

Analgesia by ultrasound guided subpectoral interfascial plane block for median sternotomy in a pediatric patient

S. Debbag, B. Celebioglu

¹Department of Anesthesiology and reanimation, Faculty of Medicine, Hacettepe University, Ankara, Turkey

Corresponding author: S. Debbag, Department of Anesthesiology and reanimation, Faculty of Medicine, Hacettepe University, Ankara, Turkey E-mail: sehenddebbag@gmail.com

Keypoints

1. Postoperative sternotomy pain is a significant problem that can impair pulmonary function, lead to delayed recovery, and leave the patient vulnerable to pulmonary infections. These problems are even more pronounced in patients with muscle disease. Good postoperative pain control reduces mortality and morbidity and hastens discharge from the hospital.
2. In recent years, a multimodal analgesia approach is recommended to manage postoperative pain and maximize the effect of analgesics.
3. The use of local anesthesia in the perioperative period reduces postoperative pain and reduces the side effects of opioids by reducing the use of opioids.
4. Ultrasound-guided subpectoral interfascial blockade may provide profound analgesia, more cardiovascular stability, and lower levels of anxiety in pediatric patients after median sternotomy.

Abstract

Systemic opioids are generally used to provide analgesia for pediatric patients after median sternotomy. In order to reduce side effects from opioids and to provide better analgesia through a peripheral nerve block (the cornerstone of multimodal analgesia), we report the first use of an ultrasound-guided subpectoral interfascial plane block in a 12-year-old pediatric patient after median sternotomy for thymectomy.

Keywords

Postoperative pain, Median sternotomy, Analgesia, Regional anesthesia, Nerve block, Intercostal nerve

Introduction

Postoperative sternotomy pain is an important concern because it may adversely affect pulmonary functions by affecting breathing, which may lead to delayed recovery and

predispose the patient to pulmonary infections. These problems are more pronounced in patients with muscle weakness, such as those with myasthenia gravis (MG).¹ Raza et al.² showed that sternum analgesia can be provided by blocking the anterior branches of the intercostal nerves using a bilateral subpectoral interfascial plane block (SIP). We report successful pain control using a bilateral SIP block in an adolescent patient with MG after median sternotomy due to thymectomy.

Case report

A 12-year-old female patient (height, 140 cm; weight, 46 kg; American Society of Anesthesiologists [ASA] score, 2) diagnosed with MG underwent thymectomy under general anesthesia. The patient's family gave informed

consent for the publication of this case report. She was treated with pyridostigmine and prednisolone before the surgery. During the pre-operation evaluation, the patient and her family expressed concerns about pain resulting from the surgery, and we suggested the application of a block to reduce the pain. The patient was premedicated with 2 mg intravenous midazolam before entering the operating room. In addition to standard monitoring, neuromuscular monitoring was performed. General anesthesia was induced with 3 mg/kg propofol, 1 µg/kg fentanyl, and 0.4 mg/kg rocuronium. Anesthesia was maintained with 2% sevoflurane and 0.4 mcg/kg/min remifentanyl. In the peri-operative period, both surgery and anesthesia were unremarkable. The operating time was 150 minutes, and 800 mg of paracetamol was administered intravenously 20 minutes before the end of surgery. After closing the skin, a high frequency (4–12 MHz) linear probe (GE Healthcare; Chicago, IL, USA) was placed bilaterally at 2 cm lateral to the sternum edge in the parasagittal plane to identify the ribs, pectoralis major muscle (PMM), pleura, and external intercostal muscle (EIM). To perform the block, a 100-mm 22-gauge regional block needle (UniPlex, PAJUNK; Geisingen, Germany) was inserted at the sixth rib using the in-plane technique in the cephalic direction until the needle tip was placed between the PMM and EIM (Figure 1). A mixture of the local anesthetic (2 mg/kg 0.5% bupivacaine and 3 mg/kg 2% prilocaine) diluted with normal saline was injected between these two muscles (Figure 1). To ensure effective analgesia, another insertion of the needle was performed at the fourth rib and the same process was repeated. The same procedure was performed on the other side of the sternum. The patient received 30 mL in total of local anesthetic (7.5 mL at each insertion). After performing the block, 2 mg/kg of sugammadex was administered, and soft extubation was achieved. The patient was transferred to the intensive care unit (ICU), and in the ICU, the visual analog score (VAS) was 0. The first analgesic requirements was observed when the VAS score achieved 4 at the 10th hours after the surgery. In

the postoperative period, intravenous paracetamol was adequate to keep the patient's VAS score below 3 and there was no need to perform any opioid analgesic agents. During the postoperative period, vital signs were stable and there was no postoperative nausea or vomiting. The patient was discharged to the ward 22 hours after surgery.

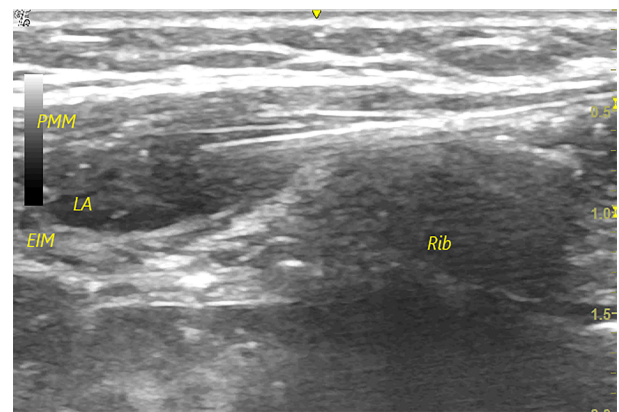


Figure 1. The SIP block: The distribution of local anesthesia between pectoralis major and external intercostal muscles. PMM- Pectoralis major muscle, EIM-external intercostal muscle, LA-local anesthesia, Rib-the fourth rib.

