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ORIGINAL RESEARCH

Periosteal Nerve Block Vs. Intravenous Morphine in Pain Relief of Distal Radius and Ulna Fracture; a Double-Blind Randomized Clinical Trial

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Abstract: **Introduction:** Distal forearm fractures' realignment and fixation is a painful procedure. This study aimed to compare the efficacy of periosteal nerve block and intravenous morphine in distal radius and ulna fractures' pain management.

Methods: In the present randomized, parallel, double-blind, controlled clinical trial, patients with distal radius or ulna fractures were divided into two groups. In the first group, for periosteal nerve block, 1% lidocaine was injected at a distance of 6 to 8 cm near the wrist from the lateral radius and medial ulna. In the second group, morphine sulfate at a dose of 0.1 mg/kg was slowly injected through the peripheral vein within 5 minutes. The visual analog scale (VAS) score was evaluated before the intervention and every 15 minutes until 90 minutes after the intervention and was compared between the two groups.

Results: 75 subjects were studied (39 in the periosteal nerve block and 36 in the intravenous morphine group). There were no significant differences between the groups in terms of mean age ($p = 0.384$), gender distribution ($p = 0.464$), past medical history ($p = 0.106$), trauma type ($p = 0.836$), fracture type ($p = 0.613$), and baseline pain severity on VAS ($p = 0.987$). Both methods reduced the VAS scores during the 90 minutes of the study. The mean pain scores of the patients in the periosteal nerve block group with 2.56±1.44, 2.15±1.11, 2.66±1.26, and 3±1.27 at 15, 30, 45, and 60 minutes after the analgesic injection, respectively, were significantly lower than those of the intravenous morphine group with 4.75±1.27, 4.22±1.22, 3.97±1.27, and 4.13±1.35, respectively ($p < 0.001$ for all comparisons). In the present study, no local or systemic complications were observed in the periosteal nerve block group, while the complications of dyspnea, vomiting, and pruritus were reported by 5.5%, 2.8%, and 2.8%, respectively, in the intravenous morphine group. Moreover, the percentage of need for additional analgesia in the intravenous morphine group was higher than that of the periosteal nerve block group.

Conclusion: In the first hour after the intervention, pain reduction in periosteal block was significantly higher than intravenous morphine administration. Also, the incidence of complications and the need for additional analgesia were lower in the periosteal block group compared to intravenous morphine administration.

Keywords: Wrist Fractures; Pain; Visual Analog Scale; Nerve block; Morphine

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1. Introduction

Forearm fractures account for up to 44% of total bone fractures and affect almost the entire age range of the population (1). In approximately 20% of cases, more commonly in elderly ones, the treatment requires hospitalization and invasive surgical procedures (2). The primary approach to this fracture is a crucial determinant of the need for surgery and further hospitalization. Most of these patients need manipu-

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lation, usually consisting of bone realignment and fixation, in the emergency departments (EDs) (3). To perform the manipulation, patients must be anesthetized. Different systemic and local anesthesia techniques have been applied to reduce pain in these patients. The most common methods employed for manipulating these fractures include, but are not limited to, using intravenous morphine sulfate (for systemic anesthesia) and the hematoma block, the Bier block, and the brachial plexus block (for local anesthesia). All these methods have their advantages and disadvantages. In distal forearm fractures, the local anesthetics could spread out into the volar periosteum, because of the fracture's location, and consequently reduce the efficacy of the hematoma block (4). Furthermore, there is the risk of adverse events due to the diffusion of the regional drugs into the circulatory system, both in the hematoma and Bier blocks. These complications include arrhythmia, hypotension, and central nervous system (CNS) complications such as tinnitus, confusion, drowsiness, and seizure (5). Also, the brachial plexus block requires hospitalization and skilled practitioners, making this method infrequent. There is no consensus on the most efficient method for manipulating distal radius and ulna fractures (6-9).

On the other hand, the periosteal nerve block is a recent method that seems to have fewer complications due to the site of injection and the procedural method, which results in a less unpleasant vascular and systemic involvement. It has also been hypothesized that it might better reduce the pain as this method is performed closer to the nerve origin. Tageldin et al. conducted a clinical study on the effects of the periosteal nerve block on the pain intensity and the success rate of manipulating the closed distal radius and ulna fractures. They showed that this method could yield promising results and be effective in these patients (10). In fact, a complicated sensory and autonomic nerve supply is present in bones. The nutrient arteries are accompanied with nerves within the perivascular spaces inside the Haversian systems and provide osteocytes with polypeptides, which contribute to regulate the osteoblastic and osteoclastic activity. However, it must be noted that proposing the precise location for applying the anesthesia could be challenging due to the lack of knowledge about the exact mechanism of periosteal pain sensation.

