Regional analgesia in Cardiac anesthesia: Welcoming a new era in perioperative pain management.

Soojie Yu[1] and Oscar Aljure[2]

[1]Mayo Clinic Arizona
[2]University of Miami School of Medicine

March 07, 2024

Regional analgesia in Cardiac anesthesia: Welcoming a new era in perioperative pain management.

Soojie Yu MD[1], Oscar D. Aljure MD[2]

[1] Mayo Clinic Arizona, Department of Anesthesiology

[2]University of Miami, Department of Anesthesiology, Division of Cardiovascular and Thoracic Anesthesiology

Poorly controlled post-operative pain can delay recovery and may increase the risk of morbidity in patients undergoing cardiac surgery. After surgery, the sternal incision is the most common source of pain[1]. Historically, the mainstay for pain management in this population has been usage of narcotic analgesics but with the recognition that overprescription of opioids may be contributing to the opioid pandemic, an adoption of a multimodal approach for pain management has been gaining more popularity among institutions in the US. Neuraxial analgesia and anesthesia has been used in the past but its impact in hemodynamics added to the risk associated with heparinization and coagulopathy has limited its use in cardiac surgery[2]. Newer regional anesthesia/analgesia methods utilizing ultrasound guidance are associated with lower risk of complications when compared to neuraxial approach. Regional blocks that cover post-sternotomy pain include transverse thoracic muscle plane (TTMP) block, parasternal block, pecto-intercostal fascial blocks (PIFB), and erector spinae plane blocks[2]. Out of all these newer techniques, the number of published prospective double blinded studies are limited[2]. A contributing factor to the difficulty finding literature for these type of blocks is the description of the technique by the authors. A good example is the TTMP block where the local anesthetic is deposited in the TTMP block is similar to the described approach for the parasternal nerve block[3, 4]. Nomenclature aside, Kar and Ramachandran showed there are few prospective randomized control studies published on newer non-neuraxial regional techniques for postoperative pain control after cardiac surgery[2].

In this issue of the Journal of Cardiac Surgery, Zhang et al present a prospective double-blinded study that looks at TTMP blocks placed pre-incision for post-sternotomy pain control after induction of anesthesia. In their study, for their TTMP block, the technique defined by the authors deposits local anesthetic between the costal cartilage and the transversus thoracis muscle as described similarly in other reports [5].

Zhang and collaborators described on their study a significantly lower consumption of intraoperative opioids in the intervention group, that goes in hand with prior studies that have shown similar results when the block is performed after induction of anesthesia[6, 7]. In a study by Padala et al, patients who received blocks pre-incision had decreased fentanyl administration intraoperatively compare to patients who received the block prior to sternotomy closure[7]. In Zhang's study, the block group had faster extubation times, decreased pain scores up to 24 hours after surgery and decreased post-operative opioid administration. The block group also had improved quality of sleep after extubation which can enhance recovery and decrease risk of delirium[8].

While regional blocks are very effective as shown by Zhang et al, a common issue is the short duration of the analgesic effects. Studies based on patient satisfaction have shown that the majority of patients continue to have mild to moderate sternotomy pain especially with movement and coughing up to post-operative day three or later[9]. Whether the block was placed post-induction or prior to sternal closure, Padala's study showed timing of placement of regional block did not seem to affect the total opioid requirement nor the pain scores for up to 24 hours postoperatively[7]. Another study by Lee and collaborators, evaluated if the administration of Liposomal Bupivacaine would prolong the analgesic effect of the regional block. This formulation of bupicaine can have analgesic effects up to 72 to 96 hours[10]. In the study, the parasternal intercostal block was placed just before sternotomy closure[10]. Overall pain scores up to 72 hours postoperatively were significantly lower when utilizing a linear mixed effects model at a 5% significance level in the Experal group compare to the placebo group[10]. Opioid administration though was not significantly different overall nor at individual time points up to 72 hours post-operatively[10].

In this article, Zheng discusses the placement of a continuous infusion catheter as compared to a single shot block as an option to prolong the analgesic effects of the TTMP block. On a similar study, Ueshima, et al placed bilateral catheters after performing a TTMP block in two patients undergoing a median sternotomy. These catheters were administering intermittent and on demand boluses of levobupivacine for two days postoperatively. Both patients did not require any additional analgesics[11]. A limitation for this technique is that the catheters were placed after induction of general anesthesia and this could not be feasible in all cardiac surgeries with median sternotomy. The internal mammary artery (IMA) and vein courses through the TTMP therefore administration of local anesthetic or placement of a catheter could be an issue in patients undergoing coronary artery bypass grafting with IMA harvesting[6].

