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Original Research Article

# Comparison of dexmedetomidine and clonidine as an adjuvant to levobupivacaine in transversus abdominis plane (TAP) block for postoperative analgesia following inguinal hernia repair

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ABSTRACT

**Background:** Postoperative analgesia for inguinal hernia procedures can be provided safely and effectively with USG guided TAP blocks. In the TAP block following inguinal hernia repair, we compared the analgesic effectiveness of dexmedetomidine and clonidine.

**Materials and Methods**: Seventy four patients undergoing inguinal hernia repair under spinal anesthesia were randomly divided in to Group LD (n=37) and Group LC (n=37). Patients in Group LD received a unilateral USG-guided TAP block with 0.5% levobupivacaine 18ml and dexmedetomidine 1 $\mu$g/kg in NS to make a total 20ml at the conclusion of surgery after regression of sensory block to the T10 dermatome, whereas patients in Group LC received 0.5% levobupivacaine 18ml and clonidine 1 $\mu$g/kg. Duration of postoperative analgesia, quality of analgesia (VAS), total rescue analgesic consumption in 24 hours and adverse effects were noted.

**Result:** Time for the initial application of rescue analgesia took substantially longer in Group LD (1006.49± 29.89 min) than in Group LC (512.35 ±27.14 min) (p ≤0.0001). At 8h, 16h, and 20h postoperatively, Group LD had a significantly lower VAS score both at rest and during hip flexion. It was discovered that Group LD had considerably decreased overall analgesic consumption. Incidence of postoperative side effects was comparable between two groups.

**Conclusion**: In comparison to clonidine, TAP block with dexmedetomidine as an adjuvant to levobupivacaine greatly prolongs postoperative analgesia and lowers 24-hour analgesic use.

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## 1. Introduction

The repair of inguinal hernias is one of the surgical operations that more than 20 million people undergo annually.[1,2] The postoperative pain and discomfort that people experience after this operation, however, ranges from moderate to severe. Transversus abdominis plane block (TAP) block is one of the upcoming techniques used to block the spinal nerves originating from T7 to L1 spinal roots providing multidermatomal analgesia.[3] It increases duration of analgesia & prolongs the time to first analgesic request, reduces postoperative analgesic consumption and reduces opioids related side effects. Although levobupivacaine is a powerful anaesthetic, its analgesic effect lasts only briefly, necessitating the use of various adjuvants to extend the analgesic effect. Most commonly used are dexmedetomidine and clonidine. However, any comparative data between the two is scanty in Indian literature. This small-scale study was therefore carried out at a tertiary care facility in Chhattisgarh to evaluate their effectiveness in extending the duration of post-operative analgesia. The study's objective was

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to evaluate the effectiveness of dexmedetomidine and clonidine as analgesic adjuvants to levobupivacaine in TAP block after inguinal hernia surgery. Primary objective was to assess the duration of postoperative analgesia while secondary objectives were to compare the quality of analgesia as measured by VAS score, the total amount of rescue analgesics consumed in 24 hours, side effects, and complications if any between the two adjuvants.

## 2. Materials and Methods

It was an interventional comparative, randomized; double-blind study conducted based on preformed pretested proforma on all patients who underwent elective unilateral inguinal hernia surgery under subarachnoid block in the major operation theatre in Dr. Bhimrao Ambedkar Hospital Raipur, Chhattisgarh over a period of 1.1 year from September 2020-October 2021. The study has been registered in CTRI and registration number is CTRI/2021/05/033559.

Male patients with ASA Grade I & II, age between 18-65 years, height 140-170 cm, weight 30-90 kg with BMI<30 kg/m$^2$ were included in the study. Patients who refused to enroll, were non-cooperative, with pre-existing abdominal pain, on analgesic drugs, surgery duration >2 hours with any intraoperative surgical complications were excluded from the study. Also, those with systemic disorders of liver, kidney, cardiac, respiratory, neurological, psychiatric disorders and bleeding tendencies, the presence of any neuraxial anaesthetic contraindications and a history of an allergic reaction to local anaesthetics were excluded from the trial. After Institutional ethics and scientific committee approval, informed and written consent was obtained from all the patients who fulfilled the inclusion criteria for the study. Preoperative assessment was done in anaesthesia OPD the day before the surgery including complete history, clinical examination and recording of vital parameters along with routine investigations

Following the evaluation of 88 patients over the course of the study, a total of 74 patients were included, and using the sealed envelope method, they were randomly divided into two groups: Group LD (levobupivacaine-dexmedetomidine, 37 patients) and Group LC (levobupivacaine-clonidine, 37 patients). All the patients were kept nil per orally for 6 h prior the surgery and they were informed about the use of ultrasound guided TAP block as well as the use of visual analogue scale (VAS) ranging from 0 (no pain) to 10 (maximum pain) for post-operative pain relief. Under strict aseptic conditions, subarachnoid space was accessed through L4-L5 or L3-L4 intervertebral space using 26-gauge Quincke's spinal needle. After confirmation of free flow of CSF, 3 ml of hyperbaric bupivacaine injection 0.5% (w/v) was administered for the surgery.

