

Awake cardiac surgery using the novel Pectoralis-Intercostal-Rectus Sheath (PIRS) Plane Block and Subxiphoid approach

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Abstract

BACKGROUND Postoperative pain after cardiac surgery is a very important issue and affects recovery, risk of postoperative complications and quality of life. The pain management has been traditionally based on intravenous opioids with growing evidence suggesting the use of opioid-free and opioid-sparing techniques to reduce its adverse effects. **CASE PRESENTATION** We report the case of a 75-years-old frail patient underwent awake mediastinal revision with subxiphoid access due to deep sternal wound infection using a Pectoralis-Intercostal Rectus Sheath (PIRS) plane block. During the procedure the patient never reported pain receiving acetaminophen 1 g every 8 hours for postoperative pain management without others pain relievers. **CONCLUSION** Ultrasound guided PIRS block could be an effective and safe analgesic technique to manage sternal and subxiphoid drainage pain in patients undergoing cardiac surgery via subxiphoid approach.

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ABSTRACT

BACKGROUND

Postoperative pain after cardiac surgery is a very important issue and affects recovery, risk of postoperative complications and quality of life. The pain management has been traditionally based on intravenous opioids with growing evidence suggesting the use of opioid-free and opioid-sparing techniques to reduce its adverse effects.

CASE PRESENTATION

We report the case of a 75-years-old frail patient underwent awake mediastinal revision with subxiphoid access due to deep sternal wound infection using a Pectoralis-Intercostal Rectus Sheath (PIRS) plane block. During the procedure the patient never reported pain receiving acetaminophen 1 g every 8 hours for postoperative pain management without others pain relievers.

CONCLUSION

Ultrasound guided PIRS block could be an effective and safe analgesic technique to manage sternal and subxiphoid drainage pain in patients undergoing cardiac surgery via subxiphoid approach.

Keywords: Pectoralis-Intercostal Rectus Sheath block; PIRS; Rectus Sheath block; Parasternal block; Pectointercostal fascial plane block; Deep sternal wound infection; Awake cardiac surgery

Introduction

Post-operative pain following cardiac surgery is a very important issue for patients and affects recovery, risk of post-operative complications and quality of life. Pain is known to arise not only from the surgical approach itself, but also from chest drainage tubes placed through the rectus abdominis muscle ⁽¹⁾. Drugs commonly used to treat moderate to severe pain are opioids that have multiple side effects, such as nausea and vomiting, ileus, respiratory depression, and sedation. A multimodal opioid-sparing analgesia strategy ⁽²⁾ and the use of locoregional anesthesia techniques ⁽³⁾ have been therefore suggested.

We report the case of an ultrasound-guided Pectoralis-Intercostal-Rectus Sheath (PIRS) block used for a mediastinal revision.

In accordance with local guidelines, institutional review board approval was waived, and the patient consented the use of his clinical data.

Case

A 75-year-old male with a known history of hypertension, chronic kidney disease IIIb and hyperuricemia underwent aortic valve replacement with a 25-mm bioprosthesis and mitral valve repair with a 30-mm ring via median sternotomy. On the fourth postoperative day, a surgical mediastinal revision due to deep sternal wound infection was needed.

Given the patient's frailty and the recent cardiac surgery, an awake cardiac operation with subxiphoid access using a Pectoralis-Intercostal Rectus Sheath (PIRS) plane block (Figure 1 A, B) was planned.

In the operating room intraoperative monitoring was provided by ECG, peripheral oxygen saturation, non-invasive blood pressure and end-tidal CO₂. The patient was warmed with an active warm touch and received midazolam 2 mg intravenous as preoperative anxiolytic prior to the administration of the ultrasound-guided PIRS.

Once analgesia of the xiphoid region was achieved, surgery was initiated using a subxiphoid access approximately 8 cm long and 6 cm deep (Figure 2).

During the procedure, vital parameters remained stable, and the patient never reported pain. At the end of the procedure, the patient was transferred to the intensive care unit (ICU) with a scheduled infusion of paracetamol (1 g every 8 hours) for 48 hours. No implementation of the analgesic plan was required during the ICU stay and no major effects directly attributable to analgesic technique were observed. On the second postoperative day, the patient was discharged from ICU without any rescue analgesia administration.

PIRS- technique

With the patient in supine position, a linear ultrasound probe was positioned 2-3 cm from midline slightly cephalad to the umbilicus to perform the Rectus Sheath block (RSB). A 22-gauge 50 mm SonoPlex Stim needle (Pajunk Medical System) was then inserted in plane and in lateral-medial direction, targeting the space between the rectus abdominis muscle and the posterior sheath. After the position of the needle tip was confirmed, 20 ml of Ropivacaine 0,375% was administered and the same procedure was performed on the other side (Fig 1 A).

