Original Article

Analgesic efficacy of classical thoracolumbar interfascial plane block versus modified thoracolumbar interfascial plane block in patients undergoing lumbar disc surgeries: A comparative, randomised controlled trial

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ABSTRACT

Background and Aims: We compared classical (medial) and modified (lateral) thoracolumbar interfascial plane block (TLIP) with only general anaesthesia (GA) using multimodal analgesia in patients undergoing lumbar disc surgeries. **Methods:** In this study, 100 patients aged 18–70 years were randomised to Group cTLIP (conventional TLIP block with 20 mL of 0.25% ropivacaine with GA), Group mTLIP (modified TLIP block with 20 mL of 0.25% ropivacaine with GA), and Group C (only GA using multimodal analgesia). The primary outcome was to assess the total peri-operative opioid consumption in the first 24 h. The secondary outcomes were to assess pain score upon arriving in the post-anaesthesia care unit, time to first analgesic need after surgery, post-operative opioid consumption in 24 h, and incidence of nausea and vomiting. **Results:** The total peri-operative opioid consumption in Group cTLIP (507.58 (258.55) μg) and Group mTLIP (491.67 (165.39) μg) was significantly lower than that in Group C (1225.4 (237.03) μg); ($P < 0.001$). However, it was comparable between groups cTLIP and mTLIP ($P = 0.767$). Pain score was comparable in groups cTLIP and mTLIP. It was significantly lower than Group C ($P = 0.001$). Rescue analgesia was needed in all (100%) patients of Group C but in only 15.2% of patients of the cTLIP and mTLIP groups. No patient in groups cTLIP and mTLIP complained of nausea and vomiting in the first 24 h, whereas it was significantly higher (61.8%) in Group C ($P = 0.001$). **Conclusion:** The analgesic effect of the modified TLIP block was not superior to the conventional TLIP block. Both techniques provided the same intra-operative and post-operative analgesia for lumbar disc surgeries.

Keywords: Analgesia, lumbar disc surgery, peri-operative analgesia, thoracolumbar interfascial plane block

INTRODUCTION

Spinal surgeries are frequently conducted to stabilise the vertebrae and discs of the spine.[1,2] These surgeries typically require substantial manipulation of subcutaneous tissues, bones, and ligaments, which can result in significant postoperative pain. In most cases, this intense pain continues for at least 3 days.[3] The number of vertebrae involved correlates directly with the magnitude of postoperative discomfort experienced. A combination of preexisting pain and

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long-term use of analgesics and/or opioids render these patients more susceptible to pain, thus complicating the management of pain.[4] Effective pain management facilitates early mobilisation and accelerates hospital discharge.[5,6]

Various analgesic techniques have been used to manage postoperative pain in lumbar disc surgeries. The thoracolumbar interfascial plane (TLIP) block was initially reported by Hand *et al*.[7] to block the dorsal rami of the thoracolumbar nerves as they travel through paraspinal muscles. The erector spinae muscle comprises three muscles from medial to lateral: multifidus, longissimus, and iliocostalis. Under ultrasound guidance, in classical or medial TLIP block, a local anaesthetic (LA) is administered into the interfascial plane between the multifidus and longissimus muscles at the level of the L_3 vertebra. However, in modified or lateral TLIP, LA is administered into the interfascial plane between the longissimus and iliocostalis muscles. This approach is away from the midline and is simpler to conduct owing to improved plane identification.[8,9]

The present study aimed to compare the perioperative opioid consumption in the first 24 h of the two approaches of TLIP block (classical vs lateral with general anaesthesia [GA]) and only GA method (no blocks) using intravenous (IV) multimodal analgesia in patients undergoing spinal disc surgeries. We hypothesised that the modified lateral approach of TLIP block with GA provides superior peri-operative analgesia compared to the classical TLIP approach with GA and only the GA method (control group) in patients undergoing lumbar disc surgeries.

