Original Article

Comparison of the analgesic efficacy of ultrasound-guided transmuscular quadratus lumborum block versus thoracic erector spinae block for postoperative analgesia in caesarean section parturients under spinal anaesthesia–A randomised study

Address for correspondence:
Dr. Ashok Jadon,
Duplex-63, Vijaya Heritage Phase-6, Marine Drive, Kadma, Jamshedpur – 831 005, Jharkhand, India.
E-mail: jadona@rediffmail.com

Submitted: 24-Jan-2022
Revised: 18-Mar-2022
Accepted: 15-Apr-2022
Published: 06-Jun-2022

Access this article online

Website: www.ijaweb.org

DOI: 10.4103/ija.ija_88_22

Quick response code

Apoorva Bakshi, Surabhi Srivastawa, Ashok Jadon, Khalid Mohsin, Neelam Sinha, Swastika Chakraborty

Department of Anaesthesia and Pain Relief Service, Tata Motors Hospital, Telco Colony, Jamshedpur, Jharkhand, India

ABSTRACT

Background and Aims: Truncal blocks play an important role in multimodal analgesia regimens to manage the postoperative pain after lower segment caesarean section (LSCS). This study was aimed to compare the analgesic efficacy of ultrasound (US)-guided transmuscular quadratus lumborum block (TQLB) and thoracic erector spinae plane block (TESPB) in parturients of LSCS done under subarachnoid block (SAB). **Methods:** In a randomised and double blind study, 60 parturients scheduled for LSCS under spinal anaesthesia were randomly divided into two equal groups: group E (n = 30) and group Q (n = 30). After surgery, each parturient received either US guided bilateral TQLB (group Q) or TESPB (group E) with 20 ml 0.375% ropivacaine and 4 mg dexamethasone on each side. Assessments were done at 2, 4, 6, 8, 10, 12 and 24 h. The primary objective was to compare the duration of analgesia (first request to rescue analgesia) and the secondary objectives were to compare pain scores [numerical rating score (NRS)], total amount of tramadol consumption, incidence of nausea-vomiting, parturient satisfaction and other adverse effects in 24 hours postoperatively. **Results:** The duration of analgesia (mean ± standard deviation) was comparable in group E (11.90 ± 2.49 h) and group Q (12.56 ± 3.38 h), P = 0.19. Pain scores (NRS) at rest and on movement were comparable at all time points of 2, 4, 6, 8, 10, 12, and 24 h (P > 0.05). The amount of tramadol used was comparable in group E and group Q (P = 0.48). **Conclusion:** TESPB and TQLB are equally efficacious to provide postoperative analgesia after LSCS done under SAB when used as a part of multimodal analgesia.

Key words: Analgesia, caesarean section, nerve block, post-operative pain, ultrasonography

INTRODUCTION

Lower segment caesarean section (LSCS) often results in significant postoperative pain. Satisfactory control of pain following LSCS is essential to facilitate early mobilisation of the mother and to decrease complications.[1] Currently, multimodal analgesic technique involving abdominal nerve blocks along with parenteral analgesics is becoming a popular choice.[2] Quadratus lumborum block (QLB) is now an established technique; however, literature is

How to cite this article: Bakshi A, Srivastawa S, Jadon A, Mohsin K, Sinha N, Chakraborty S. Comparison of the analgesic efficacy of ultrasound-guided transmuscular quadratus lumborum block versus thoracic erector spinae block for postoperative analgesia in caesarean section parturients under spinal anaesthesia – A randomised study. Indian J Anaesth 2022;66:S213-9.

limited on the erector spinae plane block (ESPB) as a post-operative analgesic adjunct in caesarean section.[3,4] Moreover, comparative studies between transmuscular quadratus lumborum block (TQLB) and thoracic erector spinae plane block (TESPB) were lacking; therefore, this study was aimed to compare the analgesic efficacies with respect to postoperative pain scores and duration of analgesia in parturients after caesarean section.

