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Comparison of Mean Duration of Post-operative Analgesia in Patients Undergoing Lower Abdominal Surgeries Receiving Ultrasound Guided Transversus Abdominis Plane (TAP) Block with Bupivacaine and Dexmedetomidine versus Bupivacaine and Dexamethasone

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ABSTRACT

Objective: To compare the mean duration of post-operative analgesia in patients undergoing lower abdominal surgeries receiving ultrasound-guided TAP block with bupivacaine plus dexmedetomidine versus bupivacaine plus dexamethasone.

Methodology: This randomized controlled trial (NCT07508202), conducted at the Department of Anesthesia, Pakistan Institute of Medical Sciences (PIMS) in Islamabad from March 26, 2026, to June 26, 2026, enrolled a total of 60 patients aged 18–60 years with ASA physical status I–II who were scheduled for lower abdominal procedures, and divided them equally into two groups of 30 patients each. In Group A, a bilateral ultrasound-guided transversus abdominis plane (TAP) block was performed at the end of surgery using 20 mL of 0.25% bupivacaine combined with 4 mg of dexamethasone, whereas Group B received the same volume of 0.25% bupivacaine along with 0.5 µg/kg of dexmedetomidine. The primary outcome measured was the duration of postoperative analgesia, defined as the time interval from the completion of the block to the patient's first request for rescue analgesia, with the aim of determining which adjuvant offers superior prolongation of analgesic effect in lower abdominal surgeries.

Results: When comparing the dexamethasone group to the dexmedetomidine group, the mean duration of post-operative analgesia was substantially greater (420.03 ± 39.05 minutes vs. 370.30 ± 33.00 minutes; $p < 0.001$). Stratified analysis demonstrated consistently longer analgesia duration with dexamethasone across age groups, gender, ASA status, BMI categories, and surgery duration subgroups.

Conclusion: Ultrasound-guided TAP block with bupivacaine and dexamethasone provided considerably longer duration of postoperative analgesia compared with dexmedetomidine in patients undergoing lower abdominal operations.

Keywords: Analgesia, Bupivacaine, Dexamethasone, Dexmedetomidine, TAP block, Ultrasound-guided.

Authors' Contribution:
[1,2]Conception; Literature research; manuscript design and drafting; [3,4]Critical analysis and manuscript review; [5,6]Data analysis; Manuscript Editing.

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Introduction

An important part of surgical treatment is managing postoperative pain effectively, as it has a direct impact on the patient's recovery and final results. Inadequately managed pain not only delays convalescence but also increases reliance on

opioids, raising the risk of dependence and associated complications.[1] Pain following lower abdominal surgery primarily originates from abdominal wall incisions, with the somatic component transmitted through afferent nerves located in the transversus abdominis neurofascial plane.[2] Approximately 75% of surgery patients report moderate to severe immediate postoperative pain, and almost 80% of those patients have this discomfort.[3]

To reduce the need for opioids during abdominal surgeries, regional anesthesia methods, especially local anesthetics, have become more popular.[4] For lower abdominal procedures, one common method to improve postoperative analgesia is the transversus abdominis plane (TAP) block, which is an ultrasound-guided peripheral nerve block. By acting on the thoracolumbar nerves (T6-L1) that supply the anterior abdominal wall with nerve impulses, the TAP block is able to alleviate pain.[5] When incorporated into multimodal analgesic regimens, peripheral nerve blocks significantly reduce opioid consumption, thus enhancing pain relief while limiting adverse effects. Nevertheless, the duration of analgesia achieved with local anesthetics alone remains relatively short, necessitating early supplementation with systemic analgesics.[6] The average duration until patients needed their first rescue analgesic was 391.20 ± 13.02 minutes in the group given bupivacaine with dexmedetomidine, as opposed to 350.0 ± 13.48 minutes in the group given bupivacaine with dexamethasone ($p < 0.001$), according to Sobhy et al. (2022).[7]

Despite these encouraging findings, current literature remains limited, with few regional and international trials addressing this subject. Additionally, there is a lack of data from the local community, especially from those having lower abdominal procedures. Reassessing these combinations could provide valuable insights into optimizing perioperative pain management, potentially reducing opioid consumption, enhancing patient satisfaction, and refining clinical practice. Specifically, we want to see how much longer patients with lower abdominal operations who have an ultrasound-guided Transversus abdominis plane (TAP) block with bupivacaine and dexmedetomidine fare compared to those who get bupivacaine and dexamethasone.

