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Comparative study of effect of adjuvant dexamethasone and dexmedetomidine with bupivacaine on postoperative analgesia in transverse abdominis plane block: A randomised prospective study

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Abstract
Background: The aim of this study is to comparative study of effect of adjuvant dexamethasone and dexmedetomidine with bupivacaine on Postoperative analgesia in Transverse abdominis plane block.
Methods: A randomised prospective study was conducted in Sir Sunderlal hospital, Banaras Hindu University. The study included ASA I-II patients scheduled for lower abdominal surgeries. After induction of General Anaesthesia TAP block was given bilaterally with ultrasound guidance using a high frequency (5-10MHz) linear probe. In the Group AD 20 ml of 0.25% bupivacaine and 2 ml dexamethasone (8 mg) as adjuvant was given whereas, in Group BD 20 ml of bupivacaine 0.25% and dexmedetomidine 1.2 mcg/kg as adjuvant was administered. Visual analogue score (VAS) and patient satisfaction score were used to assess the quality of analgesia in immediately as well as at 2, 4, 8, 12 and 24 hours respectively in the postoperative period. Results were given as mean ± SD. Data collected were analysed using Student's t-test. Differences were considered statistically significant if P values were <0.05.
Results: Sixty patients were included in the study of which 30 patients each were randomly assigned to one of the 2 groups. Two Patients dropped out from the group AD. Patients who had dexmedetomidine as an adjunct in their TAP block had lesser variation in Heart Beat, MAP and lesser VAS score and higher Patient Satisfaction Score($p<0.05$).
Conclusion: We conclude that TAP block with 0.25% bupivacaine plain with dexmedetomidine 1.2 mcg/kg 20 ml on each side provides better postoperative analgesia and lesser VAS score which is better than TAP block with 0.25% bupivacaine plain with dexamethasone 8mg 20 ml on each side.

Keywords: heartrate; MAP; SBP; TAP; postoperative-analgesia; dexamethasone; dexmedetomidine; VAS; PSS

Introduction

The transversus abdominis plane (TAP) block is often used to provide surgical anaesthesia for minor, superficial procedures on the lower abdominal wall or postoperative analgesia for procedures below the umbilicus providing anaesthesia to the ipsilateral lower abdomen below the umbilicus. As the thoracolumbar nerves originate from the T6 to L1 spinal roots and run in this plane while providing sensory supply to the anterolateral abdominal wall [1], hence local anaesthetic spread in this plane can cause blockade of nerve afferents, resulting in analgesia.

TAP blocks have become more precise and safer to perform as a result of technological advancement in ultrasound. This resulted in increased interest in TAP blocks as a mode of analgesia in lower abdominal surgeries. The evidence supports the usefulness of TAP blocks in various abdominal surgeries for example caesarean section, total abdominal hysterectomy, cholecystectomy, colectomy, prostatectomy, and repair of hernia [2, 3], while the analgesia effectively covers only somatic pain for a short period [4], it does play a major role in multimodal analgesia. It was observed in a meta-analysis that, after TAP block there was a reduction in need for use of opioid in postoperative period, prolongation of the duration for requirement of first request for further analgesia, and more efficient pain relief with reduced side effects; facilitating early mobilization of the patients and decreasing postoperative morbidity.

Many adjuvants such as dexmedetomidine, dexamethasone, fentanyl, butorphanol and magnesium sulphate can be added to local anaesthetics for prolongation of duration and quality of analgesia for peripheral nerve blocks, have been studied.

Pertaining to this study, dexmedetomidine is a lipophilic α2 agonist with a much higher affinity for α2-receptors than clonidine (α2: α1 specificity ratio is 200:1 for clonidine and 1600:1 for dexmedetomidine). It has analgesic, sedative and sympatholytic effects. Using dexmedetomidine as adjuvant to bupivacaine in TAP block results in better anaesthesia and post-operative pain control without major side-effects.

On other hand, Dexamethasone, a high-potency, long-acting glucocorticoid, has been shown to prolong peripheral nerve blockade [5]. Dexamethasone binds to glucocorticoid receptors and inhibits potassium conductance, which decreases nociceptive C-fibre activity [6, 7]. Dexamethasone may also extend the duration of analgesia via local vasoconstrictive and systemic anti-inflammatory effects [7, 8].