METHODS

After ethical clearance from our hospital and registration with the Clinical Trial Registry of India (CTRI/2020/12/029857), this prospective double blind randomised trial was done at a teaching industrial hospital from December 2020 to January 2021. After taking informed consent, 63 parturients aged between 20 and 40 years scheduled for elective LSCS under subarachnoid block (SAB), and belonging to American Society of Anesthesiologists (ASA) grade II were enroled for the study. Refusal to participate, contraindications to regional anaesthesia (allergy, bleeding diathesis, infection at the site of block and peripheral neuropathy), presence of major systemic disease and body mass index (BMI) >35 kg/m^2 (to limit maximum ropivacaine dose to 3 mg/kg) were exclusion criteria for the study [Figure 1].

The aim of the study was to compare the analgesic efficacy of ultrasound-guided TQLB and TESPB as part of a multimodal analgesic regimen for postoperative analgesia in parturients after caesarean section. The primary objective was to compare the duration of analgesia (first request to rescue analgesia) and the secondary objectives were to compare pain scores (Numerical rating score (NRS)], total amount of tramadol consumption, incidence of nausea and vomiting, parturient satisfaction and other adverse effects in 24 hours postoperatively.

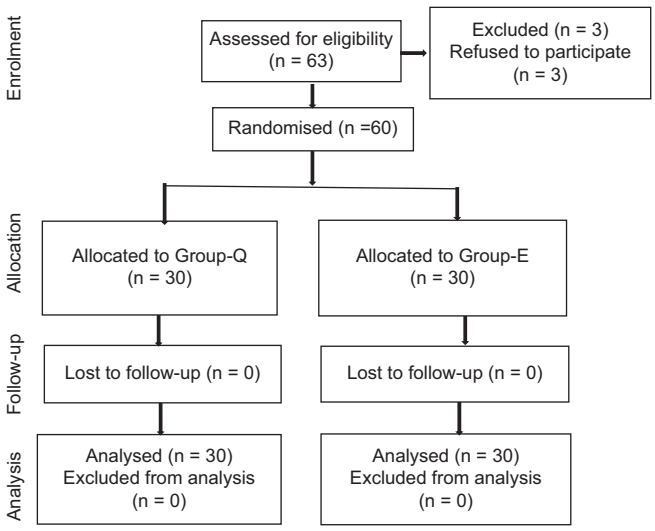

Figure 1: Consolidated Standards of Reporting Trials (CONSORT) flow diagram for enrolment, group allocation, follow-up and analysis. Gr-Q; TQLB (transmuscular quadratus lumborum block, Gr-E; TESPB (thoracic erector spinae plane block)

Each parturient was enroled in the study after obtaining a detailed history and conducting a clinical examination during the pre-anaesthetic check-up. All 60 eligible participants were randomly allocated to either: group Q (TQLB) or group E (TESPB) (n = 30 in each group) by a table of random numbers. In the operation room, an 18-gauge intravenous cannula was inserted into the non-dominant hand and non-invasive monitors were attached. The co-loading with normal saline (15 ml/kg) was started. All parturients received spinal anaesthesia with 2.6 ml mixture consisting of 2.2 ml 0.5% hyperbaric bupivacaine + 0.4 ml (20 µg) of fentanyl at L3-L4 or L2-L3 level with 26 G Quincke spinal needle in sitting position with standard aseptic precautions. After the completion of surgery, the parturients were positioned in left lateral decubitus position. The sealed opaque envelope containing the group allocation was opened by the attending anaesthesia resident (who was not a part of the study) to decide the block. The back was cleaned with chlorhexidine gluconate solution and was draped with sterile drapes. Both the blocks were given using 21 G, 100 mm long (B Braun Stimuplex®A) insulated blunt tip needles. Both the groups received bilateral ultrasonography (USG)-guided block with 20 ml of 0.375% ropivacaine + 4 mg of dexamethasone performed by anaesthesia consultants having experience of 5 years in ultrasound-guided blocks. The procedure was performed using aseptic technique (gown, gloves, facemask and protective sheath for the ultrasound probe).

