



Ultrasonography-Assisted Infraclavicular Block in Upper Extremity Surgery with 3 Different Bupivacaine Doses

Fatih Dogu Geyik^{1*}, Yucel Yuce¹, Zakiye Likoglu¹, Necati Citak²

1.Kartal Dr. Lutfi Kirdar Education and Research Hospital, Anaesthesiology and Reanimation Department, Kartal, Istanbul, Turkey

2.Bakırköy Sadi Konuk Education and Research Hospital, Department of Thoracic Surgery, Bakırköy, Istanbul, Turkey

***Corresponding author:**

Fatih Doğu Geyik, Specialist, MD
Kartal Dr. Lutfi Kirdar Education and Research Hospital,
Anaesthesiology and Reanimation Department,
Kartal, Istanbul,
Turkey
Tel: 00 90 216 458 30 00
Fax: 00 90 216 352 00 83
E-mail: dogugeyik@hotmail.com

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General Note

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ABSTRACT

Aim: Ultrasonography in peripheral nerve blocks without nerve stimulator has become increasingly widespread. We tried to determine the minimum effective bupivacaine dose using three different constants of bupivacaine.

Materials and Methods: 60 patients with the infraclavicular brachial block in hand, wrist, and forearm surgeries were evaluated prospectively. Group I: 20 ml bupivacaine 0.5% + 5 ml serum physiologic + 5 ml lidocaine, Group II: 15 ml bupivacaine 0.5% + 10 ml serum physiologic + 5 ml lidocaine Group III: 10 ml bupivacaine 0.5 + 15 ml SF + 5 mL of lidocaine was administered. We recorded the demographic data, motor and sensory block onset times, VAS scores, patient, surgeon and anesthetist satisfaction.

Findings: There was no statistical difference in age, sex, and ASA among the groups ($p = 0.272$, $p = 0.169$ and $p = 0.432$, respectively). Neither local anesthetic toxicity, neurological complications nor drug allergy was observed in any of the patients. In all cases, the VAS at the 24th hour was 4.9 ± 1.2 when the 6th hour VAS was zero. There was a statistically significant difference between groups regarding 24-hour VAS ($p = 0.03$).

Discussion and Conclusion: Ultrasonography improves the success rate of the infraclavicular block and reduces the associated complications. We believe that single-point injection by ultrasonography is successful in constellations where 10 ml bupivacaine and 5 ml lidocaine are added on selected occasions.

Keywords: infraclavicular block, ultrasonography, regional anesthesia

1. INTRODUCTION

Today, peripheral nerve blocks are common for anesthesia and postoperative analgesia in extremity surgeries. The lateral sagittal infraclavicular block (LSIB) recommended by Klaastad et al. in 2004 for upper extremity surgery is a preferred block application with high success rate and low risk of complication¹.

During peripheral nerve blocks, nerve localization can be performed by using anatomical landmarks and using paresthesia and electrical nerve stimulation. However, these three methods do not provide information about the distribution of the injected local anesthesia when the needle tip includes information about the nearness of the target sinus². With the use of ultrasound (US) technology in peripheral nerve blocks, the location of the nerve, visually control of the needle tip, and distribution of injected local anesthesia (LA) can be monitored. In general, US guidance improves the success rate of the block and decreases the complication rate³. Also, the US makes it possible for a successful nerve block when the assessment of the muscle response to the neurostimulation stimulus is not reasonable.

We aimed to determine the optimal dose for upper extremity surgery using three different bupivacaine doses in the presence of ultrasound imaging technique; follow up of possible side effects and complications, and comparison of postoperative analgesia durations.