Methodology

This randomized controlled study was carried out in the Department of Anesthesia, Pakistan Institute of Medical Sciences (PIMS), Islamabad. The research took place over the course of six months from 26th March 2026 to 26th June 2026. Thirty patients from each group made up the total number of recruited individuals. The sample size was determined level of significance to be 5% and power of test 90%, based on an expected mean duration of postoperative analgesia of 391.20±13.02 minutes in the bupivacaine with dexmedetomidine group and 350.0±13.48 minutes in the bupivacaine with dexamethasone group among patients undergoing lower abdominal surgeries.[7] The method utilized was a non-probability, sequential sampling strategy. A BMI of 25–35 kg/m² was considered an inclusion criterion, a patient's age being between 18 and 60 years old, and its classification as either I or II as stipulated by the ASA. Eligible participants were those scheduled for lower abdominal surgeries performed below the L2–L3 vertebral level, such as hysterectomy, hernia repair, cesarean section, hip or knee surgery, and tibia or fibula fracture surgery, under general anesthesia. Before anyone could be enrolled, they had to give their written informed permission. Any signs of coagulopathy, incapacity to collaborate, talk, or read, or infection at the injection site were all grounds for exclusion. Patients receiving cardiovascular medications, anticoagulants, or antiplatelet therapy, as well as those with a known hypersensitivity to local anesthetics, were excluded. Additionally, the study did not include individuals diagnosed with ischemic heart disease (with an ejection fraction ≤ 40%) or

pulmonary dysfunction (defined as FEV1 ≤ 70% of expected values), uncontrolled hypertension (systolic blood pressure > 140 mmHg), or diabetes that has not been adequately managed. After then, two groups of patients were selected at random using a lottery system. Patients were randomly allocated into two equal groups (1:1 ratio) using a computer-generated randomization sequence. Allocation concealment was ensured by using sequentially numbered, sealed opaque envelopes, which were opened only after patient enrollment. This was a single-blind randomized controlled trial. Patients were unaware of their treatment allocation. The study medications were prepared and administered by the attending anesthesiologist; however, patients remained blinded throughout the study.

The first group was given 20 ml of a solution containing 20 % bupivacaine and4-milligrams of dexamethasone in 2-milliliters of normal saline, whereas the second group was given 20 ml of a solution containing 20 % bupivacaine and 2 milliliters of normal saline with 0.5 micrograms per kilogram of dexmedetomidine.

Before surgery, it was advised that all patients fast for a minimum of six hours. Standard monitoring techniques were implemented in the operating room, including the establishment of intravenous access. Before treatment, all patients were prescribed 40 mg of omeprazole. All patients in both groups were given the same doses of propofol (1.5-2 mg/kg), fentanyl (1 mcg/kg), and atracurium (0.5 mg/kg) during anesthesia induction. Mechanical ventilation was used to keep patients anesthetized during the surgery, and a combination of oxygen and air with 1.2% Isoflurane was used (FiO_2 60%). A Transversus abdominis plane (TAP) block, guided by ultrasonography, was done on both sides before the patient woke up from anesthesia. While the patient remained in the supine posture, a linear ultrasonic probe with a high frequency of 8-13 MHz was implanted transversely along the abdominal wall, mid-axillary line, between the costal border and iliac crest. The intermuscular fascia between the transversus abdominis and internal oblique was targeted by a needle that was advanced in-plane with the use of real-time ultrasonography. After the blood aspiration came back negative, 2 ml of normal saline was administered to make sure the needle was in the right area. Subsequently, the TAP block solution was administered according to the patient's group allocation. The anesthetic was withdrawn following the injection of the block. Neostigmine and pyrolate, each at 3 mg, were used to counteract any remaining neuromuscular inhibition, and extubation was then carried out. Postoperatively, intravenous tramadol 50 mg was administered whenever a patient reported a Visual Analogue Scale (VAS) score greater than 4 or requested additional analgesia. Patients were followed postoperatively until they reported pain with a VAS score greater than 4, at which point rescue analgesia was administered. The interval from completion of the TAP block to the administration of the first rescue analgesic was recorded as the duration of postoperative analgesia. Demographic data, including age, weight, height, and BMI, as well as surgical details, were documented on a structured proforma. The lead investigator and all other members of the surgical team performed all surgeries, and in order to reduce the possibility of bias, all patients had their postoperative pain evaluated using the same chart. Predefined exclusion criteria were used to adjust for confounding factors. We used SPSS version 25 for data entry and analysis. Height, age, body mass index (BMI), weight, length of operation, and length of postoperative analgesia were all continuous variables that were represented as mean ± standard deviation and range. The two groups' mean duration of analgesia was compared using an independent sample t-test; a p-value of < 0.05 was deemed statistically significant. Frequencies and percentages were used to display categorical characteristics, such as gender and ASA status. We controlled for impact modifiers by stratifying the data according to age, gender, body mass index (BMI), ASA status, and

length of operation. This time, after stratification, we used an independent sample t-test with a significance level of $p < 0.05$.

