RESEARCH ARTICLE

A Clinical Prospective Randomised Comparative Study Of Ultrasound Guided Bilateral Subcostal Transversus Abdominis Plane Block And Port Site Infiltration With Bupivacaine For Post-Operative Analgesia In Patients Undergoing Laparoscopic Cholecystectomy

Viswa Abhishek N[1], Khajabanu Y Hugar[2], Sunitha M[3*], Sreedhar P[4], Sneha Padma[4]

[1]*Department of Anaesthesiology, Gleneagles BGS Hospital, Uttarahalli main road, Kengeri, Bengaluru, India.* [2]*Department of Anesthesiology, Gadag Institute of Medical Science, Gadag, Karnataka, India.*
[3]*Department of Anaesthesia, Kasturba Medical College, Manipal, Karnataka, India.*
[4]*Department of Anaesthesia, BGS Global Hospitals, Bengaluru, India.*

Received: 25th March, 2024; Revised: 10th July, 2024; Accepted: 15th August, 2024; Available Online: 31st August, 2024

ABSTRACT

Background: Post-operative pain management is critical in laparoscopic cholecystectomy to enhance patient recovery and satisfaction. This study compares the efficacy of ultrasound-guided bilateral subcostal transversus abdominis plane (TAP) block and port site infiltration with bupivacaine for post-operative analgesia.

Methods: In this prospective, randomized, comparative study, 60(30/30) patients undergoing elective laparoscopic cholecystectomy were randomly assigned to one of two groups: Group A received an ultrasound-guided bilateral subcostal TAP block with 0.25% bupivacaine (20 ml on each side), while Group B received port site infiltration with 0.25% bupivacaine (5 ml per port). The primary outcome was the duration of post-operative analgesia, assessed by the time to first rescue analgesic request. Secondary outcomes included total analgesic consumption in the first 24 hours post-operatively, pain intensity measured by the Visual Analog Scale (VAS) at 1, 4, 8, 12, and 24 hours, and any complications related to the procedures.

Results: The TAP block group (Group A) demonstrated a significantly longer duration of analgesia compared to the port site infiltration group (Group B) ($p < 0.05$). Group A also exhibited lower total analgesic consumption and lower VAS scores at all time points. No significant complications were observed in either group.

Conclusion: Ultrasound-guided bilateral subcostal TAP block with bupivacaine provides superior post-operative analgesia compared to port site infiltration in patients undergoing laparoscopic cholecystectomy, with a longer duration of pain relief and reduced analgesic requirements. This technique should be considered a viable option for enhancing post-operative recovery in these patients.

Keywords: Cholecystectomy, Transversus abdominis plane, Subcostal, Bupivacaine.

International Journal of Pharmaceutical Quality Assurance (2024); DOI: 10.25258/ijpqa.15.3.39

How to cite this article: Abhishek VN, Hugar KY, Sunitha M, Sreedhar P, Padma S. A Clinical Prospective Randomised Comparative Study Of Ultrasound Guided Bilateral Subcostal Transversus Abdominis Plane Block And Port Site Infiltration With Bupivacaine For Post-Operative Analgesia In Patients Undergoing Laparoscopic Cholecystectomy. International Journal of Pharmaceutical Quality Assurance. 2024;15(3):1340-1344.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Laparoscopic cholecystectomy, a minimally invasive surgical procedure for the removal of the gallbladder, is widely recognized for its reduced postoperative pain, shorter hospital stays, and faster recovery times compared to traditional open cholecystectomy. Despite these advantages, managing postoperative pain remains a critical aspect of patient care, as inadequate pain control can lead to complications such as delayed recovery, increased hospital stays, and patient dissatisfaction [1]. Effective pain management strategies are therefore essential to enhance patient outcomes and improve overall surgical experiences. In recent years, the use of regional anesthesia techniques, particularly the transversus abdominis plane (TAP) block, has gained popularity as an adjunct to multimodal analgesia in laparoscopic surgeries.

**Author for Correspondence: sunitha.m@manipal.edu*

The TAP block is a regional anesthesia technique that targets the nerves supplying the anterior abdominal wall. By blocking these nerves, the TAP block can provide effective analgesia for patients undergoing abdominal surgeries, including laparoscopic cholecystectomy [2]. Traditionally, the TAP block has been performed using anatomical landmarks, but the advent of ultrasound guidance has significantly improved the accuracy and efficacy of this technique [3]. Among the various approaches to the TAP block, the bilateral subcostal approach is particularly relevant for upper abdominal surgeries, as it specifically targets the upper abdominal wall and provides analgesia in the T6–T9 dermatomes, which are involved in pain sensation following laparoscopic cholecystectomy [4].

