A Serratus Posterior Superior Intercostal Plane Block for Postoperative Analgesia in Minimally Invasive Pectus Excavatum Repair Surgery with a Video-Assisted Thoracic Surgery Technique: Case Report

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Video-assisted thoracic surgery (VATS) is currently used for the repair of pectus excavatum. Analgesia after thoracic surgery can be provided with nerve blocks, intravenous drugs, or neuraxial techniques. Serratus posterior superior intercostal plane block (SPSIPB) is a novel interfascial plane block and it is performed between the serratus posterior superior muscle and the intercostal muscles at the level of the second and third ribs. In this case, we present our successful analgesic experience with SPSIPB in a patient who underwent minimally invasive pectus excavatum repair with a VATS technique. (A&A Practice. 2024;18:e01773.)

The most common deformity of the chest wall is pectus excavatum. It occurs in 0.25% of all births, mostly in males.[1]

Minimally invasive pectus excavatum repair (MIRPE), also known as Nuss surgery, was defined by Nuss et al[2] in 1998. It does not include sternum or cartilage resections, and is performed by placing a substernal bar with a minimal entry from the lateral side of the chest wall using a video-assisted thoracoscopic surgery (VATS) method. It has become the preferred method for this surgery.[3]

Effective control of severe postoperative pain due to stretching of the intercostal nerves and chest wall is necessary to ensure early mobilization, adequate respiratory function, and overall patient satisfaction.[4]

The most commonly used drugs for postoperative analgesia management are opioids, but these drugs have undesirable side effects such as nausea, vomiting, urinary retention, and ventilatory depression.[5] For this reason, clinicians are using regional anesthesia techniques for postoperative analgesia management. Various regional anesthesia techniques such as thoracic epidural blocks, erector spinae plane blocks (ESPB), thoracic paravertebral blocks, serratus anterior plane blocks (SAPB), thoracic intercostal nerve blocks, and pectoral I/II (PECS I/II) blocks can be used for pain management after MIRPE.[6,7]

SPSIPB is a newly defined type of block that has been shown to provide analgesia in the anteroposterior hemithorax from C3 to T10 levels by administering local anesthetic in the fascial plane between the serratus posterior superior muscle and the intercostal muscles at the level of the second and third ribs under ultrasound guidance.[8,9] Written and verbal consent was obtained from the family for the publication of this case report.

CASE DESCRIPTION

MIRPE was planned for the patient by the surgical team after the female patient with an American Society of Anesthesiologists physical status I, 155 cm height and 40 kg weight, with no known drug use or allergies, presented to the thoracic surgery outpatient clinic with a pectus excavatum. She complained of pain, exertion-induced shortness of breath, and cosmetic concerns. After induction of anesthesia with 100 mg kg^{-1} iv propofol, 80 µg kg^{-1} iv fentanyl, and 20 mg kg^{-1} iv rocuronium, she was intubated orotracheally. The surgery lasted 2 hours 35 minutes. Thirty minutes before the end of surgery, 400 mg intravenously ibuprofen and tramadol 100 mg were administered as part of our multimodal analgesia protocol. No complications were observed during the surgery. After the surgical procedure was completed (Figure 1), the patient was placed in a lateral decubitus position to perform an SPSIPB before extubation. After antisepsis, an ultrasound linear probe was placed on the spine of the scapula in the sagittal plane and then rotated medially (Figure 2). After visualizing the third rib just medial to the scapula, the trapezius, rhomboid, and serratus posterior superior muscles were visualized from superior to inferior. A 22-G, 80-mm block needle was advanced in a craniocaudal direction with an in-plane technique until it contacted the rib. After the contact, 5 mL isotonic sodium chloride serum was injected to confirm the plane between the serratus posterior superior muscle and the intercostal muscles, and 20 mL of 0.25% bupivacaine was injected. The spread of local anesthetic in a craniocaudal direction was visualized by ultrasound. The procedure was repeated in the same way for the other side in the same lateral position. A total of 40 mL of local anesthetic was injected. Anesthesia was discontinued. After spontaneous breathing was observed, the patient was extubated and transferred to the postoperative anesthesia care unit (PACU). The patient was provided intravenous patient-controlled analgesia (PCA) with fentanyl (infusion: none, bolus: 10 µg, lock time: 20 minutes). Scheduled ibuprofen

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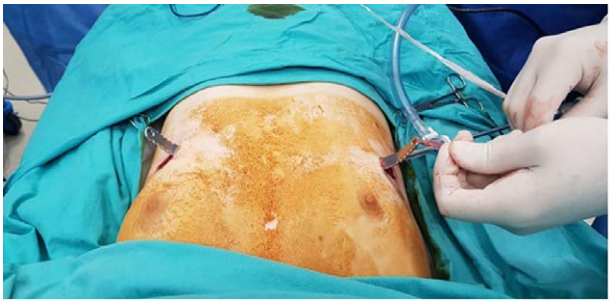

Figure 1. Image of the surgical area.

400 mg intravenously was administered every 8 hours, and 0.5 mg/kg intravenous meperidine for rescue analgesia (for a numerical rating scale [NRS] >4) was ordered. The patient was monitored static and dynamic (while coughing) NRS scores, opioid use, need for rescue analgesics, side effects, and possible complications.

The patient's highest NRS score was 2 (Table 1). In the first postoperative hour, a pinprick test confirmed that analgesia was provided in the anteroposterior dermatome between C5 and T9 bilaterally (Table 2). We did not evaluate the distribution of coverage in the arm. During the 24-hour follow-up, the patient used a total of 40 µg of fentanyl, 20 µg at the second hour, and 20 µg at the 16th hour. The patient required no other analgesics. No nausea, vomiting, itching, hematoma, or systemic toxicity occurred.