2. MATERIALS & METHODS

A total of 60 patients, aged between 18 and 65 years, who were in the physical state of the American Society of Anesthesiologists (ASA) I-II were enrolled in the study after approval from institutional ethical committee with date 31.01.2017 and number 2017/514/100/5. Exclusion criteria before work were; bleeding-clotting disorder, the presence of infection in the injection site, being under 18 years old and over 65 years old, not to be compare-oriented, and to be allergic to the drugs used. On the day of the illness operation day, one day before the other illness operation, the prospectus forms were read and explained. Standardized monitoring (electrocardiogram, pulse oximetry, sphygmomanometer, oxygen mask) was applied to the patient who had not been premedicated for 8 hours before the operation and vein path was opened without operation. The patient's position was adjusted in the contralateral direction of the head, in the supine position of the unblocked arm adduction. The ultrasound probe was placed under the clavicle, medial to the coracoid process, marking the clavicle and coracoid overhang. In the guiding of the notch portion of the ultrasonic probe, the point of use of the in-plane technique was determined as the injection point. After sterilization, local anesthesia was performed with 4 ml of lidocaine (2%) instead of intervention. The local anesthetic drug was injected 10 cm long with 21 G stimulus needle via in-plane technique at the injection point and axillary artery posterior to the nerve cord. We divided the cases randomly into three groups:

Group I: 20 ml bupivacaine 0.5% + 5 ml serum physiologic + 5 ml lidocaine, Group II: 15 ml bupivacaine 0.5% + 10 ml serum physiologic + 5 ml lidocaine Group III: 10 ml bupivacaine 0.5 + 15 ml serum physiologic + 5 mL of lidocaine was administered. The

practitioner gave the 30 ml solution which is unknown in which group is aspirated. Aspirations were repeated after five mL of local anesthetic was administered. In the first aspiration, the injection point was changed in case of blood. Sensory and motor block onset was recorded by the patients at 5-minute intervals until 30 minutes. After 30 minutes, general anesthesia was passed to patients who did not have enough sensory and motor blocks, and the block was considered as unsuccessful and noted. Sedation (2mg of midazolam) was used as an adjunct to patients with discomfort during the operation. During the operation and in the postoperative collection room; nausea, vomiting, pruritus, respiratory depression, pain and Horner's syndrome were complications. Patient sensory and motor block onset times, the comfort of the perioperative patient and the surgeon, pain initiation times were determined after 24 hours and one week postoperatively.

SPSS 19.0 package program was used for statistical analysis of the data. Categorical measurements were summarized regarding number and percentage as the mean and standard deviation (median and minimum-maximum) for differential measurements. Chi-square test was used to compare comprehensive analyses between groups. In the comparison of numerical studies between groups, Student t-test was used in case of normal distribution of variance, Mann Whitney U test in case of no normal distribution. Chi-square test and Fisher-Freeman-Halton test were used to compare categorical variables among the groups. $P < 0.05$ was considered significant.

3. RESULTS

The average age of the patients was 37.7 ± 15.1 , 40 of them were male, and 20 of them were female. The ASA score was 1 in 41.7% of the cases ($n = 25$) and the ASA score was 2 in 58.3% ($n = 35$). There was no statistically significant difference between groups in terms of age, sex and ASA ($p = 0.272$, $p = 0.169$ and $p = 0.432$, respectively) (Table 1).

The motor block was initiated on the fifth minute in 19 cases, in 10 minutes in 27 cases, in 15 minutes in 11 cases and 30 minutes in one case while general anesthesia was passed because two blocks failed. One of these two cases was in Group 1, and the other was in Group 3. There was a statistically significant difference between the groups regarding the number of motor block starts ($p = 0.04$). In Group 1, the onset time was up to 5 minutes ($n = 11$; 61.1%) in Group 2 and in Group 3, at the 10th minute ($n = 10$, 50% and $n = 12$, 60%, respectively). There was a statistically significant difference between Group 1 and Group 2 ($p = 0.04$) and between Group 1 and Group 3 ($p = 0.009$) while there was no statistically difference between Group 2 and Group 3 ($p = 0.885$) (Table 1).

