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Ultrasound-guided lumbar erector spinae plane block versus caudal block for postoperative analgesia in pediatric hip and proximal femur surgery: a randomized controlled study

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Background: According to previous research, 20% of infants experience prolonged postsurgical pain 6–12 months after major surgery, which is linked to functional impairment and a lower quality of life. The aim of our study is to evaluate whether the analgesic effect of the erector spinae plane block (ESPB) is superior to that of caudal epidural anesthesia (CEA) in pediatric patients undergoing hip or proximal femoral surgeries.
Methods: Seventy-six children ranging in age from 1 to 7 years scheduled for hip or proximal femur surgery were randomly assigned to receive either a unilateral ultrasound-guided ESPB or CEA with bupivacaine 0.25% at a dose of 0.5 ml/kg. The primary outcome was the Face, Legs, Activity, Cry, and Consolability (FLACC) scale 2 h postoperatively. The secondary outcomes were pain scores every 15 min for the first hour and then at 6, 12, and 24 h postoperatively; the block failure rate; time to perform a successful block; and time to first rescue analgesia.
Results: The FLACC score 2 h postoperatively was not superior in the ESPB group compared to the CEA group; indeed, it was significantly higher in the ESPB group at 15 and 30 min post-operation ($P = 0.005$, 0.004, respectively). Additionally, the time to first rescue analgesia was prolonged in the CEA group ($P < 0.001$). The time to perform a successful block was comparable between the groups.
Conclusions: The analgesic effect of the ESPB was not superior to that of CEA in pediatric patients undergoing hip and proximal femur surgery.

Keywords: Analgesia; Anesthesia; Caudal anesthesia; Nerve block; Pain clinics; Pediatrics.

Introduction

Children can experience substantial pain after hip operations, causing agitation, depression, and sleep disruption, which can have a negative impact on their health [1]. According to the previous research, approximately 20% of children experience prolonged postsurgical discomfort 6 to 12 months following major surgery [2,3], which is linked to functional impairment and a lower quality of life [3]. Therefore, it is critical to properly address pain during acute hip fracture surgery. Opioids are frequently recommended for postoperative pain relief; however, they are associated with several serious side effects including nausea, vomiting, constipation, severe sedation, disorientation, and respiratory

depression.

To avoid postoperative pain, regional anesthetic techniques have been used extensively in pediatric surgeries [4]. Caudal epidural anesthesia (CEA) is a well-established neuraxial technique that has been widely used in pediatric patients undergoing lower abdominal and lower extremity surgeries [5]. Although the effectiveness and safety of CEA are well established, it has various contraindications, such as anatomical anomalies or the presence of an infection at the injection site, which can hinder its usage.

Ultrasonographic monitoring has made single-dose and continuous procedures safer for regional anesthesia. When combined with general anesthesia, the consumption of intraoperative and postoperative analgesic medications can be reduced and quick and painless rehabilitation can be ensured [6,7]. The erector spinae plane block (ESPB) is a relatively novel technique that has shown promising results in a few studies [8,9]. In adults, the ESPB has been used for postoperative analgesia in lower extremity procedures [10]. With the ESPB, the local anesthetic mixture spreads to the paravertebral area and may produce multiple dermatomal analgesic effects that address both somatic and visceral pain. The dermatomal spread of the ESPB is affected by the injection area, local anesthetic volume, and concentration. In pediatrics, Elkoundi et al. [11] described a successful ultrasound-guided ESPB at the level of the L2 transverse process in a 4-year-old girl prior to surgical repair for hip dysplasia. However, no study has compared the analgesic impact of erector spinae blocks versus CEA in pediatric patients undergoing hip and proximal femur operations.

Therefore, in this study, we aimed to evaluate whether the analgesic effect of the ESPB is superior to that of CEA in pediatric patients undergoing hip or proximal femoral surgeries.

Materials and Methods

This prospective, double-blind, randomized clinical trial was approved by the institutional research ethics committee of Cairo University El-Kasr Alainy Hospital (IRB no. MD-340-2020). The trial was pre-registered on ClinicalTrials.gov with the identifier NCT 05157516 and was conducted in compliance with the 2013 Helsinki Declaration. The study was conducted between December 2021 and June 2022. All patients that were screened and met the eligibility criteria were invited to participate in the trial, and the parents or legal guardians of the enrolled patients all provided written informed consent. Patients were asked for their consent upon arrival at the operating room (OR) for their procedure or on the ward if they were hospitalized the night before.

