Analgesic Effect of Ultrasound Guided Paravertebral Block in Laparoscopic Cholecystectomy

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ABSTRACT

INTRODUCTION: Laparoscopic cholecystectomy is the most commonly performed surgical procedure in an adult population. Though it's a minimally invasive procedure, significant proportion of patients have severe postoperative pain. Pain following laparoscopic cholecystectomy is multifactorial and complex in nature. Several modalities have been used to manage this pain. Ultrasound guided bilateral paravertebral block is one of the emerging technique. We aimed to evaluate the analgesic effect of ultrasound guided bilateral paravertebral block in patient undergoing laparoscopic cholecystectomy.

METHOD: This is a clinical prospective, observational study. Fifty two patients, aged 18-70 years, American society of anesthesiologist (ASA) classification I and II scheduled for elective laparoscopic cholecystectomy under general anesthesia were enrolled and divided in two groups. Group1, received general anesthesia and ultrasound guided bilateral paravertebral block with Ropivacaine 20 ml 0.25% in each side group2 received general anesthesia without any block. We observed intraoperative additional fentanyl requirement and time of first rescue analgesia.

RESULT: In group1, none of the patient required additional intraoperative analgesia where as in group 2, 15.38 % (4/26) required additional analgesic, (p=0.045).Time of first rescue analgesia was longer (161.26 ±138.98mins) in paravertebral block group than in control group (41.68±24.96 mins) p<0.001.

CONCLUSION: Preoperative ultrasound guided bilateral paravertebral block using ropivacaine for laparoscopic cholecystectomy is effective for decreasing the additional intraoperative analgesia requirement and prolongs the analgesia duration in postoperative period.

KEY WORDS: *Laparoscopic cholecystectomy, Pain, Paravertebral block, Ultrasound guided*

INTRODUCTION

Laparoscopic cholecystectomy is one of the most commonly performed surgical procedure. Despite of its minimal invasive nature, pain following the laparoscopic cholecystectomy is still the common complain of patient. Origins of pain in laparoscopic cholecystectomy are; somatic, due to multiple port site incision, visceral, due to dissection of calo t's triangle and referred, shoulder pain due to irritation of phrenic nerve. Moderate to severe intensity of pain persists for 3 to 4 days following laparoscopic cholecystectomy, however, pain may remain severe in 10 to 13% of patients throughout the first week.

Ultrasound guided paravertebral block (PVB) is a regional anesthetic technique, where the administration of local anesthetic into the wedge-shaped space on the anterolateral thoracic spine (figure 1). It provides abdominal and thoracic analgesia resulting by ipsilateral somatic and sympathetic nerve blockade in multiple contiguous dermatomes above and below the site of injection. Since the last decade

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ultrasound guided PVB block is emerging technique of pain management strategy in thoracic and abdominal surgery.[9] Parenteral opioids are still a commonly used method to manage postoperative pain after laparoscopic cholecystectomy, but they come with few notorious side effects. Research indicates that bilateral paravertebral block can not only decrease the amount of opioids needed during surgery but also significantly reduces the opioids requirements in post-operative period while maintaining excellent pain relief.[10]

This study aimed to evaluate the analgesic effect of bilateral single level paravertebral block with Ropivacaine in term of intraoperative additional Fentanyl requirement and duration of analgesia in postoperative period in laparoscopic cholecystectomy.

