RESEARCH ARTICLE

A Prospective Study of the Efficacy of 0.25% Bupivacaine and 0.25% Bupivacaine with Dexmedetomidine as Post-operative Analgesia in Transversus Abdominis Plane Block in Elective Lower Abdominal Surgeries

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ABSTRACT

Background: Managing discomfort after surgery lower abdominal surgery is challenging, impacting recovery and patient well-being. This study compares the efficacy of two abdominis transversus plane (TAP) block formulations—0.25% bupivacaine and 0.25% bupivacaine with dexmedetomidine to optimize analgesia and reduce reliance on systemic medications.

Method: Focusing on elective lower abdominal surgeries, the study assesses the formulations' performance. Key objectives include evaluating time to first rescue analgesia, length of time sensory block, quality of blockade, total rescue analgesia dose within 24 hours, and pain and sedation scores.

Result: Critical insights into the comparative performance of TAP block formulations are obtained. Findings encompass time to first rescue analgesia, sensory block duration, blockade quality, rescue analgesia dose, and pain and sedation scores, providing a comprehensive understanding of the effectiveness and potential side effects.

Conclusion: This study contributes clinical data to enhance post-operative pain management for lower abdominal surgeries. Anticipated outcomes involve improved patient comfort, quicker recovery, and the potential for more personalized approaches, ultimately advancing patient outcomes and pain management protocols.

Keywords: Lower abdominal surgery, Transversus abdominis plane, Bupivacaine, Dexmedetomidine, Sensory block.

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INTRODUCTION

This study delves into the intricacies of post-operative pain management via a comparison of two transversus abdominis plane (TAP) block formulations: 0.25% bupivacaine in combination with dexmedetomidine and 0.25% bupivacaine alone. Acute pain following lower abdominal surgery, especially within the first 24 hours, presents a significant challenge.[1,2] Inadequate pain control not only hinders functional recovery and quality of life but also increases the risk of complications and extends hospital stays.[3-6] Therefore, effective post-operative analgesia is crucial to minimize reliance on systemic medications, mitigate side effects, and optimize pain control.[7]

Among the diverse approaches to managing post-operative pain, TAP blocks have emerged as a promising option. These involve a precise injection targeting sensory neurons with a local anesthetic administered between the transversus abdominis and internal oblique muscles from T6 to L1. However, traditional blind TAP techniques carry risks like inaccurate plane identification and potential tissue damage.[8-10]

This study focuses on patients undergoing surgery in the lower abdomen that is elective and compares the analgesic efficacy of the two TAP block formulations. The primary objective is to assess when to start using rescue analgesia, offering insights into block duration and clinical effectiveness.[11,12] Additionally, it investigates the duration of sensory block, providing a nuanced understanding of pain relief over time. Blockade quality is evaluated to gauge the consistency of pain relief throughout the post-operative period.

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By assessing the whole amount of pain relief required in the first 24 hours, the study comprehensively evaluates overall analgesic efficacy. Pain and sedation scores serve as direct measures of the formulations' effectiveness while also shedding light on potential side effects.

This study aims to contribute valuable clinical data to the field of post-operative pain management, potentially paving the way for the development of more effective and personalized pain management strategies for patients undergoing lower abdominal surgeries. Ultimately, it seeks to improve patient comfort, accelerate recovery, and enhance overall patient outcomes.

MATERIALS AND METHODS

The study employed a prospective randomized single-blinded design and was held in Salem at the Vinayaka Missions Kirupananda Variyar Medical College & Hospitals. Sixty adult patients of both genders undergoing lower abdominal surgeries were included over a one-year period. The inclusion criteria comprised ASA grade I and II, age between 18 to 60 years, and elective procedures involving the lower abdomen. Exclusion criteria encompassed patient refusal, age below 18 and above 60 years, ASA 3 & ASA 4, emergency surgeries, local infection at the puncturing site, ischemic and rheumatic heart diseases, coagulation defects, anticoagulant use, and a history of diabetes, hepatic & renal failure. Pre-operative investigations included assessments of hemoglobin, random blood sugar, serum electrolytes, urea and creatinine, and a chest X-ray, electrocardiogram, blood grouping & coagulation profile, and serology. About 60 participants, two groups were arbitrarily assigned: Set A (30 participants) received 0.25% bupivacaine (20 mL) + 2 mL of a placebo, while group B (30 subjects) received a mixture of 0.25% bupivacaine and 0.5 mcg/kg dexmedetomidine (2 mL). The TAP block, or transversus abdominis plane technique, was meticulously detailed. In the operating room, all necessary equipment was checked, and patients were premedicated and connected to monitors. A subarachnoid block was administered, and intraoperative vital signs were closely monitored. A bilateral TAP block was used after the procedure of strict aseptic precautions and the plane technique for needle insertion. The procedure included local infiltration if needed, monitoring of sensory block duration and quality, and continuous patient observation for potential complications. Sedation scores were recorded, and all parameters were closely monitored throughout the study.