METHODS

This comparative, randomised, parallel assignment trial was conducted at a tertiary healthcare hospital. This study was registered with the Clinical Trials Registry-India (vide registration number CTRI/2020/09/027901; www.ctri.nic.in) after the approval of the institutional ethics committee for postgraduate research (vide approval number ECPG-387/26.08.2020 dated 26 August 2020). After obtaining written informed consent, including patient participation in the present study and use of their data for research and educational purposes, we recruited 100 American Society of Anesthesiologists (ASA) physical status I–II patients aged 18–70 years, undergoing lumbar disc surgeries enroled from September 2020 to May 2022. Patients who refused to participate, previous lumbar spine surgery, major lumbar spine procedures such as large tumour removal, scoliosis correction, body mass index (BMI)>35 kg/m^2, history of opioid tolerance, contraindications to regional technique, such as local infection (administration site), systemic infection, coagulopathy, and pregnancy or lactation were excluded. The research was conducted in accordance with the principles of the Declaration of Helsinki 2013 and good clinical practice.

All recruited patients underwent a routine pre-anaesthetic assessment, and adequate fasting was ensured. The study protocol was explained to them in their language with the help of the patient's information sheet. Patients were also explained how to express pain using a numerical rating scale (NRS), patient-controlled analgesia (PCA), and the operation of the PCA pump when they experienced pain.

All recruited patients were allocated to one of the groups. Randomisation was done using a computer-generated random numbers table (www.randomizer.org). The allocation concealment was accomplished by putting the assignments inside opaque, numbered envelopes concealing the randomisation group that were sealed and only revealed when the patients reached the surgery room. Envelopes were prepared by an independent person not involved in the study. Each envelope was labelled with a number from 1 to 100 and contained a folded slip that allocated the participant to either Group cTLIP, Group mTLIP, or Group C. This process was performed for each patient, and they were allowed to choose the sealed envelope. Patients were blinded to the allocated group.

In the operating room, baseline monitors such as electrocardiogram (ECG), non-invasive blood pressure (NIBP), pulse oximeter (SpO^2), and neuromuscular monitoring (NMT) were attached to all patients, and baseline haemodynamic parameters were noted before anaesthetic induction. IV access was secured with an appropriately sized cannula, and a balanced salt solution was administered.

All patients were preoxygenated for 3 min with 100% oxygen before induction of anaesthesia. Induction in all patients was achieved with IV fentanyl 1.5–2 μg/kg, IV propofol 2–2.5 mg/kg, oxygen (100%), and isoflurane (2%-4%), keeping minimum alveolar concentration (MAC) of 0.8–1.2. NMT was initiated in all patients after anaesthesia induction. Tracheal intubation

was facilitated by IV atracurium 0.5 mg/kg when the train of four (TOF) count was zero. The airway was secured by an appropriately sized cuffed endotracheal tube (ETT), and its position was confirmed clinically by 5-point chest auscultation and capnography. Once the ETT tube was fixed, surgeons catheterised the patients with appropriately sized Foley catheters, and all patients were positioned prone.

Patients in Group cTLIP (n = 33) received a classical TLIP block with 20 mL of 0.25% ropivacaine and GA. In Group mTLIP (n = 33), patients received a modified lateral TLIP block with 20 mL, 0.25% ropivacaine and GA. In Group C (Control group) (n = 34), patients received GA only without any block. As a premedication, all patients received oral alprazolam 0.25 mg and ranitidine 150 mg the night before and early morning on the day of operation.

In the Group cTLIP, the third lumbar vertebra (L_3) was identified and marked. The skin was sterilised with 2% chlorhexidine. A Sonosite S-Nerve ultrasonography (USG) machine (FUJIFILM Sonosite Inc., USA) with a low-frequency (5–2 Hz) curvilinear probe was placed transversely at the level of L3 vertebra in the midline and adequate depth of 3–8 cm was adjusted on USG screen. After identification of the corresponding spinous process and interspinal muscles, namely multifidus, longissimus, and iliocostalis from medial to lateral, under real-time ultrasound guidance, a 10-cm, 21-G Stimuplex needle (Braun Medical Inc, Bethlehem, PA, USA) was inserted in plane in a lateral-to-medial direction, at an angle of approximately 30° to the skin and advanced towards the multifidus muscle through the belly of longissimus muscle. As the needle tip reached the longissimus/multifidus interfascial muscle plane close to the superior articular process, confirmed by hydrodissection, a total volume of 15 mL of ropivacaine 0.25% was administered with intermittent negative aspiration. The remaining 5 mL of 0.25% ropivacaine was injected below the ipsilateral thoracolumbar fascia. The same procedure was repeated on the contralateral side [Figure 1].

