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Original Research

Our Ultrasound Guided Brachial Plexus Block Experiences for Upper Extremity Surgeries in Pediatric Patients

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Abstract

Objectives: Brachial plexus block is the most effective analgesia and anesthesia procedure for the upper extremity surgeries in pediatric patients. In recent years, ultrasound guidance for this procedure has reduced the fail and complications like pneumothorax, intravascular injection and nerve damage. However, the number of studies about brachial plexus block is not enough, particularly in pediatric patients, which remained under-researched. In our study, we aimed to discuss the efficacy and safety of the ultrasound-guided brachial plexus block in pediatric patients by retrospectively examining their data.

Methods: We retrospectively reviewed the data of pediatric patients who underwent ultrasound-guided brachial block in our clinic between January 2015-January 2017. Demographic data, diagnosis, procedure and operation times, medications, motor and sensorial block times were recorded.

Results: Between January 2015 and January 2017, the number of pediatric patients who underwent ultrasound-guided peripheral nerve block in our clinic was 24. In 15 of these patients, the supraclavicular block was applied in 15, and the infraclavicular block was applied in nine patients. The mean age of the patients was 9.6±3.12, with a male/female ratio 14/10. The mean duration of the procedure was 9.54±2.14 minutes in patients for the supraclavicular block and 12.9 ± 2.8 minutes for the infraclavicular block. The mean surgery time was 64±13.6 minutes. As a local anesthetic, bupivacaine was used in three patients; bupivacaine+lidocaine combination was used in 21 patients and adjuvants were added in eight patients. The block procedure was performed under general anesthesia in 12 patients and under sedation in 12 patients. The mean motor block time was 7.5±2 hours in patients who received supraclavicular block, and 7.4±1.5 hours in patients who received infraclavicular block. The mean sensorial block time was 10.5±1.7 hours in the supraclavicular block, and 10.45±1.15 hours in the infraclavicular block. The mean motor block period with added adjuvants was 7.7±0.5 hours, and the sensorial block period was 11.12±1.1 hours. No complications were seen during the procedure, intraoperative and postoperative follow-up.

Conclusion: Ultrasound-guided brachial plexus block in pediatric patients is effective and safe, with longer analgesia duration and lower complication rates. Prospective studies with a larger number of patients are needed in this regard.

Keywords: Brachial plexus block; ultrasound

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In upper extremity surgery, brachial plexus blocks are often preferred due to their advantages, such as long postoperative analgesic efficacy and shortening the length of hospital stay. This application reduces the use of opioids for postoperative analgesia and provides protection from their side effects. However, procedure failure, nerve injury and intravascular injection are the most common complications. These blocks were performed with a nerve stimu-

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lator as a standard procedure in the past years. In recent years, performing ultrasound-guided blocks has increased the success of the procedure and decreased the complication rate.[1–3]

Low number of studies, knowledge and experience in pediatric patients led to worries that complications will be more common and caused less use of regional anesthesia techniques. However, good visualization of the anatomy in ultrasound-guided blocks and successful results in adult patients brought up the application of ultrasound-guided brachial plexus blocks in children.[2]

In our study, we aimed to discuss the efficacy and safety of the brachial plexus block in the pediatric patient group retrospectively, by examining the data of the patients who underwent an ultrasound-guided brachial plexus block in our clinic over a 2-year period.

Methods

This study was carried out by retrospectively analyzing the data of 93 children aged 1-15 years, who underwent upper extremity surgery by our hospital orthopedics clinic between January 2015 and January 2017, after the approval of the Ethics committee (Date: February 20, 2018, No: 1905). Patients whose data were not available from the perioperative and postoperative records and patients without brachial plexus block under ultrasound guidance were excluded from this study.

Demographic data, such as age, gender and operation diagnoses of patients, were recorded from the preoperative anesthesia evaluation form.

In our clinic, ultrasound-guided brachial plexus applications are performed routinely in the regional block room in the premedication unit or in the operation room after general anesthesia. Standard monitoring is performed to patients with heart rate and peripheral oxygen saturation (SpO_2) measurements. All the procedures are carried out with a 6-18 MHz linear probe and portable ultrasound device (ESAOTE, Italy). SonoTAP cannula, 22 G, 80 mm (Pajunk Medizintechnologie GmbH Geisingen, Germany), is used for the procedure.

Procedure and operation times were examined through anesthesia documents retrospectively and recorded as study data. The duration of the procedure was defined as the time between skin disinfection and administration of the local anesthetic. The operation time was defined as the time from skin incision to the last suturing.

