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Evaluation of the effects of ultrasound-guided infraclavicular nerve block on postoperative pain in pediatric supracondylar fracture surgery

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Ethics Committee Approval
Ethical approval was obtained from Selcuk University, Medical School Ethics Committee (Ref no: 2017/201).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

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Abstract

Background/Aim: Ultrasound-guided upper and lower extremity nerve blocks offer significant advantages in adult patients. However, the effectiveness of these advantages in children is being investigated. The aim of this study was to evaluate postoperative pain scores of single-injection infraclavicular nerve block in pediatric patients who underwent supracondylar surgery.

Methods: Forty-one patients who underwent supracondylar surgery between December 2016 and December 2017, with either general anesthesia (GA, n=19) or ultrasound-guided infraclavicular block (ICB, n=22) were included in this retrospective cohort study. Postoperative visual analogue scale (VAS) pain scores at the 30th min, 2nd, 6th, 12th, and 24th hours, the total amount of pethidine and paracetamol administered, and time until the first analgesia requirement were evaluated.

Results: The demographic characteristics of the patients were similar ($p>0.05$). The VAS scores and total amount of consumed pethidine and paracetamol were lower in the ICB group in the first 12 hours than in the GA group, but the opposite was true at the 24th hour ($P<0.001$). The first analgesia requirement time was much longer in the ICB group than in the GA group ($P<0.001$). The two groups were similar in terms of complications ($P<0.05$).

Conclusion: Ultrasound-guided infraclavicular block could be a useful option for postoperative analgesia control in patients undergoing supracondylar surgery.

Keywords: Supracondylar surgery, Infraclavicular nerve block, General anesthesia, Ultrasonography, Visual analogue score

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Introduction

Supracondylar fracture of the humerus requires approximately 85% surgical intervention in pediatric orthopedic practice, accounting for more than half of all elbow fractures and roughly 33% of all pediatric limb fractures [1]. Although surgical procedures generally require general anesthesia in children, regional anesthesia is used more frequently. In recent years, brachial plexus anesthesia has become a valuable option in the surgical treatment of the upper extremity in children. In pediatric regional anesthesia practice, the use of ultrasonography (USG) has various reported effects such as shortening the time to onset of the block, high rates of block success, and postoperative analgesia [2]. In addition, USG-guided pediatric regional anesthesia decreases the amount of intraoperative anesthetic and systemic narcotic drugs, it can be used in pediatric trauma surgery where general anesthesia can be dangerous due to the high risk of gastric aspiration, and more importantly, it helps control postoperative pain [3-5].

In this study, it was aimed to evaluate postoperative pain scores of single injection infraclavicular nerve block in pediatric patients who underwent supracondylar surgery.

Materials and methods

This retrospective clinical study was approved by the Ethics Committee of Selcuk University, Faculty of Medicine (Ref no: 2017/201). From all patients admitted from December 2016 to December 2017, anesthesia data of 41 patients aged between 5-12 years who were American Society of Anesthesiologists (ASA) risk group I/III and scheduled for surgery due to supracondylar humerus fracture were included. The information of the patients was collected from the hospital automation database. The patients included in the study were evaluated; those who received general anesthesia comprised the GA group (n=19), and those who underwent infraclavicular nerve block were assigned to the ICB group (n=22).

All patients received a standard GA protocol. Anesthesia induction was performed with 2 mg kg^{-1} propofol, 2 mg kg^{-1} fentanyl, and 0.6 mg kg^{-1} rocuronium at the onset of GA induction in the GA group. Anesthesia continued with 1-2% sevoflurane, 40% O_2, and 0.1 mcg kg min^{-1} remifentanil infusion at regular intervals and muscle relaxants. Intravenous paracetamol (15 $mg.kg^{-1}$) was administered to all patients prior to any surgical incision for the purpose of preemptive analgesia.