To perform TQLB, the curvilinear probe (2-5 MHz, SonoSite Turbo-M) was placed in the transverse axial plane just cranial to the iliac crest. The "shamrock sign" was visualised (viz., the transverse process (TP) of vertebra L4 is the stem, whereas the erector spinae muscle (ESM) posteriorly, quadratus lumborum (QL) muscle laterally and the psoas major (PM) muscle anteriorly represent the three leaves). The needle was introduced using an in-plane technique from the posterior end of the transducer through the QL muscle. The target for injection was the fascial plane between the QL and PM muscles [Figure 2a and b].

Similar steps were followed to give the block on the other side as described earlier.[5]

To give TESPB, the curvilinear probe was placed in a transverse orientation over the spinous process of T9 (correct level was confirmed by counting ribs from first rib downwards and reconfirmed by counting from 12th rib to upward till T9)). The needle was inserted using an in-plane lateral-to-medial approach to contact the TP of T9 on that side. The target for injection was just anterior to the ESM between the fascia covering of ES and TP at the level of the costo-transverse junction [Figure 2c and d]. Then the needle was introduced in a similar fashion to contact the TP of T9 on the other side and the local anaesthetic (LA) was injected.[6] The longitudinal spread of LA was also confirmed in the para-sagittal plane. Post-operative analgesia was given with 1 gm of intravenous (IV) paracetamol 8-hourly (first dose given at closure of skin incision). Parturients were shifted to the post-anaesthesia care unit (PACU) and tramadol was given in the form of IV-parturient-controlled analgesia (PCA) set at a bolus dose of 25 mg tramadol and with a lockout period of 15 minutes. The parturient was explained about the use of IV-PCA. All parturients were assessed at an interval of 2, 4, 6, 8, 10, 12 and 24 hours after the surgery by an observer who was unaware about the groups. Pain was assessed using NRS of 0 = no pain or discomfort and 10 = most severe pain during rest and on movement. The assessment during movement was done by asking the parturient to fold the lower limbs and to turn on both sides. Severity of postoperative nausea and vomiting (PONV) was measured according to a 4-point rating score (0-absent, 1- mild, 2- moderate and 3- severe nausea and vomiting). Rescue antiemetic (4 mg of IV ondansetron) was offered to parturients who complained of nausea or vomiting. Parturient satisfaction was assessed 24 hours after the surgery and all the subjects were asked to rate on a 3-point scale (1—Dissatisfied, 2—satisfied and 3—highly satisfied) their satisfaction with pain management.

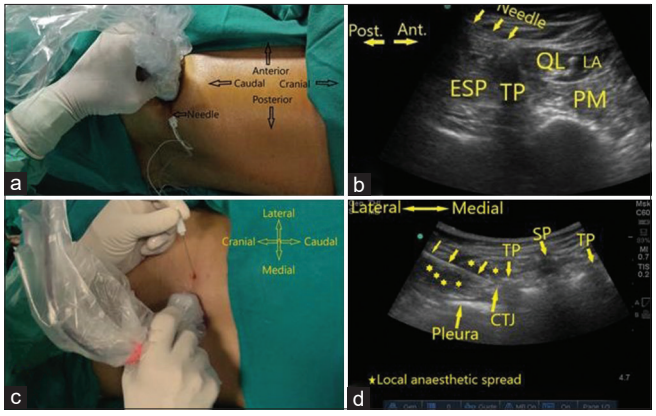

Figure 2: (a) The parturient in lateral position for TQLB; curvilinear probe (2-6 MHz) just above and posterior to the iliac crest with the needle entering from the posterior to the anterior direction. (b) Sonoanatomy, needle position and spread of local anaesthetic between quadratus lumborum and psoas major muscle. (c) Parturient is in left lateral position for TESPB; ultrasound probe position and block needle entry from lateral to medial direction, (d) Sonoanatomy of TESPB; needle at transverse process and spread of LA. TP-transverse process, SP-spinous process, ESP-erector spinae muscle, CTJ-costotransverse junction, QL – quadratus lumborum, PM – psoas major, LA – local anaesthetic