After completion of surgery, the patients were moved to the post-anesthesia care unit. A single shot unilateral TAP block was then performed on the side of the surgery under ultrasound guidance after the sensory block had regressed to the T10 dermatome. Patients in Group LD received 18ml of 0.5% levobupivacaine and 1$\mu$g/kg of dexmedetomidine in NS to make a total of 20ml, whereas patients in Group LC received 18ml of 0.5% levobupivacaine and 1$\mu$g/kg of clonidine. Data were collected in postoperative period (0-24 h) from all the patients and observations were analyzed and compared. Post-operative pain was evaluated on flexion of hip joint and at rest, using VAS scores 0 to 10 in post anaesthesia care unit (PACU) at 0,2,4,8,12,16,20 & 24 h after block. Ramsay sedation score were used for assessing the level of sedation, which was evaluated at 0,2,4,8,12,16,20 & 24 h after block. Ramsay sedation score > 3 was considered as undue sedation. Hemodynamic variables including HR, SBP, DBP, MBP, RR and $SpO_2$ were recorded at every 5 min interval up to 30 min, then at every 30 min interval up to 2 h then every 4 hours up to 24 hrs. Whenever there is request for rescue analgesic at any time, i.v. paracetamol 10 mg/kg was given to the patients. If pain was persistent then inj. tramadol 2 mg/kg i.v was given as second rescue drug. Duration of analgesia i.e from the time of instillation of the drug in TAP block until the patient's initial request for analgesia, the time was recorded. Total consumption of injectable paracetamol and injectable tramadol during the first 24 hours following surgery was calculated as the total analgesic dose in 24 hours. Adverse effect like nausea, vomiting, bradycardia, hypotension, respiratory depression were promptly noted and adequately treated. Ondansetron 0.01 mg/kg was administered intravenously for nausea and vomiting, and atropine 0.6 mg IV was given for bradycardia (HR 50 bpm). Intravenous fluid boluses were used to treat hypotension (20% fall in baseline SBP), if persisted then was treated with a bolus of injection mephenteramine 3 mg. Assisted ventilation was used to treat any respiration depression. The statistical analysis was carried out using IBM SPSS (Statistical Package for Social Sciences) statistical version 21. Level of significance was taken as p<0.05.

## 3. Result

Table 1 shows that the demographic details for the two groups were comparable. When compared to Group LC (512.35±27.14 min), the time for the first rescue analgesia was significantly longer in Group LD (1006.49±29.89 min) (p< 0.0001). At 8h, 16h, and 20h postoperatively, the VAS score at rest and during hip flexion was significantly lower in Group LD (p< 0.05). The mean i.v. paracetamol consumed in the first 24 hours after surgery was 1054.05 mg in group LD and 1621.62 mg in group LC, respectively. The difference in the IV paracetamol requirement between the 2 groups was statistically significant (p<0.00001). Mean IV tramadol intake in the LD and LC groups, respectively, was 5.41±22.92 mg and 8.33±28.03 mg in the first 24 hours

following surgery. The required amount of tramadol varied across the two groups, but the difference was statistically insignificant. The intake of analgesics overall was shown to be lower in Group LD. Between the two groups, postoperative nausea incidence was comparable. In terms of adverse effects such as hypotension, bradycardia, and respiratory depression, there was no statistically significant difference.

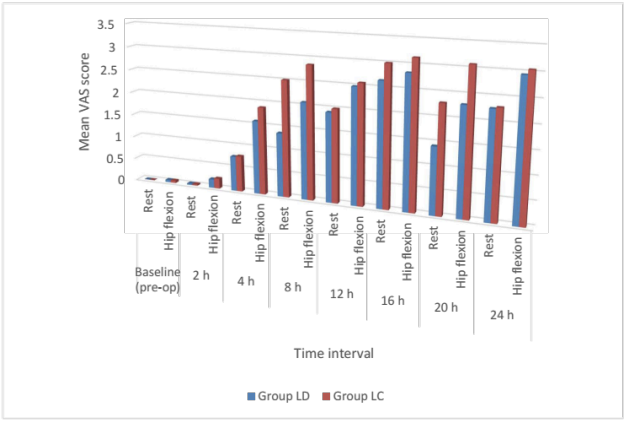


**Fig. 1:** In two groups, the mean VAS values at rest and hip flexion changed with time. Throughout the study, VAS in group LD was lower than in group LC, but at 8 h, 16 h, and 20 h ($p<0.05$), the difference was statistically significant

