BMH MEDICAL JOURNAL

BMH Med. J. 2022;9(2):27-37. **Research Article**

Comparison of the Analgesic Efficacy of Ultrasound Guided Pectoral I, Pectoral II and Serratus Anterior Plane Block Versus Intravenous Fentanyl in Patients Undergoing Off Pump Coronary Artery Bypass Grafting

Nithin Kumar MP, Joel Devasia, Suresh G Nair, Nisha Rajmohan

Department of Anaesthesia and Critical Care, Astermedcity, Kochi, Kerala, India

Address for Correspondence: Dr. Nisha Rajmohan, DA, MD (Anaesthesia), PDCC, Consultant Anesthesiologist, Department of Anaesthesia and Critical Care, Astermedcity, Kuttisahib Road, Cheranalloor, South Chitoor, Kochi, Kerala, India. Email: nishavismaya@gmail.com

Abstract

Introduction: This study was undertaken to compare the analgesic efficacy of Ultrasound-guided (USG) Pectoral block (PECS 1 and 2) and Serratus Anterior Plane (SAP) block versus intravenous fentanyl in patients undergoing off pump coronary artery bypass grafting. (OP-CABG).

Methods: Sixty adult patients posted for OP-CABG were randomly assigned to two groups of 30 each. Group A was given PECS 1 & 2 with SAP Block with 0.25% Bupivacaine, 2% Lignocaine + Adrenaline and Dexamethasone up to maximum of 60 ml under USG guidance bilaterally (30ml on each side) after induction. Group B received only intravenous Fentanyl (2mcg/kg/hour) infusion. Patients were assessed for vitals, numerical rating scale (NRS) score and Richmond agitation sedation scale (RASS) for 48 hours. Time of extubation, duration of mechanical ventilation, total opioid consumed in 48 hours, adverse events and length of intensive care unit (ICU) and hospital stay were compared.

Results: Patients in group A had significantly lower pain scores ($P < 0.05$) throughout the study. The total dose of intraoperative fentanyl used in Group B was significantly higher ($P <0.001$) than that in Group A. The total postoperative use of fentanyl (781.67 +/- 354.22 mcg vs 1349.25 +/- 366.88 mcg) was significantly lower ($P <0.001$) in group A. Comparison of median RASS revealed that majority in Group A were alert. Adverse effects, duration of ventilation, ICU and hospital stay were comparable between groups.

Conclusion: In patients undergoing OP-CAB surgeries, the analgesia provided by PECS with SAP block is superior to intravenous fentanyl alone. Reduced narcotic usage resulted in optimal sedation profile in the ICU.

Keywords: Off-pump coronary artery bypass, nerve block, Postoperative analgesia, Sternotomy

Introduction

Sternotomy, rib retraction, conduit harvest, and drain tubes are some of the unavoidable causes of pain after off pump coronary artery bypass graft (OP-CABG) surgery. [1,2] Pain following cardiac surgery is most severe on the first postoperative day. In addition, the severity of pain is more in obese and younger patients. Inadequate pain relief is associated with long term complications like chronic pain, ineffective postoperative pulmonary toileting leading to increased postoperative pulmonary complications, slower recovery from surgery, ineffective wound healing and increased infection rates.[3]

Intravenous narcotic infusions in the postoperative period have been the standard of care following coronary artery bypass surgery (CABG) for decades. However, the use of intravenous fentanyl considerably delays the postoperative recovery of these patients and in this era of fast-tracking, is not an option that is widely accepted. The use of thoracic epidural catheters in cardiac surgical patients saw a revolutionary change in pain management after CABG.[4] Although the use of thoracic epidural catheters is associated with excellent postoperative analgesia, the risk of epidural haematoma has always hounded the use of this technique. [5]

In recent years regional analgesia using nerve blocks have revolutionized pain relief in the postoperative period. They give excellent pain relief with minimal side effects. Despite being the preferred analgesic technique in breast and chest wall surgeries, there is deficit of evidence demonstrating the composite role of Pectoral 1, Pectoral 2 (PECS) and Serratus Anterior plane (SAP) block in cardiothoracic surgery, especially following sternotomy. This study aims to address the efficacy and safety of a combination of thoracic nerve blocks with the traditional technique of intravenous fentanyl for postoperative pain relief in patients undergoing OP-CABG.