To calculate the sample size, we conducted a pilot study on 20 parturients (10 parturients in each group) in which the request to first analgesic was 10.65 h and 12.61 h in ESPB and TQLB groups, respectively, with a standard deviation (SD) of 2.6 h. Sample size was calculated using the ClinCalc Sample Size Calculator. Taking confidence level at 95% and power of study at 80%, each group required 28 parturients, and considering the possible attrition, we enroled totally 63 parturients for the study (the parturients studied during pilot study were not included). The results were analysed using statistical software (MedCalc version 20.0). Continuous data were assessed for the normality using the Kolmogorov–Smirnov test of normality. Normally distributed data (represented as mean ± SD) were assessed using the Student's *t*-test (two-tailed, equal variances) and non-normally distributed data [represented as median (range)] were assessed using the Mann–Whitney U test. Ordinal data were represented as median and interquartile range (IQR) and assessed using the Mann–Whitney U test. The time to first analgesic request was assessed using the log rank test. A *P* value of <0.05 was considered significant.

RESULTS

A total of 63 parturients were screened, three were excluded, and remaining 60 were randomised and analysed as all were able to complete the study [Figure 1]. The demographic variables like age, weight, duration of surgery and intraoperative variables were comparable in groups E and Q [Table 1]. The duration for first rescue analgesia mean ± SD in group E was 11.90 ± 2.49 h (95% CI: 10.97, 12.83) and 12.56 ± 3.38 h (95% CI: 11.29, 13.82) in the group Q (P = 0.19, Log Rank test) [Figure 3]. Pain scores (NRS) at all observation time points (2 h to 24 h) during rest and on movement were comparable between group E and group Q ($P > .05$) [Table 2]. The amount of tramadol (median, IQR) used as rescue

Table 1: Demographic variables, incidence of postoperative nausea-vomiting (PONV), amount of tramadol used and satisfaction between two groups

Variables	Group E (*n*=30)	Group Q (*n*=30)	*P*
Age in years, mean (SD)	27.6 (11.97)	27.97 (11.62)	0.68*
Weight in kg, mean (SD)	60.8 (26.79)	62.28 (31.28)	0.14*
Duration of surgery in minutes, mean (SD)	88.66 (27.63)	85.33 (6.65)	0.63*
Tramadol used (mg)			
Median[IQR (75-25)]	50[25 (75-50)]	50[25 (50-25)]	0.48†
PONV			
Nausea	2	2	0.76‡
Nausea and Vomiting	2	3	
Satisfaction			
Satisfied	08	10	0.74‡
Highly Satisfied	20	19	
Dissatisfied	02	01	

P>0.05 (Not significant). *Student *t*-test (unpaired), †Chi-square statistics, ‡Mann–Whitney *U* Test. Group E (TESPB-Thoracic erector spinae plane block), Group Q (TQLB-Transmuscular quadratus lumborum block).
SD: Standard deviation; IQR: Interquartile range; NRS: Numerical rating score

Table 2: Comparison of numeric rating score (NRS) at rest and on movement between two groups

