


Comparative Study of Radial and Median Nerve Blocks with Hematoma Block under Ultrasound Guide in Distal Radius Fracture Reduction: A Randomized Clinical Trial

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Abstract

Background: Distal radius fractures are one of the most common upper extremity fractures, and their incidence continues to increase due to an aging population and an increase in osteoporosis. Various methods of analgesia for distal radius fractures have been described—including hematoma blocks and nerve blocks. Hematoma blocks are a simple and effective method of providing analgesia; nonetheless, their efficacy may be limited in some cases. On the other hand, nerve blocks provide more targeted analgesia and may be more effective in reducing pain during fracture reduction. This study aimed to compare the analgesic effectiveness of radial and median nerve blocks with hematoma blocks under ultrasound guidance in treating distal radius fractures. Also, this study aimed to compare the analgesia of radial and median nerve blocks with hematoma blocks under ultrasound guidance to reduce distal radius fractures.

Methods: In this prospective trial, patients with distal radius fractures referring to 2 academic centers were placed into 2 randomized groups, including hematoma block, and radial median block, both of which were ultrasound-guided. The patient's pain levels were measured and recorded based on the visual analog scale before the block, 5, 10, and 15 minutes after the block, at the start of reduction, during reduction, and 5, 10, and 15 minutes after reduction. Patient satisfaction and physician satisfaction rates were assessed, and side effects were also observed for 1 week. Quantitative variables were reported as mean \pm standard deviation, and number and frequency percentages were reported for qualitative variables. The Student t test and the chi-square test were used on a case-by-case basis. The significance level was set at $P < 0.05$.

Results: In this study, 120 patients were included. The groups had no significant differences in pain reduction during the procedure. Analgesic medication was needed during the procedure for 17 patients; nerve blocks were applied for 6 patients, and hematoma blocks for 11 patients, which was statistically significant ($P = 0.041$). Satisfaction rates for patients and physicians performing the procedure were significantly higher in the nerve block group than in the hematoma block group ($P = 0.001$; $P < 0.001$, respectively).

Conclusion: The results of this study suggest that ultrasound-guided radial and median nerve blocks can be used as alternative methods of analgesia with other techniques in the reduction of distal radius fractures in emergency departments.

Keywords: Hematoma block; Nerve block; Procedural Sedation; Analgesia

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Introduction

Procedural sedation and analgesia (PSA) is a common method used to reduce pain and anxiety during procedures

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↑What is “already known” in this topic:

Nerve blocks using a hematoma block under ultrasound guide is an effective technology in distal radius fracture reduction. However, there is enormous uncertainty around its effectiveness.

→What this article adds:

Through a randomized clinical trial, we tried to find any relevant evidence about the effect of radial and median nerve blocks using hematoma blocks under ultrasound guidance in reducing distal radius fractures. We found that the reduction of distal radius fractures in emergency rooms can be accomplished with ultrasound-guided radial and median nerve blocks in addition to existing analgesic techniques.

in patients referred to emergency departments. During the recovery stage and for the duration of the patient's stay in the emergency room, PSA requires patient monitoring by a qualified and empowered professional (1, 2). Distal radius fracture is commonly treated and reduced in emergency departments. Reduction of distal radial fracture is a painful process, and various methods are used for analgesia, the most common of which include sedation with medication, hematoma block, Bier block, and regional anesthesia. Each method has advantages and disadvantages (3, 4).

Regional anesthesia for distal radius fracture is performed using the brachial plexus block of the supra- or infraclavicle, interscalene, axillary, or elbow area (3, 5). When the block is performed in a higher area, the risk of complications is higher.

Minniti et al indicated that the radial and median nerve block was effective in treating distal radius fracture and resulted in high patient satisfaction and no complications (6). Ultrasound-guided radial, ulnar, and median nerve blocks were used to successfully end all treatments for patients in the Otto et al study (7). In one case report, two effective ultrasound-guided ulnar nerve blocks were performed on the fifth finger after surgery (5).

The current double-masked study aimed to compare the analgesia of radial and median nerve blocks with hematoma blocks guided by ultrasound during the reduction of distal radius fractures.

Methods

Study Design and Setting

In this study, distal radius fracture patients who required distal radius reduction and visited the emergency rooms of 2 academic hospitals in Tehran (Hazrat Rasoul and Sina) during the course of a year participated in this clinical trial. Both emergency departments receive more than 40,000 referrals annually. This study was approved by the Ethics Committee of Tehran University of Medical Sciences (NO. IRCT201111058000N1), and written consent was obtained from all participating patients.

