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RETROSPECTIVE ANALYSES OF SACRAL ERECTOR SPINAE PLANE BLOCKS IN PEDIATRIC PATIENTS

Sevim Cesur*[1], Hadi Ufuk Yörükoğlu[1], Emil Bosinci[2], Can Aksu[1], Alparslan Kuş[1]

[1]Kocaeli University, Department of Anesthesiology and Reanimation, Kocaeli, Türkiye; [2]University Children's Hospital Tirsova, Department of Anesthesiology and Reanimation, Belgrade, Serbia

ORCID iD: Sevim Cesur: 0000-0002-8764-1251; Hadi Ufuk Yörükoğlu: 0000-0001-7572-1580; Emil Bosinci: 0000-0003-3520-9704; Can Aksu: 0000-0002-4389-4257; Alparslan Kuş: 0000-0001-6381-6371

***Sorumlu Yazar / Corresponding Author:** Sevim Cesur **e-posta / e-mail:** svmcsr@gmail.com

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Abstract

Objective: The erector spinae plane block (ESPB) was first described in 2016. Recently the use of ESPB at the sacral levels was defined for adult surgeries, and a modification of the technique for pediatric surgeries, with the claim that it could replace caudal blocks, was described by our clinic.

Methods: This retrospective cohort study was approved by the institutional ethical committee of Kocaeli University Hospital (GOKAEK-2021/6.04). The data were obtained from the registry of regional anesthesia saved in the department. Pre- and perioperative data regarding age, height, weight, American Society of Anesthesiologist classification, surgery duration, and anesthesia duration during the perioperative period were collected. US-guided S-ESPB was successfully applied to 16 patients included in the retrospective study. The registry of regional anesthesia data includes detailed information on block performance, postoperative pain severity, and complications in the early postoperative period (for at least 24 h).

Results: 16 pediatric patients were included in the retrospective study. The mean age of the patients was 21,5 months. The mean weight of the patients was 13,1kg. In the postoperative 24-hour follow-up, one patient had a The Face, Legs, Activity, Cry, Consolability (FLACC) score greater than 4 in the PACU. None of the patients were observed to have postoperative complications.

Conclusions: To our knowledge, this study is the first to retrospectively investigate the efficacy of the S-ESPB in pain management in pediatric patients. The sacral ESPB appears to be an effective option for postoperative pain in pediatric patients undergoing lower abdominal surgery.

Keywords: *Analgesia, postoperative pain, regional anesthesia.*

Introduction

Since it was first described by Forero et al.[1], erector spinae plane block (ESPB) has gained increasing popularity. Although randomized controlled studies in pediatric patients are limited, it is reported that ESPB has been applied for different indications at many different levels in large case series.[2,3] Recently, the use of ESPB at sacral levels was described by our group for pediatric surgery, with a modification of the technique described for adults, suggesting that sacral ESPB may replace caudal blocks.[4,5] In this technique, the ultrasound is placed longitudinally at the body's midline, above the sacrum. Following the identification of median sacral crests, the block needle is advanced just above the fourth median sacral crest, and the local anesthetic (LA) is introduced there.[6] Bilateral spreading of LA, and bilateral analgesia were defined with the technique. It was shown to provide opioid-free postoperative analgesia in pediatric patients for hypospadias surgery, anoplasty, sacral teratoma excision, and the excision of the coccyx.[5-7] Although Hamilton[8] stated some concerns about anatomical nomenclature, and we agreed that this technique could be renamed to meet the general terminology, this block technique will be termed sacral ESPB (S-ESPB) in this manuscript.[9] The present study is the first to retrospectively investigate the efficacy of S-ESPB in the pain management of pediatric patients.

Methods

This retrospective cohort study was approved by the institutional ethical committee of Kocaeli University Hospital (GOKAEK-2021/6.04). After receiving ethics approval, the study was registered at ClinicalTrials.gov (NCT05415046). The data were obtained from the regional anesthesia archive. Pre- and perioperative data were collected regarding age, height, weight, American Society of Anesthesiologists (ASA) classification, surgery duration, and anesthesia duration during the perioperative period. The registry of regional anesthesia data includes detailed information on block performance, postoperative pain severity, and complications in the early postoperative period and not less than the first 24 hours post-surgery.

Statistical Analysis

All statistical analyses were performed on IBM SPSS for Windows version 20.0 (SPSS, Chicago, IL, USA). The Shapiro-Wilk test was used to assess the assumption of normality. Numerical variables were presented as mean ± standard deviation or median (25th-75th percentile) values, according to the normality of the data.