Time (h)	Group E (*n*=30)	Group Q (*n*=30)	*Z* score	*P*†
NRS at rest				
2	1[1.5 (2.25-0.75)]	1.5[3 (3-0)]	0.08	0.93
4	2.5[3 (4-1)]	3[4 (5-1)]	0.40	0.68
6	4[3 (5-2)]	3[3.25 (5-1.75)]	0.29	0.76
8	3[2 (4-2)]	3[3 (5-2)]	0.01	0.99
10	3[2 (4-2)]	3[2 (4-2)]	0.02	0.98
12	4[2 (4-2)]	3[2 (4-2)]	0.68	0.49
24	1[1.25 (2.25-1)]	1.5[1.25 (2.25-1)]	0.10	0.92
NRS on movement				
2	1.5[2 (3-1)]	2[3 (3-0)]	0.05	0.95
4	3[4 (5-1)]	3[4 (5-1)]	0.12	0.86
6	4[3 (5-2)]	4[3 (5-2)]	0.59	0.55
8	4[2.25 (5.25-3)]	4[3 (5-2)]	1.08	0.27
10	4[2.25 (5-2.75)]	4[2.25 (4.25-2)]	0.29	0.76
12	4[3 (5-2)]	3[3 (5-2)]	0.70	0.48
24	1[1.25 (2.25-1)]	1.5[2 (3-1)]	0.07	0.94

Data is represented as Median [Interquartile Range (75-25)]. †Mann-Whitney U Test. Group E (TESPB-Thoracic erector spinae plane block), Group Q (TQLB-Transmuscular quadratus lumborum block). NRS: Numerical rating score

analgesic was comparable, in group E 50 (75-50) and in group Q 50 (50-25) mg (P = 0.48) [Table 1]. PONV was comparable between the groups (P = 0.76) [Table 1]. The satisfaction was comparable as 28 (93.3%) parturients in group E and 29 (96.6%) parturients in group Q were satisfied or highly satisfied with the pain management (P = 0.74) [Table 1]. Calculated Cohen's D was 0.22 for duration of analgesia.

DISCUSSION

This prospective randomised study showed that both the techniques, TQLB and TESPB, were effective in

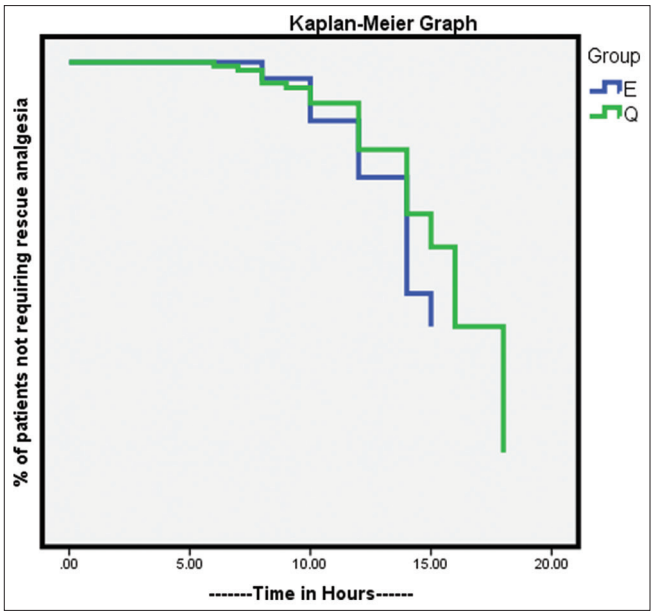

Figure 3: Kaplan–Meier graph showing the % of parturients in each group not requiring rescue analgesia (tramadol) over time (P = 0.18, log rank test). Group E (TESPB-Thoracic erector spinae plane block), Group Q (TQLB-Transmuscular quadratus lumborum block)

reducing postoperative pain and had comparable analgesic efficacy with respect to pain scores, duration of analgesia and use of rescue analgesic.

LSCS results in significant postoperative pain and multimodal analgesia which often includes truncal blocks that are effective to mitigate the severity of pain.[2,7] To begin with, transversus abdominis plane (TAP) block was used; however, due to poor control over visceral pain, other truncal blocks like QLB and ESPB were incorporated.[8-10]

QLB is an effective technique in providing analgesia after LSCS. Even when compared with the TAP block, the QLB was found more efficacious than the TAP block.[11]

Various studies have shown that QLB is efficacious in reducing pain scores.[3,9,11,12] The results of our study corroborated well with the above-mentioned studies as our results showed that TQLB effectively reduced the pain score at all time points from 2 h to 24 h during rest (median score 1.5–3) and on movement (median score 1.5–4).