Based on the above-mentioned points, the current study aimed to compare the efficacy of periosteal nerve block and intravenous morphine in distal radius and ulna fractures' pain management.

2. Methods

2.1. Study design and setting

The present study was a randomized, parallel, double-blind, controlled clinical trial conducted from 2018 to 2019 in Sina Hospital to compare the efficacy and complications of the two mentioned methods in distal radius and ulna fractures' pain management. This trial was in concordance with the declaration of Helsinki and its later amendments. The ethics committee of Tehran University of Medical Sciences approved this trial (IR.TUMS.MEDICINE.REC.1396.2838), and all patients provided informed consent before entering the study. This study was registered in the Iranian Registry of Clinical Trials (registry code: IRCT20131203015640N6).

2.2. Participants

We included patients older than 18 years old with closed distal radius or ulna fractures who needed manipulation in ED. The exclusion criteria were open fractures or fractures associated with evidence of neurovascular damage or compartment syndrome, patients with head or multiple trauma, patients with the loss of consciousness, and patients with contraindication for lidocaine or morphine use.

2.3. Data gathering

At the beginning of the study, the primary demographic and clinical data (age, gender, and the fracture site) were recorded. A visual analog scale (VAS) was used to estimate the amount of pain during the trial. The VAS score is a broadly used instrument that consists of a 10-cm ruler extending longitudinally between zero to ten, with zero indicating no pain or discomfort and ten indicating pain too intense to be tolerated. Patients were asked to mark their inconvenience on this ruler. We recorded VAS just before the injection and at 15, 30, 45, 60, 75, and 90 minutes after the injection in both groups.

The diagnosis by the emergency medicine specialist was based on the clinical examination and radiological findings (anterior and lateral X-ray images of the distal forearm). These patients were classified, based on the guidelines of American Society of Anesthesiologists, either as Class-I (normal healthy patients) or Class-II (patients with mild systemic disease).

2.4. Randomization and blinding

The participants were equally randomized into two groups in a 1:1 ratio. The randomization method was based on permuted block randomization with block sizes of four.

In addition, lidocaine and distilled water were prepared in 10cc syringes and labeled B1 and B2 before the intervention in order to comply with blinding conditions. Moreover, morphine sulfate with the dose of 0.1mg was diluted with distilled water in 5cc syringes such that each cc contained 1mg of morphine (5mg in total). Other 5cc syringes containing placebo were prepared and coded with labels M1 and M2. Then, a 10cc syringe containing lidocaine (B1) and a 5cc syringe containing distilled water (M1) were placed in 46 en-

velopes (as the periosteal nerve block group). Furthermore, a 10cc syringe containing distilled water (B2) and a a 5cc syringe containing placebo (M2) were placed in the other 46 envelopes (as the intravenous morphine group). The envelopes were provided to the emergency medicine specialist daily to administer 10cc syringes in the periosteal nerve and 5cc syringes intravenously. Thus, the interventionist, the patient, the evaluator, and the statistical analyst had no knowledge of the type of intervention in each group until the end of the study.

2.5. Intervention

To perform periosteal nerve block, an injection was performed in the first intervention group using a 10cc syringe with a 22-gauge needle containing 1% lidocaine at a distance of 6-8 cm proximal to the wrist from the lateral radius and medial ulna. In this group, 5cc of distilled water was injected intravenously as placebo instead of morphin.

It is necessary to mention that the periosteal nerve block was performed in the same way as described in Tagelbin et al.'s study (10). The patients were positioned supine on the procedural table with the affected hand on a pillow placed on the dressing table, which was considered to cause the least vascular or neurological complications. Afterward, the 22-gauge needle was directed towards the radius at a right angle until the needle tip leaned on the lateral aspect of the radius. Then, lidocaine solution was injected centrally, slightly anteriorly, and posteriorly to cover the entire lateral surface of the radius. Next, the needle was withdrawn and replaced by another needle at the same entry point. After touching the bone, the injection continued side to side with radius by inserting 0.5 ml of lidocaine solution for every 0.5 cm advancement of the needle. This process continued until the bone could no longer be felt with the needle tip. After withdrawing the needle, the skin was rotated posteriorly, and the needle tip was inserted towards the dorsal surfaceby using the same entry point. The mentioned procedure was repeated for the ventral side. Moreover, this nerve block protocol was also performed for ulnar fracture in the same way (Figure 1).