The inclusion criteria were as follows: male or female children aged 1–7 years with American Society of Anesthesiologists scores 1–2 scheduled for hip or proximal femur surgery that had no contraindication to peripheral regional anesthesia blocks. The exclusion criteria were as follows: parents/guardians refusal to participate, known local anesthetic drug sensitivity, bleeding disorders with International Normalized Ratio (INR) > 1.5 and/or platelets < 100,000/mm^3, and pre-existing infection at the block site.

Using a computer-generated random number table, the patients were allocated to one of the study groups. Patients assigned an even number were placed in the ESPB group, and those assigned an odd number were placed in the CEA group. The patient study code number and group allocation were typed on separate pages, folded, and concealed in sequentially numbered, sealed envelopes. Block randomization in groups of six individuals was applied to ensure a similar number of patients in each group as the study progressed. An independent third party possessed the randomization key. Both patients and anesthetists involved in postoperative data collection were blinded to the allocated groups.

Before arrival to the OR, all participants were premedicated with an intramuscular injection of atropine ding continuous electrocardiogram (GE-Datex Ohmeda 3-lead ECG cable, GE Healthcare, India), pulse oximetry (GE-Datex Ohmeda pediatric finger SpO_2 sensor, GE Healthcare, India), and non-invasive arterial blood pressure (GE-Datex Ohmeda NIBP cuff, GE Healthcare, India) were initiated. Baseline vital signs were recorded, including non-invasive heart rate; oxygen saturation; and systolic, mean, and diastolic arterial pressures. General anesthesia was induced using sevoflurane. A peripheral venous cannula was inserted after loss of consciousness. Atracurium (0.5 mg/kg) was administered intravenously to facilitate endotracheal intubation and fentanyl (1 μg/kg) was administered to prevent a stress response to intubation. Pressure-controlled ventilation was adjusted to maintain normocapnia (CO_2, 35–40 mmHg). Anesthesia was maintained with 1–1.5% isoflurane in a mixture of oxygen and air (50/50) and atracurium top-ups were administered every 30 min at a dose of 0.1 mg/kg. A total of 76 patients were recruited, 38 of which were randomly assigned into either the ESPB group (Group A) or the CEA group (Group B).

Both blocks were performed by the primary investigator under the supervision of consultant anesthesiologists who had a minimum 5 years experience in regional anesthesia and was familiar with the ESPB and CEA. After induction of general anesthesia, the envelopes were opened to reveal the group allocation. Prior to the start of surgery, the corresponding block was performed under fully aseptic conditions.

For the ESPB group, ultrasound guidance was provided by a SonoSite M Turbo (Bothel, USA). A linear multi-frequency 6–13 MHz transducer (L25 × 6–13 MHz linear array, SonoSite, USA)

scanning probe, which was placed in a sterile cover using a 22 gauge/50-mm block needle (Pajunk Sonoplex, Germany) was used as described below.

A unilateral block was performed in the lateral decubitus position, with the patient turned on his/her side so that the blocked side was facing up. Using strict sterilization techniques, the skin was sterilized with povidone-iodine at the site of needle entry. The level of the second lumbar vertebra was determined on ultrasound by identifying the lumbosacral junction (LSJ), which is the point of lordotic transition from the relatively straight line on the dorsal side of the lumbar vertebrae. The vertebra proximal to the LSJ was labelled as the third lumbar vertebra (L3). The ultrasound transducer was placed at the midvertebral line in the sagittal plane. The transducer was shifted 3.5–4 cm laterally from midline to the surgical side to visualize the erector spinae muscle and transverse process. Using the out-of-plane technique, the needle was advanced until the transverse process was reached. The correct location of the needle tip in the fascial plane deep to the erector spinae muscle was confirmed by injecting 0.5–1 ml of saline and observing the fluid lifting the erector spinae muscle off the transverse process while avoiding muscle distension (hydrodissection). Once the needle was at the correct location, a negative aspiration test was confirmed. Bupivacaine 0.25% at a dose of 0.5 ml/kg was then injected, with care taken to not exceed the maximum recommended dose (2 mg/kg). The distribution of the injectate within the fascial plane was observed. The patient was then placed in the supine position, and surgery commenced 15 min after the block was administered (Supplementary Video 1).