Selection of Participants

Patients aged ≥ 18 years with distal radius fractures that required reduction in the emergency department (short radius of ≥ 1 cm, triangulation dorsal $>15^\circ$ in a standard graph) were included in the study. These patients did not indicate surgery and were discharged from the emergency department after successful reduction.

Patients with impaired consciousness, trauma elsewhere, soft tissue injury, open fractures, hemodynamic disorders, neural or vascular damage at the same time, a history of serious diseases (cardiovascular, respiratory, kidney, and liver disorders), other pain factors, or a history of allergy to lidocaine as well as those patients who had any indication of surgery were excluded from the study.

The sample size of this study was calculated based on the following formula, the data obtained from previous similar studies, and by considering a 10% loss to follow-up rate; and it was equal to 120 patients. Sample size calculation components include mean (M), standard deviation (SD) and C. C was 7.9 and 10.5, respectively, at a significance level of .05. The power of the test was 80% and 90%.

$$N = 2 C \times [\sqrt{(SD_1^2 + SD_2^2)} / (M_1 - M_2)]^2$$

Interventions

Block randomization was used to divide the patients into 2 groups: ultrasound-guided hematoma block (US-HB group) and ultrasound-guided radial and median nerve block (US-RM group). Patients underwent examination and radiography, and after being diagnosed with distal radius fracture requiring a reduction in the emergency department, they were randomly assigned to 2 groups. Single blinding was used in this study, and the participants were randomly divided into 2 groups after explaining the study process. The block under ultrasound guidance was conducted by 4 emergency medicine attending physicians who had under 1 hour of theoretical training and had done at least 25 radial and median nerve ultrasounds. They had 5 years of experience working with emergency ultrasound. The Madison Ultrasound Device (X 8) and 7.5/10 MHz level probes were used. In the US-HB group, the deformity location was sterilized with betadine, and the transducer with a sterile cover was used. The fracture location was then identified by placing the probe on the radius bone sagittally at the area of deformity. The needle was inserted into the hematoma in the middle part of the probe in the dorsal forearm. Aspiration was performed, and 15 ccs of 1% lidocaine were injected. In the US-RM group, the area was disinfected with betadine solution, and a probe with a sterile cover was placed in the lateral arm about 2 cm above the lateral epicondyle. At the same time, the elbow was flexed 90° . This is the place of the oval-shaped radial nerve before it is split into deep and shallow parts between the brachialis and brachioradialis muscles, which was seen as hypoechoic, and 5 ccs of 1% lidocaine was injected around the radial nerve. Then, the probe with a sterile cover was laid in the inner anterior part below the elbow. The median nerve on the side of the ulnar artery, which was hypoechoic, was identified, and 5 ccs of 1% lidocaine were injected around the nerve under direct vision. Prior to the reduction, the patient is tested to determine whether the block worked; if the discomfort subsided, the reduction has occurred. In case of block failure, injectable analgesia has been used for patients. The decline was done 15 minutes after the block began (Figures 1 and 2).

Methods of Measurement

The patient's pain levels were recorded at the beginning of the procedure, 5, 10, and 15 minutes after the block, at the beginning of the reduction, during reduction, and 5, 10, and 15 minutes after reduction using the visual analogue scale method. The time spent performing the block and the length of the patient's stay in the emergency department (from the beginning of the block to patient discharge) were recorded. Early complications such as paresthesia, dizziness, nausea, vomiting, seizures, or allergy to injection were examined and recorded. Late complications, including neurological and infection complications, were studied 24 hours later by phone and a week later in

