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ORIGINAL ARTICLE

Comparison of dexamethasone versus dexmedetomidine as an adjuvant to 0.25% bupivacaine in ultrasound-guided transversus abdominis plane block on postoperative analgesia duration in patients undergoing laparotomy.

Mariam Mumtaz[1], Mohammad Omer Ajmal[2]

ABSTRACT… Objective: To compare the efficacy of dexamethasone and dexmedetomidine as adjuvants to bupivacaine in TAP block in patients receiving laparotomy. **Study Design:** Prospective Comparative study. **Setting:** Department of Anaesthesia, Sahiwal Teaching Hospital, Sahiwal. **Period:** 2nd October 2025 to 2nd March 2026. **Methods:** Ninety-six patients undergoing laparotomy were equally distributed into two groups. Group A were treated with 0.25% bupivacaine with dexamethasone (8 mg), while Group B received 0.25% bupivacaine with dexmedetomidine (1 µg/kg) in ultrasound-guided TAP block. Postoperative pain was determined using Visual Analogue Scale (VAS) at different timepoint from 0 to 24 hours. Additional parameters such as first rescue analgesia timepoint, total analgesic intake, and hemodynamic parameters were also recorded. **Results:** Baseline characteristics were comparable and difference were statistically insignificant. However, intensity of pain reduced significantly in Group B patients from 2 to 24 hours ($p < 0.05$). Participants in Group B required survived longer without the need of first rescue analgesia (11.4 ± 2.1 vs. 6.9 ± 1.5 hours; $p < 0.001$), and total ketorolac use was lower (51.3 ± 15.6 mg vs. 79.6 ± 18.2 mg; $p < 0.001$). Similarly, other evaluated postoperative parameters such as mean arterial pressure, heart rate, nausea and vomiting scores were also significantly lower in Group B ($p < 0.05$). **Conclusion:** Dexmedetomidine is a more effective adjuvant than dexamethasone in TAP block, providing prolonged analgesia and reduced analgesic requirements after laparotomy.

Key words: Bupivacaine, Dexmedetomidine, Dexamethasone, Laparotomy, Postoperative Pain, TAP Block.

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INTRODUCTION

Optimal control of postoperative pain plays a vital role in facilitating patient recovery and minimizing postoperative complications.[1,2] Various modalities are available for pain control, including systemic analgesics and regional anesthesia techniques. Among regional anesthesia techniques, the transversus abdominis plane (TAP) block is commonly utilized to provide anesthesia to the anterior abdominal wall. This technique achieves analgesia through the deposition of local anesthetic into the fascial layer located between the internal oblique and transversus abdominis muscles.[3-5]

Despite its effectiveness, when local anesthetics are used alone in TAP block, the duration of analgesic effect remains restricted.[6,7] To overcome this limitation and prolong analgesic effect, various adjuvants such as corticosteroids, alpha-2 adrenergic agonists, opioids, and ketamine are administered in peripheral nerve along with local anesthetics.[8]

Dexamethasone, a glucocorticoid agent, is frequently administered to surgical patients for its antiemetic, anti-inflammatory, and analgesic properties. Additionally, evidence indicates that its use as an adjunct to local anesthetics potentiates analgesic efficacy.[9,10] Whereas Dexmedetomidine is a highly selective alpha-2 adrenergic agonist well known for its sedative and analgesic characteristics. Its adoption as an adjunct in regional anesthesia has expanded considerably owing to its ability to prolong analgesic duration and improve the quality of peripheral nerve blocks.[11,12]

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Several studies have demonstrated that use of dexamethasone or dexmedetomidine in addition to local anesthetics improves postoperative analgesia compared to local anesthetic alone. These improvements include prolonged analgesia duration and consequently low intake of total analgesics.[13-15] A study evaluating sedative effects of the two in addition to levobupivacaine in ultrasound-guided TAP block reported that initial pain scores were almost similar between the two study groups but became significantly lower in the patients treated with dexmedetomidine at 6, 9, and 12 hours after surgery.[16] Similarly, another study in patients undergoing laparoscopic cholecystectomy showed that dexmedetomidine resulted in lower pain scores at both rest and moving state and better analgesic effects compared to dexamethasone.[14]

However, there are limited studies directly comparing two drugs as adjuvants to bupivacaine in ultrasound-guided TAP block, particularly in patients treated through laparotomy. In addition, local data in this patient population are scarce. Therefore, the rationale of our study is to evaluate and compare the efficacy of dexamethasone and dexmedetomidine as adjuvants to bupivacaine in TAP block in order to determine the more effective agent for prolonging postoperative analgesia and reducing analgesic requirements in patients receiving laparotomy.

METHODS

This prospective comparative study was held in the Anaesthesia Department, Sahiwal Teaching Hospital, for six months after institutional review board (161-/IRB/SLMC/SWL/3-12-24) and approval. In total 96 patients were considered for the study, such that each group had 48 patients, based on sample size calculation using the WHO OpenEpi calculator. Patients from both gender with in age range of 25-65 years, classified under "ASA class I and II, and undergoing laparotomy were included". Patients who refused consent, had "comorbidities such as hypertension, diabetes mellitus, chronic liver disease, chronic kidney disease", bleeding disorders, infection at the injection site, known drug allergies, or polytrauma were excluded.