In addition to the TAP block, local anesthetic infiltration at the port sites is another common method for managing postoperative pain in laparoscopic surgeries. Bupivacaine, a long-acting local anesthetic, is frequently used for this purpose due to its prolonged duration of action and favorable safety profile [5]. Port site infiltration with bupivacaine is a straightforward technique that involves the administration of the anesthetic directly into the tissues around the laparoscopic port sites, providing localized pain relief and reducing the need for systemic analgesics. However, while port site infiltration is effective in managing somatic pain from the port sites, it may not adequately address the visceral pain originating from the surgical manipulation of the gallbladder and surrounding tissues.Given the distinct mechanisms of pain following laparoscopic cholecystectomy—somatic pain from the port sites and visceral pain from the surgical site—a multimodal approach to analgesia that combines different techniques may offer superior pain relief. This study aims to compare the efficacy of ultrasound-guided bilateral subcostal TAP block with port site infiltration using bupivacaine in providing postoperative analgesia for patients undergoing laparoscopic cholecystectomy. By conducting a prospective, randomized, comparative analysis, this research seeks to determine whether one technique offers a significant advantage over the other in terms of pain relief, opioid consumption, and patient satisfaction. The findings of this study have the potential to inform clinical practice and enhance the management of postoperative pain in laparoscopic cholecystectomy, ultimately improving patient outcomes and quality of care.

Methods

The study was conducted at BGS Global Hospital, Department of Anaesthesia, Kengeri, Bangalore, focusing on patients aged 20 to 70 years undergoing laparoscopic cholecystectomy. This clinical prospective randomized controlled trial spanned one year, from August 2019 to August 2020. The sample size was calculated based on the difference in the mean time to the first analgesic requirement between the subcostal TAP group and the port-site infiltration group, as reported in the study by Suseela et al.[6] With a 99% confidence level and 90% power, the required sample size was 9 per group, considering a 10% non-response rate. However, to ensure normal distribution, 30 subjects were included in each group, totaling 60 participants for the study.

Procedure

Patients admitted for elective laparoscopic cholecystectomy who meet the eligibility criteria will be selected after providing informed consent. They will undergo thorough pre-anaesthetic evaluation and be randomized into either Group A or Group B. All patients will receive general anesthesia with Propofol, Fentanyl, and Atracurium, followed by endotracheal intubation. Anesthesia will be maintained with oxygen, air, Isoflurane, and Atracurium. Intraoperative monitoring will include ECG, blood pressure, pulse oximetry, and end-tidal CO2. Group A will receive port-site infiltration with 0.25% Bupivacaine, while Group B will receive a bilateral subcostal transversus abdominis block with 0.25% Bupivacaine. Postoperative monitoring will continue for 24 hours, with pain scores and hemodynamic parameters recorded at regular intervals. Rescue analgesia with Paracetamol and Tramadol will be provided as needed, and all complications will be documented and managed.

Statistical Methods

Data was entered into Microsoft Excel and analyzed using SPSS v.23 (IBM Statistics, Chicago, USA) and Microsoft Office 2007. For continuous variables, mean ± standard deviation (SD) was used for summary statistics, while categorical data were summarized using counts and percentages, with diagrammatic presentations. The Chi-square ($\chi 2$) test assessed associations between categorical variables, and an unpaired t-test evaluated mean differences between two independent groups. A p-value of < 0.05 was considered statistically significant.

RESULTS

Table 1 presents the demographic parameters, ASA grade distribution, and duration of surgery for Groups A and B. The mean age of participants was similar between the two groups (44.6 ± 12.3 years for Group A and 45.4 ± 13.0 years for Group B, $p = 0.808$). The mean height and weight were also comparable, with no significant differences observed ($p = 0.663$ and $p = 0.163$, respectively). Gender distribution was nearly identical, with males comprising 33.3% of Group A and 36.7% of Group B ($p = 0.787$). ASA Grade distribution was evenly matched between the groups, with no significant difference ($p = 0.796$). The mean duration of surgery was slightly longer in Group A (69.7 ± 11.6 minutes) compared to Group B (66.3 ± 10.6 minutes), but this difference was not statistically significant ($p = 0.249$).