In the second intervention group, morphine sulfate was calculated at the dose of 0.1mg per kilogram of body weight and diluted with distilled water in pre-prepared syringes such that each cc contained 1mg of morphine. This amount was slowly infused through the peripheral vein within 5 minutes. Block operation was also done using distilled water.

The manipulation procedure was performed 15 minutes after performing periosteal nerve block or intravenous morphine injection. It should be noted that in both methods, if the patient's pain score did not reach less than 5 within 30 minutes after the intervention, fentanyl at the dose of 1mcg/kg after dilution with 5cc of distilled water was administered intravenously as the additional analgesia.

2.6. Outcomes

Change in pain severity at 15, 30, 45, 60, 75, and 90 minutes after the injection (based on VAS score) and systemic or local complications were considered as outcomes of this study.

2.7. Statistical analysis

The sample size was estimated to be 46 patients in each group, considering the confidence level of 95% and the test power of 80%, as well as the assumption of equal variance of pain in the two groups, and the mean difference of pain equal to 0.6.

The statistical package of social science software (SPSS Inc., Chicago, IL, USA) was used to compare the two study groups. Continuous variables were represented using mean and standard deviation, while categorical variables were demonstrated as frequency and percentage. A Chi-squared test was performed to evaluate the differences between categorical parameters. Considering the result of the Kolmogorov-Smironov test indicating the normal distribution of data, univariate analysis was used to compare the mean pain score between the two groups by adjusting need for additional analgesia. Moreover, independent samples t-test was used to compare other quantitative variables between the two groups. The significance level of p-value less than 0.05 was considered in all analyses.

3. Results

3.1. Baseline characteristics of studied cases

From a total of 92 patients, 17 subjects were excluded due to patients' refusal to continue the trial, and finally 75 subjects, including 39 patients in the periosteal nerve block group and 36 patients in the intravenous morphine group, remained for the final analysis (figure 2).

The periosteal nerve block group comprised 9 (23.1%) female and 30 (76.9%) male patients with the mean age of 35.53±17.13 years, and the intravenous morphine group consisted of 11 (30.6%) females and 25 (69.4%) males with the mean age of 36.22±13,71 years. Table 1 compares the baseline characteristics of studied cases between groups. There were no significant differences between the groups in terms of mean age (p = 0.384), gender distribution (p = 0.464), past medical history (p = 0.106), trauma type (p = 0.836), fracture type (p = 0.613), and baseline pain severity on VAS (p = 0.987).

3.2. Comparing the outcomes

Pain management

Table 2 and figure 3 compare the VAS scores between groups 15, 30, 45, and 60 minutes after the intervention. Both methods reduced the VAS scores during the 90 minutes of the study. The mean pain scores of the patients in the periosteal

nerve block group with 2.56±1.44, 2.15±1.11, 2.66±1.26, and 3±1.27 at 15, 30, 45, and 60 minutes after the analgesic injection, respectively, were significantly lower than those of the intravenous morphine group with 4.75±1.27, 4.22±1.22, 3.97±1.27, and 4.13±1.35, respectively ($p < 0.001$ for all comparisons). However, this difference became insignificant 75 ($p = 0.062$) and 90 ($p = 0.138$) minutes after the intervention. As shown in Figure 3, these analgesic effects were attenuated over time. It should also be noted that the slightest pain perception was reported 30 minutes after the intervention in the periosteal nerve block group and 45 minutes after the intervention in the intravenous morphine group; thus, these were probably the best times for performing the reduction.

Complications

In the present study, no local or systemic complications were observed in the periosteal nerve block group, while dyspnea, vomiting, and pruritus were reported by 5.5%, 2.8%, and 2.8%, respectively, in the intravenous morphine group. Moreover, the percentage of need for additional analgesia in the intravenous morphine group was higher than that of the periosteal nerve block group. These differences were at a statistically borderline significance (Table 2).

4. Discussion

The results of the present study showed that from fifteen minutes after the intervention, the periosteal nerve block method was more effective than intravenous morphine administration in reducing patients' pain.