Previous studies have reported the efficacy of

dexmedetomidine and dexamethasone as adjuvant to local anaesthetics in regional blocks. However, none of the studies compared these two drugs to establish statistically significant correlation between each other. Therefore, we designed this study to compare and evaluate the efficacy and safety of dexmedetomidine and dexamethasone as adjuvant to bupivacaine in ultrasound-guided TAP block for post-operative analgesia in patients undergoing lower abdominal surgeries under general anaesthesia.

Methods

Study Design

A prospective study was conducted from March 2018 to February 2019 in the Institute of Medical Sciences, BHU, Varanasi, after obtaining approval form the Institute Ethical Committee and an informed consent was taken from all the patients or their relatives.

Study Population

This randomized study was carried out on 60 adult patients of ASA grade I and II, scheduled for lower abdominal surgeries. Patients were included in the study based on the following criteria:

Inclusion criteria

1. American society of anaesthesiologist physical status 1 and 2
2. Lower abdominal surgery
3. Age group between 20 to 55 years
4. Hemodynamic stability

Exclusion criteria

1. Allergy to opioids, amide group of local anaesthetic & nonsteroidal anti-inflammatory drugs
2. Patient refusal
3. Deranged coagulation and bleeding parameters (INR >1.5)
4. Infection at puncture site of the proposed block
5. Emergency surgery

Based on the above-mentioned criteria, 60 adult patients were included and were allotted randomly into following 2 groups of 30 each:

- Group AD: 20 ml of 0.25% bupivacaine and 2 ml of dexamethasone (8 mg) was given in TAP block.
- Group BD: 20 ml of bupivacaine 0.25% and dexmedetomidine 1.2 mcg/kg was dissolved in 2 ml of normal saline and given in TAP block.

Study Technique

Informed written consent was taken from all individual patients. All patients were pre-medicated with Tab. Alprazolam 0.25mg orally, Tab. Ranitidine 150mg orally and Tab. Metoclopramide 10mg orally on the night before surgery and 2hrs before surgery.

A peripheral intravenous line with 18 gauze cannula was secured in one of the upper limbs. All patients were preloaded with 500ml of Lactated Ringer solution. Patients then received injection midazolam 30mcg/kg.

Baseline readings of Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), Oxygen Saturation (Sa02), and End Tidal CO2(ETCO) were recorded prior to induction in the OR.

Intraoperative monitoring and recording of Heart rate (HR), non-invasive Systolic blood pressure (SBP), and Diastolic Blood pressure (DBP), Mean arterial blood pressure (MAP), oxygen saturation (SpO2), end-tidal carbon dioxide (EtCO2) was done.

After induction of general anaesthesia, preparation of skin was done with 2% chlorhexidine solution and a high frequency (5-10MHz) linear ultrasound probe was placed horizontally across the abdomen. The tracing of muscle layers in the anterolateral part of the abdomen was performed by scanning in the mid-axillary line from midline towards the area between the costal margin and iliac crest.

The rectus abdominis muscle was identified, just adjacent to midline, as an oval or elliptical structure. The ultrasound transducer was moved to scan laterally where three muscle layers were seen running parallel to each other. After visualisation of correct plane, the regional block needle was inserted in between the internal oblique and transversus abdominis muscle plane. After excluding puncture of blood vessel by careful aspiration, the solution of isobaric bupivacaine 0.25% with either dexamethasone or dexmedetomidine was injected, resulting in separation of the internal oblique and transversus abdominis muscle.

Increment in the blood pressure or heart rate by > 20% after giving TAP Block was defined as insufficient analgesia or failed block, which was treated by administering intravenous fentanyl 0.5 µg/kg and diclofenac.

After completion of surgery, patients were extubated after complete reversal of muscle relaxation and awakening. Patents were transferred to the post-anaesthesia care unit (PACU). Quality of analgesia was assessed immediately and at 2, 4, 8, 12 and 24 hours respectively in the post-operative period by visual analogue score (vas) and patient satisfaction score. Intravenous diclofenac 75 mg was administered as rescue analgesia for patients, developing pain later. Also, patients were observed for side effects, for rescue analgesia and its time and dose, complications (nausea and vomiting, infection or hematoma formation) and degree of satisfaction of the patients which was assessed on a 5-point scale (completely dissatisfied, dissatisfied, not satisfied nor dissatisfied, satisfied or completely satisfied.