Patients randomized to the CEA group received CEA as described below.

After induction of general anesthesia, the patient was placed in the left lateral position with the upper hip flexed at 90° and the lower hip flexed at 45°. The region was then swabbed in a craniocaudal direction with a 70% alcohol solution. Intensive disinfection with alcoholic solution, sterile drapes, and the use of sterile gloves is standard for all neuraxial blockades at our institution.

After palpating the landmarks (the upper posterior iliac spine and sacral hiatus from the edges of an equilateral triangle), an epidural puncture was performed in the most proximal region of the sacral hiatus with the needle inclined 45–60° to the skin. While palpating with the index finger of the left hand, the needle was inserted immediately below the spinous process S4. After perforating the membrane, which occludes the sacral hiatus, the needle was advanced no more than 1–3 mm to avoid a bloody puncture or an intrathecal injection. Bupivacaine 0.25% at a dose of 0.5 ml/kg was injected, with care taken to not to exceed the maximum recommended dose (2 mg/kg) [11].

The surgical incision was performed 15 min after the block was administered. Intraoperatively, an increase in hemodynamics in response to the skin incision by more than 20% from baseline values 5 min after intubation or thereafter was managed by intravenous administration of fentanyl 0.5 μg/kg to a maximum dose of 2 μg/kg.

At the end of the surgery, inhalational anesthesia was discontinued. After the return of spontaneous breathing, reversal of muscle relaxation was achieved with intravenous atropine (0.02 mg/kg) and neostigmine (0.05 mg/kg). Patients were transferred to the post-anesthesia care unit (PACU) for 60 min for monitoring while they completed their recovery.

In the PACU and during the postoperative period, the pain score (Face, Legs, Activity, Cry, and Consolability [FLACC] scale) was assessed by the attending anesthetist. When the score exceeded 4/10, rescue analgesia in the form of intravenous paracetamol at a dose of 15 mg/kg was administered in the immediate postoperative period for patients weighing ≥ 10 kg, and a dose of 7.5 mg/kg for patients weighing <10 kg. If the FLACC score remained ≥ 4 after 30 minutes from paracetamol administration, IV nalbuphine 0.1 mg/kg was administered. Another dose of nalbuphine 0.1–0.2 mg/kg was administered in the PACU if the score remained ≥ 4 after 30 min, and every 3–4 h as needed thereafter, to a maximum daily dose of 2.4 mg/kg.

After discharge from the PACU, the analgesic plan was to alternate doses of intravenous paracetamol 15 mg/kg for patients weighing ≥ 10 kg or 7.5 mg/kg for patients weighing < 10 kg and ketorolac 0.5 mg/kg every 6 h if the FLACC score remained ≥ 4/10.

The primary outcome was the FLACC score at 2 h post-operation.

The secondary outcomes were the FLACC score collected in the PACU every 15 min post-operation for the first hour and then at 6, 12, and 24 h postoperatively; block failure rate (block failure was defined as more than two doses of rescue analgesia in the first hour postoperatively); time taken to perform a successful block (block time); the incidence of adverse effects; and duration of the block (from immediately after the block was administered until the first postoperative rescue analgesia, which was administered if the FLACC score was ≥ 4/10); the degree of contralateral motor blockage; and lower limb weakness using the modified Bromage scale.

Statistical analysis

Since pain evaluations are usually subjective, with high interpersonal variability, we conducted a pilot study to explore actual

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data from patients, with surgeons with the same surgical skills and the same drugs used in our study. According to Abdulatif et al. [12], conducting a pilot study is considered the best method for sample size estimation.

