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Orıgınal Artıcle

Ultrasound-guided axillary approach for brachial plexus block reduces block onset time compared to midhumeral approach

Brakiyal pleksus bloğu için ultrason eşliğinde uygulanan aksiller yaklaşım, midhumeral yaklaşıma göre blok başlangıç süresini azaltır

Aylin KESKE [1], Semih BASKAN [2], Ismail AYTAC [2], Ayse LAFCI [2*]

[1]University of Health Sciences, Kayseri City Hospital, Department of Anesthesiology, Kayseri/TURKEY
[2]University of Health Sciences, Ankara City Hospital, Department of Anesthesiology, Ankara/TURKEY

ABSTRACT

Aim: Brachial plexus block under ultrasonography guidance is a successful and frequently used anesthesia method for hand, wrist and forearm surgery. Brachial plexus block can be performed with axillary or midhumeral approach technique. In this study, we aimed to compare the intraoperative and postoperative anesthetic and analgesic properties of axillary or midhumeral approach in ultrasonography-guided brachial plexus block.

Material and Methods: This randomized, controlled, double-blind, single-center study included 90 ASA I-III risk patients, aged 18-70 years, who underwent hand, wrist and forearm surgery. In Group I, axillary; in Group II, midhumeral approach techniques were performed for brachial plexus block. Cold test was used to evaluate sensory block, and three-point scale was used to evaluate motor block. Postoperative pain was assessed by visual analog scale.

Results: There was no statistical difference between age, height, weight, BMI and gender characteristics of the patients included in the study. There was no statistically significant difference between the groups in terms of block onset and regression times on both sensory and motor examination ($p > 0.05$). The main result was that axillary approach shortens the complete block onset time on both sensory and motor examination ($p < 0.05$). Another important result was that axillary approach provides higher surgeon and patient satisfaction levels significantly comparing to mid-humeral approach ($p < 0.05$).

Conclusion: Both approaches can be applied successfully in brachial plexus block and can be used effectively in elective surgeries. In patients who underwent axillary approach technique for brachial plexus block, full block onset time is earlier than in patients undergoing midhumeral approach technique. Therefore, axillary approach technique may be preferred in cases requiring urgent surgical intervention.

Keywords: Brachial plexus block; ultrasonography; axillary block; midhumeral block

Corresponding Author*: Ayse Lafci, University of Health Sciences, Ankara City Hospital, Department of Anesthesiology, Ankara/TURKEY
E-mail: ayselafci971@gmail.com
ORCID: 0000-0002-3215-4114
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ÖZ

Amaç: Ultrasonografi eşliğinde yapılan brakial pleksus bloğu el, el bileği ve ön kol cerrahisi için, sık kullanılan, başarılı bir anestezi yöntemidir. Brakial pleksus bloğu, aksiller yaklaşım ya da midhumeral yaklaşım ile uygulanabilmektedir. Biz bu çalışmada, ultrasonografi eşliğinde uyguladığımız brakial pleksus bloğunda aksiller yaklaşım ile midhumeral yaklaşımın, intraoperatif ve postoperatif anestezik ve analjezik özelliklerini karşılaştırmayı amaçladık.

Gereç ve Yöntemler: Randomize, kontrollü, çift kör ve tek merkezli olarak planlanan bu çalışma, ASA I-III risk grubu, 18-70 yaş arası, el, el bileği ve ön kol cerrahisi geçiren, toplam 90 hastayı kapsadı.

Grup I deki hastalara, aksiller yaklaşım ile blok uygulanırken Grup II deki hastalara da midhumeral yaklaşım ile blok uygulandı. Duyusal bloğu değerlendirmede soğuk testi, motor bloğu değerlendirmede 3 nokta skalası kullanıldı. Hastanın operasyon sonrası dönemde ağrısı visual analog skala ile değerlendirildi.

Bulgular: Çalışma kapsamına alınan hastaların yaş, boy, kilo, BMI ve cinsiyet özellikleri arasında istatistiksel olarak fark yoktu. Hem duyu hem de motor muayenede blok başlangıç sürelerinde ve blok gerileme sürelerinde gruplar arasında istatistiksel olarak anlamlı fark yoktu ($p>0,05$). Çalışmamızın en temel sonucu, aksiller yaklaşımın hem duyusal hem de motor muayenesinde tam blok başlangıç süresini kısaltmasıydı ($p <0.05$). Bir diğer önemli sonuç, aksiller yaklaşımın midhumeral yaklaşıma göre anlamlı olarak daha iyi cerrah ve hasta memnuniyeti düzeyleri sağlamasıydı ($p <0.05$).

