



EVALUATING POST-STERNOTOMY PAIN RELIEF IN CARDIAC SURGERY: A COMPARATIVE STUDY OF USG-GUIDED TRANSVERSUS THORACIC MUSCLE PLANE BLOCK AND PECTO-INTERCOSTAL FASCIAL BLOCK.

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ABSTRACT

Background and Aims: Pain management after sternotomy in cardiac surgery is vital for recovery. Fascial plane blocks represent a transformative approach to alleviating pain, in recent years with the use of ultrasound, its recognition has risen. Transversus Thoracic Muscle Plane Block (TTMPB) and Pecto-Intercostal Fascial Block (PIFB) are such blocks. In view of similar effectiveness of both blocks, present study was conducted to compare two USG guided pain management technique- Transversus Thoracic Muscle Plane Block (TTMPB) and Pecto-Intercostal Fascial Block (PIFB) **Methods:** A randomised double blind study was designed with 59 patients in each group who underwent cardiac surgery. In group TTMPB 20ml of 0.2% ropivacaine was injected bilaterally using sonographic assistance in transversus thoracic plane while in group PIFB, 20ml of 0.2% ropivacaine was injected in Pecto-intercostal plane. Outcome was to observe opioid consumption in first 24hr and the pain scores at different intervals. **Result:** The two groups were similar with respect to patient characteristics. Opioid consumption was similar in both the groups (P Value = 0.672). There was no difference in Numeric Rating Score (NRS) score between two groups at different time intervals (P > 0.05). **Conclusion:** TTMPB and PIFB have similar effectiveness in acute post-sternotomy pain treatment. PIFB may be a more enticing preference for acute post-sternotomy pain management.

KEYWORDS : TTMPB, PIFB, Post-sternotomy pain**INTRODUCTION:**

Optimal pain management following sternotomy in cardiac surgery plays a crucial role in facilitating a swift return to regular activities [1]. Pain has the potential to lead to pulmonary issues, including inadequate secretion clearance, prolonged weaning, acute respiratory failure due to shallow breathing, and ineffective coughing [2,3]. Although opioid-based analgesia strategies are currently predominant post-cardiac surgery.

Central neuraxial techniques and nerve blocks are few other options for multimodality approach[4]. Facial plane blocks, characterized by a lower risk of bleeding compared to central neuraxial techniques or deep nerve blocks, are increasingly integrated into multimodal analgesia protocols as an alternative strategy for pain management in cardiac surgery[5]. Transversus Thoracic Muscle Plane Block (TTMPB) and Pecto-Intercostal Fascial Block (PIFB) are such blocks.

Ueshima et al. [6] were the first to publish a report on the TTMPB. It is suggested that the TTMPB may block several anterior branches of the intercostal nerves (T2-6), which innervate the internal mammary region, including the sternum. In TTMPB local anaesthetic drug is injected in the space between the internal intercostal and transversus thoracic muscles covering anterior intercostal nerve branches from T2 to T6, providing analgesia to the sternum region. Similar block was described for breast surgeries by De la Torre [5] called PIFB where was drug injected between the pectoralis major and external intercostal muscles since they also blocks the same nerve roots their efficacy should be comparable. Moreover pleura being away in PIFB as compared to TTMPB, PIFB can be less invasive [7,8]. Till date several studies have been done with TTMPB but there is paucity of literature comparing TTMPB with PIFB. In this context current study was designed based on the hypothesis that the perioperative analgesic effectiveness of TTMPB and PIFB in patient undergoing cardiac surgery via median sternotomy is comparable in terms of opioid consumption and pain score.

MATERIAL & METHODS:

A prospective randomised double blind trial was conducted in a tertiary care university teaching hospital from January to May 2024 after approval from institutional ethical committee.

Written informed consent was taken from patient. One hundred twenty four patients planned for cardiac surgery through midline sternotomy were enrolled for the study. The patients were randomized into two groups (59 each) – group TTMPB (Transversus Thoracic Muscle Plane Block) and group PIFB (Pecto-Intercostal Fascial Block) – using computer generated random numbers in a randomised manner. The group allocation numbers were concealed in sealed opaque envelopes that were opened after enrolment of the patients.

All selected patients underwent comprehensive pre-anaesthetic assessment before surgery. Standard investigations were conducted following hospital protocol, and patients were instructed to fast for 8 hours prior to the surgical procedure. In the pre-induction room, midazolam (1-3 mg IV) was used as a premedication. After connecting standard monitors, fentanyl (5-6 microgm/kg), propofol (2 mg/kg), and atracurium (0.5 mg/kg) were used to induce anaesthesia, after which patient was maintained with oxygen, air and 0.8%-1% isoflurane on controlled mechanical ventilation. The heart rate and blood pressure were maintained within 20% of baseline levels. After endotracheal intubation, arterial and central venous catheters were inserted.

After induction patients in the **TTMPB group** (n=59) received bilateral Transversus Thoracic Muscle Plane Block with 20 mL of 0.2% Ropivacaine administered on either side. The patient was positioned supine, and following proper sterilization, a linear probe was utilized before making the surgical incision. A 21-gauge 4 inch needle with a short bevel was inserted in the fourth intercostal space, extending to the sternum, once the anatomical plane between the internal intercostal and transversus thoracic muscles was identified. Achieving the TTMPB block involved injecting 20 ml of 0.2% ropivacaine, and the same procedure was repeated on the opposite side.