Table 1 Demographic characteristics of the patients and their findings during anesthesia and comparison of these findings with the groups

	GROUP 1 (n=19)	GROUP 2 (n=20)	GROUP 3 (n=21)	p	TOTAL (n=60)
Mean age	44.1±15.9	31.4±11.8	37.9±15.4	0.272	37.7±15.1
Gender					
Male	13	16	11	0.169	40
Female	6	4	10		20
ASA					
1	9	6	10	0.432	25
2	10	14	11		35
Motor block onset *					
5.min	11 (61.1%)	5 (25%)	3 (15%)	0.04 ^a	19 (32.8%)
10.min	5 (27.8%)	10 (50%)	12 (60%)		27 (46.6%)
15.min	2 (11.4%)	4 (20%)	5 (25%)		11 (19%)
30.min	--	1 (5%)	--		1 (1.7%)
Sensory block onset *					
5.min	13 (72.2%)	9 (45%)	3 (15%)	<0.001 ^b	25 (43.1%)
10.min	5 (27.8%)	8 (40%)	13 (65%)		26 (44.8%)
15.min	--	3 (15%)	4 (20%)		7 (12.1%)
Demand of additional support	5.3%	15%	33.3	0.02 ^c	18.3%
Total motor block	14.1	12.4	12.1	0.06 ^d	12.8

duration (mean, hour)					
Total sensory block duration (mean, hour)	16.4	14.0	12.6	0.001 ^e	14.2

*In Group 1 and Group 3, one case was not taken into account because it was turned into general anesthesia

^a Group 1 vs Group 2; $p=0.04$, Group 1 vs Group 3; $p=0.009$, Group 2 vs Group 3; $p=0.885$

^b Group 1 vs Group 2; $p=0.03$, Group 1 vs Group 3; $p<0.001$, Group 2 vs Group 3; $p=0.108$

^c Group 1 vs Group 2; $p=0.329$, Group 1 vs Group 3; $p=0.02$, Group 2 vs Group 3; $p=0.180$

^d Group 1 vs Group 2; $p=0.117$, Group 1 vs Group 3; $p=0.06$, Group 2 vs Group 3; $p=0.771$

^e Group 1 vs Group 2; $p=0.03$, Group 1 vs Group 3; $p<0.001$, Group 2 vs Group 3; $p=0.218$

The sensory block was initiated at the fifth minute in 25 cases, at 10 minutes in 26 cases, at 15 minutes in seven cases, and in two cases the general anesthesia was passed because the block was unsuccessful. These two cases were the two mentioned above. There was a statistically significant difference between the groups regarding the number of sensory block initiation ($p < 0.001$). In group 1, the onset time was 5 minutes max ($n = 13$; 72.2%), and 5 minutes in group 2 ($n = 9$, 45.5%). In group 3, it started at the 10th minute ($n = 13$, 65%). There was a statistically significant difference between Group 1 and Group 2 ($p = 0.03$) and between Group 1 and Group 3 ($p < 0.001$), while there was no statistically difference between Group 2 and Group 3 ($p = 0.108$) (Table 1).

Gender did not affect the both motor and sensory initiation times ($p = 0.249$ and $p = 0.387$, respectively). In 18.3% of cases ($n = 11$) additional support was needed and 81.7% ($n = 49$) was not needed. The additional support requirement was not related to age ($p = 0.846$), gin ($p = 0.736$) or ASA ($p = 0.338$). However, the group of patients was statistically significant ($p = 0.02$). The additional support requirement was 5.3% in Group 1, 15% in Group 2 and 33.3% in Group 3 (Group 1 vs Group 2, $p = 0.329$, Group 1 vs Group 3, $p = 0.02$, Group 2 vs Group 3; $p = 0.180$). 85% of the patients ($n = 51$) were very satisfied with the procedure and 11.7% ($n = 7$) were satisfied. Similarly, 83.3% of the surgeons were satisfied with the operation ($n = 50$), while 13.3% ($n = 8$) were satisfied. 80% ($n = 48$) of the anesthetists were very satisfied, 13.3% ($n = 8$) satisfied, 3.3% ($n = 2$) were not satisfied (Table 2).

Statistical differences were found between the groups in terms of patient satisfaction, surgeon satisfaction and anesthesiologist satisfaction ($p = 0.01$, $p = 0.008$ and $p = 0.01$, respectively) (Table 2).