Ethical approval of the study was taken from institutional ethical review committee of PIMS **(F-5-2/2024(ERRC)/PIMS** and It was registered through departmental account on clinicaltrials.gov **clinical trial registration number: NCT07508202**

Results

Both groups of patients had similar baseline characteristics. Patients in the dexmedetomidine group had an average age of 30.87 ± 12.62 years, compared to 39.57 ± 11.22 years in the dexamethasone group. In the dexamethasone group, 13 (43.3%) patients were aged 18–35 years and 17 (56.7%) were aged 36–60 years, whereas in the dexmedetomidine group, 12 (40.0%) and 18 (60.0%) patients belonged to these age groups, respectively. In the group given dexamethasone, 63.3% were men and 36.7% were females; in the group given dexmedetomidine, 66.7% were men and 33.3% were females. Between the two groups, the average height of patients was 168.60 ± 6.21 cm and their average weight was 75.50 ± 10.40 kg, which is similar to 75.50 ± 9.09 kg. Both the dexamethasone and dexmedetomidine groups had average body mass indexes of 26.50 ± 2.80 and 27.16 ± 2.94 kg/m², respectively according to Table I. We compared the two groups based on the average amount of time patients stayed on analgesics after surgery. With an average of 420.03 ± 39.05 minutes, patients in the dexamethasone group felt the effects of analgesia for a longer period of time, compared to 370.30 ± 33.00 minutes in the dexmedetomidine group given in table II.

Stratified analysis revealed that, across most subgroups, the dexamethasone group had longer mean post-operative analgesic durations than the dexmedetomidine group. In both age categories (18–35 years and 36–60 years), the dexamethasone group demonstrated significantly longer analgesia duration ($p = 0.001$). After adjusting for gender, the results remained the same: the dexamethasone group's patients, regardless of gender, had noticeably longer periods of analgesia than the dexmedetomidine group ($p \leq 0.001$). When stratified by ASA status, the dexamethasone group also showed significantly greater analgesia duration in both ASA I and ASA II patients ($p = 0.001$). In addition, compared to the dexmedetomidine group, individuals whose surgeries lasted 75-95 minutes or 96-120 minutes experienced noticeably longer periods of analgesia when they were in the dexamethasone group ($p < 0.05$). According to Table 3, dexamethasone reliably extended the duration of post-operative analgesia across various patient subgroups.

Table I: Baseline Characteristics of Patients

Variable	Group A (Bupivacaine + Dexamethasone) n=30	Group B (Bupivacaine + Dexmedetomidine) n=30
Age (years)		
Mean ± SD	39.57 ± 11.22	30.87 ± 12.62
18–35 years	13 (43.3%)	12 (40.0%)
36–60 years	17 (56.7%)	18 (60.0%)
Gender n(%)		
Male	19 (63.3%)	20 (66.7%)
Female	11 (36.7%)	10 (33.3%)
Height (cm)	168.60 ± 6.21	165.57 ± 7.43
Weight (kg)	75.50 ± 10.40	75.50 ± 9.09
BMI (kg/m²)		
Mean ± SD	26.50 ± 2.80	27.16 ± 2.94
Normal	13 (43.3%)	7 (23.3%)
Overweight	17 (56.7%)	23 (76.7%)
ASA Physical Status		
ASA I	18 (60.0%)	20 (66.7%)
ASA II	12 (40.0%)	10 (33.3%)
Duration of Surgery (min)		
Mean ± SD	92.83 ± 10.30	91.37 ± 5.18
75–95 min	16 (53.3%)	18 (60.0%)
96-120 min	14 (46.7%)	12 (40.0%)

Table II: Study Group Comparison of Postoperative Analgesia Duration in Minutes				
Variable	**Group A (Bupivacaine + Dexamethasone) (n=30)**	**Group B (Bupivacaine + Dexmedetomidine) (n=30)**	**Mean Difference**	**p-value**
Duration of Post-operative Analgesia (min)	420.03 ± 39.05	370.30 ± 33.00	49.73	<0.001*

* A significance level of *p < 0.05 was used in the independent sample t-test.