Methods

This prospective, randomized controlled study was approved by the Institutional Ethics Committee (AM/EC/40-2018). Written informed consent was procured from each patient for participation in the study. The trial was conducted in the period between July 2018 and April 2019 and it adhered to the principles of the declaration of Helsinki of 2013.

Sixty adult patients posted for OP-CABG surgery belonging to American Society of Anesthesiologists (ASA) grade 3 or 4, of either sex were included in the study. Patient refusal, preexisting infection /lesion at the block site, Body mass index (BMI) greater than 40, allergy to local anaesthetics, renal dysfunction, psychiatric illness and patient refusal were considered as exclusion criteria for the study. The manuscript adheres to the applicable CONSORT guidelines.

The randomization was carried out with the computer-generated random number table and group allocation was done with sealed envelope method before the surgery. Patients were assigned to one of the two groups of 30 each.

Selected patients were pre-medicated with oral Pregabalin 75 mg, and Pantoprazole 40 mg. Maltodextrin drink was given on the night before and 3 hours before surgery. In the operation theatre (OR), after connecting to baseline monitors and an invasive arterial line, all patients were induced using a combination of midazolam (0.05-0.1 mg/kg), fentanyl (3-5 mcg/kg), propofol (1-2 mg/kg) and pancuronium (0.15 mg/kg) or rocuronium (1.2 mg/kg). After intubation of the patient and connecting to a ventilator, all patients had a central venous line placed through the right internal jugular vein.

Group A (n =30) received PECS 1 and 2 blocks with SAP Block using 0.25% Bupivacaine (up to 3 mg/kg) + 2% Lignocaine + Adrenaline (7 mg/kg) + Dexamethasone 2ml (8 mg) up to a maximum volume of 60 ml, 30 ml on each side (PECS 1 -10 ml, PECS 2 -10 ml and SAP -10 ml)

under USG guidance after induction. Group B (n=30) received only intravenous fentanyl infusion as a part of analgesia.

For both the PECS and SAP blocks the operator stood at the head end of the patient with the patients arms abducted. All blocks were given using a 12-15 MHz linear ultrasound (US) probe and the depth set at 3-5 cm. From this position it was easy to guide the injection needle "in line" to the desired plane. All aseptic precautions were taken during the procedure.

In PEC 1 and 2 blocks, the US was held in a parasagittal plane in the mid-clavicular position. The subclavian vessels were first identified and the rib identified as the second rib. The probe was then moved infero-laterally to the level of the third rib and minimally rotated until all the three muscles, the pectoralis major, pectoralis minor and the serratus anterior muscles (SAM) were identified. In the single puncture technique, the needle was introduced "in-line" to the facial plane between the pectoralis minor and serratus anterior muscle where 10 ml of the local anaesthetic was deposited. (PECS 2) The needle was then withdrawn till it was placed in the facial plane between pectoralis major and minor and another 10 ml was given. (PECS 1)

While performing the SAP block, the US probe was placed in the mid-clavicular position and moved inferiorly and laterally while counting the ribs. The block is given at the level of the 4^{th} or the 5^{th} rib in the mid-axillary level. In this position, the latissimus dorsi muscle can be superficial and cranial to the SAM. The SAM originates from the surface of the first eight ribs and is attached to the anterior border of the scapula and the posterior edge of the latissimus dorsi muscle. An "in-plane" approach was used and 10 ml of the local anaesthetic was injected deep to the SAM. The entire exercise is then carried out on the opposite side.