In the Group mTLIP, the L_3 vertebra was identified, and skin asepsis was achieved with 2% chlorhexidine. After identification of all structures, under real-time ultrasound guidance, a 10-cm, 21-G Stimuplex needle was inserted at an angle of 30° to the skin from lateral to the medial direction and advanced towards the longissimus muscle through the belly of the IC muscle. Once the needle tip reached the longissimus/iliocostalis muscle interface (hydrodissection), 15 mL of ropivacaine 0.25% was administered intermittently with repeated negative aspiration. The remaining 5 mL of 0.25% of ropivacaine was injected below the ipsilateral thoraco-lumbar fascia. The same procedure was repeated on the other side. Immediately after drug administration, its spread was confirmed by ultrasound in both the study groups. All blocks were performed by a senior anaesthesiologist with more than 15 years of experience. The control group (Group C) received GA only with IV analgesic drugs.

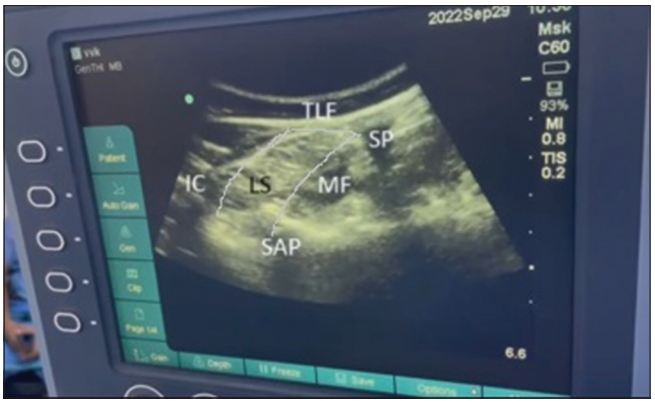

Figure 1: Ultrasound-guided thoracolumbar interfascial plane block (TLIP). TLF = thoracolumbar fascia, LS = longissimus muscle, IC = iliocostalis muscle, MF = multifidus muscle, SP = spinous process, SAP = superior articular process

Anaesthesia was maintained with isoflurane (1%–2%) in oxygen and air (50:50) with a target MAC of 0.8–1.2. Intraoperative neuromuscular blockade was maintained by intermittent boluses of IV atracurium 0.2 mg/kg guided by NMT (TOF count zero). If the heart rate and mean arterial pressure (MAP) were increased by 20% of the baseline, IV fentanyl 0.5–1.0 μg/kg was administered after excluding the other causes of tachycardia. In all patients, IV paracetamol 15 mg/kg and IV ondansetron 4 mg were administered 30 min before the end of surgery. At the end of the surgery, residual neuromuscular blockade was reversed by IV neostigmine 50–70 μg/kg and glycopyrrolate 7–10 μg/kg. All patients were extubated once they fulfilled the criteria of extubation. Then, all patients were transferred to the postanaesthesia care unit (PACU).

The NRS score at rest and on movement was recorded at 0, 1, 3, 6, and 24 h after arrival in the PACU. The post-operative pain was recorded as per NRS score: 0 for no pain, 1–3 for mild pain, 4–7 for moderate pain, and >7 for severe pain. If the NRS score was >3, all patients received a bolus of fentanyl 1.0 μg/kg, and they were subsequently connected to a fentanyl-based

IV PCA pump, which was adjusted to deliver 20 μg fentanyl after each button press with a lockout interval of 15 min. Maximum fentanyl delivered by PCA pump was limited to 80 μg/h and 320 μg in 4 h.