Analysis of Data

The analysis was done using SPSS IBM Version 20. Comparison of Proportions was done using Chi-square or Fisher's exact test. The parameters for two groups were compared using SPSS for ordinally Scaled Data by Mann-Whitney U, Sign Test, and Wilcoxon test.

Results

Sixty patients were included in the study with 30 in each group, but 2 patients of group Dexamethasone dropped out because of the unsatisfactory surgical analgesia by TAP block procedure. Thus, data of 58 patients were included in result analysis. The following observations were made.

Table 1: Comparison of heart rate (HR) among two groups

Heart Rate	Group Dexamethasone Mean±SD N=28	Group Dexmedetomidine Mean±SD N=30	t-value	p-value
Preop HR	90.53±6.404	89.33±6.789	0.704	0.484
HR 0hour	100.10±10.111	99.37±9.246	0.293	0.770
HR 2hour	85.13±8.609	78.00±13.209	2.478	0.056
HR 4hour	82.30±9.308	76.70±14.561	1.775	0.081
HR 6hour	82.97±9.640	76.23±13.693	2.202	0.052
HR 8hour	89.23±9.576	77.50±15.596	3.512	0.001
HR 12hour	101.77±8.811	77.70±14.245	7.870	<0.001
HR 18hour	102.89±8.856	97.0±7.591	7.113	0.092
HR 24hour	104.30±6.204	97.37±7.476	3.909	0.078

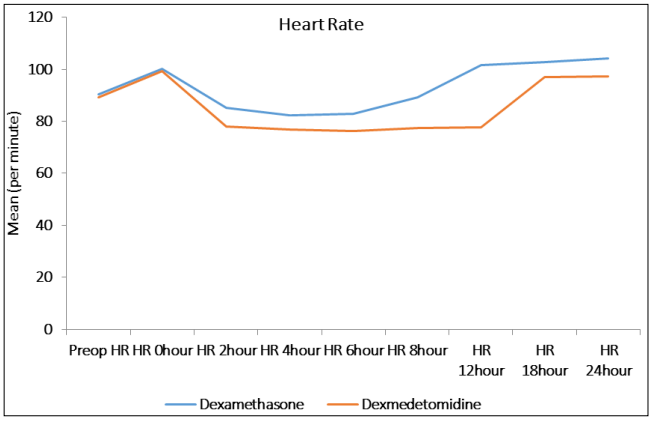

Fig 1

There were statistically significant variations present in heart rate at 8 and 12 hours between two groups. (p<0.05)

Table 2: Comparison of mean arterial pressure (MAP) among study groups

Mean arterial Pressure	Group Dexamethasone Mean±SD N=28	Group Dexmedetomidine Mean±SD N=30	t-value	p-value
Preop MAP	91.8556±11.51667	95.3778±12.74349	-1.123	0.266
MAP 0hour	95.0889±10.02599	97.2889±11.70248	-0.782	0.437
MAP 2hour	89.1333±9.40881	85.3778±10.21296	1.481	0.144
MAP 4hour	89.8111±9.36599	86.1556±10.64032	1.412	0.163
MAP 6hour	91.0333±8.90837	87.0889±10.61263	1.559	0.124
MAP 8hour	93.4222±8.60497	87.1111±10.48017	2.549	0.013
MAP 12hour	97.6889±8.78824	88.5556±10.93076	3.567	0.001
MAP 18hour	98.2334±8.94224	96.0022±9.63018	4.760	0.132
MAP 24hour	99.2778±8.99940	96.4889±10.68523	1.093	0.279

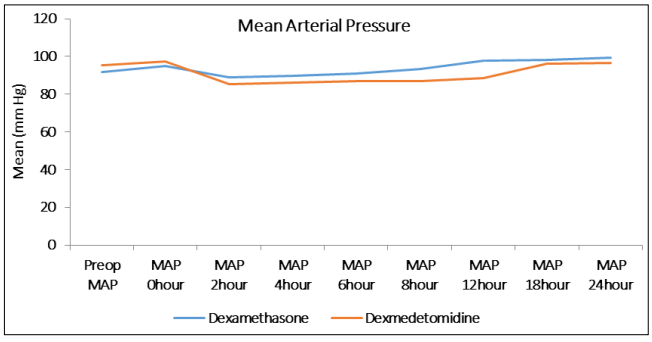

Fig 2

There was statistically significant variations present in mean arterial pressure at 8 and 12 hours between two groups. (p<0.05)