In both groups, a fentanyl infusion at 0.5-2 mcg/kg/min was started immediately after induction of anaesthesia. Heart rate and blood pressure were continuously monitored and an increase of more than 20% from the baseline were used as a measure of inadequate analgesia/anaesthesia. In response, the dose of fentanyl was increased. Vitals were recorded every 15 minutes till the end of procedure. Similarly, a drop-in baseline blood pressure or heart rate was used to reduce the dose of fentanyl.

After the procedure, patients were shifted to the ICU where the dose of fentanyl was reduced to 0.5 mcg/kg/hour till the patients were extubated. A Numerical Rating Scale (NRS) was used for pain assessment and the dose of fentanyl was titrated accordingly. An increase in NRS by more than 4 was used as an indication to give a rescue bolus of fentanyl (0.5 mcg.kg). In addition to fentanyl infusion, patients in both groups received injection paracetamol (1gram intravenous thrice daily) and pregabalin 75 mg once daily.

In addition to the NRS score, the Richmond Agitation Sedation Scale (RASS) was assessed every 2 hours after extubation for up to 24 hours, and 4 hours thereafter for next 24 hours. Hemodynamic changes were noted at all time points. Time of extubation was noted and duration of mechanical ventilation was calculated as the time from ICU admission to the point of extubation. The total dose of opioids consumed in 48 hours after surgery, length of ICU and hospital stay was noted. Any adverse events including nausea, vomiting, pruritus, convulsions, pneumothorax or hematoma was noted. Respiratory depression was considered if: a) If patient had a drop-in saturation to <92% and arterial partial pressure of oxygen (PaO2) < 60 mmHg, or b) Arterial partial pressure of carbon dioxide (PaCO2) increases of > 45 mmHg. Respiratory depression was managed with the use of non-invasive ventilation.

NRS for pain was considered as "low" when the score was < 2, "moderate" when between 3-5 and "severe" when it was > 6.

Considering the 24-hour opioid consumption observed in a previous study with a confidence interval of 95% and precision of 5%, and a complication rate of 50% in each arm, sample size needed for each group was 25.[6] The final sample size was 50 patients (25 each in group A and Group B). However, we recruited 30 patients in each group resulting in a total of 60 cases.

Statistical analysis

The data entry was done using Microsoft Windows EXCEL 2010 and data analysis was done using IBM SPSS version 20.0. Categorical variables were portrayed as frequencies and percentages. Continuous variables were summarized as Mean +/- standard deviation (S.D). Normality was analyzed by Kolmogorov- Smirnoff test.

Independent sample means for normal data was tested using Student T test and independent sample medians of non-normal data was tested using Mann Whitney U test. Pearson Chi square test and Fischer exact test were used to find the association between categorical variables and P <0.05 was considered to be statistically significant.