Description of the S-ESPB and Anesthetic Care

Patients were monitored in the operating room with standard ASA monitoring (Electrocardiogram, blood pressure, peripheral oxygen saturation). Patients with intravenous (iv) vascular access were sedated with 0.03 mg/kg of midazolam. In contrast, for patients who did not have iv vascular access, venous access was achieved after an inhalational induction with 8% sevoflurane and 50% air in oxygen. Remifentanil 1 µg/kg and propofol 2 mg/kg were administered for anesthesia induction. A supraglottic airway or endotracheal tube was placed according to the anesthesiologist's preference or surgical time. Sevoflurane, in combination with nitrous oxide in oxygen at a ratio of 2:1 in 3 L of fresh gas flow, was used for anesthesia maintenance.

All blocks were performed with the patient in the prone position under general anesthesia. The linear ultrasound probe (Esaote My Lab 6 US machine, Florence, Italy) was placed longitudinally to the midline upon the sacrum. Median sacral crests and erector spinae muscle were identified, as described by Aksu et al.[6] A 22 G, 50mm needle (B. Braun Melsungen, Germany) was used. The needle was inserted using an in-plane technique in a cranial to caudal direction. Following negative aspiration, 1 mL/kg of 0.25% bupivacaine was injected into this area (Fig 1).

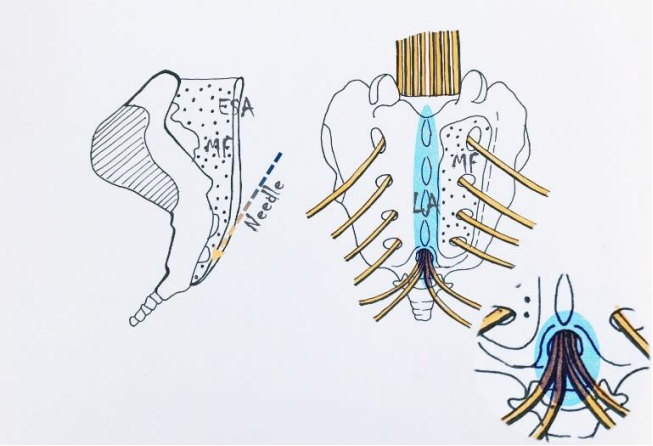

Figure 1. Illustration of the posterior and lateral sacrum. ESA: erector spinae aponeurosis, MF: multifidus muscle, LA: Local anesthetic. (The figure was drawn by Sedef Okan, who declares no conflicts of interest).

Afterward, the patients were returned to the supine position, and the surgery started. As standard, 15 mg/kg iv paracetamol was given to all patients at the end of the surgery as a part of multimodal postoperative analgesia management. If the patients were under the age of 1 year, paracetamol was given every 6 hours, as it is our routine clinical practice. All patients were extubated before transport to the postanesthesia care unit (PACU).

The Face, Legs, Activity, Cry, Consolability (FLACC) scales of the patients were scored in the first postoperative 24 hours, and the patients were followed up for pain in the first, second, fourth, eighth, twelfth, and twenty-fourth hours by a pain nurse. It was planned to administer iv morphine to the patients with FLACC scores of ≥4 in the PACU; 7 mg/kg of oral ibuprofen was scheduled to be administered to the patients with a FLACC score of ≥2. In the clinic, if the FLACC score was ≥4, additional paracetamol was planned, while oral ibuprofen was scheduled for a FLACC score of ≥2. In addition, patients were followed up in the first 24 hours for possible complications.

Results

Clinical details and demographic data are summarized in Table 1. Ultrasound (US)-guided S-ESPB was successfully applied in 16 patients included in the retrospective study. The mean age of the patients was 21.5 ± 13.9 months. The mean weight of the patients was 13.1 ± 5.9 kg. In the postoperative 24-hour follow-up, one patient who had undergone hypospadias and circumcision surgery had a FLACC score >2 in the PACU and received additional rescue non-steroid pain medicine. None of the patients were observed to have postoperative complications.

Table 1. Clinical details and demographic data

Case	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Weight (kg)	13	10	5	28	8	10	8	18	8	13	8	15	21	18	13	14
Duration of surgery (min)	90	105	90	90	75	135	90	75	90	105	105	75	75	75	135	105
Surgery types	Hipospadias + Circumcision	Hipospadias	Anoplasty	Bilateral hidrocelectomy	Bilateral inguinal hernia	Hipospadias	Bilateral undescended testis	Bilateral undescended testis	Intraabdominal mass	Hidrocelectomy	Undescended testis	Bilateral inguinal hernia	Undescended testis	Bilateral inguinal hernia	Bilateral dysplasia of the hip	Bilateal inguinal hernia
Additional Paracetamol	Once time	Once time	4x1 routinely	No	No	Yes	No	No	4x1 routinely	No	4x1 routinely	No	No	No	Once time due to fever	No
Additional NSAID	1 time	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Complication	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No

NSAID: Non-steroidal anti-inflammatory drug

Discussion

When the S-ESPB was defined by Tulgar et al.[4], it was stated that it differed from thoracolumbar ESPB and targeted the retrolaminar area more than the transverse process. Although it was noted in the first manuscript that this block did not affect the anterior branches of the sacral plexus, thus limiting its use, there are articles suggesting that it was effective in different indications and also had effects on the ventral rami.[7] Piraccini et al.[10] stated, in a case report in which they applied S-ESPB due to radicular pain from the S1 intermediate sacral crest, that a cranial spread of the injectate was clearly observed, and anterior branches were also affected in the patient. In further reports of S-ESPB providing adequate analgesia in vaginismus, sacral pelvic fractures, anoplasty, and urologic surgeries, it was found clinically that craniocaudal and ventral spread may occur.[11,12] However, in the literature, there are differences in the anatomical terminology of the block, as well as in its application and its reported dermatomal spread.