In our pilot study of 10 pediatric patients not included in the final data analysis, FLACC scores at 2 h post-operation were 4 ± 1.2 in patients undergoing hip or femur surgeries receiving CEA. Using MedCalc software version 14.10.2 (MedCalc software bvba, Belgium), a sample size was calculated that could detect a 20% difference in FLACC scores between the two study groups. A minimum number of 72 patients (36 patients per group) was calculated to have a study power of 80% and an alpha error of 0.05. The number of patients was increased to 76 (38 patients per group) to compensate for possible dropouts. Data were coded and entered using the Statistical Package for the Social Sciences (SPSS) version 26 (IBM Corp., USA). Data are summarized using means and standard deviations for normally distributed quantitative variables, medians and interquartile ranges for non-normally distributed quantitative variables, and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were performed using unpaired t-tests for normally distributed quantitative variables and non-parametric Mann-Whitney tests for non-normally distributed quantitative variables. The chi-square (c2) test was used to compare categorical data. The Fisher's exact test was used when the expected frequency was < 5. Statistical significance was set at $P < 0.05$.

Results

The Consolidated Standards of Reporting Trials (CONSORT) flow diagram for this trial is shown in Fig. 1. Eighty-seven individuals were first examined for inclusion, 76 of which met the eligibility requirements and were selected at random to obtain either an ESPB or CEA at Cairo University Children's Hospital (Abu El-Reesh). All recruited participants were followed up successfully, and no patients were abandoned to follow-up.

Baseline participant information was comparable between the two groups; however, the duration of general anesthesia and surgery were prolonged in the CEA group compared to the ESPB group ($P = 0.018$ and $P = 0.002$, respectively) (Table 1).

The patient hemodynamics for each group are presented in Tables 2 and 3. Hemodynamics were comparable, except that the mean arterial pressure (MAP) at 10, 20, 30, 50, and 60 min and the mean MAP reading in the first 60 min intraoperatively were higher in the ESPB group than in the CEA group.

Table 4 shows the FLACC scores in the first 24 h after surgery for both groups. FLACC score at 2 hours postoperative was com-

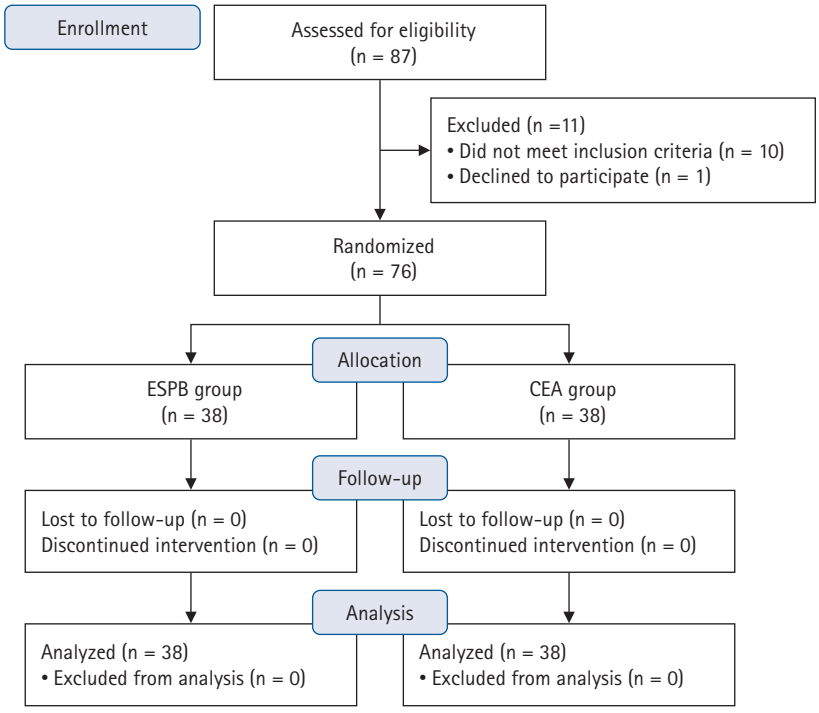

Fig. 1. Consolidated Standards of Reporting Trials (CONSORT) flowchart. ESPB: erector spinae plane block, CEA: caudal epidural anesthesia.