Previous studies including a meta-analysis of five studies on TQLB for LSCS have shown the median (IQR) time to first analgesic request 8.37 h (0.19–16.54) to 12 (9.25–13) hours.[3,9] In our study, the first request to analgesia in group Q was (mean 12.56 ± 3.38 h)

which was similar to other studies.[3,9] Salama ER has reported the median (IQR) time to first analgesic request as 17 h (6–36) in parturients who received QLB.[13] However, the drug and volume used in this study were different (24 ml 0.375% ropivacaine) and all parturients received two parenteral analgesics (paracetamol and diclofenac) instead of only paracetamol as was used in our study.

We used TQLB approach in the present study as among various approaches of QLB, TQLB has been found to be superior as it blocks somatic nerves, sympathetic trunk of lower thoracic levels, upper roots and branches of lumbar plexus, and sympathetic nerve fibres as it spreads along the thoracolumbar fascia.[14,15] It is one of the novel techniques and has shown promising results by reducing the 24-hour opioid consumption post-caesarean delivery.[3,9,12-14] The results of our study also showed minimal use of rescue analgesic (tramadol) [median (IQR), 50 mg (50–25)] by group Q parturients in 24 hours.

Since the first description of ESPB by Mauricio Forero in 2016 for thoracic neuropathic pain,[16] the indications of ESPB have increased exponentially over the years and it is being used for pain relief from the cranial to sacral area.[17,18] In this block, LA is injected in a fascial plane between the ESP muscles and the tip of the transverse vertebral process. Cadaveric studies have shown that the LA spreads both cranially and caudally, and through the costotransverse foramen, it may reach the anterior paravertebral space. As a result, it not only blocks the dorsal and ventral rami but also the rami communicantes and this maybe the reason for both somatic and visceral pain blockage.[19]

In the context of post-caesarean analgesia, recent publications have demonstrated that the ESPB is effective for pain relief after caesarean section.[20,21] Several recent studies in patients undergoing percutaneous nephrolithotomy and breast surgery have shown the analgesic efficacy of ESPB.[22,23] However, as far as comparison of ESPB with existing TQLB in LSCS is concerned, studies are not available to our knowledge.

In our study, the first request to analgesia in group E (mean 11.90 ± 2.49 h) was similar to other studies done by Hamed *et al*. (12 ± 2.81 h)[24] and by Boules *et al*.,[10] median (IQR) 12 h (10-14), and it was less than the earlier reported by Rincon *et al*. (22 h) and Malawat *et al*. (43.53 h).[20,25] However, one study was a single case report[20] and the other study used inadequate number of participants required for statistical analysis which might have influenced the outcome.[25] We used 20 ml drug on each side as the extent of paravertebral spread following ESPBs might not significantly increase by increasing the volume of injection beyond 20 ml at one level.[26]

The TQLB is considered a deep block and requires high level of competence to avoid complications.[5] Contrary to it, the unique selling point (USP) of TESPB is that it is considered as a plane, simple and safe block.[27] However, we did not observe any serious complication in any parturient of both the groups. The PONV was comparable between group E and group Q ($P = 0.76$).

High satisfaction in parturients who received QLB and ESPB has been reported in earlier studies.[14,21] In the present study, the satisfaction was comparable in both the groups as 28 (93.3%) parturients in group E and 29 (96.6%) parturients in group Q were satisfied or highly satisfied with the pain management ($P = 0.74$).