Table 2 presents the comparison of heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) between Group A and Group B at various time points. The heart rate in Group A was consistently higher than in Group B, with statistically significant differences observed from 1 hour post-operation ($p = 0.001$) to 24 hours ($p = 0.045$). Similarly, Group A exhibited higher SBP values compared to Group B, with significant differences starting at 2 hours ($p = 0.044$) and continuing through 24 hours ($p = 0.049$). For DBP, significant differences between the groups were noted at 6 hours ($p = 0.002$), 12 hours ($p < 0.001$), and 24 hours ($p = 0.039$).

Table 1: Demographic Parameters, ASA Grade Distribution, and Surgery Duration

Demographic Parameters	*Group A*	*Group B*	*P value*
	Mean ± SD (%)	*Mean ± SD (%)*	
Age (Yrs)	44.6 ± 12.3	45.4 ± 13.0	0.808
Ht (Cm)	155.7 ± 9.1	156.8 ± 9.7	0.663
Wt(Kg)	68.5 ± 6.9	71.2 ± 8.2	0.163
Male	10 (33.3%)	11 (36.7%)	0.787
Female	20 (66.7%)	19 (63.3%)	
ASA Grade Distribution			
Grade I	15 (50.0%)	16(53.3%)	0.796
Grade II	15 (50.0%)	14 (46.7%)	
Duration of Surgery			
Duration of Surgery	69.7 ± 11.6 min	66.3 ± 10.6	0.249

Table 3 presents the VAS scores comparing Group A and Group B at various time intervals post-surgery. The mean VAS scores for Group A were consistently higher across all time points (1, 2, 3, 6, 12, and 24 hours) compared to Group B.

Table 4 presents the time to first rescue analgesic request in minutes, with Group A averaging 243 ± 37.6 minutes and Group B averages 453.8 ± 40.2 minutes (P<0.001).

Table 5 presents the total amount of rescue analgesic requests in minutes, comparing Group A and Group B. The mean request time for Group A was 153 ± 31.5 minutes, while Group B had a significantly lower mean request time of 51.2 ± 40.5 minutes, (P<0.001).

DISCUSSION

Truncal blocks are frequently employed for managing postoperative pain in various abdominal surgeries, both anterior and posterior. The use of ultrasonography in anesthesia has increased the popularity of truncal blocks by providing real-time imaging, which reduces failure rates and toxicity. Effective postoperative analgesia is crucial for comprehensive perioperative care. Truncal nerve blocks have been shown to enhance perioperative outcomes, decrease perioperative stress, and increase patient satisfaction. They also lead to lower opioid use, fewer side effects, and a reduced need for rescue analgesia following elective laparoscopic cholecystectomy [7]. The Bilateral Subcostal TAP block has been shown to provide effective analgesia to the skin and muscles of the anterior abdominal wall in patients undergoing Laparoscopic Cholecystectomy. Patients who received the subcostal TAP block experienced no breathing difficulties, were able to cough freely without restriction, and reported better pain scores compared to those in the port site infiltration group. The prolonged analgesic effect of the subcostal TAP block may be attributed to the relatively low vascularity and slower drug clearance from the transversus abdominis plane [7]. Ultrasound-guided TAP blocks can be administered using several techniques, with the three primary approaches being posterior, subcostal, and oblique subcostal [8]. The classical

Table 2: Comparison of HR, Systolic BP and Diastolic BP, between the study groups across 24 hour period