## 4. Discussion

With a substantial impact on our healthcare system and increased perioperative morbidity and mortality, post-operative pain is still one of the most critical issues following surgeries.[2] Postoperative analgesia is one of the crucial elements of enhanced postoperative recovery, which improves patient satisfaction, accelerate recovery after surgery, and enables early hospital discharge. Inguinal hernia repair surgery which is a very common procedure performed routinely, is associated with moderate to severe postoperative pain and discomfort in patients. The majority of patients' complaints of this discomfort are primarily caused by abdominal wall incisions, with the remainder coming from internal visceral trauma.

A number of techniques have been used to provide analgesia for abdominal surgeries, including the administration of NSAIDS, paracetamol, opioids, infiltration of local anaesthetics in the skin around the surgical wound, insertion of an epidural catheter,[4,5] and regional analgesia like transversus abdominis block. Dr. Rafi from Ireland carried out the first TAP block in 2001 using the lumber triangle as an anatomical reference point, and Hebbard later documented the ultrasonic approach in 2007. TAP block is a safer method when compared to systemic & neuraxial opioids, which require more monitoring and have more adverse side effects, such as respiratory depressions, drowsiness sedations, nausea, vomiting, and constipations,[6] etc.

The anterior rami of spinal nerves T7 to L1 are the source of the anterolateral abdominal wall's innervation. The intercostal nerves (T7-T11), the subcostal nerve (T12), and the iliohypogastric and ilioinguinal nerves (L1) are all branches from the anterior rami. As they become more superficial, they produce anterior and lateral cutaneous branches. The goal of a TAP block is to administer local anaesthetic medications to the spinal nerves that are present in the plane between the internal oblique (IO) and transversus abdominis (TAM). A high frequency (3-12 MHz) linear array transducer is used along with a 22-gauge 89 mm short bevel (Quincke's spinal needle). A 1-2 ml dose of local anaesthesia (or saline) is administered into the TAP once the needle has been located there to ensure proper placement. Following verification of the proper local anaesthetic distribution, 20 ml of local anaesthetic is gradually injected while observing for an expanding anaechoic fluid collection within the TAP. However, the main drawback is the relatively brief duration of analgesia, so various adjuvants, such as dexmedetomidine, clonidine, dexamethasone, etc., have been tried in peripheral and field block to lengthen the duration of local anaesthetic and postoperative analgesia.[7]

In this trial, levobupivacaine was combined with either clonidine or dexmedetomidine. Bupivacaine's S-enantiomer is levobupivacaine. It binds to the sodium channel's intracellular domain and stops sodium from entering nerve cells, preventing depolarization. Its half-life is 3.3 hours. It is available in 0.25%, 0.5%, 10 ml and 20 ml ampoules. Dosage for post- operative pain with 1.25 mg/dl concertation is 10-15 ml/h (12.5-18.75 mg/h) and for 2.5 mg/dl it is 5-7.5 ml/h (12.5-18.75 mg/h). It is roughly 13% less potent (by molarity) than racemic bupivacaine and has a decreased risk of toxicity to the heart and neurological system, as well as having a lesser effect on inotropy and QT prolongation.

Dexmedetomidine is a novel highly selective ($\alpha 2$) adrenergic receptor agonist with analgesic and sedative property.[8] Perineural dexmedetomidine injection can lengthen the time of sensory and motor blockage as well as analgesia.[4] It comes in 100$\mu$g/ml in 1 ml and 2 ml ampoules. A maintenance infusion of 0.2 to 0.7 $\mu$g/kg/h with a loading infusion of up to 1 $\mu$g/kg over 10 min. After a continuous intravenous infusion, peak concentrations are typically reached within an hour of the action starting. Onset of action: roughly 15 minutes. $\alpha$ terminal elimination half-life is between 2.0 and 2.5 hours, while $\alpha$ half-life is 6 minutes. It reduces the affective-motivational aspect of pain in order to give analgesic effect at the spinal and supraspinal levels. Hypotension, hypertension, nausea, bradycardia, atrial fibrillation, and hypoxia are some of the

