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EDITED BY
Hong Liu,
UC Davis Health, United States

REVIEWED BY
Abhijit Nair,
Ministry of Health, Oman
Yuwei Qiu,
Shanghai Jiao Tong University, China

*CORRESPONDENCE
LiJing Deng
✉ deng_lijing@163.com

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Case report: Ultrasound-guided bilateral serratus anterior plane block in intensive care unit—An alternative to opioid-sparing postoperative analgesia after sternotomy in infants

MingZhe Xu¹, Zhi Li², Yi He¹ and LiJing Deng^{3*}

¹Department of Anesthesiology, West China Hospital, Sichuan University and The Research Units of West China (2018RU012), Chinese Academy of Medical Sciences, Chengdu, Sichuan, China, ²Department of Critical Care Medicine, West China Hospital, Sichuan University, Chengdu, Sichuan, China, ³Department of Critical Care Medicine, West China Hospital/West China School of Medicine, Sichuan University, Chengdu, Sichuan, China

Introduction: The high-opioid technique was applied in the setting of congenital cardiac surgery on the belief of severe pain management and analgesic limitation in children along with delayed extubation time and other side effects. Thoracic nerve blockade demonstrated superior postoperative analgesia and stable hemodynamics and lower perioperative opioid consumption and related complications in cardiac surgery. SAPB is a fascial plane block technique that is considered an alternative to paravertebral block for perioperative thoracic pain relief, targeting intercostal nerve.

Cases presentation: We present 3 cases to describe the efficacy of SAPB as an alternative to opioid-sparing analgesia performed in infant patients after sternotomy in pediatric cardiac intensive care units. It was successfully used as a part of perioperative pain management. All patients were extubated early and recovered soon with no other complications.

Conclusion: SAPB lowers perioperative opioid consumption and related complications in cardiac surgery with satisfactory postoperative analgesia and stable hemodynamics.

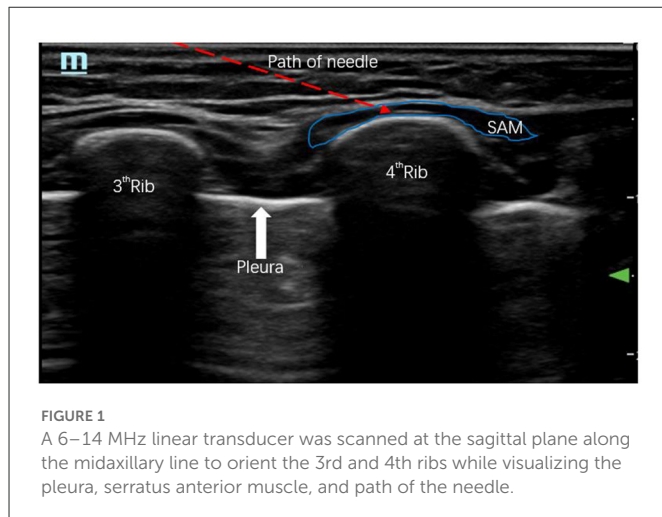
KEYWORDS

serratus anterior plane block, intensive care unit, sternotomy, infant, case report

Introduction

Cardiac surgery with cardiopulmonary bypass in the pediatric population is associated with significant costs and morbidity, along with postoperative pain, pulmonary complications, and prolonged hospitalization. Although less invasive cardiac surgical techniques have emerged, median sternotomy is still the most commonly used approach for congenital cardiac surgery. High-dose opioids remain the mainstay for postoperative pain management after pediatric cardiac surgery despite opioid-related side effects [1, 2]. The demonstration that regional anesthesia can lower perioperative opioid consumption and related complications when used with general anesthesia has propelled renewed interest in regional anesthesia techniques [3, 4].

Ultrasound-guided serratus anterior plane block is a fascial plane block technique that deposits local anesthetics between the serratus anterior muscle and latissimus dorsi muscle, targeting the lateral cutaneous branches of the intercostal nerves. This has been reported as



an alternative to paravertebral block for perioperative thoracic pain relief [5, 6]. In thoracic surgery, the validity and safety of this fascial plane block technique has been well established [7, 8]. Nevertheless, there is a lack of evidence proving the feasibility of SAPB applied in poststernotomy patients, especially in infants.

Case report

Patient 1 was a 10-month-old boy weighing 7 kg who was scheduled to undergo repair of partial endocardial cushion defects. Case 2 (infant boy) and case 3 (infant girl) were both 7 months old, weighing 5 and 7 kg, respectively, and presented for elective closure of ventricular septal defects only. Informed consent forms were obtained from caregivers.

