data, including age, weight, height, and Body Mass Index (BMI), along with ASA physical status, were found to be comparable across all groups (Table 1).

Table 1: Demographic Data

Variable	Group C	Group L	Group LD
Median Age (years)	29	30	30
Mean Weight (kg)	65.02	63	65.34
Mean Height (cm)	154.86	154	154.43
Mean BMI (kg/m²)	26.98	26.43	27.397

Duration of Surgery: The duration of surgery was similar across the groups, with no statistical significance noted (Table 2).

Table 2: Duration of Surgery (Mean ± SD in minutes)

Group	Duration	p-value (Group C vs. L)	p-value (Group C vs. LD)	p-value (Group L vs. LD)
Group C	78.33 ± 17.80	0.532	0.5089	0.876
Group L	81.7 ± 19.26	-	-	-
Group LD	84.166 ± 25.01	-	-	-

First Request for Rescue Analgesia: A significant delay in the first request for rescue analgesia was observed in Group L and Group LD compared to Group C, with Group LD patients demonstrating the longest duration of pain relief (Table 3).

Table 3: Time to First Request for Rescue Analgesia (Median with IQR in minutes)

Group	Time (Median)	IQR
Group C	90	Q1: 60, Q3: 130
Group L	352.5	Q1: 168.75, Q3: 487.5
Group LD	600	Q1: 240, Q3: 1110

Pain Score at Rest: Pain scores at rest, measured at 6, 12, and 24 hours postoperatively, were significantly lower in Group L and Group LD compared to Group C. The pain scores at 12 and 24 hours were notably lower in Group LD compared to Group L (Table 4 and 5).

Table 4: Number of Patients Requesting Rescue Analgesia

Time	Group C	Group L	Group LD
6h	29	17	10
12h	30	25	16
24h	30	27	24

Table 5: Mean Pain Score at Rest (VAS)

Time	Group C	Group L	Group LD
6h	6.13 ± 1.8	3.6 ± 2.37	2.93 ± 1.74
12h	5.9 ± 2.36	3.7 ± 1.96	2.36 ± 1.47
24h	6.1 ± 1.95	3.63 ± 2.07	2.13 ± 1.48

Mean Pain Score on Movement: Similarly, pain scores on movement were significantly lower in Group L and Group LD compared to Group C at all assessed time intervals. Group LD exhibited significantly lower scores compared to Group L at 12 and 24 hours (Table 6 and 7).

Table 6: Pain Score on Movement (VAS at 6, 12, and 24 hours)

Time	Group C	Group L	Group LD
6h	6.66 ± 1.6	4.36 ± 2.06	3.3 ± 1.84
12h	6.3 ± 2.3	4.4 ± 1.67	3.13 ± 1.38
24h	6.36 ± 1.97	4.43 ± 1.90	2.76 ± 1.4

Satisfaction Score: Patient satisfaction scores at 24 hours were highest in Group LD, followed by Group L and Group C, indicating superior pain management in the former groups (Table 9).

Table 9: Satisfaction Score at 24 Hours (Mean ± SD)

Group	Score
Group C	6.06 ± 1.79
Group L	7.76 ± 1.27
Group LD	8.83 ± 0.69

Side Effects: Nausea was noted in 4 patients in Group C, 2 in Group L, and 2 in Group LD. Pruritus was observed in 2 patients each in Group C and L, and 1 in Group LD. All subjects had a Ramsay sedation score of 2, indicating they were tranquil and comfortable.

In conclusion, the study found that the addition of dexmedetomidine to levobupivacaine in TAP block provided superior postoperative pain relief, both at rest and on movement, and increased patient satisfaction with fewer requests for rescue analgesia, especially notable in Group LD. The side effects were minimal and comparable across the groups.

Discussion

The findings of our study significantly contribute to the growing body of literature on the efficacy of Transversus Abdominis Plane (TAP) block with levobupivacaine, both with and without dexmedetomidine, for postoperative analgesia following cesarean delivery under spinal anesthesia.