Table 1. Comparison of Patient Demographics and Surgical Features between the ESPB and CEA Groups

Type of surgery	Variable	ESPB group	CEA group	P value
	Age (yr)	4.57 ± 2.99	4.16 ± 3.76	-
	Weight (kg)	18.92 ± 8.77	18.58 ± 9.78	-
	Duration of GA	79.74 ± 18.67	92.05 ± 25.12	0.018*
	Duration of surgery	61.95 ± 17.96	78.08 ± 24.11	0.002*
	ASA I	38 (100.0)	37 (97.4)	0.320
	ASA II	0 (0.0)	1 (2.6)	0.320
	DDH	26 (68.4)	24 (63.2)	0.630
	Slipped capital femoral epiphysis	4 (10.5)	6 (15.8)	0.498
	Developmental coxa vera	6 (15.8)	7 (18.4)	0.763
	Hip or proximal femur fracture surgery	2 (5.2)	1 (2.6)	0.560

Values are presented as mean ± SD or number (%). ESPB: erector spinae plane block, CEA: caudal epidural anesthesia, GA: general anesthesia, ASA: American Society of Anesthesiologists' classification, DDH: developmental dysplasia of the hip. *indicates statistical significance.

Table 2. Comparison of the MAP between the ESPB and CEA Groups

Variables	ESPB group	CEA group	95% CI	P value
MAP baseline	73.00 ± 11.59	70.61 ± 15.68	−3.91, 8.69	0.452
MAP 5 min	72.03 ± 11.44	67.84 ± 11.91	−1.14, 9.52	0.123
MAP 10 min	76.18 ± 12.25	66.50 ± 11.65	4.21, 15.14	< 0.001*
MAP 20 min	74.84 ± 12.00	67.41 ± 16.15	0.92, 13.93	0.027*
MAP 30 min	73.92 ± 11.67	66.76 ± 13.36	1.42, 12.89	0.016*
MAP 40 min	71.60 ± 14.73	65.25 ± 11.73	0.26, 12.43	0.107
MAP 50 min	75.21 ± 10.01	67.43 ± 12.49	2.60, 12.95	0.009*
MAP 60 min	73.69 ± 8.56	67.48 ± 12.19	1.39, 11.02	0.036*
Mean	73.80 ± 1.47	67.44 ± 1.43	5.69, 7.02	< 0.001*

Values are presented as mean ± SD. MAP: mean arterial pressure (mmHg) from the time of induction of anesthesia until 60 min after induction, ESPB: erector spinae plane block, CEA: caudal epidural anesthesia. *indicates statistical significance.

Table 3. Comparison of HR between the ESPB and CEA Groups

Variables	ESPB group	CEA group	95% CI	P value
HR baseline	114.18 ± 16.00	127.74 ± 20.50	−21.96, −5.15	0.002*
HR 5 min	112.32 ± 18.27	121.13 ± 23.40	−18.40, 0.78	0.071
HR 10 min	110.61 ± 15.12	115.11 ± 23.70	−13.58, 4.58	0.328
HR 20 min	109.53 ± 13.85	112.05 ± 22.24	−10.98, 5.94	0.558
HR 30 min	106.97 ± 13.90	111.41 ± 18.98	−12.04, 3.16	0.254
HR 40 min	108.30 ± 14.61	110.03 ± 17.27	−9.04, 5.58	0.693
HR 50 min	106.21 ± 12.92	104.87 ± 19.47	−6.21, 8.89	0.750
HR 60 min	103.00 ± 13.84	97.20 ± 18.36	−1.63, 13.23	0.196
Mean	108.89 ± 3.33	112.44 ± 8.75	−6.57, −0.52	0.021*

Values are presented as mean ± SD. HR: heart rate from the time of anesthesia induction until 60 min after induction in beats/min, ESPB: erector spinae plane block, CEA: caudal epidural anesthesia. *indicates statistical significance.

parable between both groups (P = 0.562), FLACC score were significantly lower at 15 and 30 min post-operation in CEA compared to ESPB (P = 0.005 and P = 0.004, respectively); however, the difference in the mean FLACC score in the first 24 h postoperatively was not statistically significant between the groups (P = 0.191).