The time of the first bolus dosage delivered was recorded as the first analgesic requirement within the first 24 h. In addition, all patients received IV paracetamol 15 mg/kg every 6 h for the first 24 h following surgery.

The number of postoperative nausea and vomiting (PONV) episodes was recorded over the first 24 h. PONV was assessed as follows: 0 = no nausea or vomiting, 1 = nausea but no vomiting, 2 = vomiting once in 30 min, and 3 = two or more bouts of vomiting in 30 min. If the score was >1, IV ondansetron 4 mg was administered. In case of inadequate relief, IV metoclopramide 150 μg/kg was administered as a rescue antiemetic.

In addition to routine haemodynamic monitoring in the postoperative period, respiratory rate (RR) and SpO_2 were monitored for the first 24 h to maintain SpO_2 of >94% and RR of >10/min. Patient with respiratory depression was diagnosed when RR <8/min, SpO_2 <90% (with supplemental oxygen via facemask at 5 L/min), or Partial pressure of carbondioxide ($PaCO_2$) >70 mmHg. If a patient had pruritus, 0.25–1 μg/kg of IV naloxone was administered.

The primary outcome of the study was to assess the total perioperative (intraoperative and 24 h postoperative) opioid consumption in the first 24 h. The secondary outcomes were to assess haemodynamic response to surgical stimulus during the operation, NRS score upon arriving in the PACU, time to first analgesic requirement after surgery, postoperative opioid consumption in the first 24 h, and incidence of drug-related complications in both groups.

Ammar MA *et al*.[10] reported 24-h opioid consumption as 25.88 (5.17) mg in the control group as compared to 9.7 (6.38) mg in the TLIP group. Considering a 20% decrease in opioid consumption in the TLIP group, we estimated a sample size of 100 patients with an alpha error of 0.05, power of 80% (adjusted for three groups), and 20% contingency for drop-outs. Data were analysed using Statistical Package for the Social Sciences (SPSS) statistics software version 23.0 (Armonk, NY: International Business Machines Corp, USA) statistical software. The Shapiro-Wilk test was used to determine the normal data distribution. The demographic statistics were reported as mean accompanied by a standard deviation. The One-Way analysis of variance (ANOVA) test was used to analyse normally distributed continuous data. The Kruskal-Wallis test was used to study non-normally distributed continuous variables. The Chi-square test was used to compare categorical data. A *P* value of 0.05 or lower was considered to indicate statistical significance.

RESULTS

Nine of 109 patients scheduled for lumbar disc surgeries were excluded during the study period. Three patients declined to participate, and the remaining six did not meet the inclusion criteria. Hence, 100 patients were included in the study [Figure 2]. The patients recruited in the study had comparable baseline characteristics [Table 1].

The total intraoperative opioid consumption was significantly higher in Group C compared to Group mTLIP and Group cTLIP ($P < 0.001$). However, it was comparable between the study groups mTLIP and cTLIP ($P = 0.103$). The total post-operative opioid consumption in the first 24 h was significantly higher in Group C compared to Group mTLIP and Group cTLIP. In addition, it was comparable between the study groups mTLIP and cTLIP ($P = 0.752$). The total peri-operative fentanyl consumption was significantly higher in group C ($P = 0.001$) compared to the groups cTLIP and mTLIP. However, the total peri-operative fentanyl consumption between the study groups cTLIP and mTLIP was comparable ($P = 0.767$) [Table 2, Figure 3].

In groups cTLIP and mTLIP, only 15.2% of patients required rescue analgesic boluses, whereas in Group C, all patients (100%) required rescue analgesia [Table 2]. Time to the first analgesic request was significantly prolonged in groups cTLIP and mTLIP compared to

Table 1: Comparison of demographic data of study groups

Variable	Group cTLIP (*n*=33)	Group mTLIP (*n*=33)	Group C (*n*=34)
Age (years)	41.03 (11.71)	42.64 (12.04)	40.93 (12.23)
Weight (kg)	64.88 (08.49)	63.79 (06.61)	65.62 (10.35)
Body mass index (kg/m^2)	24.18 (02.79)	23.61 (02.12)	23.81 (02.94)
Gender (Male/Female)	17/16	19/14	15/19
American Society of Anesthesiologists physical status (I/II)	23/10	21/12	27/7

