BRAKİYAL PLEKSUS ANESTEZİSİ İÇİN SİNİR STİMÜLATÖRÜ VE ULTRASONOGRAFİ UYGULAMASININ KARŞILAŞTIRILMASI

Amaç: Üst ekstremite ameliyatlarında değişik teknikler kullanılarak aksiller brakiyal pleksus bloğu yapılabilmektedir. Çalışmamızdaki amaç, aksiller brakiyal pleksus bloğunda ultrasonografi ve periferik sinir stimülatörü kullanımının etkinliğini karşılaştırmaktır.

Hastalar ve Yöntemler: Çalışmaya elektif önkol ve el cerrahisi geçirmesi planlanan 60 hasta dahil edildi. Grup 1'(n=30)'e ultrasonografi kullanılarak, Grup 2 (n=30)'ye periferik sinir stimülatörü kullanılarak aksiler blok yapıldı. Duyusal ve motor bloğun kalitesi ve başlangıç zamanı değerlendirildi.

Bulgular: Aksiller bloğun oluşması için gereken zaman her iki grupta benzerdi. İstatistiksel açıdan anlamlı olmamakla birlikte duyusal bloğun oluşması Grup 1'de daha erkendi. Fakat motor bloğun derecesi Grup 1'de Grup 2'ye göre daha yoğundu.

Sonuç: Ultrasonografi eşliğindeki aksiller brakiyal pleksus bloğu; hızlı etki başlangıcı ve daha iyi motor blok kalitesi ile, periferik sinir stimülatörü tekniğine göre tercih edilebilir bir yöntemdir.

Anahtar sözcükler: sinir stimülatörü, brakiyal pleksus, ultrasonografi, rejyonal anestezi, aksiller sinir bloğu.

COMPARISION OF NERVE STIMULATOR AND ULTRASONOGRAPHY APPLICATION FOR BRACHIAL PLEXUS ANESTHESIA

Objectives: Axillary brachial plexus block can be provided through various techniques in upper extremity operations. The purpose of our study was to compare the efficacy of axillary brachial plexus block using an ultrasound technique to peripheral nerve stimulation technique.

Patients and Methods: Sixty patients who are planned an elective forearm and hand surgery were included in the study. Group 1 (n=30) was applied axillary block by using ultrasonography, Group 2 (n=30) was applied axillary block by using peripheric nerve stimulator. The quality and the time of onset of the sensorial and motor blockade were assessed.

Results: The average time needed to perform the axillary brachial plexus block was similar in both groups. Although not significant statistically, it was observed that the sensory block was formed earlier in Group 1. However, the degree of motor blockade was more intense in Group 1 than in Group 2.

Conclusion: The ultrasound-guided axillary brachial plexus block is a preferable method with faster onset time and better quality of motor blockade compared to PNS technique.

Key words: Nerve stimulator, brachial plexus; ultrasonography, regional anesthesia; axillary nerve block.

Introduction

Regional anaesthesia can be defined as removing nerve conduction and pain at certain parts of the body without causing sensory loss.[1] Many other methods have been described until today since Hirschel's application of the blinding axillary block in 1911.[2,3]

Brachial plexus can be blocked through various anatomical approaches such as interscalene, supraclavicular, infraclavicular and axillary approaches. Axillary block techniques can be applied by using transarterial fixation, paresthesia or nerve stimulator.[4] Current techniques available for nerve localization mark anatomical indicators for the estimated location of brachial plexus. As well as causing anxiety in the patient and long application processes, blinding techniques may also cause nerve damages, vein perforations and complications such as systemically local anaesthetic toxic reactions.[4] Nerve stimulator technique, however, ensures that the needle is correctly placed without causing paraesthesia. Ultrasonography allows us to display brachial plexus with a higher quality and helps nerve localization and these can increase the quality of the nerve block. Through ultrasonography (US), peripheral nerves, needle localization and local anaesthetic distribution, that is required for a successful conduction of a block, can be directly displayed.[5]

In our study, we have aimed to compare the sensory and motor block effects of peripheral nerve stimulation (PNS), which facilitates the application of axillary brachial plexus block (AXB) and increases the prospects, and the technique of US that has recently been put into use.

Patients and Methods

Having obtained the required written consents both from the Ethics Committee and from the 60 ASA I-II patients undergoing elective upper minor-limb surgery, including forearm, wrist, and hand procedures, the patients were prospectively enrolled. Using a computer-generated sequence of random numbers and sealed envelope technique, patients were randomly allocated to receive axillary brachial plexus block using either ultrasound (US-guided group, n = 30) or nerve stimulation (PNS group, n = 30) guidance. Those with history or presence of cardiac, respiratory and/or renal failures and those who were pregnant were not included in the study. No premedications were applied to the cases.