Sonuç: Brakial pleksus bloğunda her iki yaklaşım da başarı ile uygulanabilen ve elektif cerrahilerde etkin olarak kullanılabilen tekniklerdir. Brakial pleksus bloğu için aksiller yaklaşım tekniği uygulanan hastalarda, midhumeral yaklaşım tekniği uygulanan hastalara göre, tam blok başlangıç zamanı daha erkendir. Bu nedenle acil cerrahi girişim gerektiren durumlarda aksiller yaklaşım tekniği tercih edilebilir.

Anahtar kelimeler: Brakiyal pleksus bloğu; ultrasonografi; aksiller blok; midhumeral blok

Introduction

Brachial plexus blocks are commonly used anesthesia techniques of distal upper extremity, especially for hand, wrist and forearm surgery. As the use of ultrasonography (USG) has become widespread in anesthesia practice, it has been possible to block by visualizing the brachial plexus at different anatomical points throughout the course. USG, furthermore shortened the time to readiness for surgery and decreased the required local anesthetic volume and complications of blocks. [1,2,3]

Traditionally, the brachial plexus block is performed in the axillary fossa or in the midhumeral sheath. The characteristics and patient outcomes of the two aforementioned block methods are scarce.

The aim of this study was to compare the axillary and midhumeral brachial plexus block in terms of patient outcomes and to determine which method would be more appropriate in emergency or elective situations.

Material and Methods

This study was planned as a randomized, controlled, double-blind, single-center study with the approval of local ethics committee numbered E-16-897. Ninety ASA I-III risk patients, aged 18-70 years, undergoing upper extremity distal surgery were included in the study. Patients with concomitant severe cardiac, respiratory, hepatic or renal disorder, mental status disorder, coagulopathy, pregnancy, local analgesic allergy, neurological or neuromuscular disease, infection at the site of application, and patients who did not want to use this method were excluded from the study. After obtaining informed consent, the patients were randomized into two groups. The application site was prepared according to the rules of asepsis-antisepsis. In group I, axillary artery image was detected in axillary fossa by using 6-12 mHz linear ultrasound probe (Logiq e, General Electric, USA). The ulnar, radial and median nerves around the artery were imaged and a 5 cm peripheral nerve block needle was used to block the nerves with the same amount of local anesthetic (5 ml for each nerve). For each patient, in order to relieve tourniquet pain, 5 ml local anesthetic was applied to musculocutaneous nerve between biceps and coracobrachialis muscles.

In group II, axillary artery image was detected in the humeral canal using 6-12 mHz linear ultrasound probe (Logiq e, General Electric, USA) and each of the musculocutaneous, ulnar, radial and median nerves were blocked with 5 ml local anesthetic.

The researcher assessing the block level was blind to the study protocol. Block success was evaluated by sensory and motor block levels. Cold test was used to evaluate sensory block. The sensation of coldness was evaluated by touching with a cotton pad and ice pack. Evaluation was performed on a scale of 0 = no block, 1 = analgesia (positive sense of touch,

negative sense of temperature), 2 = complete sensory block (negative sense of touch), and compared with the opposite arm. A 3-point scale (0 = no block, 1 = partial motor block, 2 = complete motor block) was used to evaluate the motor block. Loss of movement was evaluated by elbow flexion, thumb abduction, adduction and opposition for musculocutaneous, radial, median and ulnar nerves; respectively. The evaluation was done in every 5 minutes for the first 30 minutes. The total score of sensory and motor block was 12. Surgical anesthesia level and block were accepted as unsuccessful if the total score obtained under block was less than 10. For successful block, total score of sensory blocks should be at least 5 out of 6. Patients with block failure within 30 minutes were considered to be unsuccessful as a consequence they were excluded from the study and additional anesthesia was applied. Motor and sensory block regression times were considered as the time when the score per nerve decreased from 2 to 1 according to the 3-point scale and cold test, and the time of termination of the block was considered as the moment when the score per nerve was zero. Postoperative pain was evaluated with visual analog scale (VAS). When the VAS value was greater than 4, additional analgesic requirement was considered. Surgical anesthesia duration, patient and surgeon satisfaction were evaluated as very good, good, moderate and bad. Patients were also observed for possible complications by the blinded researcher during the first 24 hours of hospitalization.

Statistical analysis

Data analysis was performed using SPSS 23.0 statistical package program. When evaluating study data descriptive statistical methods (frequency, percentage, mean, standard deviation, median, min-max) were used and qualitative data were compared using Pearson Chi-Square, Fisher or Yates tests. Kolmogorov-Smirnov test was used to determine whether the data were normally distributed or not. Independent Samples t test was used to evaluate the normal distribution of quantitative data. Mann-Whitney U test was used for nonparametric tests. Power analysis was performed with G * Power 3.1.9.2 statistical package program. As n1 = 45, n2 = 45, α = 0.05, Effect Size d = 0.8; Power (1-β) = 0.96 was found.