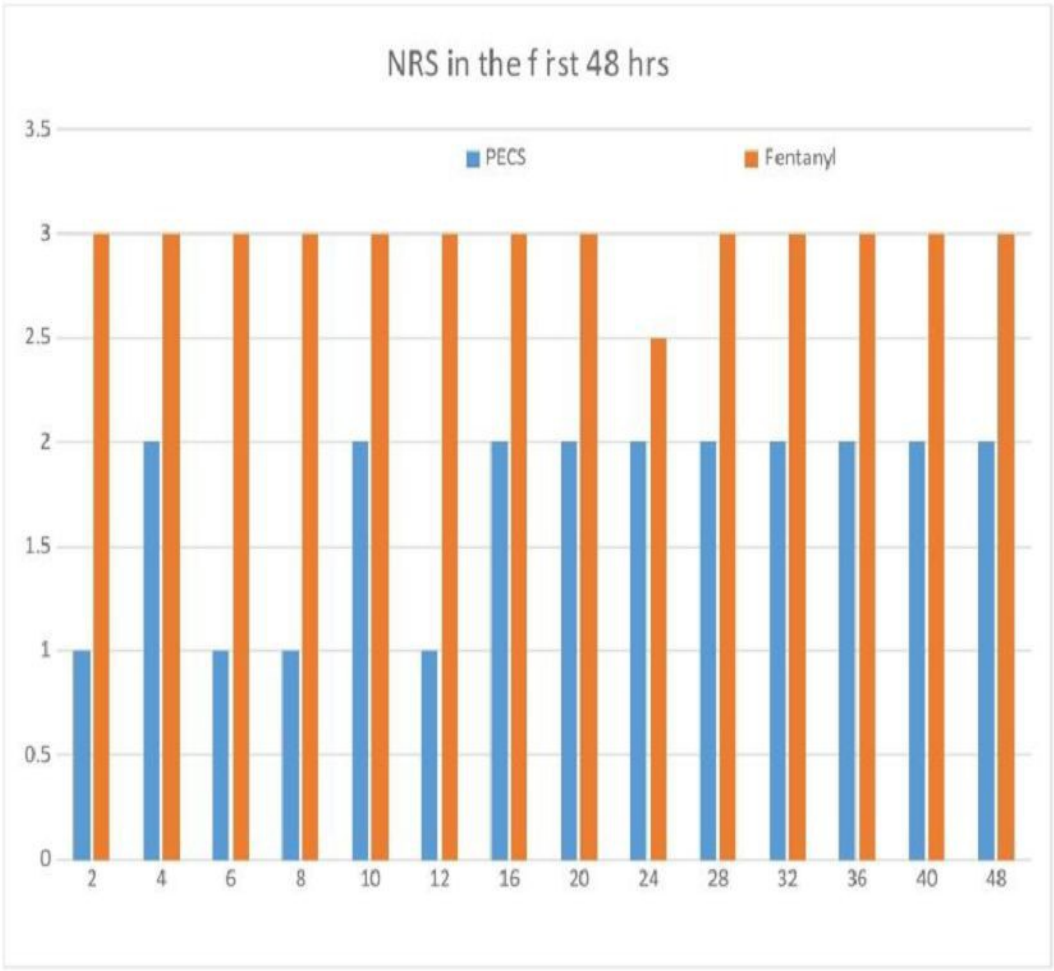
Results

Demographic data, ASA status and duration of surgery were comparable between the two groups. (**Table 1**) The NRS score assessed on postoperative day (POD) 0 and 1 and 2 shows a statistically significant lower subjective pain score in PECS +SAP block group. (**Figure 1**)

Table 1: Patient demographics

Variable	Group A (N=30)	Group B (N=30)	P value
Age in years (Mean ±SD)	60 ± 7.78	57.40 ± 9.02	0.237
Male/Female	5/25	6/24	0.739
Height in cm (Mean ±SD)	162.57 ± 8.83	165.1 ± 9.6	0.280
Weight in kg (Mean ±SD)	63.1 ± 9.0	66.4 ± 13.5	0.274
ASA grade 3/4	8/18	5/21	

SD = standard deviation, ASA=American Society of Anesthesiologist classification



NRS Numerical rating scale

Figure 1: Comparison of NRS scores between two groups on postoperative day 0 and

1. NRS scores were statistically significant between two groups at all time points

The intraoperative fentanyl use in Group B (540.72 +/- 133.10 mcg) was significantly higher (P <0.001) than that in Group A (296.58 +/- 120.44 mcg). Fentanyl use on POD 0 (337.33 +/- 129.480 mcg vs 583.58 +/- 163.25mcg) and POD 1 (405 (225-660) mcg vs 750 (642.5-975) mcg and the total postoperative use of fentanyl (725 (490-1007.5) mcg vs 1315(1200-1605) mcg were significantly lower (P <0.001) in group A (**Table 2**). Only 9 of 30 patients in Group A required rescue analgesia as compared 26 of the 30 patients in Group B (P <0.001). Comparison of median RASS between two groups in the first 48 hours revealed that the majority of the patients in Group A in were alert and calm as compared to Group B. (**Figure 2**)

There was no significant difference between the groups with respect to heart rate (HR), SpO2, and mean arterial pressure (MAP) during the perioperative period. No block-related complications, such as pneumothorax, vascular puncture, or local anaesthetic toxicity were recorded. There was no significant difference between groups regarding the duration of ventilation or length of stay hospital. The duration of the surgical procedure also did not show any significant difference between groups. (**Table 3**) Although the incidence of respiratory depression and vomiting was greater in fentanyl group, this did not reach statistical significance.