Patients in group ICB were also lying in the supine position after routine GA induction and intubation, and the patient's head was turned to the opposite side of where the block was performed. The skin on the infraclavicular block area and its surroundings were sterilized using 10% povidone iodine. The block applications were performed using an Esaote MyLab 30 US (Florence, Italy) device with a broadband, and multifrequency linear probe (10-18 MHz). After aseptic preparation, the USG linear probe was placed perpendicularly to the proposed region (the point where the clavicle and coracoid protrusion intersect) to apply infraclavicular block through the lateral-sagittal technique proposed by Klaastad et al. [6]. When the cords (lateral, medial, and posterior) of the axillary artery, vein, and brachial plexus were visualized, 22-G nerve stimulation needle (Stimuplex, Braun®, Gemany) USG probe was directed towards the 3-6-9 alignment relative to the artery. As a local anesthetic, 0.3 $mg.kg^{-1}$ of 0.25% bupivacaine (Bustesin® 0.5%, Istanbul, Turkey) was administered in divided doses, with intermittent negative aspiration to avoid intravascular injection. It was observed with USG that the local anesthetic brachial plexus spread around all three cords in a "U" shape.

Postoperative VAS-3 levels were considered painful for group GA and group ICB and 10 $mg.kg^{-1}$ paracetamol was administered orally. If VAS-3 pain values did not decrease after 15 min, 1 $mg.kg^{-1}$ pethidine IM was given.

Clinical evaluation

Sociodemographic and clinical data were recorded in the preoperative period. Age, sex, weight, height, ASA status, operation side, and anesthesia and surgical time were evaluated. VAS pain scores at the postoperative 30th minute, and 2nd, 6th, 12th, and 24th hours, total amount of paracetamol and pethidine, first opioid analgesia requirement time, and complications were evaluated.

Statistical analysis

The statistical analyses of the study were performed with the SPSS 20.0 software. Descriptive measures of continuous and categorical variables were extracted and are presented as tables and graphs. Continuous variables are presented in the form of mean (standard deviation or error) and the frequencies and percentages of categorical variables are given. The Kolmogorov-Smirnov normality test was used for continuous variables. Group comparisons of the variables that showed normal distribution were performed using one-way analysis of variance (ANOVA). Mann-Whitney U variance analysis was used for discrete numeric variables that did not show normal distribution. Relationships between the categorical variables were determined by preparing crosstabs and using the Chi-square (χ^2) test. In all analyses, $P<0.05$ was considered statistically significant.

Results

Data were obtained from hospital anesthesia records from December 2016 to December 2017. A total of 41 pediatric patients who underwent surgery for supracondylar humerus fractures were included. Two patients were excluded from the analysis due to data loss. Accordingly, 17 patients in the GA group and 22 patients in the ICB group were included in the final analysis. The patients' demographic characteristics, ASA status, operation side, and duration of surgery and anesthesia were similar ($P>0.05$) (Table 1).

Table 1: Patient characteristics and clinical data

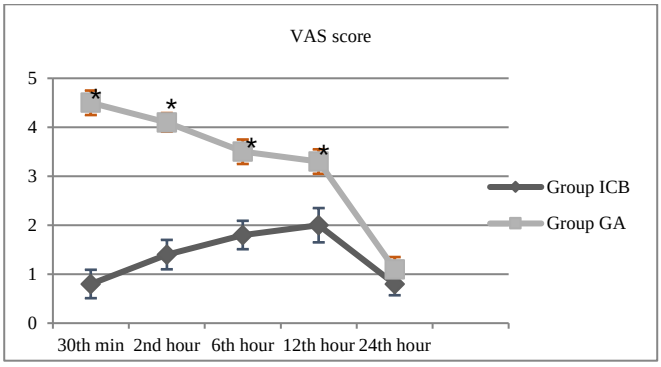
	Group ICB n=22	Group GA n=17	*P*-value
Gender, M/ F	13/9	11/6	0.512
Age, years	8 (3.3)	7.8 (4.6)	0.867
Weight, kg	25.1 (9.7)	26.5 (8.3)	0.789
Height, cm	114.2 (13.9)	111.9 (15.0)	0.811
ASA I / II	21/1	17/0	0.504
Anesthesia time, min	99.2 (15.6)	102.8 (12.3)	0.622
Surgical time, min	89.5 (14.7)	93.0 (12.4)	0.432
Side of surgery, R / L	13/11	10/7	0.247

Values are presented as mean (standard error) or number of patients. ICB: infraclavicular nerve block, GA: general anesthesia, ASA: American Society of Anesthesiologists, F/M: female/male, R/L: right/left

Within the first 24 hours postoperatively, there was a significant difference between the VAS scores of the GA and ICB groups ($P<0.001$). VAS pain scores (at 30th min, and 2nd, 6th, and 12th hours) were significantly lower in group ICB than in group

GA at all measurement points, except for the 24th hour (P<0.001, P<0.001, P=0.018, P=0.033, and P=0.416, respectively) (Figure 1).