The time to first rescue analgesia was prolonged in the CEA group compared to the ESPB group (P < 0.001), and the number of doses of rescue analgesia was lower in the CEA group compared to the ESPB group (P = 0.035). No adverse events occurred

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Table 4. Comparison of Pain Scores (FLACC) from 15 min to 24 h after Extubation between the ESPB and CEA Groups

Variables	ESPB group	CEA group	95% CI	P value
Pain score (15 min)	2.11 ± 1.74	1.03 ± 1.08	0.41, 1.74	0.005*
Pain score (30 min)	2.55 ± 1.29	1.74 ± 0.92	0.29, 1.32	0.004*
Pain score (45 min)	3.21 ± 1.04	2.92 ± 0.94	−0.16, 0.74	0.239
Pain score (60 min)	3.45 ± 0.86	3.39 ± 1.05	−0.37, 0.49	0.798
Pain score (2 h)	3.05 ± 0.98	3.18 ± 0.95	−0.57, 0.31	0.562
Pain score (6 h)	4.05 ± 1.18	3.82 ± 0.80	−0.23, 0.69	0.360
Pain score (12 h)	4.68 ± 1.16	4.53 ± 1.08	−0.36, 0.66	0.545
Pain score (24 h)	4.32 ± 0.82	4.42 ± 1.01	−0.32, 0.52	0.637
Mean	3.42 ± 0.82	3.12 ± 1.14	−0.75, 0.15	0.191

Values are presented as mean ± SD. FLACC: Face, Legs, Activity, Cry, and Consolability scale, ESPB: erector spinae plane block, CEA: caudal epidural anesthesia. *indicates statistical significance.

Table 5. Comparison of Secondary Outcomes between the ESPB and CEA Groups

Variables	ESPB group	CEA group	95% CI	P value
Time to first rescue analgesia (min)	141.13 ± 47.66	190.42 ± 56.10	−73.08, −25.49	< 0.001*
Block time (min)	1.53 ± 0.60	1.32 ± 0.47	−0.03, 0.45	0.094
Fentanyl top ups	12 (31.6)	10 (26.3)	14.7, 24.81	0.613
Failed block	3 (7.9)	1 (2.6)	−6.7, 18.38	0.303
Number of rescue analgesia doses				
0	11 (28.9)	20 (52.6)	1.65, 42.78	0.035*
1	17 (44.7)	16 (42.1)	−18.83, 23.7	0.820
2	7 (18.4)	1 (2.6)	1.58, 30.94	0.025*
3	3 (7.9)	1 (2.6)	−6.71, 18.38	0.305

Values are presented as mean ± SD or number (%). ESPB: erector spinae plane block, CEA: caudal epidural anesthesia, block time: time required to perform a successful block. *indicates statistical significance.

in either group, and the time to perform a successful block, total intraoperative fentanyl consumption, block failure rate, and number of rescue analgesic doses in the first 24 h were comparable between the groups (Table 5).

Discussion

This is the first randomized controlled study comparing the ESPB to CEA in pediatric patients undergoing hip or proximal femur surgeries. The main finding of our study was that the analgesic effect of the ESPB was not superior to that of CEA in pediatric patients undergoing hip or proximal femur surgery. In contrast, CEA actually appeared to provide a better analgesic effect, as demonstrated by the longer time to first rescue analgesia and lower FLACC scores in the early postoperative period in the CEA group. Perioperative hemodynamics were generally comparable between the two groups, and both blocks stabilized hemodynamic parameters after skin incision to the early postoperative period in the PACU.

Consistent with our findings, CEA has previously been reported to be an excellent route for analgesia in pelvic and lower extremity procedures in children and superior to general anesthesia alone in a study conducted by Wiegele et al. [13]. Additionally, results of CEA were favorable when compared with an ultrasound-guided quadratus lumborum block in a prospective randomized study conducted by Salim et al. [14] and when compared with a lumbar plexus block in a study done by Villalobos et al. [15].

Tulgar et al. [16] performed an ultrasound-guided ESPB at the L4 level in adults undergoing hip and proximal femur surgeries. Computed tomographic imaging after the ESPB showed spread of contrast along the lumbar plexus from the T12 to S1 vertebrae. Relying on the hypothesis that the local anesthetic of the ESPB would spread in the lumbar region similar to that at the thoracic levels [17], we anticipated that a lumbar ESPB performed at the L3 level would provide a higher dermatomal spread and thus better analgesic coverage for hip and proximal femur surgery.