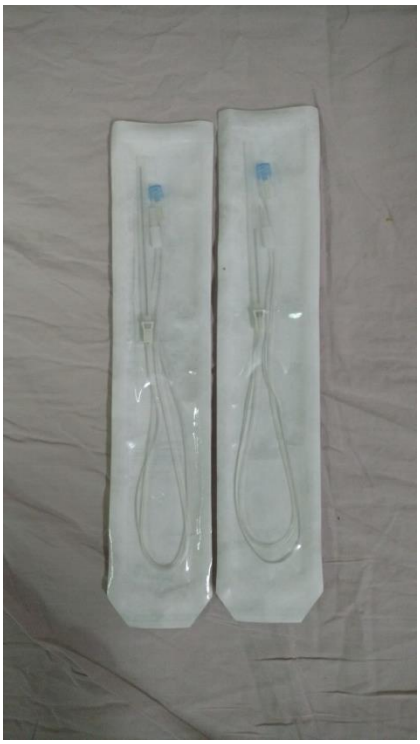
In our study, Group LD (levobupivacaine with dexmedetomidine) showed a notably longer time to the first request for rescue analgesia compared to Group L (levobupivacaine alone) and Group C (control). This delay in the need for additional analgesia suggests that the addition of dexmedetomidine to levobupivacaine enhances the analgesic efficacy of the TAP block. These findings align with the work of Srivastava et al. [10], who reported that the addition of dexmedetomidine to ropivacaine in a TAP block for abdominal hysterectomies resulted in prolonged analgesia. Furthermore, the mean pain scores, both at rest and on movement, were significantly lower in Group LD, echoing the results of a study by Al-Metwalli [11], where dexmedetomidine added to ropivacaine in TAP blocks improved postoperative analgesia in patients undergoing lower abdominal surgeries.

Interestingly, our findings of improved pain control with the addition of dexmedetomidine also corroborate with Bollag et al.'s [12] work, which suggested that dexmedetomidine, when used as an adjunct, can enhance the quality and duration of regional anesthesia. The exact mechanism behind this improved analgesia is not entirely understood but is hypothesized to be due to dexmedetomidine's action as an α2-adrenergic agonist, leading to hyperpolarization of nerves and thereby reducing the release of norepinephrine and the propagation of pain signals [13].

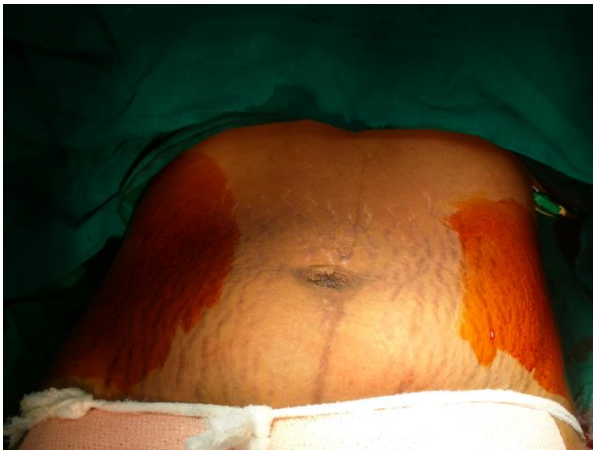
In terms of patient satisfaction, Group LD scored higher than both Group L and Group C. This finding is significant because patient satisfaction is a multifaceted outcome influenced not only by pain control but also by the side effects experienced. Despite the superior analgesia in Group LD, the incidence of side effects such as nausea and pruritus was comparable across all groups. These findings are in contrast to studies such as that of El-Boghdadly et al. [14], which reported a higher incidence of bradycardia and hypotension with dexmedetomidine. However, it is important to note that our study only evaluated nausea and pruritus, and careful monitoring for other potential dexmedetomidine-related side effects is advised.

A limitation of our study, and indeed a common limitation in regional anesthesia research, is the variability in techniques and dosages used for TAP blocks. While we standardized the procedure as much as possible, individual anatomical variations and the skill level of the practitioner can influence outcomes. This issue is addressed in studies like that of Abdallah et al. [15], emphasizing the need for standardized techniques and training in ultrasound-guided regional anesthesia.