Table 2: Comparison of intraoperative, postoperative and total use of fentanyl between the two groups (n=60)

Time period	Group A Fentanyl use (mcg)	Group B Fentanyl use (mcg)	**P value**
Intra-operative	296.58 ±120.44	540.72 ± 133.10	<0.001
24 hours postoperative	337.33 ± 129.48	583.58 ± 163.25	<0.001
24-48 hours postoperative	444.33 ± 282.42	765.67 ± 275.21	<0.001
Total fentanyl in the post-operative period	781.67 ± 354.22	1349.25 ± 366.88	<0.001
Rescue analgesia in the postoperative period	9/30	26/30	<0.001

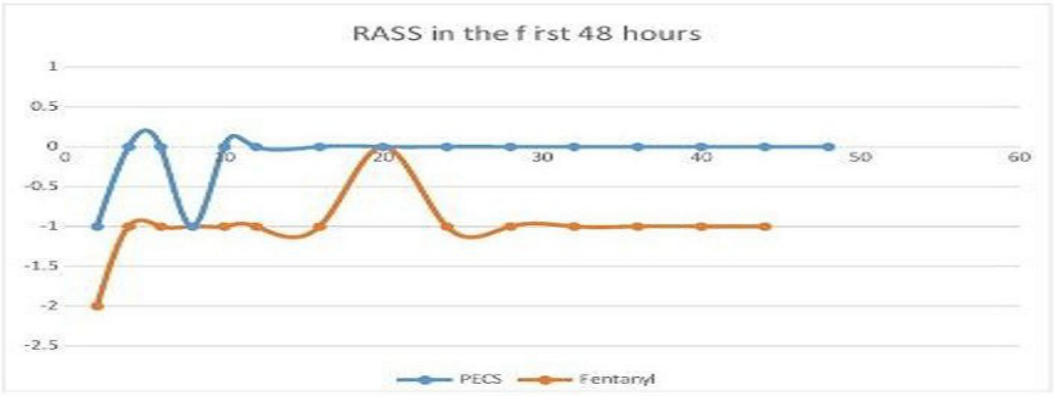


Figure 2: Comparison of median RASS between two groups postoperative day 0 and 48 hours.

RASS - Richmond Agitation-Sedation Scale. The RASS score indicated the level of comfort of the patients in the intensive care unit (ICU). The RASS scale ranged from +5 to -5. A more alert and calmer patient is signified by a value of "0" whereas, a more positive value indicated a very combative and agitated patient while a negative value indicated a more sedated and unresponsive patient.

Table 3: Comparison of duration of postoperative ventilation, duration of hospital stays, incidence of respiratory depression and vomiting between two groups

Parameter	Group A	Group B	P value
Ventilation (minutes)	270	262	0.887
LOS- hospital (Days) (median)	7	6	0.477
Duration surgery (min)	388.67	414.50	0.166
Respiratory depression (no)	2	6	0.129
Vomiting (no)	0	2	0.150

LOS - Length of stay
No - Number of patients

Discussion

Pain after cardiac surgery can be severe and distressing and can have a number of unwanted side effects. In this study we showed that a combination of chest wall nerve blocks could efficiently reduce postoperative pain and significantly reduce the consumption of narcotics which has been the staple analgesic used traditionally after cardiac surgery.