Table III: Post-stratification Analysis of Duration of Post-operative Analgesia (minutes) between Study Groups			
Variable	**Group A (Bupivacaine + Dexamethasone) Mean ± SD**	**Group B (Bupivacaine + Dexmedetomidine) Mean ± SD**	**p-value**
Age (years)			
18–35 years	429.69 ± 34.84	374.50 ± 35.56	0.001*
36–60 years	412.65 ± 41.46	367.50 ± 31.91	0.001*
Gender			
Male	420.53 ± 44.38	372.20 ± 36.53	0.001*
Female	419.18 ± 29.59	366.50 ± 25.83	<0.001*
BMI (kg/m²)			
Normal	414.23 ± 46.18	385.00 ± 30.96	<0.001*
Overweight	424.47 ± 33.40	365.83 ± 32.93	<0.001*
ASA Physical Status			
ASA I	418.61 ± 42.52	373.50 ± 33.13	0.001*
ASA II	422.17 ± 34.88	363.90 ± 33.51	0.001*
Duration of Surgery (min)			
75–95 min	418.81 ± 35.06	374.94 ± 27.80	<0.001*
96–120 min	421.43 ± 44.48	363.33 ± 39.85	0.002*

* A significance level of *p < 0.05 was used in the independent sample t-test.

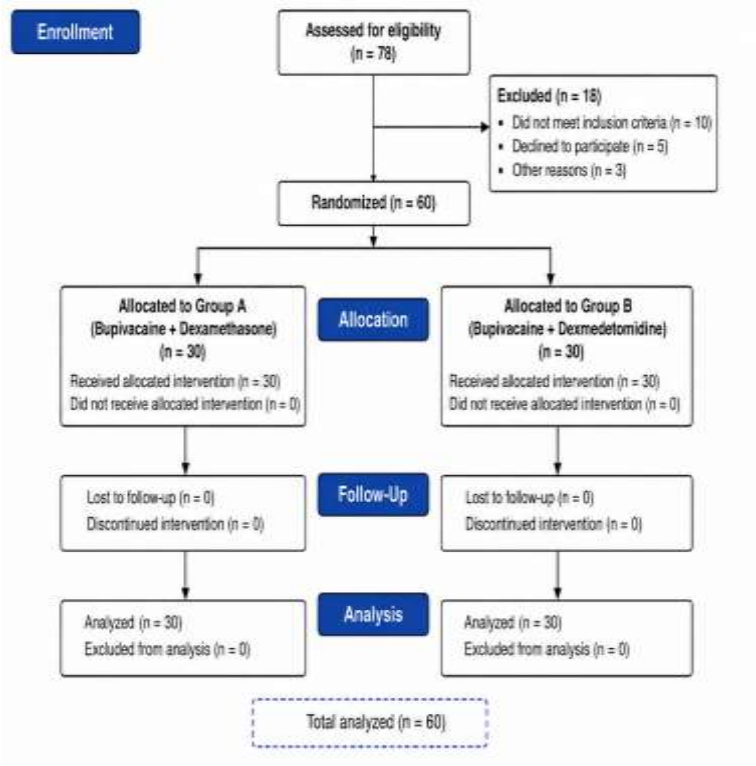

Figure 1. CONSORT flow diagram of patient enrollment, randomization, allocation, follow-up, and analysis

Discussion

Moderate to severe discomfort, emanating from wounds in the abdominal wall, is a common complication of lower abdominal procedures. As a dependable method of regional anesthetic, ultrasound-guided Transversus abdominis plane (TAP) blocks have recently been developed.[8,9] Bupivacaine is commonly used, but its limited duration necessitates the use of adjuvants. Dexmedetomidine, α2 adrenergic agonist and dexamethasone, a corticosteroid, are both employed to prolong analgesia.[10] Comparative evidence regarding their efficacy in TAP block remains limited, particularly in local populations.

In this study, researchers looked at how long patients were pain-free after surgery after getting either bupivacaine or dexmedetomidine as part of an ultrasound-guided TAP block. There was a 49.73-minute statistically significant difference ($p < 0.001$) in the mean duration of post-operative analgesia

between the dexmedetomidine group (370.30 ± 33.00 minutes) and the dexamethasone group (420.03 ± 39.05 minutes). Stratified analysis further confirmed that dexamethasone provided consistently longer analgesia across different age groups, genders, ASA status, and surgery duration categories.