While 100% of the patients in Group 1 were very satisfied, 90% of Group 2 patients were satisfied with 75% of Group 3 patients (Group 1 vs Group 2, $p = 0.177$, Group 1 vs Group 3, $p = 0.02$, Group 2 vs Group 3; $p = 0.222$) (Table 2).

Table 2 Satisfaction and comparisons among patients, surgeons and anesthesiologists

	GROUP 1 (n=19)	GROUP 2 (n=20)	GROUP 3 (n=21)	p
Patient satisfaction				
Very pleased	100%	90%	75%	0.01 ^a
Pleased	--	10%	25%	
Not satisfied	--	--	--	
Not at all satisfied	--	--	--	
Surgeon satisfaction				
Very pleased	100%	90%	70%	0.008 ^b
Pleased	--	10%	30%	
Not satisfied	--	--	--	
Not at all satisfied	--	--	--	
Anesthesiologist satisfaction				
Very pleased	100%	90%	60%	0.01 ^c
Pleased	--	--	40%	
Not satisfied	--	10%	--	
Not at all satisfied	--	--	--	

^a Group 1 vs Group 2; $p=0.177$, Group 1 vs Group 3; $p=0.02$, Group 2 vs Group 3; $p=0.222$

^b Group 1 vs Group 2; $p=0.177$, Group 1 vs Group 3; $p=0.01$, Group 2 vs Group 3; $p=0.120$

^c Group 1 vs Group 2; $p=0.177$, Group 1 vs Group 3; $p=0.002$, Group 2 vs Group 3; $p=0.267$

90% of Group 2 patients and 70% of Group 3 patients were very satisfied (Group 1 vs Group 2; $p = 0.177$, Group 1 vs Group 3; $p < 0.001$), while 100% of the surgeons in Group 1 were very satisfied ($p = 0.01$, Group 2 vs Group 3; $p = 0.120$) (Table 2). 90% of Group 2 and 60% of Group 3 were satisfied (Group 1 vs Group 2, $p = 0.177$, Group 1 vs Group 3, $p < 0.001$), while 100% of the anesthetists in Group 1 were very satisfied ($p = 0.002$, Group 2 vs Group 3; $p = 0.267$).

The mean total motor block was 12.8 ± 3.3 hours, and the mean total sensory block was 14.2 ± 3.5 hours. There was a statistically significant difference between the groups regarding the motor ($p = 0.06$), but there was a significant difference between the groups in sensation ($p = 0.001$). The mean motor block was calculated as 14.1 hours in Group 1, 12.4 hours in Group 2 and 12.1 hours in Group 3 (Group 1 vs Group 2, $p = 0.117$, Group 1 vs Group 3, $p = 0.06$, Group 2 vs Group 3; $p = 0.771$). The mean sensory scores were 16.4 hours in group 1 and longer than Group 2 (mean 14 hours) and Group 3 (mean 12.6 hours) (Group 1 vs Group 2, $p = 0.03$, Group 1 vs Group 3, $p < 0.001$, Group 2 vs Group 3; $p = 0.218$). Age, gender, and ASA were not effective on the total motor and sensory block ($p > 0.05$).

In all cases, the VAS at the 24th hour was 4.9 ± 1.2 when the 6th hour VAS was zero. There was a statistically significant difference between groups regarding 24-hour VAS ($p = 0.03$). There was no difference between Group 1 and Group 2 ($p = 0.435$) and between Group 2 and Group 3 ($p = 0.172$) in terms of VAS at 24th hour ($p = 0.01$). Age, gender, and ASA were not sufficient at 24 hours ($p > 0.05$).

4. DISCUSSION

Peripheral block application in the guideline of ultrasonography is almost indispensable. At this rate, the success rate of operations increases and the complications decrease^{4,5}. In our study, we tried to find the minimum effective dose of infraclavicular block by single point injection using only ultrasonography in patients who had upper extremity surgery performed in our clinic. Hadzic et al.⁶ found that analgesia with infraclavicular blockade was better, with no need for additional analgesia, earlier mobilization, and superior side-effects when compared with general anesthesia and the infraclavicular block in day-to-day hand surgery.