Table 3: Comparison of visual analogue score (VAS) among study groups

	Group Dexamethasone Mean±SD N=28	Group Dexmedetomidine Mean±SD N=30	t-value	p-value
VAS 0hour	3.87±0.973	3.53±0.776	1.467	0.148
VAS 2hour	1.87±1.306	1.80±1.215	0.205	0.839
VAS 4hour	2.57±1.357	2.47±1.196	0.303	0.763
VAS 6hour	4.13±1.252	2.63±0.964	5.199	<0.001
VAS 8hour	5.13±1.167	2.97±1.189	7.126	<0.001
VAS 12hour	6.07±0.740	4.03±1.066	8.582	<0.001
VAS 18hour	6.41±0.728	5.71±1.913	7.981	0.062
VAS 24hour	6.60±0.770	5.90±0.845	3.354	0.781

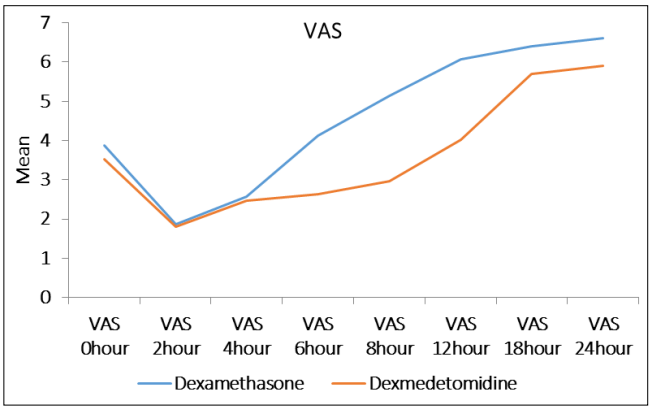

Fig 3

There was statistically significant variations present in visual analogue score at 6, 8 and 12 hours between two groups. (p<0.05)

Table 4: Comparison of time of first analgesic use among study groups

Group	N	Mean±SD	t-value	p-value
Dexamethasone	28	456.28±81.96	-10.924	<0.001
Dexmedetomidine	30	841.20±168.71		

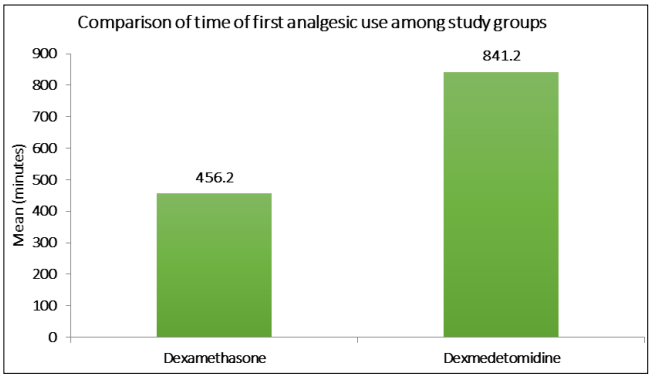

Fig 4

Hence, there was statistically significant difference (p<0.05) between two groups on comparing first analgesic.

Table 5: Comparison of patient satisfaction score (PSS) among study groups

	Group Dexamethasone Mean±SD N=28	Group Dexmedetomidine Mean±SD N=30	t-value	p-value
PSS 4hr	2.42±1.691	1.77±1.305	1.528	0.129
PSS 8hr	4.31±2.209	2.33±1.539	5.160	<0.001
PSS 12hr	7.47±1.358	3.67±1.826	9.148	<0.001
PSS 18hr	8.21±1.271	6.71±1.098	7.532	0.071
PSS 24hr	8.57±0.504	6.93±1.112	7.327	0.052

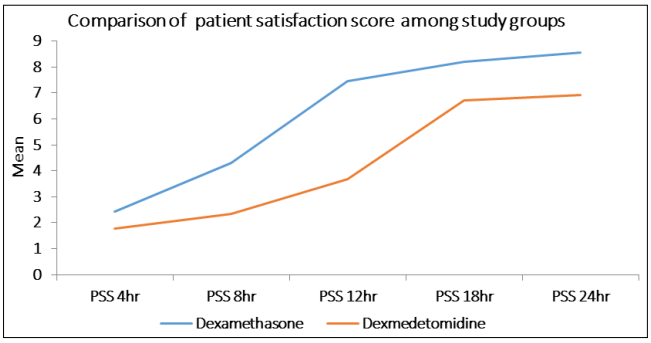

Fig 5

There was statistically significant difference (p<0.05) between two groups in on comparing patient satisfaction score at 8 and 12 hour.