Data Analysis

The study utilized a Master Chart and the Epidemiological Information Package (EPI 2010) to organize and analyze data. The software enabled descriptive statistics, hypothesis testing, and association analysis. The Master Chart and EPI 2010 software provided a robust analytical process, ensuring accurate conclusions and reliable conclusions from the collected data.

RESULT

The clinical trials registry – India (CTRI) number for this randomized control trial is CTRI/2022/02/040101. Total number of patients who participated in this study was 60. The mean age in group A (0.25% bupivacaine + PLACEBO) was 36.06 years (± 13.44) and in group B (0.25% bupivacaine + dexmedetomidine), was 35.83years (±10.77) which was statistically not significant (p-*value* 0.6043). The average heights of individuals in both groups (Group A: 0.25% bupivacaine + placebo, group B: 0.25% bupivacaine + dexmedetomidine) were statistically similar. The mean height in group A was 156.16 cm (±7.12) and in group B was 155.86 cm (± 8.51) and not statistically significant.

Table 1 reveals that group A has higher heart rate than group B at all intervals, particularly at 0 and 1-minute intervals. Heart rate decreases over time, likely due to resting. group B has higher variability in heart rate.

Table 2 reveals a notable variation in two groups' systolic blood pressure at 15-minute intervals, suggesting group A may be more effective at lowering blood pressure. The 24-hour interval results show lower systolic blood pressure for both groups, suggesting a long-term effect of the exercise program. The *p-values* are less than 0.05 at these intervals.

Table 1: Pattern of heart rate among two study groups: Effect on heart rate among study groups

Mean Heart rate (beats per minute)	*Group A*	*SD*	*Group B*	*SD*	*P Value*
0 min	84.56	12.7	81.13	13.68	0.2057
5 mins	84.63	14.05	78.83	12.23	0.1311
15 mins	84	14.73	79.16	12.42	0.3073
30 mins	84.13	12.7	78.86	14.55	0.1371
1 HR	85.46	11.47	80.53	15.59	0.051
2 HR	87.13	10.51	80.5	13.62	0.055
4 HR	83.56	13.35	79.2	14.51	0.2422
6 HR	80.13	10.81	79.36	14.98	0.8071
8 HR	79.4	10.6	76.83	14.95	0.34
10 HR	78.9	10.85	76.76	14.34	0.4867
12 HR	79.56	12.29	77.46	15.8	0.6098
24 HR	84.86	12.7	81.13	13.68	0.205

Table 2: Pattern of systolic blood pressure among two study groups

SBP (mm of Hg)	*Group A*		*Group B*		
	Mean	*SD*	*Mean*	*SD*	*p-value*
0 min	124.8	13.48	119.7	13.72	0.1239
5 mins	116.86	15.79	109.83	15.46	0.088
15 mins	118.66	20.29	104.3	12.08	0.0024
30 mins	113.5	18.58	103	9.7	0.012
1 HR	113.9	18.86	109	17.09	0.33
2 HR	112.4	16.99	105.16	15.4	0.07
4 HR	105.86	16.75	98.43	10.79	0.05
6 HR	106.16	15.66	99.16	12.03	0.07
8 HR	104	19.37	97.9	10.96	0.3145
10 HR	107	16.02	100.26	13.12	0.06
12 HR	106.5	16.76	102.16	12.21	0.5
24 HR	124.8	13.48	119.7	13.72	0.12

Table 3: Two research groups' diastolic blood pressure patterns

DBP (mm of Hg)	*Group A*		*Group B*		*p-value*
	Mean	*SD*	*Mean*	*SD*	
0 min	74.96	10.01	72.83	10	0.34
5 mins	73.56	11.07	65.96	11.05	0.007
15 mins	69.13	13.16	64.2	9.79	0.054
30 mins	67.06	15.81	61.8	10.39	0.1709
1 HR	67.26	13.61	68.13	14.65	0.9882
2 HR	67.33	13.5	63	12.86	0.3322
4 HR	62.33	11.78	58.8	11.95	0.2396
6 HR	63.06	13.2	60.56	11.07	0.5639
8 HR	61.16	15.2	57.96	10.61	0.615
10 HR	61.63	13.28	59.46	12.87	0.8417
12 HR	63.1	12.85	61.8	11.46	0.7843
24 HR	74.96	10.01	72.83	10.01	0.3434