TTMP blocks are relatively quick and easy to place but complications which include pneumothorax, local anesthetic allergy, infection [12] and injury to the internal mammary artery and vein can occur. One particular study showed tissue plane separation after the TTMP block that did not affect directly the ability to harvest the IMA nor did it have any obvious effect on the IMA[6]. In this study, Zheng had a very low incidence of complications adding to the safety profile of this block in cardiac surgery.

Another popular technique that has been recently described that also targets the anterior intercostal nerves is the pecto-intercostal fascial block (PIFB) also called parasternal intercostal nerve block (PINB)[3]. For PIFB, local anesthetic is deposited between the pectoralis major and intercostal muscles making the location more superficial to TTMP block[13]. The more superficial location potentially decreases the risk of pneumothorax while still providing post-sternotomy pain control. Similar to TTMP blocks, patients who received PIFB had decreased pain scores but the amount of opioid consumption was not significant decreased compared to placebo control[13]. There has not yet been a study published comparing TTMP to PIFB for post-sternotomy pain control and risk of complications.

In this issue of the Journal of Cardiac surgery, Zheng adds supporting evidence to the use of the newer non-neuraxial regional techniques as a feasible, practical option for the management of postoperative pain control in patients undergoing open cardiac surgery. This study adds to the growing evidence that TTMP blocks cover median sternotomy pain which is the main source of pain in post-cardiac surgery patients. The TTMP blocks are safe, easy to perform in the operating room after anesthesia and the incidence of complications is very low as reported in other studies. Limitations exist with TTMP blocks which include the relative short duration of analgesia. More studies will be needed to evaluate the continuous infusion of local anesthetic or other supplemental regional techniques to prolong the beneficial effects of this block.

1. Mueller, X.M., et al., *Pain location, distribution, and intensity after cardiac surgery.* Chest, 2000. 118(2): p. 391-6.

2. 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(2): p. 200-208.

3. Del Buono, R., F. Costa, and F.E. Agro, *Parasternal, Pecto-intercostal, Pecs, and Transverse Thoracic Muscle Plane Blocks: A Rose by Any Other Name Would Smell as Sweet.* Reg Anesth Pain Med, 2016.

41(6): p. 791-792.

4. Fujii, S., *Transversus thoracis muscle plane block and parasternal block.* Reg Anesth Pain Med, 2020. 45(4): p. 317.

5. Ueshima, H. and H. Otake, *Where is an appropriate injection point for an ultrasound-guided transversus thoracic muscle plane block?*J Clin Anesth, 2016. 33: p. 190-1.

6. Cardinale, J.P., et al., *Incorporation of the Transverse Thoracic Plane Block Into a Multimodal Early Extubation Protocol for Cardiac Surgical Patients.* Semin Cardiothorac Vasc Anesth, 2020: p. 1089253220957484.

7. Padala, S., et al., *Comparison of preincisional and postincisional parasternal intercostal block on postoperative pain in cardiac surgery.* J Card Surg, 2020. 35(7): p. 1525-1530.

8. Ranjbaran, S., et al., *Poor Sleep Quality in Patients after Coronary Artery Bypass Graft Surgery: An Intervention Study Using the PRECEDE-PROCEED Model.* J Tehran Heart Cent, 2015. 10(1): p. 1-8.

9. Lahtinen, P., H. Kokki, and M. Hynynen, *Pain after cardiac surgery: a prospective cohort study of 1-year incidence and intensity.*Anesthesiology, 2006. 105(4): p. 794-800.

10. Lee, C.Y., et al., *A Randomized Controlled Trial of Liposomal Bupivacaine Parasternal Intercostal Block for Sternotomy.* Ann Thorac Surg, 2019. 107(1): p. 128-134.

11. Ueshima, H. and H. Otake, *Continuous transversus thoracic muscle plane block is effective for the median sternotomy.* J Clin Anesth, 2017. 37: p. 174.

12. Ueshima, H. and H. Otake, *Ultrasound-guided transversus thoracic muscle plane block: Complication in 299 consecutive cases.* J Clin Anesth, 2017. 41: p. 60.

13. Khera, T., et al., *Ultrasound-Guided Pecto-Intercostal Fascial Block for Postoperative Pain Management in Cardiac Surgery: A Prospective, Randomized, Placebo-Controlled Trial.* J Cardiothorac Vasc Anesth, 2021. 35(3): p. 896-903.