Given the paucity of data on the ESPB in infants undergoing

hip or proximal femur surgeries, we used studies on adults to determine the ideal procedure, level of injection, and injectant type and concentration for an ESPB in children. Moreover, we depended on a few studies and case reports on patients undergoing hip or proximal femur surgery with ESPB to determine the injectant volume and possible side effects [11,16]. However, since the results of the only study that has evaluated an ESPB on a pediatric patient undergoing hip surgery [11] found positive results, we expected the analgesic effect of the ESPB to be superior to that of CEA. Therefore, we anticipated a maximum FLACC score of 3 in the first 24 h postoperatively, as reported in the study by Elkoundi et al. [11]. On that basis, we assumed that the analgesic effect of the ESPB would be superior to that of CEA as evidence by a FLACC score 20% lower.

Aliena et al. [18] noted that for painful sub-umbilical operations, caudal blocks are effective for postoperative analgesia, which is consistent with the findings of our study. However, in contrast to our study, these authors administered 0.25% bupivacaine at a dose of 0.75 ml/kg, while we administered the same concentration of bupivacaine at a dose of 0.5 ml/kg according to the local guidelines at our institution. We believe that a lower dose of bupivacaine not only facilitates earlier ambulation but also helps in maintaining periprocedural cardiovascular stabilization and spontaneous respiration in patients at high risk of a difficulty airway. However, the time to the first rescue analgesia was 7 h in their study compared to 3.2 h in our study. A previous study comparing different doses of bupivacaine found that increasing the bupivacaine dose from 0.5 ml/kg to 0.75 ml/kg results in a level of spread that is only modestly higher [19].

A few previous studies have evaluated the use of the ESPB for hip surgeries in adults. Ahiskalioglu et al. [20] conducted a case report and Abdelnasser et al. [21] conducted a randomized controlled pilot study. However, in the pediatric population, only one case report [17] is available on the use of the ESPB in hip surgery. These authors concluded that an ESPB performed at the L2 level as an adjunct to general anesthesia can provide reliable analgesia for pediatric hip surgeries. However, 0.25% bupivacaine at a dose of 0.3 ml/kg was administered in that study, whereas we administered the same concentration of bupivacaine at a dose of 0.5 ml/kg. In addition, these authors did not calculate the duration of the block.

Ahiskalioglu et al. [20] used the lumbar ESPB as the main anesthetic method for hip surgery in high-risk elderly patients and concluded that the lumbar ESPB combined with mild sedation provided adequate and safe anesthesia in this patient population. The block duration in that study was approximately 8 h, which is longer than that in the ESPB group in our study (2.35 h). However, this difference could be explained by the differences in the dosages and age groups of the two studies.

Our study had some limitations. First, the intraoperative hemodynamics results and postoperative pain evaluations may have been influenced by other factors, such as the duration of surgery, type of surgery, and age of the patient; nonetheless, the outcomes were measured equally to both randomized groups. Second, the types of surgery performed in each group were heterogenous. However, this difference was not statistically significant and therefore we do not think this affected the outcomes of the study. Third, interpretations of the FLACC score can be misleading, as non-pain-related distress can affect the score. However, combining the FLACC score with other outcomes, such as hemodynamics and analgesic requirements, can provide a reliable and useful tool for assessing pain intensity in this population [22].

In conclusion, the analgesic effect of the ESPB was not superior to that of CEA. In contrast, CEA was found to result in a better analgesic effect in this study, especially in the early postoperative period. However, the ESPB can be an effective alternative for postoperative pain management in pediatric patients undergoing hip or proximal femur surgery, especially for those patients with contraindications to CEA or whose procedures are anticipated to be technically difficult.

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Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author Contributions

Mohamed Elshazly (Conceptualization; Data curation; Formal analysis; Supervision; Writing – original draft; Writing – review & editing)
AbdelKhalek Shaban (Conceptualization)

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Nevine Gouda (Conceptualization; Writing – original draft; Writing – review & editing)
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Supplementary Material

Supplementary Video 1. Ultrasound guided ESPB.

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