Table 4: The two research groups' mean blood pressure patterns

MAP (mm of Hg)	*Group A (Mean ± SD)*	*Group B (Mean ± SD)*	*p-value*
0 min	90 ± 10.96	86.93 ± 8.49	0.2192
5 mins	87.46 ± 11.02	80 ± 11.89	0.009
15 mins	83.16 ± 11.77	76.96 ± 9.33	0.021
30 mins	80.83 ± 14.98	75.06 ± 9.24	0.0623
1 HR	79.9 ± 13.81	80.7 ± 15.65	0.8014
2 HR	81 ± 12.09	75.06 ± 12.98	0.122
4 HR	76.2 ± 12.85	72.36 ± 11.17	0.3708
6 HR	75.6 ± 12.15	72.63 ± 11.11	0.3399
8 HR	73.16 ± 14.03	71.56 ± 9.85	0.9175
10 HR	74.83 ± 13.02	73.20 ± 13.84	0.4284
12 HR	75.46 ± 13.15	75.70 ± 11.59	0.9293
24 HR	90 ± 10.96	86.93 ± 8.49	0.2192

Table 5: Pattern of respiratory rate among two study groups

RR (breaths/min)	*Group A*		*Group B*		*p-value*
	Mean	*SD*	*Mean*	*SD*	
0 min	15.16	0.87	15.33	0.95	0.6155
5 mins	15.2	0.8	14.63	0.808	0.009
15 mins	15.26	1.11	14.73	0.907	0.04
30 mins	15.03	0.71	14.63	0.85	0.02
1 HR	14.93	0.86	14.7	0.7	0.2449
2 HR	15.16	0.87	15.13	0.86	0.9188
4 HR	15.66	1.06	14.9	0.88	0.2386
6 HR	15.16	1.02	14.66	0.78	0.07
8 HR	16.43	1.07	16.83	0.98	0.14
10 HR	13.03	0.8	12.08	0.61	0.2386
12 HR	13	0.83	12.9	0.48	0.622
24 HR	13.03	0.71	12.86	0.628	0.3996

Table 3 reveals that group A has lower diastolic blood pressure than group B at all time intervals except for 0 minutes and 1-hour. The mean diastolic blood pressure for group A is 7.6 mmHg lower than group B. Both groups decrease over time, except for group B at the 24-hour interval. Group A has higher variability in diastolic blood pressure, possibly due to fitness level or age differences. The *p-values* $\leq$0.05 at the 5-minute interval, indicating a statistically significant difference.

Table 4 reveals that the mean arterial pressure (MAP) did not vary significantly between the two groups. at 0 and 24 hours, suggesting similar blood pressure levels. At 5 and 15 minutes, group A had significantly lower MAP than group B. From 30 minutes to 12 hours, no significant difference was found, indicating similar blood pressure levels between the two groups.

Table 5 reveals that group A has a higher respiratory rate than group B at all time intervals except for 10 and 12 hours. This is most evident at the 0-minute interval, where group A has a mean respiratory rate of 0.17 breaths per minute higher than group B. Both groups follow a U-shaped pattern, with the highest rates at the beginning and end and the lowest rates in the middle. Group A has higher variability in respiratory rate due to fitness level or age differences.

Table 6 shows baseline sedation levels in both groups at 0 minutes. However, the intervention's impact diverged over time. Group A experienced a deeper level of sedation than group B during crucial moments (all *p-values* < 0.0001), with lower RSS scores in the early stages (1, 5, 15, and 30 minutes). This trend continued at 4 and 6 hours, indicating a potentially prolonged peak sedation period. By 24 hours, both groups' RSS scores converged, indicating that the sedative effects had worn off for both groups.

Table 7 shows a notable variation between group A and B in the length of sensory blocking, with group A experiencing a longer duration (506.66 minutes) compared to group B (710.66 minutes). The standard deviation was higher in group B (33.05 minutes), indicating greater variability in sensory blockade duration. The intervention used in group

Table 6: Pattern of RSS among two study groups: Pattern of Ramsay sedation score among study groups

RSS	*Group A*		*Group B*		*p-value*
	Mean	*SD*	*Mean*	*SD*	
0 min	1	0	1	0	1
5 mins	1	0	2.16	0.37	0.0001
15 mins	1	0	2.16	0.37	0.0001
30 mins	1	0	2.16	0.37	0.0001
1 HR	1	0	2.16	0.37	0.0001
2 HR	1	0	2.16	0.37	0.0001
4 HR	1	0	2.16	0.37	0.0001
6 HR	1	0	2.16	0.37	0.0001
8 HR	1	0	2.16	0.37	0.0001
10 HR	1	0	2.16	0.37	0.0001
12 HR	1	0	2.16	0.37	0.0001
24 HR	1	0	2.16	0.37	0.0001