All patients were apprised of the study objectives and the potential for their enrollment, and written consent was sought upon approval. Patients were allocated into two groups: Group A received ultrasound-guided TAP block with 18 ml of 0.25% bupivacaine combined with 2 ml dexamethasone (8 mg), whereas Group B was given 18 ml of 0.25% bupivacaine combined with 2 ml dexmedetomidine (1 µg/kg diluted in saline).

Upon completion of the surgical procedure, bilateral ultrasound-guided TAP block was administered to the patient positioned in a supine posture using a linear high-frequency ultrasound probe placed transversely between the costal margin and iliac crest along the mid-axillary line following standard guidelines.[17] One of two evaluated adjuvants were administered to patients as per their allocation in the group.

Patients were observed for complications such as possible local anesthetic reaction and hematoma formation at the injection site. Postoperative pain was evaluated through the Visual Analogue Scale (VAS) upon arrival in the post-anesthesia care unit and at 2, 4, 6, 12, and 24 hours postoperatively. A VAS score of ≤3 was considered adequate analgesia. Patients with a score ≥4 received intravenous ketorolac 30 mg as rescue analgesia, and the time to first request for rescue analgesia was recorded. Postoperative nausea and vomiting were documented using a categorical scale. Hemodynamic parameters including heart rate and mean arterial pressure (MAP) were also recorded.

Statistical analysis was conducted using SPSS version 26. Continuous data are expressed as mean ± standard deviation, while categorical data are presented as frequencies and percentages. Depending on the nature of the variables, significance of difference in values between two groups was assessed using the independent samples t-test or the chi-square test. The difference in outcomes was considered statistically significant when a p-value of less than 0.05 was achieved.

RESULTS

As already described, the study had two groups with 46 patients each: Group A (bupivacaine with dexamethasone) and Group B (bupivacaine with dexmedetomidine). As shown in Table-I, the two

groups showed no significant differencesin terms of age, gender distribution, body mass index, ASA status, duration of surgery, and duration of anesthesia, with no statistically significant difference ($p > 0.05$).

Postoperative pain scores assessed by VAS are presented in Table-II. At 0 hours, pain scores were almost similar among all the enrolled patients and no significant difference was observed between the two groups ($p = 0.52$). However, from 2 hours onward, pain scores started to reduce significantly in patients receiving dexmedetomidine. This difference remained statistically significant at all following timepoints of 4, 6, 12, and 24 hours postoperatively ($p < 0.05$).

As shown in Table-III, the patients in group B remain anesthetized for a significantly longer duration and were administered first rescue analgesia way a head in contrast to Group A (11.4 ± 2.1 vs 6.9 ± 1.5 hours) ($p < 0.001$). Hence, total ketorolac consumption was significantly lower in Group B (51.3 ± 15.6 mg) compared to Group A (79.6 ± 18.2 mg) ($p < 0.001$). Consequently, a significantly higher number of patients in Group A required rescue analgesia (79.2%) in contrast to Group B (50.0%) ($p = 0.003$).

TABLE-I

Baseline characteristics of patients (N=96)

Variable	Group A (n=48)	Group B(n=48)	Test Value	P-Value
Age (years)	44.9 ± 11.2	48.9 ± 8.8	t = 0.28	0.78
Gender (Male/Female)	26 / 22	25 / 23	$\chi^2 = 0.04$	0.84
BMI (kg/m²)	25.1 ± 3.9	26.1 ± 2.9	t = 0.44	0.66
ASA Class (I/II)	28 / 20	27 / 21	$\chi^2 = 0.05$	0.83
Duration of Surgery (min)	99.4 ± 15.6	93.8 ± 18.9	t = 0.49	0.62
Duration of Anesthesia (min)	113.5 ± 14.2	110.9 ± 18.5	t = 0.41	0.68

TABLE-II

Postoperative Pain Scores (VAS Score) (N=96)

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	Test Value	P-Value
0 hr	2.0 ± 0.9	2.1 ± 0.7	t = 0.64	0.52
2 hours	3.7 ± 0.99	3.0 ± 0.8	t = 2.07	0.04
4 hours	4.4 ± 1.5	3.2 ± 1.0	t = 3.47	0.001
6 hours	5.5 ± 1.4	3.6 ± 0.9	t = 5.89	<0.001
12 hours	4.9 ± 1.5	3.4 ± 1.2	t = 5.68	<0.001
24 hours	4.1 ± 1.0	2.9 ± 0.9	t = 5.29	<0.001

TABLE-III

Comparison of overall postoperative outcomes between study groups (N=96)