HR	*Group A*	*Group B*	*p-value*
	Mean ± SD (%)	*Mean ± SD (%)*	
Pre-op	77.8 ± 6.4	76.7 ± 8.0	0.535
1hr	84.2 ± 4.9	79.9 ± 4.8	0.001*
2hr	82.4 ± 4.8	79.8 ± 4.0	0.031*
3hr	81.3 ± 4.1	79.0 ± 3.4	0.022*
6hr	84.3 ± 3.5	78.2 ± 3.6	<0.001*
12hr	82.8 ± 3.6	78.1 ± 4.5	<0.001*
24hr	81.0 ± 5.3	76.4 ± 5.9	<0.045*
SBP	*Group A*	*Group B*	*p-value*
	Mean ± SD (%)	*Mean ± SD (%)*	
Pre-op	125.9 ± 9.7	122.3 ± 10.5	0.173
1hr	118.8 ± 8.5	116.3 ± 8.3	0.262*
2hr	121.5 ± 7.7	117.8 ± 7.7	0.044*
3hr	121.5 ± 8.1	117.5 ± 7.6	0.049*
6hr	127.7 ± 8.8	118.0 ± 8.1	<0.001*
12hr	126.1 ± 8.3	117.7 ± 9.8	<0.001*
24hr	125.6 ± 7.7	122.0 ± 9.7	<0.049*
DBP	*Group A*	*Group B*	*p-value*
	Mean ± SD (%)	*Mean ± SD (%)*	
Pre-op	76.6 ± 4.7	75.9 ± 6.1	0.604
1hr	73.5 ± 4.8	72.2 ± 5.2	0.307
2hr	77.2 ± 4.2	75.3 ± 4.8	0.113
3hr	77.1 ± 4.2	76.5 ± 5.0	0.615
6hr	79.4 ± 4.1	75.6 ± 5.1	<0.002*
12hr	78.6 ± 3.2	74.7 ± 5.4	<0.001*
24hr	78.9 ± 3.5	76.5 ± 4.6	<0.039*

Table3: Comparison of VAS scores between the study groups over a 24-hour period.

VAS	*Group A*	*Group B*	*p-value*
	Mean ± SD (%)	*Mean ± SD (%)*	
1hr	2.2 ± 0.4	0.2 ± 0.4	<0.001*
2hr	2.4 ± 0.5	0.4 ± 0.5	<0.001*
3hr	2.8 ± 0.5	0.9 ± 0.6	<0.001*
6hr	4.1 ± 0.7	2.4 ± 0.9	<0.001*
12hr	3.8 ± 0.6	3.1 ± 0.4	<0.001*
24hr	3.7 ± 0.4	3.1 ± 0.3	0.023*

Table 4: Comparison of the time to the first request for rescue analgesia between the study groups over a 24-hour period.

Parameter	*Group A*	*Group B*	*p-value*
	Mean ± SD (%)	*Mean ± SD (%)*	
Time for first rescue analgesic request (min)	243 ± 37.6	453.8 ± 40.2	<0.001*

Table 5: Comparison of the total amount of rescue analgesia between the study groups over a 24-hour period

Parameter	*Group A*	*Group B*	*p-value*
	Mean ± SD (%)	*Mean ± SD (%)*	
Total amount of rescue analgesic request (min)	153 ± 31.5	51.2 ± 40.5	<0.001*

TAP (transversus abdominis plane) block carries potential complications such as liver injury, bowel hematoma, nerve damage, and unpredictable distribution of local anesthetics, which can lead to unintended motor block [9-11]. Additionally, there was no statistically significant difference in demographic factors such as age and gender between the two groups.

In our study, we compared heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) between Group A and Group B at various time points. Group A consistently showed higher heart rates than Group B, with statistically significant differences observed from 1 hour post-operation (p = 0.001) to 24 hours (p = 0.045). Similarly, Group A had higher SBP values, with significant differences starting at 2 hours (p = 0.044) and continuing through 24 hours (p = 0.049). Significant differences in DBP were also observed, with Group A showing higher values at 6 hours (p = 0.002), 12 hours (p < 0.001), and 24 hours (p = 0.039). Whereas in the study by Hameed et al., 2023 [7], Group P exhibited a statistically significant increase in heart rate and blood pressure during the first hour postoperatively compared to Group S. The comparison of mean arterial pressure between the two groups revealed no significant difference (P-value > 0.05), except during the first hour postoperatively, where the difference was significant (P-value = 0.007).

In our study, we compared VAS scores between Group A and Group B at various post-surgery intervals. Group A consistently had higher mean VAS scores across all time points (1, 2, 3, 6, 12, and 24 hours) compared to Group B. The p-values were less than 0.001 for all time points, except at 24 hours (p = 0.023), indicating a statistically significant difference between the groups throughout the observation period. In comparing our study's results with those of Suseela et al. [6] and Mukherjee et al.[12], distinct differences in postoperative pain control emerge. Suseela et al.,[6] administered a bilateral subcostal TAP block with 20 ml of 0.25% bupivacaine and port site infiltration with 5 ml of 0.5% bupivacaine at each of the four ports. They measured NRS pain scores at 1, 2, 3, 6, 12, and 24 hours postoperatively, finding that NRS scores were lower in the TAP block group across all time points except at 1 hour postoperatively compared to the port site infiltration group. In contrast, our study found that VAS scores were significantly lower in the subcostal TAP block group only up to 5 hours postoperatively, after which the difference diminished.