In this regard, Frenkel et al. (2011) reported an 18-year-old woman referring to the ED with an angular fracture towards the dorsal and distal radius (Colles's fracture). As the alternative sedation procedure, the supra-condylar block of the radial nerve (proximal to its branching position) was performed under ultrasonography guidance. The procedural pain was minimal, and the result of manipulation was successful (11).

It should be noted that ultrasound was not used to accurately reach the injection site for injecting lidocaine in the periosteal nerve around the radius and ulnar bone in the present study.

One reason for the limited use of local anesthesia in the treatment of forearm fractures is concerns about its effectiveness and the degree of sedation during manipulation (12). Different methods such as hematoma block, Bier block, and cubital nerve block are used for local analgesia in ractures. Some studies have reported the effectiveness of the Bier block, as compared to the hematoma block, in pain relief (13-15), even though the problems associated with Bier block included more extended preparation and administration time.

The periosteal nerve block is a relatively new method to overcome the pain induced by fracture and manipulation.

For the first time, Tageldin et al.'s (2015) study on 42 patients with closed distal fractures and ulna fractures under periosteal nerve block with 1% lidocaine showed that the reduction procedure was painless in 35 patients (83%) (VAS = 0) and had minor pain in 6 patients (14%) (VAS = 1-3). In the age range of 12 to 16 years, the reduction procedure was painless in 15 (94%) patients, and the pain was mild in 1 patient. Forty patients who had a successful manipulation procedure with a periosteal nerve block did not require any other method of analgesia. Moreover, the periosteal nerve block group showed no local or systemic complications (10).

Similar to the above-presented study, there were no complications in the periosteal nerve block group in our study, and the complication rate of only 11.1% was reported in the intravenous morphine group. Furthermore, 2.6% and 16.7% of patients in the periosteal nerve block group and the intravenous morphine group, respectively, needed an additional analgesia. However, this difference was at a statistically borderline significance.

In the most recent study, published in 2021, on pain management with periosteal nerve block for reducing distal radius fracture, as mentioned in the results, the periosteal nerve block was found to be an effective method providing satisfactory analgesia to reduce pain in distal radial and ulnar fractures. It had no complications and was free from complications associated with the conventional sedation method (16).

In a case report by Ahmad et al. (2017), a 46-year-old man with ulna fracture after a motorcycle accident underwent periosteal nerve block with lidocaine, after which, the treatment of the fracture was started. It was found that this method reduced the pain in the patient, did not need any additional analgesia, and had no reports of local and systemic complications (17).

The most commonly used drug in local anesthesia is lidocaine, which was also used in this study. In a study by Shaik et al. (18), the effect of butorphanol was evaluated as an adjuvant treatment with lidocaine in periosteal nerve block and hematoma block. According to the hypothesis of this study, pain-bearing peripheral nerves contain opioid receptors, and the block of these receptors during hematoma block or a periosteal nerve block can provide better analgesia. One hundred-fifteen patients with closed fractures were randomly assigned to two groups as follows: the first group as the periosteal nerve block group received only lidocaine 1% (2mg /kg), and the second group received lidocaine 1% (2mg/kg) and also butorphanol (0.02mg/kg). After performing the block procedure, the amount of pain was measured before, during, and after the manipulation using the VAS score. The results revealed that the onset time of anesthesia was significantly lower in the patients receiving the combination therapy, compared to those reveiving only lidocaine.

Besides, the need for additional analgesic method was signif-

icantly lower in the butorphanol group, compared to the lidocaine group. The mean VAS score in the butorphanol adjunction group was significantly less than that of the lidocaine only group during and after the reduction. The difference between hematoma block and periosteal nerve block in reducing the amount of pain and success of manipulation in the studied groups was not investigated. Our study confirmed the findings of these published studies and showed the advantage of the periosteal nerve block concerning pain relief and adverse events.

5. Strengths and Limitations

The small sample size was one of the most important limitations of the present study. Since the periosteal nerve block is a new method, the researchers in the present study tried to get patients' consent to participate in the study by expressing its significance and effectiveness in the possible pain reduction. In addition, although the use of adjacent saline (instead of lidocaine) near a fracture site can cause pain, the degree of this pain was not much different from that of the lidocaine injection. In general, the additional prescription of placebo or adjacent saline injection can be one of the weaknesses of this study. However, the prevention of bias and conformity to the blinding conditions in this study can be the strong points of the study. Another limitation of this study was not comparing the effect of periosteal nerve block with other types of blocks such as a hematoma block/other peripheral nerve block, or procedural sedation.