**Table 1:** Comparison between levobupivacaine-dexmedetomidine (LD) and levobupivacaine-clonidine (LC) groups

| S. No | Parameter | LD (n =37) | LC (n=37) | Significance |
|---|---|---|---|---|
| 1. | Mean Age | 47.3± 9.19 year | 49.19±7.66 year | p=0.34 |
| 2. | ASA1, ASA2 | 16,21 patients | 17,20 patients | |
| 3. | Mean weight | 61.62±5.82 kg | 63.38±3.38 kg | p=0.11 |
| 4. | Mean Height | 162.57±8.88 cm | 165.05±4.53 cm | p=0.13 |
| 5. | Mean BMI (kg/m2) | 23.61±2.58 kg/m2 | 23.32±1.78 kg/m2 | p=0.576 |
| 6. | Mean time to first analgesic request | 1006.49±29.89 min | 512.35±27.14 min | p<0.0001 |
| 7. | Mean VAS score at 8, 16 and 20hour post op | | | p<0.05 |
| | At Rest | 1.38±0.64,2.65±0.48 and 1.43±0.5 | 2.51±0.61,3±0.62 and 2.3±0.66 | |
| | Hip-flexion | 2.08±0.64,2.08±0.64 and 2.3±0.57 | 2.86±0.63,3.14±0.71 and 3.08±0.92 | |
| 8. | First request IV paracetamol 1gm | 12-hour post op | 8-hour post op | |
| 9. | Paracetamol 1gm in 24 hours | Twice in 2 patients, once in 35 patients | Twice in 23 patients, once in 14 patients | p<0.00001 |
| | Mean consumption | 1054.05±229.24 mg | 1621.62±491.67 mg | |
| 10. | Tramadol 100 mg in 24 hours | Once in 2 patients | Once in 3 patients | p=0.634 |
| 11. | Vitals at all hours Heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate and oxygen saturation | Stable | Stable | p>0.05 |
| 12. | Adverse effects- Nausea | 2 patients | 2 patients | p>0.05 |
| 13. | Ramsay score | 2±0 at all-time intervals | 2±0 at all-time intervals | |

side effects of dexmedetomidine.

Clonidine is a centrally acting selective partial alpha2 adrenergic agonist sympatholytic agent. It also has the ability to potentiate the effects of local anaesthetics.[9] Clonidine administered neuraxially prevents nociceptive neuron activity brought on by noxious stimuli as well as spinal substance P release. Clonidine has an elimination half-life of 9±2 h and a distribution half-life of 11± 9 min after an IV dosage. Sedation and xerostomia are the two most frequent adverse effects of clonidine.

When compared to Group LC (512.35±27.14 min), we discovered that Group LD (1006.49±29.89 min) took significantly longer for the first rescue analgesia (p<0.0001). This was comparable to Eldegwy H M et al. (2018),[10] who found that the TAP block with dexmedetomidine, without dexmedetomidine, and local wound infiltration took 907± 240 min, 604±24 min, and 313±180 min before the first request for analgesia was made (p <0.001).

According to Xiao F et al. (2017),[11] the dexmedetomidine group's mean duration of analgesia was 905±114.2 minutes, while the control group's was 741.4±105.3 minutes (p<0.001). According to Gupta et al. (2019),[4] the time required for the first rescue analgesic was longer in the dexmedetomidine group than in the clonidine group and the plain levobupivacaine group, i.e 491.50±73.29 min, 268.47±35.47min, and 129.17±10.67minutes respectively. Madangopal et al. (2020)[8] and Varshney et al. (2019)[12] also had similar findings to our study. Talebi G et al. (2021)[13] in their study observed that postoperative consumption of injection paracetamol was 1370 mg when 0.5 $\mu$g/kg dexmedetomidine was used as an adjuvant to 0.125% bupivacaine. The mean dose of inj paracetamol consumption in our study was 1054.05 mg. The use of lower concentrations of bupivacaine and dexmedetomidine in their investigation may have resulted in higher consumption. The outcomes are comparable to our study's.

At 8h, 16h, and 20h postoperatively, Group LD had a significantly lower VAS score at rest and during hip flexion (p<0.05). Madangopal et al (2020)[8] observed statistically significant difference in pain perceived by patients in terms of VAS score started early when 0.25% bupivacaine used alone as compared when dexmedetomedine was added as an adjuvant with concentration of 0.25 $\mu$g/kg and 0.5 $\mu$g/kg groups at 1.5 h to 6 h (p<0.05). Results were similar to our study.

Our study has some limitations, such as the fact that we did not measure the plasma concentrations of clonidine and dexmedetomidine to determine whether their actions were solely local or stemmed from systemic absorption. After 24 hours in the postoperative period, there was no follow-up.

## 5. Conclusion

In patients undergoing inguinal hernia repair, TAP block with dexmedetomidine as an adjuvant to levobupivacaine significantly prolongs postoperative analgesia and decreases 24-hour analgesic consumption as compared to clonidine as an adjuvant to levobupivacaine. The method is discovered to be both safe and effective.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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