Table 7: The length of the research groups' sensory blockage

Duration of sensory blockade (mins)	*Group A*		*Group B*		*p-value*
	Mean	*SD*	*Mean*	*SD*	
	506.66	18.63	710.66	33.05	0.0001

Table 8: The quantity of painkillers used for rescue after surgery in a 24-hour period

Number of rescue analgesics in Post-op 24 Hrs			
Group	*Mean*	*SD*	*p-value*
Group A	2.4667	0.5074	0.0001
Group B	1.2667	0.4498	

A produced a longer period of sensory blockage. However, the study's limitations include the lack of sample size and information about the type of intervention, dosage, and baseline characteristics of participants.

Table 8 reveals that group A used fewer rescue analgesics than group B in the post-operative 24 hours, with a statistically significant difference of 2.467 for group A and 1.2667 for group B, indicating a real difference in the effectiveness of pain management regimens.

Table 9 reveals that compared to group B, group A took noticeably longer to receive rescue analgesia. The mean time for group A was 588.66 minutes, while it was 845.83 minutes for group B. This difference is statistically significant, as shown by the *p-value* of 0.0001. This suggests that there is a real difference in the efficacy of the two groups' respective pain management regimens.

DISCUSSION

Post-operative pain following lower abdominal surgeries involves two distinct sensations: Visceral discomfort as well as somatic pain from the wound. Additionally, pain may arise from nerves beyond the surgical site due to the stretching of the skin and manipulation of internal organs during the procedure. Beyond tissue damage, psychological and socio-demographic factors significantly contribute to patients' pain perception. Kehlet's 2006[10] review underscores the shift in chronic pain development theories from a biomedical to a bio-psychosocial model, highlighting how biological and psychological factors interact. Pain is represented mentally in both short- and long-term memory, acting as an early warning system for possible dangers. The patient's perception and experience of pain play a critical role in this process.

Table 9: Time for 1st rescue analgesia among study groups

Time for 1st rescue analgesia (min)			
Group	*Mean (mins)*	*SD*	*p-value*
Group A	588.66	13.7	0.0001
Group B	845.83	33.76	

High-quality post-operative pain relief is essential for both human and medical reasons. Early mobilization is associated with improved pulmonary function, tissue oxygenation, insulin resistance, reduced thromboembolism risk, and shorter hospital stays. Effective post-operative analgesia is pivotal for facilitating early mobilization.

Since Rafi's TAP block was first introduced in 2001, many people have used it to relieve pain following lower abdominal surgery, reducing the need for opioids and minimizing their side effects.[13] Our study aligns with previous research, indicating similar outcomes using bupivacaine combined with dexmedetomidine for TAP block.

Studies by Marhofer *et al*. and Rancourt MP demonstrate prolonged block duration with dexmedetomidine, albeit with a decrease in blood pressure and heart rate.[14] Other studies, including Mirshriky BM *et al.*[13]and Lee, AJ *et al.,*[15] suggest that TAP blocks can reduce opioid-related side effects and offer efficient post-operative analgesia in lower abdominal surgeries. Consistent with Abdallah FW *et al.,*[16] results show reduced opioid usage and total consumption in lower abdominal surgeries.

The study found that both groups A and B had similar demographic characteristics, with a slightly higher number of female patients. The distribution of ASA1 and ASA2 patients was similar in both groups. However, group A had significantly higher SBP, DBP, and MAP values from 5 to 15 minutes after TAP block administration and a significant decrease in respiratory rate up to 30 minutes. Gilda Talebi *et al.,* reported drowsiness and respiratory depression following dexmedetomidine administration, findings mirrored in our study.[17]

Our study underscores that dexmedetomidine supplementation in TAP blocks decreases the need for analgesics and lengthens the period before the first dosage of pain relief. We observed that the quality and duration of sensory block were superior when dexmedetomidine was added to bupivacaine compared to bupivacaine alone, with no complications in either study group. These findings are in line with those reported by Neerja Bharti *et al.,* and Gilda Talebi.[18]

CONCLUSION

The study demonstrated that adding dexmedetomidine to TAP blocks significantly extended the time before the first dose of rescue analgesia was needed compared to using bupivacaine alone. This indicates an extended period of effective pain control within the group of dexmedetomidine.

Furthermore, patients who received dexmedetomidine in their TAP blocks required a lower total amount of opioid medication in the first 24-hour period after surgery in contrast to the bupivacaine-only group. This suggests that dexmedetomidine effectively contributed to pain management, reducing the reliance on opioids.

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