Making such a comparison is recommended to be addressed in future studies. Furthermore, lidocaine and morphine were the only drugs used in this trial. Therefor, the effectiveness of lidocaine, compared with other pain relievers should be examined in future studies.

Finally, since periosteal nerve block was found to be a promising approach for pain relief based on these results, it is suggested to consider the mentioned limitations and conduct further prospective studies with larger sample sizes and different settings to validate the obtained results.

6. Conclusion

In the first hour after the intervention, pain reduction in periosteal block was significantly higher than intravenous morphine administration. Also, the incidence of complications and the need for additional analgesia were lower in the periosteal block group compared to intravenous morphine administration. Additional trials could help validate the obtained results and reach a more comprehensive decision on the preferred method for analgesia in distal forearm fractures.

7. Declarations

7.1. Acknowledgments

None.

7.2. Conflict of interest

The authors declare that they have no conflict of interest in this trial.

7.3. Funding and support

None declared.

7.4. Authors' contribution

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7.5. Using artificial intelligence chatbots

None.

7.6. Informed consent

Informed consent was obtained from all patients included in the study.

References

1. Chung KC, Spilson SV. The frequency and epidemiology of hand and forearm fractures in the United States. J Hand Surg Am. 2001;26(5):908-15.
2. O'neill TW, Cooper C, Finn JD, Lunt M, Purdie D, Reid DM, Rowe R, Woolf AD, Wallace WA, UK Colles' Fracture Study Group. Incidence of distal forearm fracture in British men and women. Osteoporos Int. 2001;12:555-8.
3. Azizkhani R, Hassan S, Boroumand A, Rastin G, Ghasemi A, Shahbazi A. Analgesic Effects of Ketamine Nebulizer vs. Intravenous Morphine in Limb Trauma Patients in Pre-Hospital Emergency Setting; A Randomized Double-Blinded Clinical Trial. Advanced journal of emergency medicine. 2020;4(4):e84.
4. S Sankar B, Ng AB. Circumferential periosteal block in the reduction of distal radius fractures. Ann R Coll Surg Engl. 2005;87(2):141.
5. El-Boghdadly K, Pawa A, Chin KJ. Local anesthetic systemic toxicity: current perspectives. Local and regional anesthesia. 2018;11:35-44.
6. Abdolrazaghnejad A, Banaie M, Tavakoli N, Safdari M, Rajabpour-Sanati A. Pain management in the emergency department: a review article on options and methods. Advanced journal of emergency medicine. 2018;2(4):e45.
7. Handoll HH, Madhok R, Dodds C. Anaesthesia for treating distal radial fracture in adults. Cochrane Database Syst Rev. 2002(3):Cd003320.
8. Mohammadshahi A, Abdolrazaghnejad A, Nikzamir H, Safaie A. Intranasal ketamine administration for narcotic

dose decrement in patients suffering from acute limb trauma in emergency department: a double-blind randomized placebo-controlled trial. Advanced journal of emergency medicine. 2018;2(3):e30.
9. Janati M, Kariman H, Memary E, Davarinezhad-Moghadam E, Arhami-Dolatabadi A. Educational intervention effect on pain management quality in emergency department; a clinical audit. Advanced journal of emergency medicine. 2018;2(2):e16.
10. Tageldin ME, Alrashid M, Khoriati AA, Gadikoppula S, Atkinson HD. Periosteal nerve blocks for distal radius and ulna fracture manipulation–the technique and early results. J Orthop Surg Res. 2015;10:134.
11. Frenkel O, Herring AA, Fischer J, Carnell J, Nagdev A. Supracondylar radial nerve block for treatment of distal radius fractures in the emergency department. J Emerg Med. 2011;41(4):386-8.
12. Constantine E, Steele DW, Eberson C, Boutis K, Amanullah S, Linakis JG. The use of local anesthetic techniques for closed forearm fracture reduction in children: a survey of academic pediatric emergency departments. Pediatr Emerg Care. 2007;23(4):209-11.
13. Abbaszadegan H, Jonsson U. Regional anesthesia preferable for Colles' fracture: controlled comparison with local anesthesia. Acta Orthop Scand. 1990 Jan 1;61(4):348-9.
14. Cobb AG, Houghton GR. Local anaesthetic infiltration versus Bier's block for Colles' fractures. BMJ (Clinical research ed.). 1985;291(6510):1683.
15. Wardrope J, Flowers M, Wilson DH. Comparison of local anaesthetic techniques in the reduction of Colles' fracture. Emerg Med J. 1985;2(2):67-72.
16. Ali WA, Soh EZ, Abdullah S, Singh PS, Ahmad AA, Sapuan J. Pain perception during the phases of manual reduction of distal end radius fracture with a periosteal block. Cureus. 2021;13(1).
17. Ahmad AA, Ikram MA. Plating of an isolated fracture of shaft of ulna under local anaesthesia and periosteal nerve block. Trauma Case Rep. 2017;12:40-4.
18. SShaik NA, Rao SS, Chiruvella S, Rao MS, Reddy SV. Effectiveness of butorphanol as an adjuvant to lidocaine for haematoma or periosteal block: A prospective, randomised, double blind study. Indian J Anaesth. 2013;57(2):150.