Then the linear probe was placed on the chest in a parasagittal plane over the sixth rib at the midclavicular line lateral to xiphoid process, in order to perform bilateral Pectointercostal fascial plane block (PIFB) and provide analgesia of the anterior cutaneous branches of T4-T6 intercostal nerves. A 22-gauge, 50 mm SonoPlex Stim needle (Pajunk Medical System, Tucker GA) was advanced via an in-plane approach from the cranial to caudal direction until it reached the interfascial plane between Pectoralis Major muscle and External Intercostal muscle. After the position of the needle tip was confirmed, 10 ml of Ropivacaine 0,75% was administered; the same procedure was performed on the other side. (Fig. 1 B)

Discussion

Postoperative pain can interfere adversely on respiratory function inducing an alteration of patient's respiratory dynamics and, consequently, increasing the risk of respiratory complications especially in severe chronic

obstructive pulmonary disease patients (COPD) and late extubation ⁽²⁾.

Although there is evidence to support a multimodal and safe approach based on regional nerve blocks ^(3,4), confirmations of the efficacy of PIRS block are still lacking. Cibelli et al⁽⁵⁾ first described the effectiveness of PIRS block in intubated patient undergoing coronary artery bypass grafting, providing analgesia for sternotomy and surgical sites of chest drains, by effectively covering the T1-T10 dermatomes. The same authors, in a short letter to the editor, described the use of continuous PIRS plane block through catheters running from the epigastrium to the sternal notch bilaterally ⁽⁶⁾ in an intubated patient during surgery.

Jones et al ⁽⁷⁾ reported the combined use of continuous PIFB and RSB for a nail gun injury requiring a pericardial window followed by a full sternotomy. In this case continuous PIFB was performed prior to surgery and, after extubation in the operating room, RSB was continued in the trauma intensive care unit to better manage the uncontrolled pain coming from the inferior border of the surgical incision. Block catheters were removed on the fourth postoperative day at hospital discharge.

An interesting variation of the technique was described by Yamamoto et al ⁽⁸⁾, proposing a preoperative combination of Transversus Thoracic Plane block (TTPB) and RSB for postoperative pain relief after cardiac surgery with sternotomy in paediatric patients.

To our knowledge, PIRS block has never been used for procedures in awake cardiac surgery. However, we believe that, following the path of thoracic surgery that is increasingly evolving towards a minimally invasive approach often involving non-intubated and awake procedures⁽⁹⁾, cardiac surgery should also take the same direction. This is especially true in surgical procedures not requiring full median sternotomies and in frail patients where orotracheal intubation poses a risk to patients.

Both PIFB and TTPB have been shown to be effective in providing analgesia of the area along the sternum blocking the anterior branches of the intercostal nerves at T2-T6 dermatomes⁽¹⁰⁾. PIFB requires 3 needle punctures on each side and being more superficial, it appears to be associated with fewer risks compared with TTPB, since Transversus Thoracic Muscle it's located closer to the pleura resulting in a greater risk of pneumothorax⁽¹¹⁾. TTPB requires a single bilateral injection on the 4th/5th intercostal space spreading to the perivascular sympathetic plexus around the internal thorax artery.

It follows that PIFB, in which the target is localized into the fascial plane between the Pectoralis Major and Intercostal muscles, seems safer than TTPB and this would be even more true in the present case. In fact, considering the surgical subxiphoid approach, a single caudo-cranial injection at T6 level provided analgesia blocking T4-T6 dermatomes, maintaining the effectiveness of the technique by reducing the number of injections needed.

RSB has also been proposed for pain management deriving from subxiphoid drainage tube in cardiac surgery: their positioning often led to continuous irritation between adjacent tissue and the tube, with consequently direct injury to the rectus abdominis muscles⁽²⁾. Due to its potential to provide analgesia to dermatomes from T6 to T11, RSB has also been described in cardiac surgery for treatment of pain resulting from the Left Ventricular Assist Device (LVAD) implantation ⁽¹²⁾.

In our experience, PIRS has proven to be a safe and valid alternative analgesic strategy to general anaesthesia, avoiding the need of intubation, mechanical ventilation and high-dose opioids and their complications, such as respiratory depression, prolonged weaning and the risk of ventilator-associated infections.

Conclusion

Ultrasound guided PIRS block could be an effective and safe analgesic technique to manage sternal and subxiphoid drainage pain in patients undergoing cardiac surgery via subxiphoid approach. Further studies are needed to confirm the present preliminary observation.

Figure Legends:

FIG 1 Sonoanatomy of Pectoralis-Intercostal-Rectus Sheath (PIRS) block. **A**, Pectointercostal Fascial Block

(PIFB), injection of local anaesthetic between Pectoralis Major muscle and External Intercostal muscle. **B**, Rectus sheath block (RSB), injection of local anaesthetic in the space between rectus abdominis muscle and the posterior sheath.

Fig 2 Subxiphoid surgical access and chest tube drainage

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Conceptualization, AT, EB, PC; Methodology, EB, CP, AV, ES; Software, EB, AV, CP; Validation, AT, EB, ES, MR and LB; Formal Analysis, AT and PC; Data Curation, AV, CP and ES; Writing – Original Draft Preparation, AT, EB, AV, ES, CP, PC; Writing – Review & Editing, AT, ES, MR and LB; Supervision, MR and LB; Project Administration, LB.

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