Figure 2. Ultrasound-guided SPSIPB in the lateral position. SPSIPB indicates serratus posterior superior intercostal plane block.

Table 1. 24-Hour NRS Monitoring

Hour	Static NRS	Dynamic NRS
1st hour	2	2
2nd hour	1	2
4th hour	1	1
8th hour	0	1
16th hour	1	1
24st hour	0	0

Abbreviations: NRS, numerical rating scale.

DISCUSSION

We performed an SPSIPB on a patient who underwent a MIRPE with VATS. In our experience, SPSIPB provided effective analgesia management after the MIRPE.

Severe postoperative pain caused by changes in thoracic morphology after a MIRPE can prevent effective breathing, coughing, and clearance of secretions, causing pneumonia and atelectasis. Chronic pain impairs the quality of life in pediatric patients. Postoperative pain management is important in preventing complications and ensuring patient satisfaction. As ultrasound-guided regional anesthesia practices have gained popularity, the use of many regional anesthesia methods such as ESPB, TPVB, SAPB, and Pecs I/II has become widespread in thoracic surgeries such as MIRPE.[6,7]

ESPB can be performed from the cervical to the sacral regions due to the anatomy of the erector spinae muscles.[10] In reviewing bilateral ESPB applications in the literature, Tulgar et al[10] showed that, unlike other regional anesthesia techniques, cadaveric and imaging results did not correlate with clinical findings. The authors reported in studies that the spread to the epidural and paravertebral areas during ESPB was not the same in patients. ESPB has inconsistencies in cadaveric and clinical studies.[11,12]

Rhomboid intercostal block provides hemithoracic analgesia for the T2 to T9 dermatomes, but fails to cover the cranial aspect of the T2 dermatome.[9] In addition, the application of this technique, which is used in many thoracic surgeries, has not been described for MIRPE surgery.

Pecs II blocks target the lateral cutaneous branches of the third to sixth thoracic intercostal nerves, the lateral and medial pectoral nerves, and the long thoracic nerve. However, it has no analgesic effect in the parasternal area, which is innervated by the anterior cutaneous branches of the thoracic intercostal nerves. SPSIPB provides analgesia to the entire anteroposterior hemithorax.[8,9]

TPVB is the application of local anesthetic into the thoracic paravertebral space to block the thoracic spinal nerves

Table 2. Dermatome Analysis at the First Postoperative Hour

Posterolateral	+
Anterolateral	+
Anteromedial	+
Axilla	+
Dermatomal involvement	C5–T9

Abbreviation: C, cervical.

and their branches, as well as the sympathetic trunk. It can spread in cranial and caudal directions and also laterally into the intercostal and epidural spaces.[13] However, it can cause hemodynamic instability, pleural injury, and Horner syndrome.[13]

SAPB provides analgesia in the anterolateral part of the chest by targeting the lateral cutaneous branches of the T2 to T6 thoracic intercostal nerves. An SPSIPB may provide anterolateral and posterior chest wall analgesia due to its spread pattern to dorsal ramus of spinal nerves and lateral branches of intercostal nerves. According to our dermatomal evaluation of our patient, there was a dermatomal coverage in the posterolateral, anterolateral, and anteromedial parts of the chest wall and axilla. Therefore, an SPSIPB may be a better alternative to SAPB in thoracic surgery because it has a lower risk of pneumothorax and provides analgesia in the posterior part of the thorax.[8,9,14,15]

In the current literature, the reports about the analgesic efficacy of an SPSIPB for cardiothoracic surgery are limited. Ciftci et al[14] performed an SPSIPB on 10 patients who underwent video-assisted thoracoscopic surgery. They reported that an SPSIPB provided effective postoperative management, and there was an anterolateral-posterior hemi-thoracic sensory block in the patients. In another case report, Bilal et al[15] performed an SPSIPB on 3 patients who underwent minimal invasive cardiac surgery. They reported that an SPSIPB provided effective analgesia management after surgery. The first randomized-controlled study about the efficacy of an SPSIPB for VATS was performed by Avci et al. They compared an SPSIPB with control group, and reported that an SPSIPB provided effective analgesia management after VATS. Since SPSIPB provides a dermatomal blockade in the anterolateral-posterior chest wall, this specific block may be the best thing to try and may be a better alternative technique for SAPB as an analgesic technique for this surgery.

The serratus posterior superior muscle is the only muscle that originates from the C7 to T3 spinous processes and proceeds obliquely from the depth of the scapula and attaches to the lateral 2 to 5 ribs. This unique feature enables local anesthetics injected in the fascial plane between this muscle and the intercostal muscles to spread to the dorsal ramus and lateral cutaneous nerve branches of the intercostal nerves at the C3 to T7 levels.[9] The SPSIPB was first described by Tulgar et al[9] in patients with myofascial pain and in cadavers. In their study, they showed that methylene blue spread between C7 and T7 in cadavers. In the patients, they provided analgesia in the anterolateral hemithorax in the dermatomal area between C3 and T10, and observed that NRS scores did not exceed 4 in the 5 weeks of follow-up. While a wing scapula may rarely be seen due to blocking the spinal accessory and dorsal scapular nerves, these blocks can be used in spinal accessory nerve trapping and contribute to perioperative analgesia in shoulder and scapula surgery.[10] In our case, analgesia was provided to the anterolateral hemithorax between C5 and T9, and the highest NRS was 2 in 24 hours.

CONCLUSIONS

An SPSIPB in patients undergoing MIRPE surgery using VATS may be an effective method for analgesia, reducing opioid consumption, and optimizing postoperative recovery time. However, more research is needed to understand the exact mechanism, identify potential complications, and solidify its applicability in routine clinical practice.

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