Mukherjee et al.[12] used a mixture of bupivacaine 0.5% and lignocaine 2% with adrenaline for the subcostal TAP block and recorded VAS scores at 1, 2, 6, 12, 18, and 24 hours postoperatively. They concluded that 63% of patients in the TAP group had VAS scores of less than 3 up to 18 hours postoperatively, whereas in the placebo group, only 17% of patients had VAS scores below 3 up to 12 hours. The prolonged duration of analgesia in their study, lasting up to 18 hours, could be attributed to the addition of adrenaline, which likely extended the analgesic effect. In contrast, our study observed lower VAS scores in the subcostal TAP block group only up to 5 hours postoperatively, highlighting a shorter duration of analgesia, possibly due to the absence of adrenaline in our local anesthetic regimen. Similarly Tolchard et al.[13] recorded VAS scores at 1, 4, and 8 hours postoperatively and found that the subcostal TAP block significantly reduced VAS scores for up to 8 hours after surgery. The duration of effective postoperative analgesia in their study (8 hours) was longer compared to our study, where the effect lasted only 5 hours.

In our study, the time to the first rescue analgesic request was measured in minutes, with Group A averaging 243 ± 37.6 minutes and Group B averaging 453.8 ± 40.2 minutes. The P value of <0.001 indicates a statistically significant difference between the two groups. In comparison to our study, which found a mean time of 4 hours and 15 minutes for the first rescue analgesic request in the subcostal TAP block group, Suseela et al. [6] reported a longer mean time of 510.3 ± 154.55 minutes for the TAP block group compared to 290.7 ± 67.03 minutes for the port site infiltration group. This indicates a significant difference in the timing of first rescue analgesia between the studies, with our findings suggesting a shorter duration of analgesia. Similarly, Parikh et al. [14] observed an even longer mean duration of 547.13 ± 266.96 minutes for the first rescue analgesic requirement in the ultrasound-guided TAP block group compared to 49.17 ± 24.95 minutes in the placebo group. The longer duration noted in Parikh et al., [14] study could be attributed to the use of a higher concentration of local anesthetic (0.375%) and larger volumes (25 ml) on each side, which likely contributed to the extended analgesic effect compared to our study.

The results of our study revealed a comparison of the total amount of rescue analgesic requests between Group A and Group B. Group A had a mean request time of 153 ± 31.5 minutes, whereas Group B had a significantly shorter mean request time of 51.2 ± 40.5 minutes. The P value of less than 0.001 indicates that the difference between the two groups is statistically significant.

Hameed et al. [7] found that 22 patients (73.4%) in the TAP block group (group S) and 29 patients (96.7%) in the port site infiltration group (group P) required rescue analgesia at 8 hours postoperatively. While 8 patients (26.6%) in group S did not need rescue analgesia, only 1 patient (3.3%) in group P did not, and this difference was statistically significant (P = 0.023). This indicates that the TAP block group had a lower requirement for rescue analgesia compared to the port site infiltration group.

Parikh et al. [14] reported that the requirement for rescue analgesics (tramadol) was significantly lower in the ultrasound-guided transversus abdominis plane block group (103.8 ± 32

mg) compared to the placebo group (235.8 ± 47.5 mg) at 24 hours postoperatively, which aligns with our study's findings. Similarly, Tolchard et al.[13] observed a nearly 50% reduction in rescue analgesia usage in the first 8 hours postoperatively with the TAP block, and Suseela et al.[6] also found that patients receiving the subcostal TAP block required less rescue analgesic (48.69 ± 36.14 mg) compared to those receiving port site infiltration (141.8 ± 60.01 mg). These results are consistent with our study's outcomes. McDonnell et al. [15] demonstrated that the analgesic efficacy of the subcostal TAP block in elective laparoscopic cholecystectomy aligns with previous research showing reduced opioid analgesic needs and lower pain scores after TAP block in procedures such as appendectomy and hysterectomy. Recent studies have demonstrated that TAP block can provide effective postoperative analgesia for up to 24 hours following abdominal surgery [15, 16].

CONCLUSION

The significant reduction in rescue analgesic requests in Group B compared to Group A suggests that the intervention used in Group B was more effective in managing pain. This implies that the analgesic strategy in Group B provided superior pain control, potentially minimizing the need for additional medication. These results support the idea that optimizing analgesic approaches can enhance patient comfort and outcomes, and further research may help clarify the underlying mechanisms and validate these findings in larger populations.