Figure 1: Comparison of postoperative visual analogue scale (VAS) scores between the two groups



* VAS scores significantly differed except at the 24th hour (P<0.001, P<0.001, P=0.018 P=0.033 and P=0.416, respectively)

A total of 550 (82.6) mg and 1240.2 (110.8) mg paracetamol and 0 mg and 10.5 (9.3) mg of pethidine were consumed in the ICB and GA groups, respectively (P<0.001 for both) (Table 2).

Table 2: Time that elapsed until first requirement for analgesia and the total amount of pethidine and paracetamol consumed over the first 24 hours after surgery

	Group ICB n=22	Group GA n=17	P-value
Time that elapsed until first requirement for analgesia (hours)	13.2 (2.2)	6.3 (3.8)	0.021
Total amounts pethidine consumed (mg)	0	10.5 (9.3)	<0.001
Total amounts paracetamol consumed (mg)	550.5 (82.6)	1240.2 (110.8)	<0.001

Values are presented as mean (standard error). ICB: infraclavicular nerve block, GA: general anesthesia

The time until first analgesia requirement was 13.2 (2.2) and 6.3 (3.8) hours in groups ICB and GA, respectively (P=0.013) (Table 2). There was no significant difference between the two groups in terms of postoperative complications (P<0.05).

Discussion

The analgesic effect of ICB, which was added to GA in supracondylar humeral fracture surgery, was superior to the GA group in the first 12 postoperative hours. In addition, compared with the GA group, the time until first opioid analgesia administration increased in the ICB group, while the total amount of paracetamol and pethidine consumed decreased.

It has been stated that single-injection infraclavicular nerve block is safe and provides sufficient sensory and motor blockade in children [7]. Studies on infraclavicular brachial plexus block regard its comparison with other brachial nerve blocks or block formation times of different approaches of the infraclavicular block. Studies on the postoperative analgesia of infraclavicular block are relatively few.

Hadzic et al. [8] showed that analgesia scores were better in brachial plexus block compared with GA in daily hand surgery attempts. The brachial plexus block group was discharged earlier, there was no need for additional analgesia, and it was superior in terms of adverse effects. In a prospective randomized study, Aboobacker et al. [9] showed that the continuous infraclavicular block performed with USG provided better postoperative pain scores, less narcotic use and complications, and better sleep satisfaction. In our study, ICB provided superior analgesia, and less and later use of non-steroidal anti-inflammatory drugs (NSAIDs) and opioids.

There are some important problems that can be seen in ICB plexus block. First, the complications that can arise from the block: Horner syndrome, hematoma, nerve damage, arterial puncture, and pneumothorax; second, local anesthetic toxicity can develop as a result of the high amount of local anesthetic injection during the block [10]; and third, compartment syndrome [11]. The advantages of USG guidance lie in the imaging of the anatomic structures and needle during the intervention, thus avoiding nerve damage, pneumothorax, and vascular perforation. Another is the possibility to directly visualize the distribution of the local anesthetic and control the distribution [12]. De José et al. [13] reported that USG-guided supraclavicular and ICB applications might reduce existing risks in pediatric patients. In our ICB application, we think that we have achieved high success rates and low complication rates in postoperative analgesia because we performed it with the lateral sagittal ICB technique described by Klaastad et al. [9].

Limitations

Our study has some limitations. First, this is a retrospective study and including limited number of cases. Second, when evaluating VAS scores, it was not determined at what time the difference between the 12th and 24th postoperative hours disappeared. Third, the ICBs were performed by more than one anesthesiologist.

Conclusion

Single-injection infraclavicular nerve block accompanied by USG was more advantageous than systemic analgesia with superior VAS values in postoperative pain control, less opioid and paracetamol use, and prolonged first analgesia requirement time. However, we believe that stronger prospective studies are also needed.

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