These results are in contrast with those of Sobhy et al. (2022), who discovered that the dexmedetomidine group required a substantially longer amount of time (391.20 ± 13.02 minutes) before they could get their first dosage of rescue analgesic compared to the dexamethasone group (350.0 ± 13.48 minutes). They also found no statistically significant changes in postoperative pain levels across the groups, unlike us. The only time this was different was at the 6-hour interval, when the dexmedetomidine and dexamethasone groups showed better analgesia than the bupivacaine group alone.

Ramya et al. (2018) also showed that adjuvants in TAP blocks are beneficial for pain relief. They found that the study group had a substantially longer time to initial rescue analgesia (14.25 hours) compared to the control group (7.73 hours) ($p = 0.0136$).[12] Similarly, Prabhu et al. (2017) observed that increasing the concentration of bupivacaine significantly prolonged analgesia duration, with 0.25% bupivacaine producing 635.73 ± 195.58 minutes of analgesia compared with 355.67 ± 118.88 minutes with 0.125% bupivacaine ($p < 0.05$), indicating that both drug concentration and adjuvants can influence the effectiveness of TAP block.[13]

Patients who had TAP block had a lower need for rescue analgesic dosages compared to those who underwent local wound infiltration, according to Ahmad et al. (2025), who also found that TAP block was successful. The difference became statistically significant at 6, 12, 18, and 24 hours ($p = 0.002$ and $p = 0.008$), while 38.18% of patients in the wound infiltration group required additional analgesics, just 23.63% of patients in the TAP block group did so. These results provide credence to TAP block's status as a viable option for managing postoperative pain.[14] In a similar vein, Maie et al. (2018) found that using TAP block in conjunction with dexamethasone (9.8 ± 2.9 hours) or TAP block with intravenous dexamethasone (10.0 ± 2.3 hours) resulted in a substantially longer duration to initial rescue analgesia compared to using TAP block alone (5.7 ± 1.6 hours) ($p < 0.001$). on addition, the use of morphine on the first day was noticeably reduced in the dexamethasone groups (11.8 ± 3.7 mg) in comparison to the TAP block alone group (24.3 ± 3.6 mg) ($p < 0.001$), which lends credence to the idea that adjuvants might prolong the analgesic effects.[15]

Our results contradict those of Singh et al. (2025), who found that dexmedetomidine significantly prolonged analgesia more effectively than dexamethasone. They found that the time to first analgesic request was 19.66 hours for the dexmedetomidine group and 12.10 hours for the dexamethasone group.[16] However, our findings are corroborated by those of Thakur et al. (2019), who found that compared to other groups, those given a combination of bupivacaine and dexamethasone had a much longer duration of analgesia and needed less rescue analgesics.[17] Also, in their study on postoperative pain management, Niaz et al. (2024) showed that TAP blocks are generally successful. They found that the time it took for the TAP block group to experience their first analgesic was substantially longer (143.96 ± 8.15 minutes) compared to the control group (86.40 ± 7.08 minutes, $p = 0.000$).[18] In conclusion, this study's results support the use of TAP block in combination with other pain management strategies for lower abdominal procedures. In a similar vein, Tariq et al. (2024) found that administering dexmedetomidine alongside bupivacaine lengthened the time of postoperative analgesia (19.19 ± 2.49 hours vs. 11.78 ± 1.64 hours, $p = 0.001$) and decreased the number of opioids used (10.88 ± 4.53 mg vs. 20.69 ± 4.31 mg, $p = 0.001$), but it was linked to a higher rate of bradycardia (15.6%). Other studies have also

highlighted the analgesic advantages of dexmedetomidine.[19] Talebi et al. (2021) demonstrated that the duration of TAP block increased from 4 hours with local anesthetic alone to approximately 8 hours with dexmedetomidine supplementation, while also reducing analgesic requirements in the first 8 postoperative hours ($p < 0.02$). However, sedation and drowsiness were observed in patients receiving higher doses of dexmedetomidine ($p < 0.01$).[20]

Study Strength and Limitations: The strength of this randomized control study is that it minimized selection bias between study groups. Standardized intervention protocols improved the reliability of results. However, the results may not be applicable to other demographics or contexts because this study was carried out at just one tertiary care center. There may have been an impact on the study's statistical power due to the limited sample size (60 patients). Furthermore, the study focused only on short-term postoperative analgesia and did not assess long-term outcomes, complications, or patient satisfaction

Conclusion

In comparison to dexmedetomidine, the combination of dexamethasone and bupivacaine in the TAP block considerably extended postoperative analgesia. It offers a more effective option for pain control in lower abdominal surgeries. These findings should be validated by larger-scale experiments with broader populations.

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