Variable	Group A	Group B	Test Value	P-Value
Time to first rescue analgesia (hours)	6.9 ± 1.5	11.4 ± 2.1	t = 9.37	<0.001
Total ketorolac consumption (mg)	79.6 ± 18.2	51.3 ± 15.6	t = 7.52	<0.001
Patients requiring rescue analgesia	38 (79.2%)	24 (50.0%)	$\chi^2 = 8.75$	0.003
Mean VAS score (overall 24 hrs)	3.7 ± 0.8	3.1 ± 0.7	t = 5.74	<0.001
Mean MAP (mmHg)	88.2 ± 6.5	84.6 ± 5.9	t = 2.58	0.01
Mean Heart Rate (beats/min)	82.5 ± 762	77.8 ± 6.5	t = 3.22	0.002
Mean PONV score	1.3 ± 0.6	0.9 ± 0.5	t = 4.31	0.001

The overall mean VAS score over 24 hours was significantly lower in Group B relative to Group A (3.1 vs 3.7, respectively; p<0.001). MAP and heart rate were also significantly reduced in Group B compared to Group A ($p < 0.05$). Additionally, the mean postoperative nausea and vomiting score was lower in Group B (0.9 ± 0.5) compared to Group A (1.3 ± 0.6), which demonstrated statistical significance ($p = 0.001$).

DISCUSSION

Effective postoperative pain control remains an important component of perioperative care, particularly in patients receiving interventions for treating lower abdominal segment of the body. Ultrasound-guided TAPblock is widely used for this purpose; however, its duration of action is limited when local anesthetics are used alone. To bridge the efficacy gap, multiple adjuvants including dexamethasone and dexmedetomidine have been evaluated for their ability to prolong analgesia and improve pain outcomes.[18]

In the present study, dexmedetomidine, when added to bupivacaine, provided significantly better postoperative analgesia compared to dexamethasone. Pain scores were comparable immediately after surgery but became significantly lower in the dexmedetomidine group from 2 hours onward and remained lower until 1 day of observation. These findings align with already published literature, which have documented superior analgesic efficacy of dexmedetomidine over dexamethasone in TAP block and other peripheral nerve blocks.[19,20]

The sedative effect of dexmedetomidine lasted longer in the recipient group,as reflected by a longer time to first rescue analgesia. Similarly, overall postoperative consumption of all analgesics were significantly lower in this group. These outcomes are in agreement with the findings of earlier studies held in patients undergoing abdominal surgeries, where dexmedetomidine was shown to prolong the time to rescue analgesia and lower overall analgesic requirements in contrast to dexamethasone.[21] Abdallah et al. conducted a detailed review where he also demonstrated that dexmedetomidine as an adjuvant to local anesthetics significantly prolongs the duration of sensory block and increases time span until the first request for analgesia.[22]

The enhanced analgesic effect of dexmedetomidine can be explained by its multiple mechanisms of action. It produces local vasoconstriction via α2-adrenoceptor stimulation, thereby minimizing systemic uptake of the local anesthetic and prolonging its duration of action. In addition, it exerts peripheral analgesic effects by inhibiting norepinephrine release and increasing potassium channel activity in nociceptive fibers.[22,23] In contrast, dexamethasone acts mainly through its anti-inflammatory and immunosuppressive properties and modulation of potassium channels, which may explain its relatively shorter duration of analgesic effect.[20]

With regard to hemodynamic parameters, arterial pressure and heart rate were monitored and both values were lower in the dexmedetomidine group, a finding consistent with its known sympatholytic effects. Similar findings have been reported in other studies evaluating dexmedetomidine as an adjuvant in regional anesthesia.[6] However, no clinically significant bradycardia or hypotension was observed in our study, possibly due to the use of a lower dose.

We also recorded the frequency of other post-operative symptoms such as nausea and vomiting and observed lower proportion of complainants of these symptoms in the dexmedetomidine group, which may be attributed to reduced analgesic consumption. Comparable findings have been reported in previous studies.[21] The studied drugs have so far been advocated safe to use. Our study further confirms it as we haven't observed any severe complications related to the TAP block or study drugs in either group.[24,25]

In contrast to our study results, some studies have demonstrated no major difference analgesic outcomes with the additional administration of dexmedetomidine to local anesthetics, this can be explained due to variations in drug dosage, type of surgery, and block techniques.[6]

Nevertheless, our study design has still room for improvement. One of the major limitations is

that plasma levels of dexmedetomidine were not measured, making it difficult to decidewhether its effects were due to systemic absorption or purely local action. Additionally, due to relatively smaller size who were included from only one health center, the findings of the results can't be generalized. Therefore, future studies with larger and multicenter participantsare recommended to further validate the reported findings. Moreover, comparative evaluation of multiple doses of dexmedetomidine and dexamethasone, as well as assessment of long-term outcomes and patient satisfaction, may provide more comprehensive insights into their clinical efficacy. Lastly, studies evaluating the pharmacokinetics of these adjuvants in TAP block could help clarify their exact mechanism of action.

CONCLUSION

Overall, the findings of our study suggest that dexmedetomidine is a better adjuvant than dexamethasone for prolonging postoperative analgesia, reducing the need of additional analgesic consumption, and improvingpain scores in patients undergoing laparotomy.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Mariam Mumtaz:** Data analysis, drafting, data collection.
2	**Mohammad Omer Ajmal:** Review, interpretation.