The analgesic potential of PECS block has been proven beyond doubt for breast surgeries, automated cardioverter-defibrillator (AICD)/pacemaker placement, intercostal drainage tube placement and rib fractures.[6-14] However, the efficacy of bilateral PECS block for sternotomy pain has not been well established although a few studies have established their analgesic potential.[15] Effectiveness of SAP block has been reported in oesophagostomy, pain following rib fractures and lung cancers, thoracoscopy, thoracotomies and minimally invasive cardiac surgeries. [14,16-20]

PECS block was found to produce effective analgesia on the axilla, anterior and lateral chest wall. [13,15] PECS 1 blocks the medial pectoral (C8-T1) and lateral pectoral (C5-7) nerves. PECS 2 blocks lateral cutaneous branches of the intercostal nerves (T2-T6), thoraco dorsal nerve

and the long thoracic nerve.[15] The SAP block can be considered as an extension of the PEC1 block as it blocks the lateral cutaneous branches of the intercostal nerves from T3-T9. It gives analgesia to the anterior, lateral and posterior chest wall. Placement and positioning of intercostal chest tubes, rib retraction and damage to serratus/intercostal muscles and nerves can cause severe and excruciating pain following CABG. SAP block addresses all these issues. [17-19]

Moll et al in their study of 197 patient undergoing minimally invasive CABG recommended SAP block only when paravertebral blocks were contraindicated as their analgesic potential was inferior.[21] Kumar et al demonstrated that the pain score at rest and on coughing was lesser with PECS block when compared to control in adult cardiac surgeries requiring sternotomies.[22] Bilateral PECS + SAP block when used together was found to have immense opioid sparing effect for OP-CAB with midline sternotomies. In our study we demonstrated a lower NRS scores and reduced fentanyl requirements for 48 hours after surgery in the PECS/SAP group. (**Figure 1, Table 2**).

A combination of these blocks provided superior analgesia over the entire chest wall thereby providing effective pain relief for longer duration as seen in our patients. Earlier reports showed an analgesic efficacy lasting up to 24 hours when either of the blocks were used alone. [6-9,13,15,18-20] In contrast, Berthoud et al showed that SAP block had lower pain scores and opioid consumption for 48 hours following minimally invasive heart surgery.[17] We found a similar duration of pain relief and opioid sparing in our study.

To our knowledge this is one of the earliest studies that has studied the effect of combination of blocks (PECS +SAP) in cardiac surgery requiring sternotomy. A combination of PEC 1 and 2 with SAP block has been tried as a sole anaesthetic for high-risk breast surgeries and it ensured analgesia for 24 hours. [10,11] In cardiac surgery, the combination has proved to be more efficacious and with prolonged analgesic effect.

Fast tracking in CABGs with sparing of opioids due to a well-executed PECS +SAP block resulted in alert and calm patients who were mobilized early and could participate in chest physiotherapy and incentive spirometry. Improved sedation score was similarly reported when PECS was used in breast surgeries.[9]

Pain after cardiac surgery is most severe in the first 24 hours and decreases on subsequent days. [1-3] Although we gave a single shot block in our study, the pain relief was still significant at 48 hours. Continuous infusion using catheters may be more effective than single shot blocks but can be technically challenging during cardiac surgery.

The combination of these blocks can be considered as safe as we did not have to use either of the local anaesthetics in doses above the standards recommended. The longer duration of analgesia seen in our patients is probably related to the addition of dexamethasone to the drug combination. Dexamethasone is known to prolong the effectiveness of local anaesthetics probably by their anti-inflammatory effects when deposited perineurally.[23] Although the incidence of respiratory depression and nausea were greater in the fentanyl group, this did not reach statistical significance. Unfortunately, the excellent pain relief provided by the chest wall blocks did not translate into earlier discharge.

We compared the associated comorbidities and drug administered between groups. Only calcium channel blockers use showed significant difference. Eight patients in the study group were on calcium channel blockers and most of these patients received Cilnidipine as part of the hypertensive treatment protocol. Cilnidipine is a peripheral vasodilator and can cause reflex tachycardia in response to pain. However, in our study we did not see any difference in the changes in HR during sternotomy in the study group. Moreover, there was no significant difference in the HR changes during induction between groups. This could mean that the effect of

the regional block was sufficient to prevent any reflex changes in HR in the study group, and or the effect of fentanyl used during induction and maintenance was sufficient to prevent any sympathetic response.