An intravenous cannula was inserted into the contralateral arm, and a continuous crystalloid solution infusion was started. For the whole procedure the patients were routinely monitored with electrocardiogram (ECG), non-invasive blood pressure (NIBP) measurement, and pulse oximetry (SpO_2).

AXB was carried out by abducting the arm that was planned to be blocked in a way to create a 90° angle with the body and by flexing and externally rotating the forearm so that the hand can be placed right next to the head and the palm can be positioned as facedown. Following the positioning of the cases in both groups, the area on the axillary region to be operated was disinfected.

After the appropriate positioning of the US-guided group-patients and following the completion of the required preparations, a 22 G insulated needle (Stimuplex® D 50 mm, B.Braun, Germany) was inserted into the axillary region under US guidance (by using Aloka® SSD-4000, Japan, 10 Mhz prob). First radial, next median, thirdly ulnar and lastly musculocutaneous nerves were identified. After identification of each nerve, 7-

10 ml local anesthetic totally 40 ml of 0.75% ropivacaine for the four nerves was injected; until the nerve was completely surrounded.

As for the cases of PNS Group, following the appropriate positioning and completion of the required preparations, similar to the other group, in total 40 ml - for each nerve 7-10 ml - of 0.75% Ropivacaine was injected by using nerve-stimulator-specific, sterile, teflon-isolated needles (22G insulated needle) (Stimuplex® D 50 mm [15°]) in company with the available nerve stimulator (Stimuplex® Dig RC, B.Braun, Melsungen, Germany) and at the same time, the motor response given by the nerves that form the brachial plexus to nerve stimulation was also considered (radial: *arm and finger extension, supination;* median: *wrist, 2nd and 3rd finger flexion, pronation*; ulnar: *4th and 5th finger flexion, thumb adduction*, musculocutaneous: *arm flexion*).[6]

Time including sonographic overview and identification of the targeted structures for US-guided group, identification of the nerves via peripheral nerve stimulator for PNS group, subcutaneous infiltration of the injection site, and application of local anesthetic to the direct vicinity of the four targeted nerves in both of two groups.

At the end of the AXB, the anesthetist performing the block evaluated sensory and motor block as follows: every five minutes and for 30 minutes the innervated areas each dermatome was evaluated using a pinprick. When the needles were no longer felt, cutaneous anesthesia was considered to be present. The motor block was evaluated once at the end of the 30 minute period. The motor block was estimated as being 0, 33, 66 or 100 %: 100%, *no movement at all of the upper limb against gravity*; 66%, *flexion and/or extension movements in the hand but not in the arm*; 33%, *flexion and/or extension movements in both the hand and the arm against gravity but not against*

resistance; 0%, *flexion and extension movements in both the hand and the arm against resistance.*[6]

The block was considered to be complete if the dermatomes of the nerves implicated in the surgical site were anaesthetised. All nerves of the surgical site including those of the skin, muscles, and bones were considered. The block was evaluated as incomplete and in need of completion before surgery if one of the nerves of the surgical site was not anesthetized.

Statistical Analysis

All data were collected in an Excel®-Sheet for documentation. For statistical analysis, the program SPSS 13.0 ® for Windows (LEAD Technologies Inc, USA, 2004) was used. The Mann-Whitney U test was used to compare the differences between demographic data of patients such as age, height, weight, and ASA status. Chi square test was used to compare the differences related to gender. Differences in the onset times and anesthesia between the four nerves were tested using Friedman Repeated Measures Analysis of Variance (ANOVA) on Ranks. Parameters were given as mean ± standard deviation. A p value of less than 0.05 was considered statistically significant.

Results

Twenty-nine female and 31 male patients were enrolled in the study. The demographic data and ASA status of the patients are shown in Table 1. No differences between the two groups were found with regard to the demographic data or ASA status.

The time needed to perform the AXB averaged is similar in the two groups (p>0,05) (Table 2).

Although not significant statistically, it was observed that the sensory block had formed earlier in US-guided group (7.3±2.6 min in US-guided group, but 6.4±3.9 min in PNS group, p: 0.39). The degree of motor blockade was more intense in US-guided group than in PNS group (p<0.05) (Table 3). The success rate of the sonographically guided axillary plexus block was 100 %.