Data expressed as mean (standard deviation) or numbers. cTLIP: Classical thoracolumbar interfascial plane block, mTLIP: Modified thoracolumbar interfascial plane block, n=Number of patients

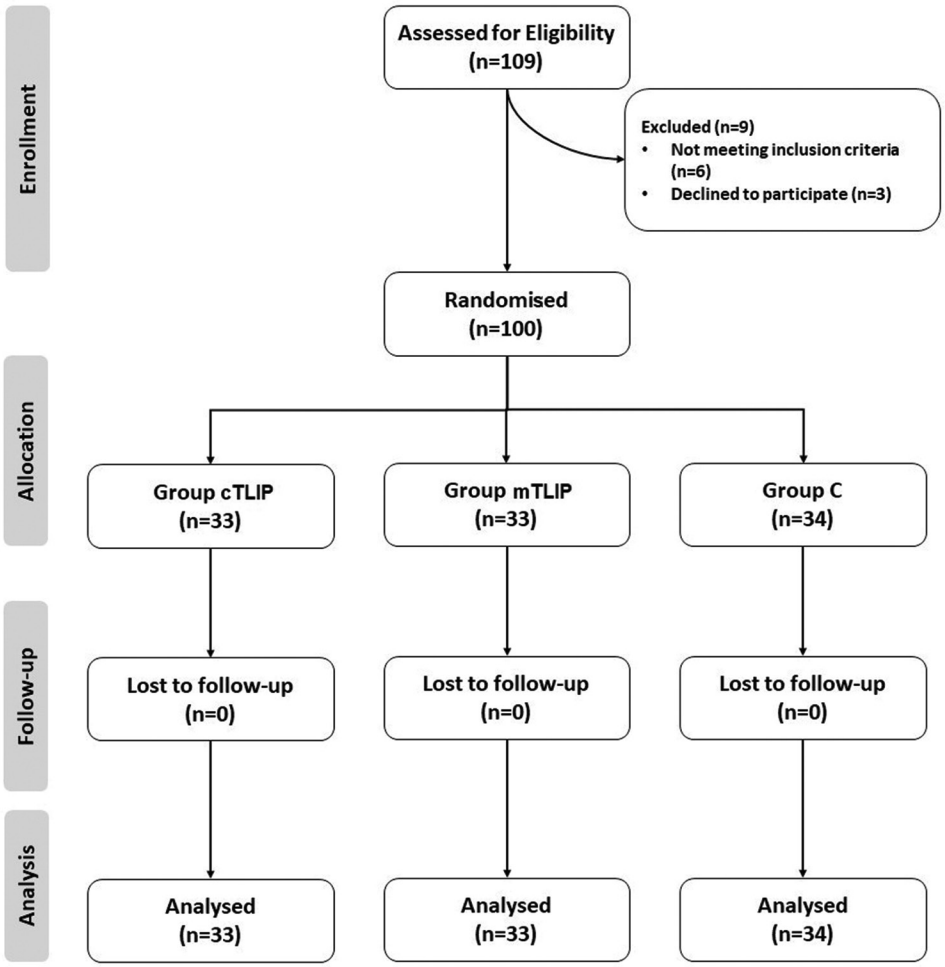

Figure 2: Consolidated Standards of Reporting Trials (CONSORT) Flow Diagram

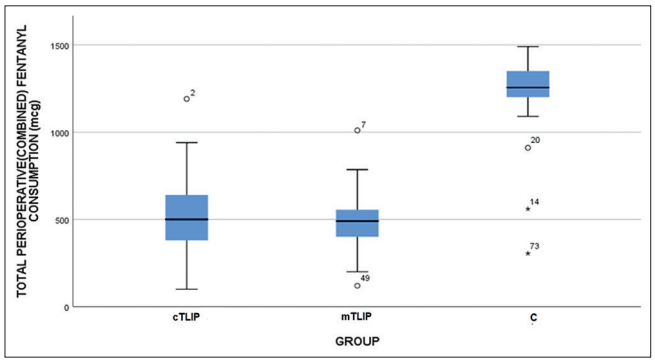

Figure 3: Perioperative opioid consumption in the first 24 h was comparable between cTLIP and mTLIP groups and significantly lower than the control group. cTLIP: Classical thoracolumbar interfascial plane block, mTLIP: Modified thoracolumbar interfascial plane block