Although easy palpation of the axillary artery facilitates blockage of the brachial plexus with the axillary approach, multiple needle penetrations and separate local anesthetic injections are required for each region. Also, axillary and musculocutaneous nerves are previously separated from the plexus so that complete plexus blockage may not be achieved with the axillary method. However, the possibility of neurological damage due to trauma has been reduced since a single injection is made with infraclavicular technique⁷. No nerve damage developed in any of our patients in our study.

Many factors such as age, weight, ASA, the contents of the anesthetic solution, and volume are affecting the regional anesthetic application. Brown described the anatomy of the brachial plexus, type of blockage, patient selection, and the purpose of the blockade to be well known⁸. Demographic data (age, weight) and ASA distribution were examined in our study, all three groups showing similar characteristics.

Arcand et al.⁹ used local anesthesia at a dose of 0.5 ml / kg (max 40 ml) and Koscielniak et al.¹⁰ 0.5 ml / kg (30-50 ml). Sandhu et al.¹¹ reported that they achieved successful results with a total of 21 ml. The risk of systemic toxicity increases especially in older, generalized impaired, patients with liver and renal failure, and in pregnancies. Therefore, it is aimed to obtain the successful block by keeping the volume as low as possible. In our study, we tried to target 10 ml bupivacaine dose to the block by trying to target the minimum effective local anesthetic amount.

Rucci et al.¹² evaluated the patients who underwent orthopedic upper extremity surgery by using 3, 20, 30, 40 ml local anesthetics (1: 200,000 adrenalin with 0.5% bupivacaine. 2% lidocaine in equal amounts) brachial plexus block were found to have higher success rates in the groups using 30 and 40 ml local anesthetics. In our study, we used 10 ml bupivacaine and the block success rates were close to each other as the motor and sensory block duration was started later than 20 ml. In the low-dose bupivacaine group, the need for additional sedation was greater.

In many studies, opioids, sedative drugs, and non-depolarizing muscle relaxants have been shown to be sex-independent factors regarding drug efficacy and safety. However, unlike these anesthetic drugs, local anesthetics cannot be determined by sex. Camorcia et al.¹³ have shown that motor fibers of men are less sensitive than women. There was no difference between the motor and the sensory block between male and female.

In our study, there was a significant difference in the postoperative pain scores between the 24-hour VAS scores and the other groups in the 20 ml group (Group I). Similarly, we did not study in the meta-analyses performed by Yan Z and colleagues showed that lower VAS scores were obtained at 24 h VAS scores¹⁴.

Koscielniak et al.¹⁵ stated that block efficacy, start time and patient satisfaction were similar. In our study, surgeon, patient and anesthetist satisfaction were identical at similar rates.

In a recent study, clonidine was added to anesthetics during nerve blocks and longer duration of motor block and analgesia were observed but they mentioned limited knowledge about dexmedetomidine¹⁶. In another study no difference was observed when clonidine was added to levobupivacaine during axillary brachial plexus block¹⁷. There are some experimental So we think that further studies are required to document safety and effect of addition of adjuncts.

The usage of a combination of local anesthetics in regional anesthesia has been very popular in recent years. These kinds of combinations take advantage of the additive effect of both local anesthetics and the probability that toxicity decreases when compared with single usage of high doses of drugs¹⁸. Lefrant et al. described lesser alterations of ventricular conduction in anesthetized piglets¹⁹. Fujita et al. found increased threshold for bupivacaine-induced ventricular fibrillation in pigs if lidocaine was added²⁰.

As a result, single point injection by ultrasonography without using neurostimulator when the infraclavicular block is performed is a satisfactory application for the patient, surgeon, and anesthetist. We believe that 10 ml bupivacaine combined with lidocaine can be used as a safe anesthesia method in selected cases.

Relatively small doses of lidocaine and bupivacaine were used in this clinical trial, so the optimal dose must be furtherly investigated.

ETHICAL STATEMENT

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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