METHODS

This is a clinical observational study that was carried out prospectively in a tertiary care hospital in Nepal between September 2021 and June 2022. The study enrolled 52 patients of American Society of Anesthesiologists Physical Status (ASA-PS) I and II, of both genders, aged between 18-70 years, who were scheduled to undergo elective laparoscopic cholecystectomy under general anesthesia, after obtaining approval from the Institutional Review Board (IRB). Patients with a history of Ropivacaine allergy, coagulopathy, infection at the PVB injection site, and thoracic spine deformity were excluded from the study. A detailed pre-anesthetic evaluation was performed the day before surgery, and patients were provided with informed consent after being informed about the study's purpose and procedure. The patients were informed about the block procedure and the Numeric Pain Score (NPS) 0-10 scale used to assess postoperative pain.The study's sample size was determined based on Agrawal A et al.'s study, which found that patients who received PVB block required less intraoperative additional Fentanyl supplementation than the control group (17.60±19.20 µg vs 38.6±23.16 µg). To achieve a power of 80% and a 95% confidence interval, the study required 26 patients in each group. Group 1 was the PVB block group, in which patients received general anesthesia and ultrasound-guided bilateral PVB block, while Group 2 was the control group that received general anesthesia without PVB block. Patients were instructed to fast for 8 hours before surgery.

Paravertebral nerve block technique: Anesthesiologist performed bilateral PVB block at either T4-5 or T5-6 before inducing anesthesia. The patient was positioned in a sitting position with their chin touching their chest, and a point 2.5-3 cm lateral to the midline was marked on both sides. After preparing the skin with antiseptic, the paravertebral space was located using a 5-10 MHz linear probe (Sonosite M turbo), and the block was performed using a 4" nerve stimulator (Stimuplex; B. Braun AG, Melsungen, Germany) with a plain technique. A small amount of normal saline was injected to confirm the correct space before injecting 20ml of 0.25% Ropivacaine in each paravertebral space. Aspiration was performed after every 5ml injection of Ropivacaine to avoid puncturing vessels or the pleura. The anesthesiologist who had performed at least 10 USG-guided PVB blocks carried out the procedure in the respective operation theater. The fullness of the paravertebral space due to the local anesthetic agent was checked after completing the PVB block. The potential complications associated with paravertebral block, including pneumothorax, hemothorax, vasovagal shock, and local anesthetic toxicity, were carefully observed and managed according to hospital protocol.

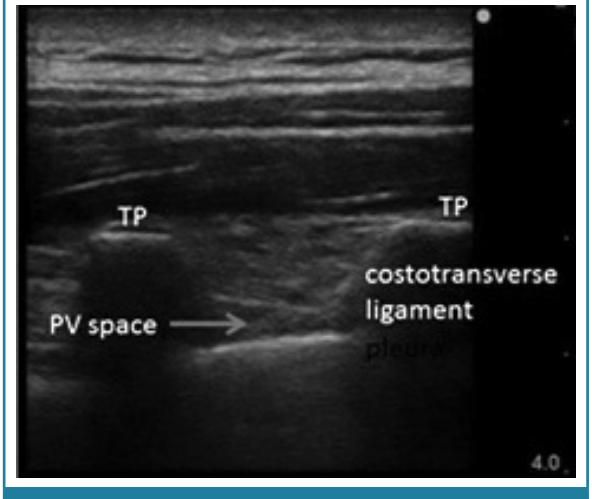

Figure 1. Sonoanatomy of paravertebral space

The anesthesia was induced with a dose of inj. Fentanyl (1.5 µg/kg) followed by titrated doses of inj. Propofol (1-2mg/kg). Tracheal intubation was facilitated by administering inj. Rocuronium (0.8mg/kg). The anesthesia was maintained with oxygen, Isoflurane, and Rocuronium. Intraoperative monitoring was performed using noninvasive blood pressure (NIBP), oxygen saturation (SPO2), electrocardiography

(ECG), and capnography (ETCO2). Additionally, inj. Paracetamol 1gm was administered after intubation. Intraoperative analgesia was provided using inj. Fentanyl (0.5 µg/kg) based on certain criteria such as an increase in heart rate or systolic blood pressure >20%, sweating, tearing, or lacrimation after excluding other causes of sympathetic activation. The number of patients requiring additional intraoperative fentanyl was recorded. A port-side infiltration with 10 ml of 0.25% Bupivacaine was performed at the end of surgery for all patients. Postoperative nausea and vomiting prophylaxis were performed using inj. Ondansetron (4mg). Awake extubation was done after reversal with inj.Neostigmine (0.05mg/kg) with inj. Glycopyrrolate (0.001mg/kg).