Table 1: Comparing the baseline characteristics of studied cases between periosteal nerve block and intravenous morphine groups

Variables	Groups		P value
	Nerve block (n= 39)	Morphine (n= 36)	
Age (years)			
Mean ± SD	35.53±17.13	36.22±13,71	0.384
Gender			
Female	9(23.1)	11(30.6)	0.464
Male	30(76.9)	25(69.4)	
Past medical history			
Diabetes mellitus	3 (7.7)	2 (5.6)	1.000
Hypertension	3 (7.7)	3 (8.3)	1.000
Ischemic heart disease	1 (2.6)	1 (2.8)	1.000
History of surgery	0 (0.0)	3 (8.3)	0.106
Type of trauma			
Car accident	19(48.7)	20(55.6)	0.836
Physical fight	4(10.3)	3(8.3)	
Falling	16(41)	13(36.1)	
Type of fracture			
Distal radius	26(66.7)	20(55.6)	0.614
Distal ulna	4(10.3)	5(13.0)	
Both distal radius and ulna	9(23.1)	11(30.6)	
Pain severity on VAS			
Mean ± SD	7.33±1.19	7.38±1.1	0.987

Data are presented as mean ± standard deviation (SD) or frequency (%). VAS: Visual Analogue Scale.

Table 2: Comparing the outcomes between periosteal nerve block and intravenous morphine groups after intervention

Outcomes Pain severity on VAS	Groups		P value
	Nerve block (n= 39)	Morphine (n= 36)	
Before the study	7.33±1.19	7.38±1.1	0.987
15 minutes	2.56±1.44	4.75±1.27	<0.001
30 minutes	2.15±1.11	4.22±1.22	<0.001
45 minutes	2.66±1.26	3.97±1.27	<0.001
60 minutes	3±1.27	4.13±1.35	<0.001
75 minutes	3.79±1.52	4.55±1.46	0.062
90 minutes	5.05±1.57	4.61±1.47	0.138
Complications			
Dyspnea	0 (0%)	2 (5.5)	0.048
Vomiting	0 (0%)	1 (2.8)	
Pruritus	0 (0%)	1 (2.8)	
Need for additional analgesia	1(2.6%)	6(16.7%)	0.050

Data are presented as mean ± standard deviation (SD) or frequency (%). VAS: Visual Analogue Scale.