Results

There were 45 patients in each group. There was no statistically significant difference between the groups in terms of age, height, weight, BMI, gender and ASA characteristics (Table 1). In the sensory and motor examination (Median-Radial-Ulnar) there was no statistically significant difference between the groups in terms of block onset time (p> 0.05). However there was a statistically significant difference between groups in terms of complete block onset time (p <0.05). In Group II, the duration of complete block onset was significantly longer (p <0.05) (Table 2)

Table 1. Comparison of Demographic Characteristics

	Group I		Group II		
	(n=45)		(n=45)		P
	Mean ± SD		Mean ± SD		
Age, year	40.4 ± 14.3		36.3 ± 15.2		0.188
Height, cm	168.6 ± 10.0		170.7 ± 8.3		0.274
Weight, kg	73.8 ± 12.8		72.4 ± 12.8		0.611
BMI	25.8 ± 3.2		24.7 ± 3.3		0.109
	n	%	n	%	P
Female	17	37.8	20	44.4	0.668
Male	28	62.2	25	55.6	
ASA I	16	35.6	13	28.9	
ASA II	28	62.2	28	62.2	0.348
ASA III	1	2.2	4	8.9	

BMI: Body Mass Index

ASA: American Society of Anesthesiologists Classification

Table 2. Block characteristics.

Complete block onset time (minute) Median (min – max)	Group I (n=45)	Group II (n=45)	P		
Sensorial	15 (10 - 25)	15 (10 - 30)			0.002
Motor	15 (10 - 30)	20 (10 - 30)			0.001
	n	%	n	%	
Additional Anesthesia requirement	0	0.0	3	6.7	0.242

There was no statistically significant difference between the groups in terms of block regression time in sensory examination (Median-Radial-Ulnar) and motor examination (Median-Radial-Ulnar) (p> 0.05). Also, there was no statistical difference between the groups in terms of the need for additional anesthesia (Table 3).

Surgeon satisfaction was significantly higher in Group I (p <0.05). In terms of patient satisfaction, there was no statistically significant difference between the groups during the anesthesia procedure (p> 0.05), while the satisfaction levels of Group I patients were higher during surgery and postoperative period (p <0.05). VAS values and time of additional analgesic requirement were also not different between the groups (p> 0.05).

During the follow-up period, no complications were observed in any of the patients in both group.

Table 3. Comparison of postoperative characteristics between groups			
Block regression time (Motor) (hour) (Mean ± SD)	Group I (n=45)	Group II (n=45)	P
Median	15.1 ± 3.7	14.1 ± 3.3	0.171
Radial	15.1 ± 3.7	14.1 ± 3.3	0.171
Ulnar	15.1 ± 3.7	14.1 ± 3.3	0.171
Block regression time (Motor) (hour) (Mean ± SD)			
Median	12.4 ± 3.2	12.4 ± 3.2	0.948
Radial	12.4 ± 3.2	12.4 ± 3.2	0.948
Ulnar	12.4 ± 3.2	12.4 ± 3.2	0.948
VAS (hour) (Mean ± SD)			
VAS (2).	0.0 ± 0.0	0.0 ± 0.0	1.000
VAS (4).	0.0 ± 0.0	0.0 ± 0.0	1.000
VAS (6).	0.0 ± 0.0	0.0 ± 0.0	1.000
VAS (8).	0.0 ± 0.0	0.1 ± 0.6	0.320
VAS (10).	0.2 ± 0.8	0.6 ± 1.5	0.137
VAS (12).	1.4 ± 2.3	2.1 ± 2.2	0.155
VAS (18).	3.8 ± 2.6	4.1 ± 2.1	0.481
VAS (24).	4.0 ± 1.1	4.1 ± 1.2	0.927
Additional analgesia time (hour) (Mean ± SD)	17.9 ± 4.6	17.2 ± 4.6	0.523
VAS: Visual Analog Scale			

Discussion

The aim of this study was comparing the anesthetic characteristics of axillary approach and midhumeral approach techniques of the brachial plexus blocks under USG guidance in patients undergoing upper extremity distal surgery. The main result was that axillary aproach shortens the complete block onset time significantly comparing to midhumeral approach at brachial plexus blockages. Consistent with the main result, an other important result of our study was higher satisfaction level of patient and surgeon in axillary approach compraring to midhumeral approaach group.