In conclusion, our study demonstrates that adding dexmedetomidine to levobupivacaine in a TAP block for cesarean delivery under spinal anesthesia significantly improves the duration and quality of postoperative analgesia with minimal side effects. These findings support the integration of dexmedetomidine as an adjuvant in TAP blocks for enhanced post-cesarean analgesia.

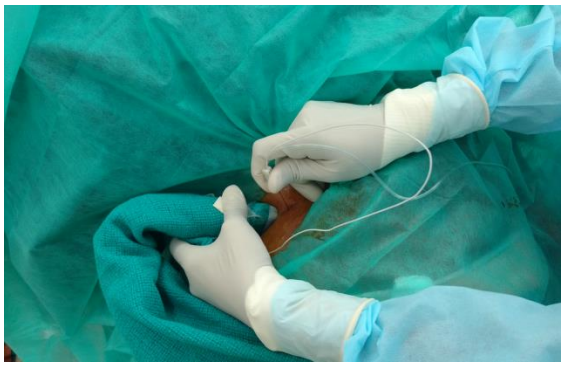


Picture 1 Block needles

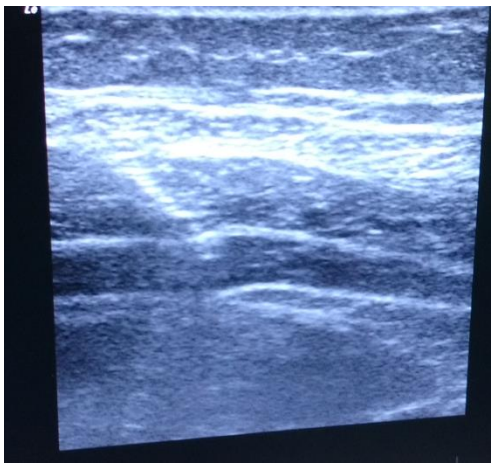


Picture 2 Patient positioned supine and part cleaned with betadine (all aseptic precautions)

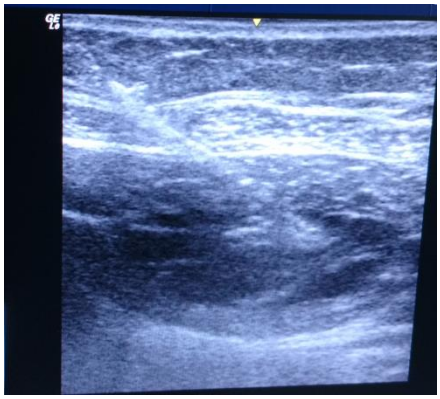
Picture 3 Transducer placed transversally in right midaxillary line, at midpoint between right costal margin and iliac crest



Picture 4 Needle introduced by in plane technique



Picture 5 Needle advancement under ultrasound guidance



Picture 6 Drug deposition in the Transversus abdominis plane

CONCLUSION

The study conclusively demonstrates that the addition of dexmedetomidine to levobupivacaine in a Transversus Abdominis Plane (TAP) block significantly improves the duration and quality of postoperative analgesia for patients undergoing cesarean delivery under spinal anesthesia. This finding was evidenced by a notable prolongation in the time to first request for rescue analgesia in the dexmedetomidine group (Group LD) compared to both the levobupivacaine alone (Group L) and control groups (Group C), with median times of 600 minutes, 352.5 minutes, and 90 minutes respectively. Additionally, both pain scores at rest and on movement were significantly lower in the groups receiving levobupivacaine, especially when combined with dexmedetomidine. Patient satisfaction scores mirrored these results, with Group LD reporting the highest satisfaction levels.

Despite the superior analgesic effects observed with the addition of dexmedetomidine, the incidence of side effects such as nausea and pruritus remained comparable across all groups, underscoring the safety profile of dexmedetomidine when used in this context. These findings are indicative of the potential benefits of incorporating dexmedetomidine into TAP blocks for cesarean deliveries, suggesting an optimized approach for postoperative pain management in this patient population.

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