REFERENCES

1. Bisgaard T, Warltier DC. Analgesic treatment after laparoscopic cholecystectomy: a critical assessment of the evidence. The Journal of the American Society of Anesthesiologists. 2006 Apr 1;104(4):835-46.
2. El-Dawlatly AA, Turkistani A, Kettner SC, Machata AM, Delvi MB, Thallaj A, Kapral S, Marhofer P. Ultrasound-guided transversus abdominis plane block: description of a new technique and comparison with conventional systemic analgesia during laparoscopic cholecystectomy. British journal of anaesthesia. 2009 Jun 1;102(6):763-7.
3. Hebbard P, Fujiwara Y, Shibata Y, Royse C. Ultrasound-guided transversus abdominis plane (TAP) block. Anaesthesia and intensive care. 2007 Aug 1;35(4):616-8.
4. Hebbard PD, Barrington MJ, Vasey C. Ultrasound-guided continuous oblique subcostal transversus abdominis plane blockade: description of anatomy and clinical technique. Regional Anesthesia & Pain Medicine. 2010 Aug 1;35(5):436-41.
5. Khan MR, Raza R, Zafar SN, Shamim F, Raza SA, Pal KM, Zafar H, Alvi R, Chawla T, Azmi R. Intraperitoneal lignocaine (lidocaine) versus bupivacaine after laparoscopic cholecystectomy: results of a randomized controlled trial. journal of surgical research. 2012 Dec 1;178(2):662-9.
6. Suseela I, Anandan K, Aravind A, Kaniyil S. Comparison of ultrasound-guided bilateral subcostal transversus abdominis plane block and port-site infiltration with bupivacaine in laparoscopic cholecystectomy. Indian journal of anaesthesia. 2018 Jul 1;62(7):497-501.
7. Hameed KS, Somanathan RM, Vijayanand K, Madhavakrishna NV. Comparative study of ultra sound guided subcostal transverse abdominis plane block versus portsite infiltration in laparoscopic cholecystectomies for postoperative pain relief. Int J Acad Med Pharm. 2023;5(6):1259-63.
8. Hebbard P. Subcostal transversus abdominis plane block under ultrasound guidance. Anesthesia & Analgesia. 2008 Feb 1;106(2):674-5.
9. Lancaster P, Chadwick M. Liver trauma secondary to ultrasound-guided transversus abdominis plane block. British journal of anaesthesia. 2010 Apr 1;104(4):509-10.
10. https://www.nysora.com/files/2013/pdf/(v12p28-33)TAPBlock.pdf
11. McDermott G, Korba E, Mata U, Jaigirdar M, Narayanan N, Boylan J, Conlon N. Should we stop doing blind transversus abdominis plane blocks?. British journal of anaesthesia. 2012 Mar 1;108(3):499-502.
12. Mukherjee A, Guhabiswas R, Kshirsagar S, Rupert E. Ultrasound guided oblique subcostal transversus abdominis plane block: An observational study on a new and promising analgesic technique. Indian Journal of Anaesthesia. 2016 Apr 1;60(4):284-6.
13. Tolchard S, Davies R, Martindale S. Efficacy of the subcostal transversus abdominis plane block in laparoscopic cholecystectomy: comparison with conventional port-site infiltration. Journal of Anaesthesiology Clinical Pharmacology. 2012 Jul 1;28(3):339-43.
14. Parikh BK, Waghmare VT, Shah VR, Mehta T, Butala BP, Parikh GP, Vora KS. The analgesic efficacy of ultrasound-guided transversus abdominis plane block for retroperitoneoscopic donor nephrectomy: a randomized controlled study. Saudi Journal of Anaesthesia. 2013 Jan 1;7(1):43-7.
15. McDonnell JG, Curley G, Carney J, Benton A, Costello J, Maharaj CH, Laffey JG. The analgesic efficacy of transversus abdominis plane block after cesarean delivery: a randomized controlled trial. Anesthesia & Analgesia. 2008 Jan 1;106(1):186-91.
16. Kamhawy G, El-Taher E, Abdelrahman M. A comparison of oblique subcostal transversus abdominis plane block versus thoracic paravertebral block for postoperative analgesia after open cholecystectomy. Egyptian Journal of Anaesthesia. 2017 Oct 1;33(4):323-9.