group C ($P < 0.001$). However, the time to the first analgesic request was comparable between the groups, cTLIP and mTLIP ($P = 0.98$) [Table 2].

On arrival at PACU, the NRS score was significantly lower in both study groups, cTLIP and mTLIP, compared to the control group ($P = 0.001$). However, it was comparable between the two groups ($P = 0.655$) [Table 2].

None of the patients in groups cTLIP and mTLIP complained of PONV in the first 24 h, whereas 21 patients (61.8%) in Group C experienced nausea and vomiting ($P = 0.001$) [Table 2]. Out of these 21 patients in Group C, nine patients had a PONV score of 1, eleven patients had a PONV score of 2 (all needed first rescue antiemetic), and one patient had a PONV score of 3 (needed second rescue antiemetic). Opioid-related side effects, such as pruritus, respiratory depression, and constipation, were not observed in any patients of the three groups.

DISCUSSION

In the present study, mTLIP and cTLIP blocks provided comparable peri-operative analgesia, no incision response, lower pain scores, less need for rescue analgesia, and a lower incidence of PONV than the control group in patients undergoing lumbar disc surgeries.

Table 2: Comparison of intra-operative and post-operative variables of study groups

Variable	Group C (*n*=34)	Group cTLIP (*n*=33)	Group mTLIP (*n*=33)	*P*
Duration of surgery (min)	101.32 (18.31) [94.93, 107.71]	101.36 (25.72) [92.24, 110.48]	116.97 (24.65) [108.23, 125.71]	0.008
Duration of anaesthesia (min)	123.06 (20.67) [115.85, 130.27]	141.61 (30.07) [130.94, 152.27]	158.09 (27.21) [148.38, 167.68]	0.001
Total intra-operative fentanyl consumption (μg)	268.1 (57.8) [247.9, 288.2]	103.0 (22.8) [94.9, 111.1]	99.55 (12.8) [95.0, 104.1]	0.001
NRS on arrival to PACU	8 [6–9]	6 [4–7]	5 [2–6]	0.001
Time to first analgesic request (min)	0 (0–5) [−4.06, 25.00]	55 (45–188) [77.97, 242.10]	135 (57–290) [119.54, 251.61]	0.001
Total postoperative fentanyl consumption (μg)	957.3 (205.2) [885.7. 1028.9]	404.2 (252.7) [314.6, 493.8]	387.6 (164.0) [329.4, 445.7]	0.001
Total peri-operative fentanyl consumption (μg)	1225.4 (237.0) [1142.7, 1308.1]	507.5 (258.5) [415.90, 599.2]	491.6 (165.3) [433.02, 550.3]	0.001
PONV incidence (No/Yes)	13/21	0/33	0/33	0.001
Need for boluses of post-operative rescue analgesics (Yes/No)	34/0	05/28	05/28	0.001
No. of boluses for post operative rescue analgesics-0/1/2/3/4/5/6 (In Group C, cTLIP and mTLIP respectively)	0/1/3/13/14/2/1	28/4/1/0/0/0/0	28/5/0/0/0/0/0	0.001

Data expressed as mean (standard deviation) (95% confidence interval), median (interquartile range) (95% confidence interval), or numbers. cTLIP: Classical thoracolumbar interfascial plane block, mTLIP: Modified thoracolumbar interfascial plane block, NRS: Numerical Rating Scale, PACU: Postanaesthesia care unit, PONV: Postoperative nausea and vomiting, No.: Number

Our results can be explained by the fact that spinal nerve blockade in both interventional groups reduced the need for peri-operative analgesics.[11-15] Chen *et al*.,[9] Ammar *et al*.,[10] and Ozmen *et al*.[16] conducted various randomised control trials on 60, 70, and 90 patients who received bilateral TLIP blocks for different lumbar disc procedures. They observed that control-group patients had higher pain scores and more opioid consumption compared to the study-group patients (who received bilateral TLIP block), who had lower pain scores and less post-operative opioid consumption. The outcomes of their studies are consistent with our research.