This may be due to the fact that in the midhumeral technique, the nerves become distally away from each other and the motor fibers are exposed to a lower rate of local anesthesia due to separation from the compartment. According to Bloc et al., the distribution of the terminal branches of the brachial plexus in the axillary fossa is well defined. The median, ulnar and radial nerves are located in their special quadrants near the axillary artery. However, the musculocutaneous nerve is usually located between the biceps brachii muscle and the coracobrachialis muscle, approximately 10 mm from the axillary artery. Because of the spatial distribution of the four nerves relative to the axillary artery, multiple needle movements and multiple local anesthetic injections may be required when performing axillary block. Therefore, regardless of the technique (perineural or perivascular) used for axillary block, specific infiltration of the musculocutaneous nerve is required. [4]

While we performed brachial plexus block in axillary approach technique, through ultrasound's instrumentality we performed the musculocutaneous nerve block firstly displayed in axillary fossa and then the combination of median, radial and ulnar nerve blocks. Thus, we performed the block by visualizing the nerves and using local anesthetic at the appropriate volume and concentration.

Bouaziz et al. suggested that the midhumeral approach was superior to the axillary block in which the nerve innervating the surgical site and the musculocutaneous nerve were blocked [5]. Conversely, according to Sia et al., both midhumeral and four nerve injection techniques can provide successful and rapid onset of axillary block. [6] The results of our study generally show anesthesia characteristics similar to studies of Fuzier et al. [7] and Bouaziz et al. [8]

We concluded that, axillary approach of nerve block might be the preferred method in cases requiring urgent surgical intervention, since the onset of the complete block is earlier in patients who underwent axillary approached brachial plexus block compared to patients who underwent brachial plexus block with midhumeral approach.

In our study both techniques provided effective analgesia in the postoperative period. Patients' VAS values and times to first analgesic requirement were similar between groups. Patient and surgeon satisfaction during tourniquet use decreased due to delayed musculocutaneous nerve blockade in midhumeral approach (Group II). Literature of the brachial plexus block comparing these two different techniques indicates that success rates are similar in both groups. [8,9] In our study, the success rate was 100% in Group I and 93.3% in Group II. This can be explained by the fact that the axillary fossa is a relatively closed compartment and that the nerves are closer to each other for axillary approach (Group I). In the midhumeral region, in contrast to the axillary region, the nerves are anatomically relatively distant and discrete. In addition, due to the lack of a closed compartment, the local anesthetic distribution may be slower and may cause each nerve to be blocked at different levels. USG-guided administration of appropriate local anesthetic volume to neural plexuses within a given compartment may ensure optimal block formation. This may have contributed to increased patient satisfaction in Group I.

Conclusion

In conclusion, both axillary and midhumeral brachial plexus block techniques can be used effectively in anesthesia of hand, wrist and forearm surgeries. According to the results of the study, it can be concluded that axillary approach technique should be the first choice especially in emergency situations because it provides surgical anesthesia level earlier and higher surgeon and patient satisfaction levels than midhumeral approach.

Declaration of conflict of interest

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References

1. Liu SS, Ngeow J, John RS. Evidence basis for ultrasound-block characteristics: onset, quality, and duration. Reg Anesth Pain Med 2010; 35: 26-35
2. Demirelli G, Baskan S, Karabeyoglu I, Aytac I, Ornek DH, Erdogmus A, Baydar M. Comparison of ultrasound and ultrasound plus nerve stimulator guidance axillary plexus block. J Pak Med Assoc 2017; 67: 508-12.
3. M. Brattwall, P. Jildenstål Upper extremity nerve block: how can benefit, duration, and safety be improved? An update. F1000 Research 2016; 5: 907
4. Bloc S, Mercadal L, Garnier T et al. Shoulder position influences the location of the musculocutaneous nerve in the axillary fossa. Journal of Clinical Anesthesia 2016; 33: 250-53.
5. Bouaziz H, Narchi P, Mercier FJ et al. Comparison between conventional axillary block and a new approach at the midhumeral level. Anesth Analg 1997; 84: 1058–62.
6. Sia S, Lepri A, Campolo MC, Fiaschi R. Four-injection brachial plexus block using peripheral nerve stimulator: a comparison between axillary and humeral approaches. Anesth Analg 2002; 95: 1075–79.
7. Re´gis Fuzier, MD, Olivier Fourcade, MD, PhD, Antoine Pianezza, MD, Marie- Luce Gilbert, MD, Vincent Bounes, MD, and Michel Olivier, MD. A Comparison Between Double-Injection Axillary Brachial Plexus Block and Midhumeral Block for Emergency Upper Limb Surgery. Anesth Analg 2006; 102: 1856–58.
8. Dupre LJ: Brachial plexus block through humeral approach. Cah Anesthesiol 1994; 42: 767-69.
9. March X, Pardina B, Torres-Bahi S et al. A comparison of triple-injection axillary brachial plexus block with the humeral approach. Reg Anesth Pain Med 2003; 28: 504-508.