The Numeric pain scale (NPS) was used to measure at rest at different time intervals (30min-1hr-2hr-3hr-4hr-8hr-16hr and 24hr) in post operative ward by the attending nursing staff or anesthesia resident doctor. If the patient reported a NPS score of greater than 3, rescue analgesia (Inj. Ketorolac 30mg IV) was given. The time from the end of surgery to the first rescue analgesia was noted as the time of rescue analgesia. No background analgesic agent was given until the time of first rescue analgesia. The primary objective of the study was to determine the time of first rescue analgesia, while the secondary objectives were to assess the intraoperative additional Fentanyl requirement and any side effects of PVB.

The data collected was analyzed using the independent samples t-test for numerical data (age, height, weight, duration of surgery, time for first rescue analgesia) and chi-square test for categorical data (ASA PS, gender, additional intraoperative Fentanyl requirement) with the help of the Statistical Package for Social Studies (SPSS -21). The results were reported as mean ± standard deviation (SD) or number (n) and percentage (%). A p-value of < 0.05 was considered statistically significant.

RESULTS

In this clinical prospective observational study, a total of 52 patients were initially enrolled. However, three patients from group 1 developed vasovagal shock during paravertebral block, and one patient in group 2 converted to open surgery. The demographic details including age, gender, weight, and ASA PS, as well as the surgery duration, were comparable between the two groups (p>0.05), as demonstrated in table 1.

Table 1. Patient characteristics and operation time

Variables	Group1(23) Mean±SD	Group2(25) Mean±SD	p value
Age (years)	43.56±12.74	45.64±10.64	0.54
Weight(kg)	61.43±9.40	62.24±7.80	0.74
Gender(M/F)	6/17	7/18	0.88
ASA PSI/II	15/8	17/8	0.83
Operation time (min)	76.47±20.43	67.76±20.43	0.11

In group1, none of the patient required additional dose of fentanyl during intraoperative period where as in group2, 15.38% (4 / 25) patient required additional intraoperative fentanyl, which was statistically significant (p=0.045) shown in table 2.

Table 2. Intraoperative additional analgesia

Intraoperative additional fentanyl (n/%)	Group1 (23)	Group2 (25)	p value
	0/23(0%)	4/25(15.38%)	0.045

Time for first rescue analgesia was longer in group1 (161.26 ±138.98 mins) than in group2 and (41.68 ±24.96 mins) which was highly statistically significant, p<0.001 shown in table 3.

Table 3. Time of first rescue analgesia

Time of first rescue analgesic (Mean±SD)	Group1(23)	Group2 (25)	p value
	161.26± 138.98mins	41.68± 24.96mins	<0.001

DISCUSSION

Multimodal approach of pain management is required to control intra and postoperative pain following laparoscopic cholecystectomy. Ultrasound guided bilateral preoperative paravertebral block is one of the effective and safe method of multimodal approach of pain management. Since the opening of ports are in both side of abdomen and pain discomfort due to pneumoperitoneum is diffuse in nature so we aimed to performed and access the effect bilateral PVB . Ultrasound also helped to visualize the spread of injected drug in paravertebral space whereas in landmark and PNS guided approach of PVB, multiple level of injection on same side, partial or fail block and chances of pneumothorax is higher than ultrasound guided block. To the best of our knowledge, our study is the first study in our setup to evaluate the analgesic effect of bilateral ultrasound guided PVB block in patient undergoing laparoscopic cholecystectomy.