The results of the current study suggest that the duration of pain relief between the group E and Q was comparable and the calculated Cohen's D was (0.22) a 'small effect size'. However, in the context of techniques used in the study, this 'small effect size' is also very important as this suggests that the TESPB which is a superficial and simple technique is as effective as the TQLB, which is already an established technique but a relatively difficult approach.[5,27]

ESPB and QLB have been used for post-caesarean analgesia. However, the present study was a noble study as comparative studies between TQLB and TESPB for LSCS analgesia are not available. Nonetheless, the present study has few limitations. First, we kept the study period for 24 hours, when it would have been better to have a longer study period. The assessment of parturient satisfaction was only directed at pain management, whereas satisfaction for a parturient may have different aspects. The other limitation is that we have not calculated the number of parturients with previous LSCS. Due to previous surgery and associated adhesions, these parturients may have higher pain scores.

The transverse approach to TESPB has been debated for its claimed advantages.[28,29] We have used the modified transverse approach as suggested by Sharma *et al*.[6] and observed that this was a simple and

effective technique. Nonetheless, the present study is the only study using this technique; therefore, a large comparative study between conventional approach and this new approach is warranted.

CONCLUSION

To conclude, both TESPB and TQLB techniques are efficacious and comparable in providing postoperative analgesia as a part of multimodal analgesia after LSCS done under SAB.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Kerai S, Saxena KN, Taneja B. Post-caesarean analgesia: What is new? Indian J Anaesth 2017;61:200-14.
2. Roofthooft E, Joshi GP, Rawal N, Van de Velde M. PROSPECT Working Group of the European Society of Regional Anaesthesia and Pain Therapy and supported by the Obstetric Anaesthetists' Association. PROSPECT guideline for elective caesarean section: Updated systematic review and procedure-specific postoperative pain management recommendations. Anaesthesia 2021;76:665-80.
3. Zhao Z, Xu K, Zhang Y, Chen G, Zhou Y. Quadratus lumborum block for postoperative analgesia after cesarean section: A meta-analysis of randomized controlled trials with trial sequential analysis. Sci Rep 2021;11:18104.
4. Altinpulluk EY, Simon DG, Fajardo-Perez M. Erector spinae plane block for analgesia after lower segment caesarean section: Case report. Rev Esp Anestesiol Reanim 2018;65:284–6.
5. Jadon A, Jain P, Dhanwani L. Bilateral transmuscular quadratus lumborum block performedin single lateral decubitus position without changing position to the contralateral side. Indian J Anaesth 2018;62:314-5.
6. Sharma SK, Mistry T, Ahmed S. Ultrasoundguided thoracic erector spinae plane block: A modified transverse approach. Saudi J Anaesth 2020;14:142-3.
7. Sangkum L, Thamjamrassri T, Arnuntasupakul V, Chalacheewa T. The current consideration, approach, and management in post cesarean delivery pain control: A narrative review. Anesthesiol Res Pract 2021;2021:2156918.
8. Jadon A, Jain P, Chakraborty S, Motaka M, Parida SS, Sinha N, *et al*. Role of ultrasound guided transversus abdominis plane block as a component of multimodal analgesic regimen for lower segment caesarean section: A randomized double blind clinical study. BMC Anesthesiol 2018;18:53.
9. Jadon A, Amir M, Sinha N, Chakraborty S, Ahmad A, Mukherjee S. Quadratus lumborum or transversus abdominis plane block for postoperative analgesia after cesarean: A double-blinded randomized trial. Braz J Anesthesiol (English Edition) 2021;S0104-0014;00263-3. doi: 10.1016/j.bjane. 2021.06.014.