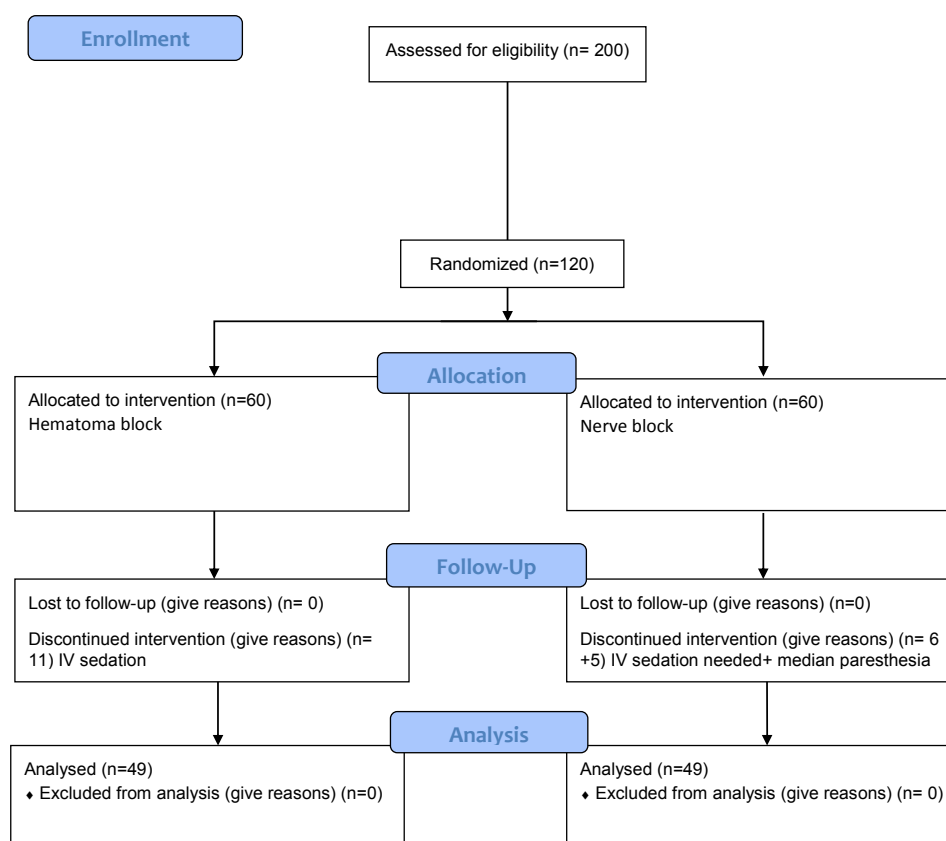


Figure 1. CONSORT Flow Diagram

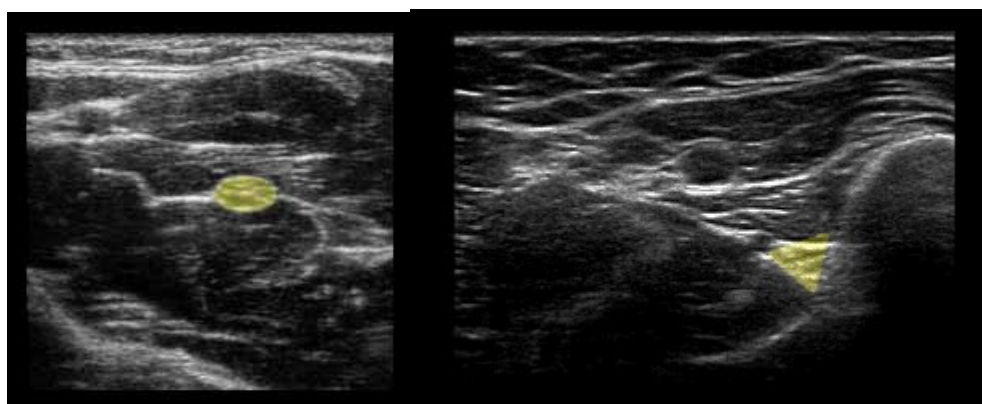


Figure 2. Ultrasound images of median and Radial nerve

the orthopedic clinic. Patients who required analgesia during the procedure were administered 1 microgram of fentanyl according to weight. Based on the Likert scale, patient satisfaction with the analgesia during the block was measured by a questionnaire on 4 levels (very good, good, fair, and poor). The physicians' satisfaction level was also in the form of a researcher's question based on a 5-point Likert scale.

Statistical Analysis

SPSS 18 software was used for data analysis. Quantitative variables were reported as mean \pm standard deviation, and number and frequency percentages were reported for qualitative variables. The Student t test and the chi-square test were used on a case-by-case basis. The significance

level was set at $P < 0.05$.

Results

Included in this study were 120 patients, 85 of whom (70.8%) were men and 35 (29.2%) were female, with an age range of 19 and 85 years (mean age, 47.72 ± 16.81 years). The mean ages of men and women were 43.46 ± 16 and 58.31 ± 13.93 years, respectively; the mean age of women was significantly higher ($P < 0.001$).

A total of 60 patients underwent hematoma block, and 60 underwent nerve block. Among the male patients, 44 (51.8%) received the nerve block procedure, and 41 received a hematoma block. Among female patients, 16 (45.7%) and 19 received nerve and hematoma blocks, respectively. There was no significant difference between

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the sexes regarding the type of anesthesia ($P = 0.571$). The mean ages of patients in the 2 groups were similar at 46.96 ± 17.65 and 48.48 ± 16.05 years, respectively ($P = 0.255$).

Among the 60 patients who underwent nerve block, 5 (4.2%) suffered from median or radial paresthesia. The paresthesia was resolved in all patients who were observed for up to 48 hours.