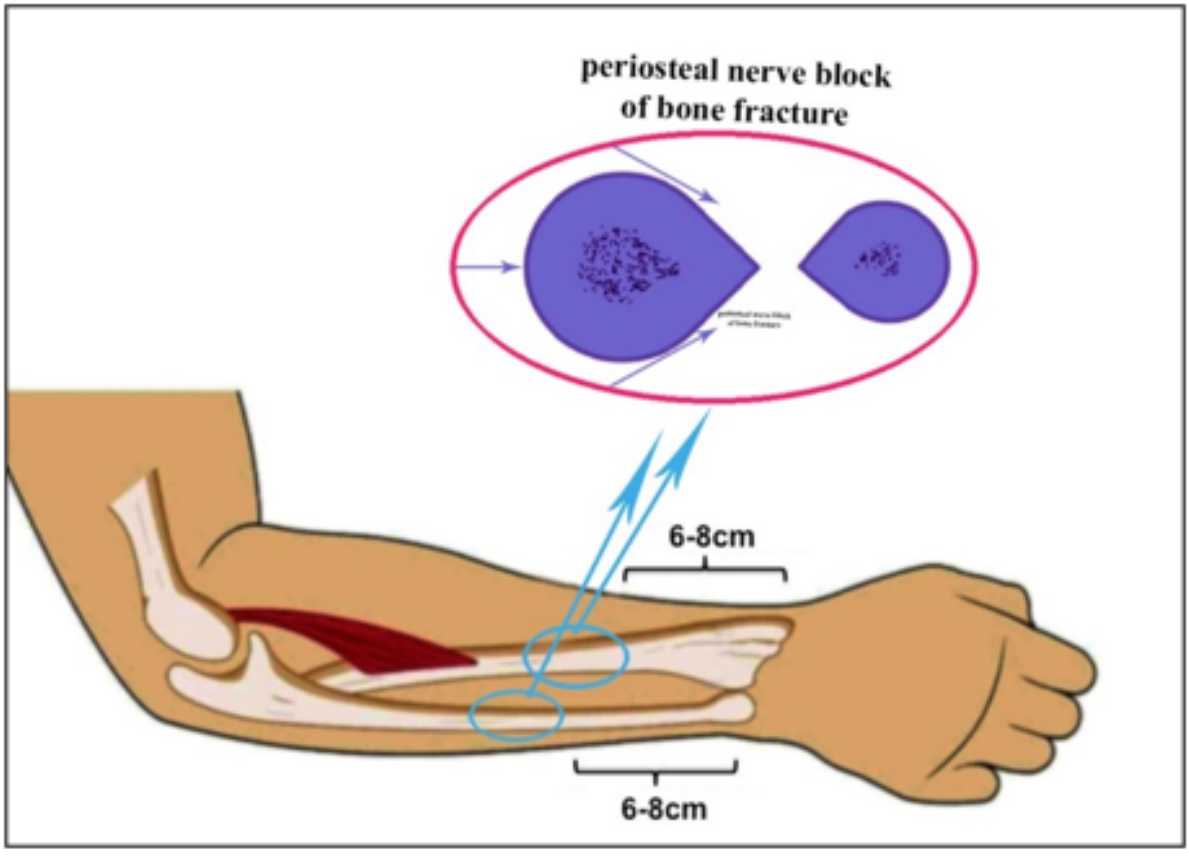

Figure 1: Performing a periosteal nerve block as a schematic section of the distal radius or ulna of the forearm 6-8 cm proximal to the wrist joint.