Kukreja et al.[13] provided adequate analgesia in gender reassignment surgeries with the technique of Aksu et al. and stated that with S-ESPB, the pudendal nerve (S2-4), the ilioinguinal (L1) and genital branch of genitofemoral nerve (L1-L2) can be blocked by the cephalic spread. Chakraborty et al.[14] modified the injection endpoint of S-ESPB to place the needle tip at the dorsal opening of the sacral foramen. They showed dermatomal and radiological spread in 10 patients with this modified S-ESPB application. Sensorial block up to the L3 dermatomes was observed in some patients with bilaterally applied blocks. They stated that contrast was seen in the presacral area, pudendal and sciatic nerve, and even in the broad ligament, but they reported that there was no spread to the caudal area in any of the patients. Considering that these authors applied the modified S-ESPB by injecting LA anesthetic through the dorsal foramen and in an adult patient population, it may be easier to discern the difference compared to our clinical data.

In order to understand the clinical results we obtained using Aksu et al.'s technique, the anatomical differences between adults and children need to be examined in detail. Anatomically speaking, the adult sacrum consists of five fused sacral vertebrae, and at birth each of these vertebral bodies is separated by an intervertebral disc. The two caudal trunks fuse at about 18 years of life, and the fusion process continues rostrally until the S1-2 interspace finally joins at around the age of 30 years.[15] The fascias at pediatric ages are more elastic, permeable, and mobile because of differences in hyaluronic acid and extracellular matrix. With aging, it hardens with the loss of hyaluronic acid, and permeability decreases. Consequently, each time the oblique muscles contract, they stretch the rectus sheath and the thoracolumbar fascia surrounding the erector spinae. This causes these fasciae to become stiffer, contributing to the increased force of muscle contraction.[16] Considering the longitudinal direction of all collagen fibers into the sacrum of the erector spinae muscle and the anatomical differences in the pediatric population, we believe that LA's distribution and spread may differ in children compared to adult patients. In our block application, we observed the concurrent craniocaudal spread and LA deposition above the sacrococcygeal ligament.

When we look at our clinical data on S-ESPB in pediatric patients, only one of the patients to whom we administered 1 mL/kg 0.25% bupivacaine required rescue analgesia within 24 hours. None of our patients developed any motor weakness, urinary retention, or constipation. In the report of Holland and Bosenberg on ESPB in pediatric patients, they recommend 0.1 mL/kg LA per dermatome. A possible explanation for the lack of need for rescue analgesics, even after bilateral inguinal hernia operations, would be the occurrence of cranial spread with our S-ESPB technique and our LA dose, and possibly epidural spread via the sacral hiatus.[3]

Caudal block is generally accepted as a safe technique in pediatric patients undergoing lower abdominal surgery. Although caudal block can be performed with the landmark technique, it has potential complications, such as hypotension and urinary retention, total spinal block, and dural puncture. However, based on our clinical experience, we see no side effects of our S-ESPB technique, even if we explain the bilateral analgesia effect by spreading LA anesthetic from the caudal area.

The S-ESP block is a relatively new technique and has a poorly understood mechanism. The data illustrating the spread, such as dye spread in cadaver studies or radiological studies, still needs to be included after a median injection at the sacral level. Unfortunately, performing cadaveric and radiologic studies in the pediatric population raises complex ethical problems.

Conclusion

We believe that S-ESPB will attain its place among the regional anesthesia techniques used for postoperative pain in pediatric patients undergoing lower abdominal surgery. However, further clinical and radiological studies are needed to better understand the mechanism of S-ESPB action in the pediatric population.

Conflicts of interest

None

Compliance with Ethical Statement

The study was approved by the institutional ethical committee of Kocaeli University Hospital (GOKAEK-2021/6.04). After receiving ethics approval, the study was registered at ClinicalTrials.gov (NCT05415046).

Informed consent was obtained from all individual participants included in the study.

All procedures involving human participants were performed by the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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None

Author Contributions

SC, HUY, CA, AK: Hypothesis; SC, HUY, CA: Design; HUY, EB, CA: Data Collection; SC, HUY, EB, CA: Analysis and Interpretation of Results; SC, HUY, EB: Writing; CA, AK: Critical Review.

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