The mean age of the 5 patients with paresthesia was 58.40 ± 18.6 , and that of other patients was 45.92 ± 17.4 years. Age was significantly higher in patients with neurological complications ($P < 0.001$). Three of these patients were men, and 2 were women. No significant correlation was observed between sex and the incidence of complications resulting from the nerve block ($P = 0.482$).

Seventeen patients (14.2%) required IV sedation during the procedure. Among these, 6 were in the nerve block group, and 11 were in the hematoma block group. A significant correlation was found between the type of procedure and the use of analgesic drugs ($P = 0.041$). Among patients requiring IV sedation, 4 (4.7%) were men and 13 (37.1%) were women. A higher percentage of women needed an injection of analgesic drugs ($P < 0.001$). The mean age of these 17 patients was 62.11 ± 17.09 years, a significantly higher mean than that of patients who did not require IV sedation (45.34 ± 15.62 ; $P < 0.001$).

Based on Table 1, the mean times to perform the nerve block and hematoma block were 6.29 ± 1.57 and 1.30 ± 0.68 minutes, respectively, with a statistically significant difference ($P = 0.025$). Lengths of stay (from the beginning of the block to discharge) in the hematoma block and nerve block were 116.12 ± 31.27 and 125.18 ± 35.67 minutes, respectively, and the difference was not statistically significant ($P = 0.313$).

Patient satisfaction with the methods used was measured. As shown in Table 2, the nerve block method was rated as very good by 35 patients, good by 19, fair by 2, and poor by 4 patients. These values for the hematoma block method were 20, 17, 15, and 8, respectively. Patient satisfaction with the nerve block method was significantly

higher ($P = 0.001$). The level of satisfaction with the treatment procedure was significantly higher in men than in women ($P < 0.000$), such that 86.9% of men rated their procedure as good or very good. Still, only 51.4% of women rated their procedure as good or very good.

The satisfaction of the physicians carrying out the reduction with the methods used was also measured. Table 2 shows that, in the nerve block method, the satisfaction level of 42 physicians was very good, 13 was good, 3 was fair, and 2 was poor. The hematoma block method values were 19, 27, 6, and 8, respectively. Physician satisfaction was also significantly higher for the nerve block procedure than the hematoma block method ($P < 0.001$).

The level of satisfaction of patients and physicians declined with increasing patient age ($P < 0.001$).

The mean of pain expression in men and women was similar at the beginning of the study (9.67 ± 0.93 in men and 9.8 ± 0.47 in women; $P = 0.430$).

Pain relief was calculated as 8.60 ± 1.25 from the beginning of the procedure until 15 minutes after the reduction. Pain relief with the nerve block and hematoma block methods was rated as 9 ± 1.32 and 8.21 ± 1.04 , respectively, a significant difference ($P < 0.001$). Patient satisfaction was analyzed and determined for pain relief, and a significant correlation was observed ($P < 0.001$). No significant correlation was observed between physician satisfaction and patient pain relief ($P = 0.555$).

Also, the amount of drug consumption was at the level of anesthesia, and no significant difference was observed. The pain reduction resulted in a higher degree of patients' satisfaction (Table 3).

Discussion

This study showed that radial nerve block in the area above the elbow and median nerve block in the antecubital area under ultrasound guidance could be used for analgesia with other methods for distal radius fracture reduction in the emergency department. As this study showed, the pain level before and after the distal radial reduction was significantly lower with the nerve block than with the he-

Table 1. Comparing pain scores before, through and after distal radial fracture reduction between study groups

Step	Nerve		Hematoma		P value		Total	
	Block	Reduction	Block	Reduction	Block	Reduction	Block	Reduction
Before	9.6±1.01	2.93±1.64	9.81±0.56	3.33±0.92	0.152	0.103	9.7±0.82	3.1±1.34
5 mins	4.9±0.7	1.83±1.52	5.9±1.2	2.53±1.03	<0.001	0.004	5.4±1.15	2.1±1.3
10 mins	2.3±1.4	0.88±1.23	3.5±1.9	1.81±0.96	<0.001	<0.001	2.9±1.8	1.3±1.19
15 mins	0.78±1.1	0.75±1.15	2.4±2.1	1.6±0.9	<0.001	<0.001	1.6±1.88	1.1±1.12

Table 2. Physicians' and patients' satisfaction regard to analgesia method N (%)