Discussion

To compare and evaluate the analgesic efficacy and safety of two adjuvants – dexmedetomidine and dexamethasone along with local anaesthetic bupivacaine in ultrasound-guided TAP block for postoperative analgesia in patients scheduled for lower abdominal surgeries under general anaesthesia was the primary objective in the study.

A significantly prolonged duration of postoperative analgesia was observed when we use dexmedetomidine was used as adjuvant as compared to dexamethasone (p<0.05), VAS score was significantly lower in dexmedetomidine than in dexamethasone group after 6 hrs. Rescue analgesia in dexamethasone group was required quite early in comparison to dexmedetomidine group which was statistically significant. In patients where dexmedetomidine was given as adjuvant, duration of hemodynamic stability and patient satisfaction score was better than patients where dexamethasone was used. No significant difference was noted in the incidence of nausea and vomiting in AD and BD group.

Other modalities for post-operative analgesia such as epidural analgesia or intravenous opioid can have several disadvantages, such as continuous monitoring of blood pressure to prevent hypotension, risk of dislodgement of epidural catheter, respiratory depression, constipation, dependence, etc. with adjuvants like dexamethasone and dexmedetomidine in TAP block, the aforementioned side effects can be effectively bypassed.

In this study, we observed that the average duration of postoperative analgesia was significantly prolonged when Dexmedetomidine was used as adjuvant in comparison dexamethasone as adjuvant, which is supported by findings of Mishra *et al*. [9] using dexmedetomidine as adjuvant to ropivacaine in TAP block.

The effectiveness of TAP blocks in management of acute pain after caesarean section was reported by Champaneria *et al*. [10]. It was discovered by Ranjit *et al* that ultrasound-guided TAP block reduced post-operative pain much effectively than local wound infiltration after surgery.

It was demonstrated by Amany *et al*. [11] that addition of Dexamethasone to Bupivacaine as adjuvant in TAP block results in increase in the duration of analgesia rather than using Bupivacaine alone. Although, we compared the efficacy of dexamethasone vs dexmedetomidine, where we noted significant prolonged postoperative pain control with dexmedetomidine (p<0.05).

A study by Xue *et al*. [12] concluded that the ultrasound-guided TAP block with dexmedetomidine as an adjunct with Ropivacaine, improved recovery from anaesthesia and reduced post-operative pain significantly than either intravenous analgesia or TAP block with plain Ropivaciane without any adjuvant. This study is similar to our study as dexmedetomidine has a better outcome than dexamethasone in TAP block regarding reduction of opioid dose, better postoperative analgesic cover and VAS score.

My study is similar to the finding of a study conducted by Parameswari *et al*. [13] reported that to bupivacaine with dexmedetomidine in the TAP block increased the time at which the first dose of rescue analgesia was needed as well as reduced the total dose of opioid requirement in the first 24 hours after Caesarean section, which supports the findings in this study that the first dose of rescue analgesia was given much later in the dexmedetomidine group than in dexamethasone group.

On comparing my study with Wengang Ding [14] found that dexmedetomidine as an adjuvant to ropivacaine increased the duration of analgesia and reduced VAS scores of TAP block after gastrectomy. Similarly, we observed significant reduction in VAS scores at 6, 8 and 12 hours. Dexmedetomidine enhanced the duration of postoperative analgesia more than dexamethasone, however but the dexamethasone was more cost-effective.

Conclusion

We conclude that TAP block with 0.25% bupivacaine plain with dexmedetomidine 1.2 mcg/kg 20 ml on each side provides better postoperative analgesia and lesser VAS score which is better than TAP block with 0.25% bupivacaine plain with dexamethasone 8mg 20 ml on each side.

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