Discussion

To our knowledge, this is the first case report for the peri-operative use of an ultrasound-guided SIP block for post-operative analgesia in a pediatric patient after median sternotomy.

Pain after sternotomy occurs due to surgery-related injuries to the bone, skin, and other tissues. The innervation of the sternum and the structures around the sternum is provided by the intercostal nerves that arise from the thoracic nerves from T2–T6.³

The high pain intensity, especially on the first day of the operation can increase the risk of developing persistent post-surgical pain.⁴ The prevalence of the development of persistent pain due to sternotomy was demonstrated in a study with 121 children undergoing cardiac surgery via sternotomy. This study reported that 21% of children had pain in the scar area and 45% of them expressed their pain intensity as more than 4 on a Numeric Pain Rating Scale (0–10).⁵

Well-managed postoperative pain in children leads to decreased mortality and morbidity and accelerates hospital discharge. In contrast, untreated pain in patients who underwent thoracic surgeries may decrease their breathing ability and removal secretions and may lead to pulmonary complications. These problems are more pronounced in patients with muscle weakness, such as those with MG.^{1,6}

Suffering due to postoperative pain in children cannot be neglected. The prevalence of moderate–severe pain in pediatric patients after surgery is still high.⁴ Fears of opioid side effects and the complexity of pain assessment in children lead to insufficient pain control in this population.⁷

In recent years, to reduce drug-related side effects and maximize analgesic effect a combination of variate non opioid analgesic agent with regional anesthesia was accepted as the multimodal analgesic option to handle postoperative pain.⁴

The use of local anesthesia as a regional or peripheral block is considered the cornerstone of the multimodal analgesic approach. In addition to reducing pain in the postoperative period and decreasing the use of opioids, the side effects caused by opioids such as nausea, vomiting, and respiratory depression are also diminished.⁴ Raza et al.² described the SIP block as an anesthetic to the anterior branches of the intercostal nerves by inserting a catheter between the PMM and EIM, providing immediate analgesia in a patient with sternal fracture pain.

Most neuroaxial blocks, including epidural and spinal blocks, have been performed for postoperative sternotomy pain after cardiac surgery in children. The fear of neurological complications such as heparin-induced hematoma, spinal cord trauma, deep infections, and other complications such as post-dural puncture headache, total spinal anesthesia, and hypotension may reduce the use of this practice.^{8,9}

A Prospective study shows that blocking the anterior branches of intercostal nerves in the parasternal region

under direct supervision by the cardiac surgeon in pediatric patients undergoing cardiac surgery via median sternotomy have positive effects on postoperative pain scores, extubation time and postoperative opioid consumption.¹⁰

The increasing use of ultrasound in anesthesia makes peripheral nerve blocks safer, simpler, and with lower risks of complications. However, peripheral nerve blocks have less serious complications compared to neuraxial procedures and should be recommended when possible. The paravertebral block also has a risk of complications, including hypotension, dural puncture and pneumothorax due to pleural puncture.^{8,9} Although there are no adequate data on the use of an erector spinae plane (ESP) block for sternotomy analgesia in children, it seems to be the more encouraged technique compared with a thoracic epidural block in terms of pain and ease of application.⁸ In pediatric patients, all regional anesthesia procedures should be performed under general anesthesia or deep sedation.

When providing analgesia for sternotomy using epidural, spinal, paravertebral, or ESP blocks, the patient should be placed in a lateral or prone position in order to perform the procedure, which may cause a delay in surgery and may impair airway safety. Ueshima et al.¹¹ had success in using an ultrasound-guided continuous transversus thoracic muscle plane block (TTP) for peri-operative sternotomy analgesia in an adult patient who underwent thymectomy.

The TTP block aimed to anesthetize the anterior branches of intercostal nerves from T2–T6 by injecting a local anesthetic agent between the transversus thoracic and internal intercostal muscles at the third and fourth ribs.

In contrast to epidural, paravertebral, and ESP blocks, the TTP block is easy to perform and could be performed in the supine position. While the TTP block provides analgesia for sternotomy pain, it may be limited due to its proximity to the intercostal artery and vein, internal thoracic artery and vein, and pleura.¹² Unlike the TTP block, the SIP block is less likely to enter the pleural and

vascular structures unintentionally and seems to be less risky, since the SIP block is applied more superficially. However, blocks like the ultrasound-guided parasternal block, pecto-intercostal block, and thoracic interfascial block are all technically similar to the SIP block because all of these blocks are intended to give the local anesthetic medication beneath the PMM as they aim to block the anterior branches of the intercostal nerves in the parasternal region.^{13, 14}

Because of concerns that the SIP block may not cover the levels from T2–T6 as mentioned in a letter to the editor,¹⁵ we performed a double injection in each side of the sternum to ensure the spread of the local anesthetic agent to all levels of the intercostal nerves causing sternotomy pain.

We conclude that when used peri-operatively, the SIP block may provide profound analgesia, good postoperative outcomes, more cardiovascular stability, and lower levels of anxiety with minimal risk of complications compared to other regional anesthetic techniques in pediatric patients after median sternotomy.

Disclosure

All authors have no potential conflicts of interest.

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