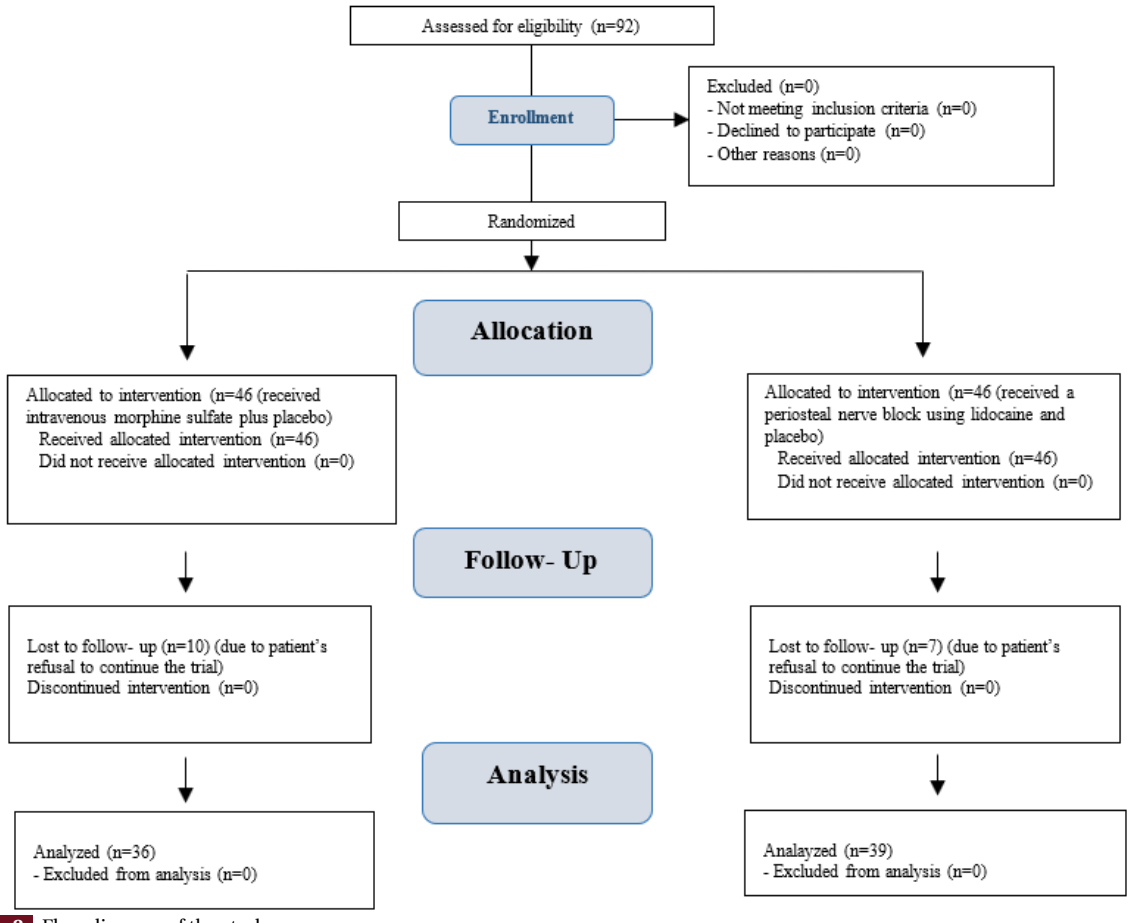

Figure 2: Flow diagram of the study.

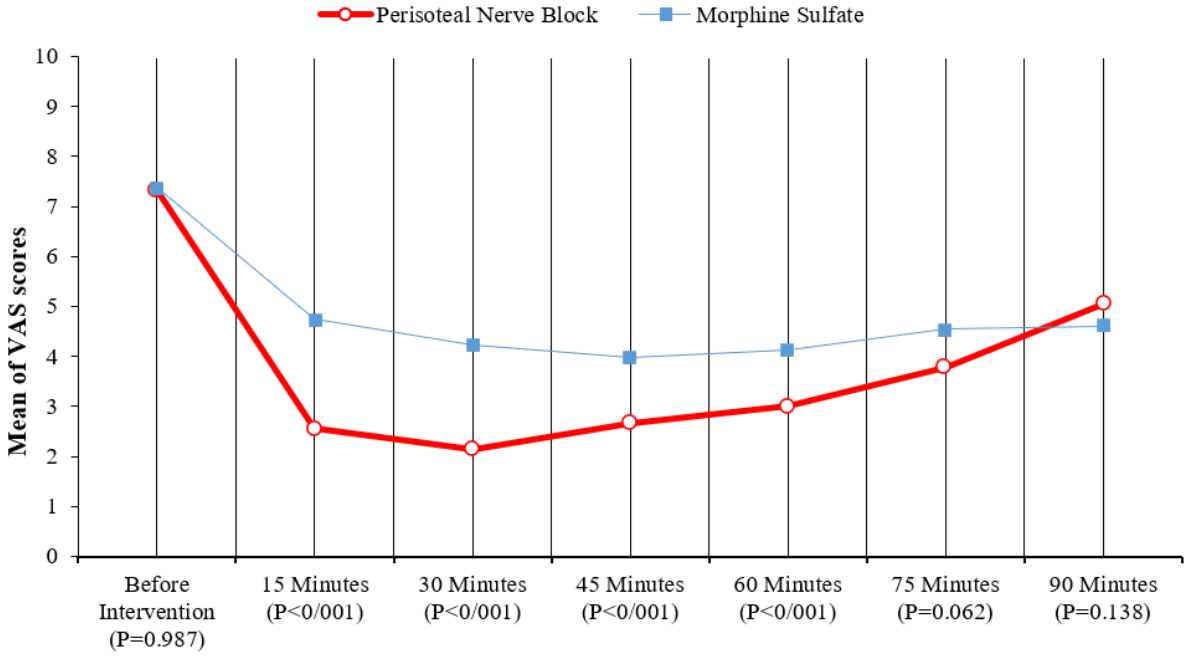

Figure 3: Visual Analogue Scale (VAS) score changes in the two groups during the trial.