None of the patients in group1 required additional Fentanyl during intraoperative period, while 4 out of 25 patients (15.38%) in group 2 required extra fentanyl, p=0.045. The time for first rescue analgesia was significantly longer in group 1 (161.26 ±138.98 mins) compared to group 2 (41.68 ±24.96 mins), p <0. 001.In our study, we found that in ultrasound guided bilateral paravertebral block group, none of the patient required additional intraoperative analgesics. Aydin G et al[8] (2018) compared the ultrasound guided unilateral PVB with 20ml of 0.5% bupivacaine and found none of the patient in PVB group (0/30) required additional analgesia during intraoperative period. Their study have shown even unilateral ultrasound guided PVB is effective as one of component in multimodal intraoperative pain management approach. Agrawal A et al. (2012) found that, 11 out of 25(44%) did not required additional analgesic PVB group where as in control group only 4 (16%) didn't required additional intraoperative analgesics. The requirement of additional analgesic is lesser in PVB group. However higher percentage of patient needed additional analgesic in PVB in comparison to our study (0 vs 44%).This difference is likely due to ultrasound guided block technique used in our study which not only make it easy to confirm the paravertebral space but also helps to visualize the drug spread to different level of paravertebral space. None of the patient required additional intraoperative analgesia in ultrasound guided PVB (unilateral) group in study done by Gündost L et al (2020). Similar results of paravertebral block have been shown in laparoscopic, open abdominal and thoracic surgeries.[4, 5]

Agrawal A et al[9] (2012) found mean time for first rescue analgesia time was 270 mins which is longer than our study (161minutes) despite of they have performed unilateral (right sided) ultrasound guided PVB. Study done by Fentie D et al mean analgesia time in postoperative analgesia in unilateral PVB (landmark) group was 120 minutes and 30 minutes in control group. They have only included the patient after success of the PVB was confirmed. Kamhawy G et al compared ultrasound guided PVB with subcostal TAP block in laparoscopic cholecystectomy. They have found mean duration of first analgesia was significantly longer in PVB group (432 mins).Use of higher concentration 0.5% of 20 ml bupivacaine (in our study we used 0.25% ropivacaine) could be the reason for prolong duration of analgesia than in our study. In group1, there was no additional requirement of intraoperative fentanyl and prolonged analgesia time in postoperative period indicates that pre-incisional PVB block also poses the preemptive analgesic effect in patient undergoing laparoscopic cholecystectomy.

Complications like pneumothorax, hematoma, epidural or intrathecal spread and vasovagal shock have been reported during thoracic paravertebral block. These complications are higher in landmark and PNS guided technique than in ultrasound guided block. In our study, none of the patient developed hematoma, pneumothorax, hemothorax but two of the patients in PVB group developed vasovagal shock during the block. One of them had dizziness, hypotension followed by bradycardia and treated with fluid bolus and inj.Mephentermine and other patient had dizziness and hypotension. Both of them were young female and last case of the list. In both the cases blood sugar level (by glucometer) was in lower side (73mg/dl and 87mg/dl). Multiple confounding factors like prolonged nil per oral, lower blood sugar level, not using any anxiolytic and systemic analgesic agent during PVB block could have been potentiated the vasovagal shock. Similar incidents during PBV have been also noticed by Agarwal s el al and Yaman F during PVB block.

LIMITATION

A limitation of our study is that we did not assess the extent of dermatomal coverage achieved by the block.

CONCLUSION

Preoperative ultrasound guided bilateral paravertebral block using Ropivacaine for laparoscopic cholecystectomy is effective for decreasing the additional intraoperative analgesia requirement and prolongs the analgesia duration in postoperative period.

RECOMMENDATION

Based on this study, ultrasound-guided paravertebral block appears to be a good option for pain management during and after laparoscopic cholecystectomy. However, further research in the form of larger randomized controlled trials is necessary to fully establish its efficacy and safety.