There are a few limitations to this study. The NRS used in the study is subjective and can vary with the patients being considered for the study. Secondly, we did not use the NRS scale during postoperative physiotherapy. Thirdly, we did not evaluate spirometry efforts in the postoperative period. This could have helped evaluate the functional efficacy of superior pain relief provided by the technique.

The fascial plane blocks are a boon in cases of thrombocytopenia, anticoagulant therapy or antiplatelet therapy where neuraxial blocks are contraindicated, [24-26] Therefore these blocks will occupy a significant place for postoperative analgesia in the anesthetist's armamentarium for cardiac cases which might be complicated by antiplatelet and anticoagulant therapy.

Conclusion

Optimal post-operative pain management is an integral part of cardiac surgery and a pre-requisite for early post-operative recovery, ambulation, and early discharge from the Intensive Care Unit (ICU). Over the years the use of narcotics has been discouraged due to its detrimental effects in the postoperative course of patients. Regional blocks have a greater role to play in the postoperative pain management. The combination of PECs 1 and 2 along with SAP block in cardiac surgery can provide prolonged excellent analgesia and a more awake and alert patient in the postoperative period. More importantly, it can significantly reduce the requirements for fentanyl in the perioperative period. These blocks can be easily learned and should be promoted for all cardiac surgical cases. Finally, the restrictions placed by the use of antiplatelet or anticoagulants does not affect the use of the technique.

Acknowledgement: Nil

Funding sources: None

Conflict of interest: None declared

References

1. Mazzeffi M, Khelemsky Y. Poststernotomy pain: a clinical review. J Cardiothorac Vasc Anesth 2011; 25:1163-78.

2. Moon MH, Kang JK, Kim HW, Jo KH, Choi SH, Song H. Pain after median sternotomy: collateral damage or mitigatable byproduct? Thorac. Cardiovasc. Surg 2013; 61:194-201.

3. Zubrzycki M, Liebold A, Skrabal C, Reinelt H, Ziegler M, Perdas E et al. Assessment and pathophysiology of pain in cardiac surgery. J Pain Res 2018; 11:1599-1611.

4. Chakravarthy M, Thimmangowda P, Krishnamurthy J, Nadiminti S, Jawali V. Thoracic epidural anesthesia in cardiac surgical patients: a prospective audit of 2,113 cases. J Cardiothorac Vasc Anesth 2005; 19:44-8.

5. Landoni G, Isella F, Greco M, Zangrillo A, Royse CF. Benefits and risks of epidural analgesia in cardiac surgery. Br J Anaesth2015; 115:25-32.

6. Kulhari S, Bharti N, Bala I, Arora S, Singh G. Efficacy of pectoral nerve block versus thoracic paravertebral block for postoperative analgesia after radical mastectomy: a randomized controlled trial. Br J Anaesth 2016; 117:382-6.

7. ELdeen HM. Ultrasound guided pectoral nerve blockade versus thoracic spinal blockade for conservative breast surgery in cancer breast: a randomized controlled trial Egypt J Anaesth. 2016; 32:29-35.

8. Zhao J, Han F, Yang Y, Li H, Li Z. Pectoral nerve block in anesthesia for modified radical mastectomy: a meta-analysis based on randomized controlled trials Medicine. 2019 ;98: e15423.

9. Bashandy GM, Abbas DN. Pectoral nerves I and II blocks in multimodal analgesia for breast cancer surgery: a randomized clinical trial Reg Anesth Pain Med2015; 40: 68-74.

10. Fusco P, Scimia P, Marinangeli F, Pozone T, Petrucci E. The association between the ultrasound-guided Serratus Plane Block and PECS I Block can represent a valid alternative to conventional anesthesia in breast surgery in a seriously ill patient Minerva Anestesiol. 2016; 82:241-2.