Case management

After the surgical procedure was completed, the patient was transferred to the pediatric intensive care unit (PICU) and intubated. Upon confirming the stable respiratory and circulatory function of the patients, SAPB was performed using the ultrasound-guided technique described by Blanco et al. [5] with the patient in the supine position, if possible, with the upper arm resting over the head slightly. Under aseptic conditions, a 6–14 MHz linear transducer was scanned at the sagittal plane along the midaxillary line to orient the 3rd and 4th ribs while visualizing the pleura, latissimus dorsi muscle, serratus anterior muscle (Figure 1), and intercostal muscles (from superficial to the deepest). With respect to the ultrasound probe, a nerve block needle (22 G*50 mm) was inserted in the plane between the serratus anterior muscle and the intercostal muscles near the rib. When good views of the needle were verified, 0.2% ropivacaine 2.5 mg/kg was deposited in the fascial plane between the intercostal muscles and serratus anterior muscle. No further opioids were administered intravenously before extubation in the absence of a response to intubation stimulation. Rescue analgesia was started when the FLACC score was >4. Patients were extubated in the PICU once the extubation criteria were met (hemodynamically stable, normal arterial blood gas analysis, with peak inspiratory pressure

<20 cm H₂O and spontaneous breathing tidal volume >5 ml/kg). Postoperative pain assessment was performed 1, 6, 12, and 24 h after extubation with Face, Legs, Activity, Cry, Consolability (FLACC) scores by nurses in the PICU. For our 3 infants, the pain scores at 1 h post extubation were 1/10, 2/10, and 0/10, those at 6 and 12 h after extubation were all 1/10, and the scores at 24 h were 1/10, 0/10, and 1/10. No extra opioid drugs were needed in the first 12 h for any of the three infants. Regular oral ibuprofen suspension (1.25 ml) was taken every 8 h during the hospital stay (0.25 ml/kg). Enteral nutrition was well established 4 h after extubation. The urinary catheters were removed on the same day, and no urinary retention or repeated urinary catheterization occurred.

Discussion

In this case report, ultrasound-guided bilateral SAPB was performed in infants for median sternotomy postoperative pain management. It offers an opioid-sparing option for cardiac patients in the PICU for analgesia and shortens the intubation time for pediatric cardiac patients. In our 3 infant cases, the intubation time was <4 h, which is in accordance with the definition of “early” extubation time recommended (4–6 h) in pediatric fast-track cardiac surgery [9].

The pain after open heart surgery is intense and can be aggravated by respiratory movement, cough and position changes. Experiences of unalleviated pain in the early stage of life show negative consequences for sensory perception, immune function, and emotional health [10]. Moreover, changes in the mature brain and cognition have also been documented [11].

Pain after cardiac surgery includes not only the mid chest but also the anterior, lateral, and posterior chest wall [12]. Multimodality analgesics used in our study included intraoperative opioids, SAPB, ibuprofen and small amounts of opioids (12 h after surgery, if necessary). Early acute pain was released in a timely manner by different synergistic actions.

Multimodal pain management, including regional and systemic analgesia, is recommended for cardiac surgery analgesia [13]. Given the limitation of analgesic drug application in pediatric patients, regional anesthesia seems to be a legitimate option for opioid-sparing techniques in the population [14]. As part of the multimodal analgesic approach to pain management, many thoracic block techniques can be performed either in the back of the chest wall or in the front, targeting the thoracic intercostal nerves [15]. For patients after cardiac operation, the position change may cause unexpected complications. With limited positioning options, SAPB could be a more beneficial alternative to neuraxial block than paravertebral block or erector spinal block. Intercostal nerve block (ICNB) was also reported as an effective blockade for open heart surgery analgesia [8]; however, ICNB required repetitive applications and relatively more vascular exposure. Taking superficial wound infection around the surgical incision into consideration, transversus thoracic muscle plane block and parasternal block were not performed in these cases.

Although the analgesic mechanism of SAPB after median sternotomy is unclear, several cases have reported good analgesic effects in these patients [16, 17]. Some studies infer the fascial plane blocks exert an analgesic effect *via* a reduction in pectoral or intercostal muscle spasm [18]. Multimodal analgesic with SAPB were shown to be superior to opioids alone. These case reports may provide clues about SAPB in open heart surgery analgesia after surgery, and

more randomized controlled studies and more fundamental studies of SAPB mechanisms are needed on this subject.

Limitations

Because this study is a case report, it cannot be generalized to all patients. In addition, the superiority of deep serratus anterior plane block or superficial serratus anterior plane block is still a controversial, special issue that we did not discuss in this article. However, a randomized controlled trial is being performed to obtain clearer results in our center.

Conclusion

For the importance of pain management in enhanced recovery and limitation of analgesic drug application in children, we look forward to more random studies to confirm the safety and feasibility of these newly developed techniques/blocks in the pediatric population undergoing cardiac surgery in the ICU.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee on biomedical research

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of West China Hospital of Sichuan University (Approval No. 2021(429)). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

ZL was involved in data collection and follow-up assessments. MX and LD were responsible for literature search, study design, and finalized the manuscript. MX and YH drafted the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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