REFERENCES

1. Harju J, Aspinen S, Juvonen P, Kokki H, Eskelinen M. Ten-year outcome after minilaparotomy versus laparoscopic cholecystectomy: a prospective randomised trial. Surgical Endoscopy. 2013;27(7):2512-2516. [PubMed]
2. Evers L, Bouvy N, Branje D, Peeters A. Single-incision laparoscopic cholecystectomy versus conventional four-port laparoscopic cholecystectomy: a systematic review and meta-analysis. Surgical Endoscopy. 2016;31(9):3437-3448. [Article] [PubMed]
3. Bisgaard T, Warltier D. Analgesic Treatment after Laparoscopic Cholecystectomy. Anesthesiology. 2006;104(4):835-846. [Article] [PubMed]
4. Wills V, Hunt D. Pain after laparoscopic cholecystectomy. British Journal of Surgery. 2000;87(3):273-284. [Article] [PubMed]
5. Bisgaard T, Klarskov B, Rosenberg J, Kehlet H. Characteristics and prediction of early pain after laparoscopic cholecystectomy. Pain. 2001;90(3):261-269. [Article] [PubMed]
6. Klein S, Bergh A, Steele S, Georgiade G, Greengrass R. Thoracic Paravertebral Block for Breast Surgery. Anesthesia & Analgesia. 2000;90(6):1402-1405. [Article] [PubMed]
7. Krediet A, Moayeri N, van Geffen G, Bruhn J, Renes S, Bigeleisen P et al. Different Approaches to Ultrasound-guided Thoracic Paravertebral Block. Anesthesiology. 2015;123(2):459-474.
8. D'Ercole F, Arora H, Kumar P. Paravertebral Block for Thoracic Surgery. Journal of Cardiothoracic and Vascular Anesthesia. 2018;32(2):915-927. [Article] [PubMed]
9. Pei L, Zhou Y, Tan G, Mao F, Yang D, Guan J et al. Ultrasound-Assisted Thoracic Paravertebral Block Reduces Intraoperative Opioid Requirement and Improves Analgesia after Breast Cancer Surgery: A Randomized, Controlled, Single-Center Trial. PLOS ONE. 2015;10(11):e0142249. [PubMed]
10. Naja MZ, Ziade MF, Lönnqvist PA. General anaesthesia combined with bilateral paravertebral blockade (T5–6) vs. General Anaesthesia for laparoscopic cholecystectomy: A prospective, randomized clinical trial. European Journal of Anaesthesiology. 2004;21(6):489–95.
11. Aydin G, Aydin O. The Efficacy of Ultrasound-Guided Paravertebral Block in Laparoscopic Cholecystectomy. Medicina. 2018;54(5):75. [Article] [PubMed]
12. Agarwal A, Batra R, Chhabra A, Subramaniam R, Misra M. The evaluation of efficacy and safety of paravertebral block for perioperative analgesia in patients undergoing laparoscopic cholecystectomy. Saudi Journal of Anaesthesia. 2012;6(4):344. [Article][PubMed]
13. Gündost L, Koltka K, Sivrikoz N, et al. Effects of paravertebral block and intravenous analgesic methods on postoperative pain management and opioid consumption in laparoscopic cholecystectomies. Agri. 2020;32(4):202-207. [Article][PubMed]
14. Fentie D, Gebremedhn E, Denu Z, Gebreegzi A. Efficacy of single-injection unilateral thoracic paravertebral block for post open cholecystectomy pain relief: a prospective randomized study at Gondar University Hospital. Local and Regional Anesthesia. 2017;10:67-74. [Article][PubMed]
15. 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;33(4):323-329. [Article]
16. Agarwal S, Bharti S, Hoda W. Vasovagal Attack during Insertion of Thoracic Paravertebral Catheter: A known but Rarely Reported Incident. Journal of Anesthesia & Clinical Research. 2019;10(1).
17. Yaman F, Tuglu D. Analgesic efficacy of ultrasound guided paravertebral block in percutaneous nephrolithotomy patients: a randomized controlled clinical study. BMC Anesthesiology. 2020;20(1). [Article][PubMed]