Applied block type (interscalene, supraclavicular, infraclavicular, axillary block), local anesthetics and adjuvants used for the block, anesthesia techniques applied during the block and the operation (intubation, laryngeal mask, sedation), sedative agents used, motor and sensorial block times, anesthesia documents and postoperative records were examined retrospectively and recorded as study data. Motor block time is defined as the time from the time when the Modified Bromage Scale (0 = no motor block, 1 = no shoulder abduction, 2 = both shoulder abduction and elbow flexion are absent, 3 = full motor block) is 1 and above until the motor block disappears completely. The sensorial block time is defined as the time between the disappearance of the sensation of pain and the reappearance of the sensation of pain in one of the dermatomes with a pinprick test performed on one of the C4-T1 dermatomes.

Side effects and complications, such as bradycardia, tachycardia, hypotension, desaturation, numbness in the tongue, convulsion, vascular puncture, pneumothorax related to the procedure and local anesthetics, were retrospectively analyzed through anesthesia documents and recorded as study data. Complications, such as bradycardia, tachycardia, hypotension, hypertension, pain sensation during the operation, were examined retrospectively through anesthesia documents and recorded as study data. Complications seen during the period until the motor and sensory block disappeared postoperatively were examined retrospectively through anesthesia documents and postoperative records and recorded as study data. However, since our follow-up did not continue after this stage, data on complications that could be seen in the long term could not be recorded.

Statistical Analysis

SPSS 15.0 for Windows program was used for statistical analysis. Descriptive statistics were given as mean and standard deviation for numerical variables.

Results

Between January 2015 and January 2017, 93 children between the ages of 1-15 had undergone upper extremity surgery in the orthopedic clinic. Ultrasound-guided brachial plexus block was performed in 24 patients. The supraclavicular block was applied to 15 of the patients, and the infraclavicular block was applied to nine patients. Interscalene block and axillary block were not applied. The mean age of the patients was 9.6±3.12 years. M/F ratio was 14/10. The duration of the procedure was 9.54±2.14 minutes in patients who received the supraclavicular block, 12.9±2.8 minutes in patients who received the infraclavicular block, and the mean operation time was 64±13.6 minutes (Table 1). Distribution of the operation diagnoses are given in Table 2, the distribution of local anesthetics and adjuvant agents used for the block are given in Table 3, the

Table 1. Demographic Data: Operative and Procedural Times

Age (year) (Mean±SD)	9.6±3.12
Gender (Male/Female)	14/10
Operative Time (minute) (Mean±SD)	64±13.6
Supraclavicular Block Time (minute) (Mean±SD)	9.54±2.14
Infraclavicular Block Time (minute) (Mean±SD)	12.9±2.8

Table 2. Distribution of Diagnoses

Diagnoses	**n=24**
Left forearm double fracture	7
Left radial head fracture	5
Right radial head fracture	4
Left ulna proximal end fracture	2
Right forearm double fracture	2
Tendon incision	4

Table 3. Distribution of Local Anesthetics and Adjuvants Used

Local Anesthetics Used	**n=24**
Bupivacaine	3
Bupivacaine+Lidocaine	21
Adjuvant Agents	**n=8**
Fentanyl	5
Dexmedotomidine	2
Dexametasone	1

Table 4. Distribution of Anesthetic Procedures, and Sedative Agents

Type of Anesthesia during Procedures	**n=24**
Intubation	1
Laryngeal Mask	11
Sedation	12
Perioperative Sedatives	**n=12**
Dexmedetomidine	5
Propofol	4
Remifentanyl	3

Table 5. Motor ve Sensorial Block Times

Patients who underwent supraklavicular Block	**n=15 (Mean±SD)**
Motor Block Times (hour)	7.5±2
Sensorial Block Times (hour)	10.5±1.7
Patients who underwent infraclavicular block	**n=9 (Mean±SD)**
Motor Block Times (hour)	7.4±1.5
Sensorial Block Times (hour)	10.45±1.15
Patients who also receved adjuvants	**n=8 (Mean±SD)**
Motor Block Times (hour)	7.7 ±0.5
Sensorial Block Times (hour)	11.12±1.1

distribution of the anesthesia techniques used during the block and the operation and the distribution of the agents used in patients receiving sedation are shown in Table 4. Motor block time was 7.5±2 hours in patients treated with supraclavicular block, 7.4±1.5 hours in patients treated with infraclavicular block. Sensorial block duration was 10.5±1.7 hours in patients receiving supraclavicular block, 10.45±1.15 hours in patients receiving infraclavicular block. Motor block time of the patients who received additional adjuvants was 7.7±0.5 hours, and sensorial block time was 11.12±1.1 hours (Table 5). None of the patients had complications during the procedure, peroperatively and during postoperative follow-up.