10. Boules ML, Goda AS, Abdelhady MA, Abu El-NourAbd El-Azeem SA, Hamed MA. Comparison of analgesic effect between erector spinae plane block and transversus abdominis plane block after elective cesarean section: A prospective randomized single-blind controlled study. J Pain Res 2020;13:1073-80.
11. Blanco R, Ansari T, Raid W, Shetty N. Quadratus lumborum block versus transversus abdominis plane block for postoperative pain after cesarean delivery: A randomized controlled trial. Reg Anesth Pain Med 2016;41:757–62.
12. Irwin R, Stanescu S, Buzaianu C, Rademan M, Gormley C, Roddy J, *et al*. Quadratus lumborum block (QLB) for postoperative analgesia after caesarean section: A randomised controlled trial. Reg Anesth Pain Med 2019;44:A83.
13. Salama ER. Ultrasound-guided bilateral quadratus lumborum block vs. Intrathecal morphine for postoperative analgesia after cesarean section: A randomized controlled trial. Korean J Anesthesiol 2020;73:121-8.
14. Maenchen N, Hansen CK, Dam M, Børglum J. Ultrasound-guided transmuscular quadratus lumborum (TQL) block for pain management after caesarean section. Int J AnesthAnesthesiol 2016;3:23937.
15. Carline L, McLeod GA, Lamb C. A cadaver study comparing spread of dye and nerve involvement after three different quadratus lumborum blocks. Br J Anaesth 2016;117:387-94.
16. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: A novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med 2016;41:621-7.
17. Jadon A, Rastogi S, Sinha N, Amir M. Use of erector spinae plane block in the management of pain from metastatic cancer of the face in a terminally ill parturient. Indian J Anaesth 2019;63:675-7.
18. Jadon A, Bakshi A, Srivastawa S. Sacral erector spinae plane block: A new approach for post-laminectomy pain. Bali J Anaesthesiol 2021;5:221-2.
19. Bonvicini D, Boscolo-Berto R, De Cassai A, Negrello M, Macchi V, Tiberio I, *et al*. Anatomical basis of erector spinae plane block: a dissection and histotopographic pilot study. J Anesth 2021;35:102-111.
20. Rincon C, Moreno DA, Moore A. Erector spinae plane block for post-cesarean delivery analgesia. Int J Obstet Anesth 2020;41:120-2.
21. Junior ID, Carvalho VH, Brito LG. Erector spinae plane block for analgesia after cesarean delivery: A systematic review with meta-analysis. Braz J Anesthesiol (English Edition) 2021;S0104-0014:00374-2. doi: 10.1016/j.bjane. 2021.09.015.
22. Ramachandran S, Ramaraj KP, Velayudhan S, Shanmugam B, Kuppusamy S, Lazarus SP. Comparison of erector spinae plane block and local anaesthetic infiltration of the incision site for postoperative analgesia in percutaneous nephrolithotomy - A randomised parallel-group study. Indian J Anaesth 2021;65:398-403.
23. Moustafa MA, Alabd AS, Ahmed AMM, Deghidy EA. Erector spinae versus paravertebral plane blocks in modified radical mastectomy: Randomised comparative study of the technique success rate among novice anaesthesiologists. Indian J Anaesth 2020;64:49-54.
24. Hamed MA, Yassin HM, Botros JM, Abdelhady MA. Analgesic efficacy of erector spinae plane block compared with intrathecal morphine after elective cesarean section: A prospective randomized controlled study. J Pain Res 2020;13:597-604.
25. Malawat A, Verma K, Jethava D, Jethava DD. Erector spinae

plane block and transversus abdominis plane block for postoperative analgesia in cesarean section: A prospective randomized comparative study. J Anaesthesiol Clin Pharmacol 2020;36:201-6.
26. Choi YJ, Kwon HJ, O J, Cho TH, Won JY, Yang HM. Influence of injectate volume on paravertebral spread in erector spinae plane block: An endoscopic and anatomical evaluation. PLoS One 2019;14:e0224487.
27. El-Boghdadly K, Pawa A. The erector spinae plane block: Plain and simple. Anaesthesia 2017;72:434-8.
28. Hruschka JA, Arndt CD. Transverse approach to the erector spinae block. Reg Anesth Pain Med 2018;43:805.
29. Philip A, Kaushik V. Erector spinae block: Transverse superior to paramedian sagittal? Reg Anesth Pain Med 2019;44:422.