There were neither cardiovascular side effects nor any accidental vascular punctures. There were no postoperative neurological symptoms reported**.**

Discussion

There are various techniques to block the brachial plexus clavicle at different levels from both under and above. Lately, most of the techniques used to inject the local anesthetics have stipulated the use of paraesthesia. However, frequency of neurologic complications that occur following the AXB, varies between 0.2 and 19%. This may occur as a result of a direct trauma to the nerve, local anesthetic toxicity, ischemia or a combination of all these factors.[7,8]

The spread of LA around all nerves is obligatory to achieve complete AXB. Anatomical studies show the neurovascular space to be divided by multiple septae.[9] And this is the main reason for incomplete AXB. Two different methods are used to solve this problem. One is the use of high LA volumes to achieve a good distribution in the axillary sheath.[10] This method has a low risk of nerve damage so the cannula is not redirected in an area already anaesthetised. But incomplete blockades occur in patients with firm tissue surrounding the nerves.

A more effective second method is the multiple approach to terminal nerve branches by using nerve stimulation.[11,12] Nerve stimulators, that were first applied in 1912 but put into clinical use in 1962, have been an alternative to the technique of paraesthesia. It was believed that nerve stimulator minimized the possibility of a probable neuropathy that could be caused by direct acute physical contact with the nerve with paraesthesia technique. But this method increases the risk of nerve damage by redirecting the cannula in a previously anaesthetized area. Therefore, paraesthesia as a warning sign loses its value.[13] Fanelli et al[11], reported a rate of 1.7% transient neurological complications using a multiple injection technique for peripheral nerve blockade.

The ultrasound approach identifies nerves, vessels, muscles, and septa. One main advantage of the sonographical approach is the ability to monitor the whole procedure of nerve blockade. Damage to important structures like vessels can be avoided during the puncture. We had no accidental vessel puncture in any patient too. Therefore, redirecting the cannula can be performed under visual control. The risk of accidental nerve damage can thus possibly be reduced. On the other hand, not only does ultrasonography give us the opportunity to observe the LA solution surrounding the nerve but also it lets us observe the optimal distribution of the injected LA solution around the nerve.

In our study, 86.67% of the cases in PNS group formed a sensory full block and 76.67% of these formed a motor full block within the first half hour.(Table 2 and 3). On the other hand, in US-guided group sensory full block and motor full block rates were 100%. The fact that we receive better results following the US application is mainly caused by the possibility of observing the nerves forming the brachial plexus and the distribution of local anaesthetic liquid. Whether the consequently applied LA liquid had completely reached the targeted tissues or not can also be monitored.

Besides, ultrasonography can also be used for difficult axillary block applications.[14] Li et al[15] reported that ultrasonography is very useful in terms of application especially for obese cases.

Schwemmer et al[16,17] stated that ultrasonography application significantly increases the success rate of axillary blocks and that starting time of operation following the block is much earlier. Throughout our study, we detected that sensory block started earlier in the ultrasonography-applied group although this was not significant statistically

and on the other hand, that motor block rate in this group was significantly higher in comparison with the other group.

Soeding et al[18] detected that ultrasonography application significantly reduced the starting time of sensory and motor block and that it significantly increased the block quality. Kefalianakis et al[19] stated that ultrasonography application decreases the starting of block. In our study, we have identified that sensory block onset was earlier in the ultrasonography-applied group although that was not statistically significant.

According to Liu et al[20], ultrasonography application provides more accomplished sensory and motor blocks. Same researchers also reported that, through ultrasonography they managed to provide a highly sufficient analgesia without any complications in sixteen axillary-block applied cases of final-stage renal failures.[21] We did not encounter any serious complications in our ultrasonography-applied group throughout the study.

Conclusions

Consequently, we detected that sensory block started earlier in the ultrasound-guided AXB although that was not statistically significant and that, however, success rate of motor block was higher. We believe that ultrasonography application can be a particularly good alternative without causing any complications in cases with anatomic complexities.

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Table 1. Demographic data and ASA status.

	US-guided group	PNS group
Age (year) (mean ± SD)	37.07±16.24	39.96±11.27
Gender (M/F)	13/17	18/12
Height (cm) (mean ± SD)	167.01±8.69	163.56±7.24
Weight (kg) (mean ± SD)	77.41±14.85	74.49±11.26
ASA Status (ASA-1/ASA-2)	14/16	12/18

Makalenin results bölümünün 1.paragrafında adı geçmektedir.

Table 2. Achievement of sensory block in 4 nerves

	US-guided group	PNS group	p value
10 min	13 (43.33%)	9 (30.00%)	0.29
20 min	24 (80.00%)	17 (56.67%)	0.21
30 min	30 (100.00%)	26 (86.67%)	0.67

Makalenin results bölümünün 2.paragrafında adı geçmektedir.

Table 3. Frequency distribution of patients in the two groups according to the motor blockade degree or quality.

Group	Motor blockade (%)			
	0%	33%	66% *	100% *
US-guided	0	0	0	30
PNS	0	0	7	23

*significant difference between the two groups (66% and 100%) ($p<0.05$).

Makalenin results bölümünün 3.paragrafında adı geçmektedir..