Conclusion

In brachial plexus blocks, imaging the distribution of important structures, such as arteries, veins, pleura adjacent to nerve structures and local anesthetic drugs used in high volumes with the use of ultrasound instead of blind techniques, both increased the block success and decreased the complication rate. With an ultrasound-guided block, the application time is shortened, the block time is extended and the local anesthetic volume used decreases.[4–6]

Because of the higher risk of pneumothorax in pediatric patients, especially in supraclavicular blocks, and avoiding the consequences of high volume local anesthetic distribution, brachial plexus blocks applied by blind technique have been avoided.[7] The number of randomized-controlled studies in this area in this patient group is very low. Marhofer et al.[8] reported in their study comparing the use of neurostimulator and the application of infraclavicular block with ultrasound guidance in children for the first time that the onset of action was shorter and the duration of motor and the sensorial block was longer with the use of ultrasound. In the ultrasound-guided group, the duration of the sensorial block was 384 minutes, while the motor block time was 310 minutes. In our study, the mean motor block time was 450 minutes, while the sensorial block time was 630 minutes.

De Jose Maria et al.[9] compared the application of supraclavicular block and infraclavicular block with ultrasound guidance and achieved 95% surgical anesthesia in the group treated with supraclavicular block and 88% in the group treated with infraclavicular block. The time to apply the block was nine minutes for the supraclavicular block and 13 minutes for the infraclavicular block. We preferred

to apply a supraclavicular block in our clinic. Our results were compatible with the literature. Our supraclavicular block application time was 9.5 minutes, and infraclavicular block application time was 12.9 minutes. We found similar motor and sensorial block times. Both blocks had similar efficacy, but the procedure time was shorter in the supraclavicular block.

Many advantages of applying brachial plexus blocks with broad clinical indications are known. However, ultrasound-guided blocks require dexterity, experience and training, especially for pediatric patients.[10]

Amiri et al.[2] reported the operation time as 61.3 minutes in ultrasound-guided supraclavicular block application. In our study, the mean operation time was 64 minutes.

Xu et al.[11] used ropivacaine in their study to determine the optimal effective local anesthetic dose with the use of ultrasound in the brachial plexus block in children and determined the optimal concentration for ropivacaine as 0.4%. In our study, we used bupivacaine 0.5% in three patients, 0.5% bupivacaine-2% lidocaine in 21 patients because ropivacaine was not available in our country. To our knowledge, there is not any research intp adjuvant use in the brachial plexus block in children is available. In studies conducted in adults, data are available indicating that adjuvants, such as dexmedetomidine, dexamethasone shorten the onset of action, prolong the duration of action and reduce the dose of local anesthetic.[12–14] In our study, dexmedetomidine was used in two patients and dexamethasone was used in one patient. There is also evidence that fentanyl supplementation prolongs block time in adult patients.[15] We used fentanyl supplementation in five patients. Although the number of our patients who used adjuvants was low, we detected prolonged motor block and sensorial block time in these patients. This prolongation was more pronounced in sensorial block time. The longest sensorial block time was 13 hours in our patient who had dexamethasone supplementation during the supraclavicular block.

There are insufficient data on general anesthesia or sedation administration in children after brachial plexus block. However, a common practice to ensure that children tolerate the procedure is to perform the procedure with general anesthesia or deep sedation. Although some studies report that the rate of complications increases in blocks administered under anesthesia, Pediatric Regional Anesthesia Network (PRAN) has reported that complication rates for regional anesthesia applications when awake, under sedation, or under general anesthesia are not different.[16, 17] In our study, the procedure was performed to12 patients after sedation in the premedication unit and to 12 patients following general anesthesia in the operation room. Only one of the patients undergoing general anesthesia was intubated, and 11 patients were applied the laryngeal mask. Infusion sedation was continued during the operation in patients who were applied block with sedation. Of these patients, dexmedetomidine was used in five patients, four patients had propofol, and three patients had remifentanil infusion. Any comparative study, including sedative agents used during regional anesthesia and operation in children, is not available. The limitation of our study is that it contains a small number of patients, there is no comparative study, and it is retrospective.

As a result, ultrasound-guided brachial plexus blocks are the most preferred supraclavicular blocks in our clinic. Ultrasound-guided brachial plexus blocks performed in pediatric patients are very effective with long analgesia times and very safe due to the absence of complications. Prospective studies with a larger number of patients are needed in this area.

Disclosures

Ethics Committee Approval: The Ethics Committee of Sisli Hamidiye Etfal Training and Research Hospital provided the ethics committee approval for this study (1905/2018).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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