Eltaher *et al*.[17] randomised 60 patients who underwent lumbar disc surgeries. The 24-h morphine consumption was 5.13 (1.55) mg in the TLIP group, which was much lower compared to the control group (14.33 (2.58) mg). This result was consistent with our study. In their research, the time to the first analgesic request post-operatively in the TLIP group was 7.30 (2.69) h. In the control group, it was 0.92 (1.23) h. In contrast, in our study, time to first analgesic request post-operatively was noted at 55[45–188] min in cTLIP and [135 (57–290)] min [median (range)] in the mTLIP group and [0 (0–5)] min [median (range)] in the control group C ($P < 0.001$). In our study, most of the patients had undergone transforaminal lumbar interbody fusion (TLIF) surgeries, which included a significant amount of bone resection, manipulations, and fixation with screws and a cage. Thus, the magnitude of bone pain is always greater, which is the probable explanation for the early demand for first-rescue analgesia.

In our study, after administration of the TLIP block, we had also confirmed ultrasound-guided real-time visualisation of drug spread in the correct interfascial plane. There was no incision response in the study group. Another observation was the formation of two vertical bands in the parasagittal region after administration of the study drug in the correct interfascial planes, which was also confirmed by ultrasound scanning [Figure 4].

In our study, except for PONV, other opioid-related side effects were not observed in any patients of all three groups. The incidence of PONV decreased in both study groups as none of the patients in groups cTLIP and mTLIP complained of PONV, compared to 21 patients (61.8%) in control group C.

As per our knowledge, nowhere in the published literature these three groups (cTLIP, mTLIP, and control) are compared simultaneously for quantitative assessment of opioid consumption peri-operatively. Another new information we present through this study is the quantification of boluses of fentanyl administered as a rescue analgesic in all three groups. This additional information on two different approaches of TLIP block and its analgesic effect on incision response should not be mentioned in the published literature.

This study has certain limitations. The research was conducted in a single centre. In the TLIP block, we did not use any adjuvant with a LA to prolong analgesia.

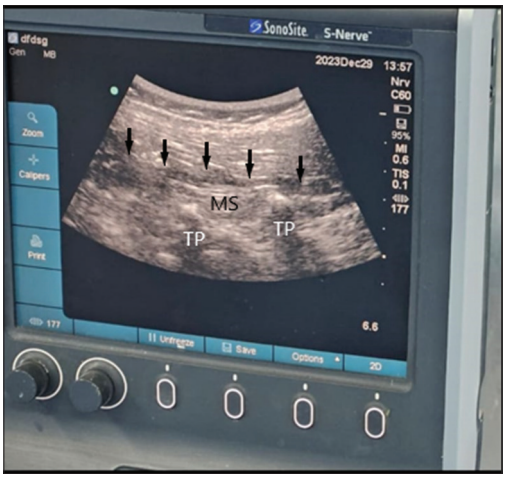

Figure 4: Spread of local anaesthetic marked by black arrows. MF = multifidus muscle, TP = transverse process

Therefore, further studies are to be conducted using different adjuvants along with LA in TLIP Block to assess the prolongation of analgesia.

CONCLUSION

The modified lateral TLIP block approach has minimal added advantages over the classical medial TLIP block approach. Our results showed that both approaches provided adequate similar magnitude of peri-operative analgesia compared to the control group and are thus an excellent opioid-sparing safe methods for pain control in patients undergoing lumbar disc surgeries, especially in the obese population.

Study data availability

De-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared upon request.

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Conflicts of interest

There are no conflicts of interest.

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