11. Bouzinac A, Brenier G, Dao M, Delbos A. Bilateral association of pecs I block and serratus plane block for postoperative analgesia after double modified radical mastectomy Minerva Anestesiol 2015;81:589-90.

12. Ahmed A. Efficacy of pectoral nerve block using bupivacaine with or without magnesium sulfate Anesth Essays Res 2018; 12:440-445.

13. Hassn AM, Zanfaly HE, Biomy TA. Pre-emptive analgesia of ultrasound-guided pectoral nerve block II with dexmedetomidine - Bupivacaine for controlling chronic pain after modified radical mastectomy Res Opin Anesth Intensive Care. 2016;3:

14. Kaushal B, Chauhan S, Saini K, Bhoi D, Bisoi AK, Sangdup S, et al. Comparison of the efficacy of ultrasound-guided serratus anterior plane block, pectoral nerves ii block, and intercostal nerve block for the management of postoperative thoracotomy pain after pediatric cardiac surgery. J Cardiothorac Vasc Anesth. 2019; 33:418-25.

15. Kar, P. and G. Ramachandran, Pain relief following sternotomy in conventional cardiac surgery: A review of non-neuraxial regional nerve blocks Ann Card Anaesth, 2020; 23: 200-208.

16. Khalil AE, Abdallah NM, Bashandy GM, Kaddah TA. Ultrasound-guided serratus anterior plane block versus thoracic epidural analgesia for thoracotomy pain J Cardiothorac Vasc Anesth. 2017; 31:152-8.

17. Berthoud V, Ellouze O, Nguyen M, Konstantinou M, Aho S, Malapert G, et al. Serratus anterior plane block for minimal invasive heart surgery BMC Anesthesiol. 2018; 18:144.

18. Saad FS, El Baradie SY, Abdel Aliem MA, Ali MM, Mahmoud Kotb TA. Ultrasound-guided serratus anterior plane block versus thoracic paravertebral block for perioperative analgesia in thoracotomy Saudi J Anaesth. 2018; 12:565-70.

19. Blanco R, Parras T, McDonnell JG, Prats-Galino A. Serratus plane block: A novel ultrasound-guided thoracic wall nerve block. Anaesthesia. 2013; 68:1107-13.

20. Semyonov M, Fedorina E, Grinshpun J, Dubilet M, Refaely Y, et al. Ultrasound-guided serratus anterior plane block for analgesia after thoracic surgery J Pain Res. 2019;12:953-60.

21. Moll V, Maffeo C, Mitchell M,Ward C T, Groff R F, Lee S C et al. Association of Serratus Anterior Plane Block for Minimally Invasive Direct Coronary Artery Bypass Surgery with Higher Opioid Consumption: A Retrospective Observational Study J. Cardiothorac. Vasc. Anesth. 2018;32: 2570-2577.

22. Kumar KN, Kalyane RN, Singh NG, Nagaraja PS, Krishna M, Babu B, et al. Efficacy of bilateral pectoralis nerve block for ultrafast tracking and postoperative pain management in cardiac surgery. Ann Card Anaesth. 2018; 21:338-43.

23. Herman J, Urits I, Urman RD, Kaye AD, Viswanath O, Eskander JP. Synergistic effect of perineural dexamethasone and dexmedetomidine (Dex-Dex) in extending the analgesic duration of a transversus abdominis plane block J Clin Anesth. 2020; 63:109750.

24. Wilson JM, Lohser J, Klaibert B. Erector spinae plane block for postoperative rescue analgesia in thoracoscopic surgery J Cardiothorac Vasc Anesth. 2018;32: e5-7.

25. De Cassai A, Iepparielloo G, Ori C. Erector spinae plane block and dual antiplatelet therapy. Minerva Anestesiol. 2018;84:1230-1.

26. Adhikary SD, Prasad A, Soleimani B, Chin KJ. Continuous erector spinae plane block as an effective analgesic option in anticoagulated patients after left ventricular assist device implantation: a case series. J Cardiothorac Vasc Anesth. 2019; 33:1063-7.