In **Group PIFB** (n=59) A 21-gauge 4 inch needle was placed in the caudal-to-cephalad direction, with in-line technique 20ml of 0.2% ropivacaine injected in the space between the pectoralis major and external intercostal muscles, after verifying needle placement.

Outcome Measures and Assessment

Primary outcome measure was opioid consumption in first 24

hours. Secondary outcome measures were pain score in numeric rating scale (NRS), when supine, and during deep inspiration, in 0, 3, 6, 12, 24 hours post extubation; need of first rescue analgesia, time of extubation from end of surgery, duration of ICU stay (hours), any other side effect.

RESULTS:

One hundred and twenty-four patients were initially enrolled for the study; however, six were subsequently excluded for not meeting the inclusion criteria. The two groups were comparable with respect to age, weight, height and American Society of Anaesthesiology Physical Status (ASA PS) status. Two groups were also similar in terms of type of surgery, duration of mechanical ventilation and intra-op fentanyl consumption (Table-1).

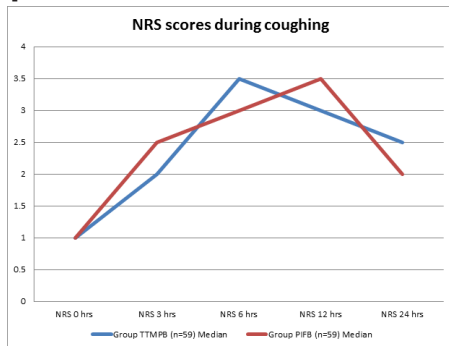


Figure-1 Data are presented as median NRS

Table-1 Demographic data

Variables	Group TTMPB (n=59)	Group PIFB (n=59)	P-value
Age (years)	52.76±9.41	55.87±8.33	0.2951
Weight (kg)	59.88±9.61	62.73±11.39	0.731
Height (cm)	168.45±6.04	170.73±7.12	0.652
ASA PS (II/III)	31/28	33/26	0.77
Intra-op fentanyl consumption	304±47.05	311.8±58.55	0.67
Duration of mechanical ventilation (Hours),	6.8±1.49	7.0±1.35	0.76

Table-2 Analgesic requirements, extubation and ICU stay

Variables	Group TTMPB (n=59)	Group PIFB (n=59)	P-value
Opioid (Tramadol) consumption	188.65±42.56	194.75±35	0.672
Need of first rescue analgesia	3.5 hours, (1.72–4.28),	3.75 hours, (1.68–4.86),	0.786
Median Time of extubation	5 (4-6)	6 (5-6)	0.608
Median ICU stay	45 (35-49)	39 (34-47)	0.598

Tramadol consumption (mg) in the two groups were similar (P Value= 0.672) (Table-2). Pain score in numeric rating scale at 0, 3, 6, 12 and 24 hours' time intervals during normal tidal volume and during coughing were similar in both the groups (P > 0.05). Need of first rescue analgesia were similar in both the groups (P=0.786). Median Time of extubation in the two groups was similar with p value being 0.608. Median ICU stay for the two group were similar (P=0.598) (Table-2). No major side effect was noted during study except episodes of vomiting, with no significant difference in two groups.

DISCUSSION:

Cardiac surgery is predominantly performed through open midline sternotomy, with the incision being a major source of morbidity [2, 3]. Effective pain management plays a crucial role in facilitating an earlier return to normal activities [1]

Thoracic epidural and paravertebral blocks have been shown to be effective in managing pain following cardiac surgeries

[11]. However, some anaesthesiologists are hesitant to use these blocks due to concerns about spinal hematoma development from heparinization and hemodilution [4].

This randomized controlled study compares the effects of bilateral ultrasound-guided TTMPB and PIFB on postoperative sternotomy pain in cardiac surgery. The results show comparable opioid consumption in the first 24 hours between the two groups. These findings align with a pilot study by Kaya et al.[12], although they compared morphine consumption, unlike our study, which compared tramadol. Another study by Mansour et al.[13] found that overall morphine usage in the first 24 hours was significantly lower in the PIFB group compared to the TTMPB group, possibly due to injection of the local anaesthetic drug into the plane at two locations (over the second and fourth ribs), unlike our study where we injected the drug at a single location, potentially resulting in better drug spread and analgesic coverage. Pain scores on the numeric rating scale (NRS) at various time points were similar in both groups; consistent with findings of Kaya et al.[12] Few studies comparing these blocks with a control group reported significantly reduced opioid usage in the block group.

The time taken for raising the first request of rescue analgesic was similar in both the groups unlike in a study done by Mansour et al [13] were it was significantly lengthier in the PIFB group than in case of TTMPB group this could again be due to injection of drug at two locations.

PIFB can be a potential alternative to TTMPB, the reasons being, while performing TTMPB only thin layer of transversus thoracic muscle separates pleura leading to increased risk to puncture it and hence at high risk of causing pneumothorax unlike PIFB where there is three muscle layer above pleura . Also internal mammary artery lies in the plane where TTMPB is performed hence while performing the block there is a high risk of vascular laceration [13].

CONCLUSION

Bilateral ultrasound guided Transversus Thoracic Muscle Plane Block (TTMPB) and Pecto-Intercostal Facial Block (PIFB) has similar effectiveness in acute post-sternotomy pain treatment in terms of opioid consumption, pain scores and first rescue analgesia requirement. PIFB may be a more attractive option for acute post-sternotomy pain management.

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