Satisfaction	Nerve		Hematoma		P value		Total	
	Patient	Physician	Patient	Physician	Patient	Physician	Patient	Physician
Perfect	35 (58.3)	42 (70)	20 (33.3)	19 (31.7)	0.001	<0.001	55 (45.8)	61 (50.8)
good	19 (31.7)	13 (21.7)	17 (28.3)	27 (45)	0.001	<0.001	36 (30)	40 (33.3)
fair	2 (3.3)	3 (5)	15 (25)	6 (10)	0.001	<0.001	17 (14.2)	9 (7.5)
low	4 (6.7)	2 (3.3)	8 (13.3)	8 (13.3)	0.001	<0.001	12 (10)	10 (8.3)

Table 3. Pain reduction and patients' satisfaction

Pain reduction	Nerve block	Hematoma block	P value	Total
Perfect	9.62±0.68	9.15±0.74	0.021	9.45±0.74
Good	8.55±1.33	7.7±0.77	0.028	8.14±1.16
Fair (moderate)	7.0±0.0	7.66±0.97	0.362	7.58±0.93
Low (poor)	6.5±1.29	8.0±0.75	0.027	7.50±1.16

matoma block. Still, during reduction, pain relief in the nerve block group was lower, albeit not significantly ($P = 0.103$). To help analgesia during the reduction, medicine was used for 6 patients (10%) undergoing a nerve block and 11 patients (18%) with a hematoma block, which was a statistically significant difference ($P = 0.041$). More fentanyl was used in hematoma blocks, which increased the need to monitor patients' airways in this group. Minniti et al (6) studied 20 patients with a distal radial fracture that required percutaneous fixation with the Kirschner and Epiblock system. In that study, the radial nerve block was done by the simulator in the gutter between the bicep and brachioradialis muscles, and the median nerve block was performed by the same method below the elbow at the forearm volar level. Fifteen blocks were completely successful, but 5 patients (25%) required intravenous injection for the procedure—a higher number of patients than the present study. In the survey conducted by Otto Liebmann et al (7) on patients requiring the studied procedure, according to the innervation, the radial, ulnar, and median nerve blocks were performed under ultrasound guidance by an emergency physician trained for an hour. Also, 22 nerve blocks were performed in 11 patients, 10 of whom had significant pain relief before the procedure. The procedure was performed without any other medication for the 1 remaining patient. In their study, Liebmann et al found that radial, ulnar, and median nerve blocks under ultrasound guidance provided adequate analgesia for the studied procedure. The mean time required for nerve block in each patient was reported for each nerve block individually and was consistent with our study; patient satisfaction was reported as good. These two studies show that using blocks to carry out the surgery in hands and distal radius fractures has a high success rate, which is in line with the findings of the present study. The advantages of the present study are the higher number of patients and the comparison with other methods.

The amount of time required to perform the nerve block was significantly higher than that for the hematoma block. Still, no significant difference between the 2 groups was seen for the length of the patient's stay in the emergency department. It can be concluded that the nerve block procedure does not cause a longer stay in the emergency department. PSA is mainly used in the emergency department, and it requires significant amounts of time and resources, a long time for recovery, familiarity with airway management, cardiovascular resuscitation, and continuous circulation and respiratory monitoring, which can lead to a longer length of stay in the crowded environment of the emergency department (6-8). In the study conducted by Fathi et al (9) on patients with radius fracture, the length of stay was 121.39 ± 54.60 minutes in the hematoma block group and 142.15 ± 34.05 minutes in the PSA group, which was significantly lower in the hematoma group. In the current study, although more time was required for the nerve block than for the hematoma block, patients' lengths of stay were not significantly different.

Regional brachial plexus blocks are done from various places—including interscalene, supra-clavicle, infra-clavicle, and axillary blocks. Their most important com-

plications include intra-arterial and intravenous injection, pneumothorax, phrenic nerve palsy, and unwanted injections to epidural and subarachnoid spaces. (10-13). In the peripheral blocks performed in the current study, the occurrence of such complications was not possible because of the remoteness of the block location from any vital organ.

Complications experienced included persistent numbness, block infection, and neuromuscular weakness after anesthesia. In our study, in the nerve block group, there were 5 cases of paresthesia, all 5 of which were resolved after 48 hours.

In our study, patients' satisfaction was significantly higher than in the hematoma block, possibly because of greater pain relief in the nerve block group.

Limitations

The major limitation of this study is the inability to blind the physicians and patients.

Conclusion

Radial and median nerve block under ultrasound guidance can be used as an alternative method of analgesia with other methods to fix distal radius fractures in the emergency department. This study is the first study on median and radial nerve block in distal radius fractures in the emergency department. More studies are needed with larger sample sizes.

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Author contributions

All authors conceived and designed the study, collected and analyzed the data, and wrote the manuscript. All authors have read and approved the final version of the manuscript.

Conflict of Interests

The authors declare that they have no competing interests.

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