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ORIGINAL RESEARCH

Nerve Stimulator Guided Axillary Block in Painless Reduction of Distal Radius Fractures; a Randomized Clinical Trial

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Abstract

Introduction: Given the high prevalence of upper extremity fractures and increasing need to perform painless reduction in the emergency departments, the use of analgesic methods with fewer complications and more satisfaction appears to be essential. The aim of this study is comparison the nerve stimulator guided axillary block (NSAB) with intravenous sedation in induction of analgesia for painless reduction of distal radius fractures. **Methods:** In the present randomized clinical trial, 60 patients (18-70 years of age) suffered from distal radius fractures, were divided into two equal groups. One group received axillary nerve block by nerve stimulator guidance and the other procedural sedation and analgesia (PSA) using midazolam/fentanyl. Onset of analgesia, duration of analgesic effect, total procedure time and pain scores were recorded using visual analogue scale (VAS) and the outcomes were compared. Chi-squared and student t test were performed to evaluate differences between two groups. **Results:** Sixty patients were randomly divided into two groups (83.3% male). The mean age of patients was 31 ±0.7 years. While the onset of analgesia was significantly longer in the NSAB group, the mean total time of procedure was shorter than PSA ($p<0.001$). The NSAB group needed a shorter post-operative observation time ($P<0.001$). Both groups experienced equal pain relief before, during and after procedure ($p>0.05$). **Conclusion:** It seems that shorter post-operative monitoring time and consequently lesser total time of procedure, make nerve stimulator guided axillary block as an appropriate alternative for procedural sedation and analgesia in painless reduction of distal radius fractures in emergency department.

Key words: Nerve block; nerve stimulator; procedural sedation and analgesia; radius fracture

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Introduction:

Given the high prevalence of upper extremity fractures and increasing requirement to perform painless reduction in the emergency departments, the use of analgesic methods with fewer complications and more satisfaction appears to be essential (1, 2). Procedural sedation and analgesia (PSA) is associated with rare but serious complications and need for constant hemodynamic monitoring (3). Nowadays, the benefits of regional anesthesia in fracture manipulation have been proven (4). Axillary nerve block introduced by Halsted and Hall in 1884, and has been approved as a safe and effective analgesic method for a variety of upper extremity fractures (5). Beside, nerve stimulator guided axillary block (NSAB) has recently been used with higher efficacy for this purpose (6, 7). Some of advantages of this technique are better localization of the nerve and consequently a shorter time needed for completing the block procedure, lower use volume of the local anesthetic agent, lower incidence of toxicity with local anesthetic agents, faster initiation and more profound block, fewer complications, lower cost and higher patient satisfaction (7-9). According to the above mentioned, the aim of this study is to compare the NSAB with PSA to induction of analgesia for painless reduction of distal radius fractures.

Methods:

Study design and setting

This randomized clinical trial compares NSAB and PSA in induction of analgesia for painless reduction of distal radius fractures. The protocol of the study was prepared based on Helsinki Declaration and approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (Code: 6451). For ethical reasons, there was no placebo arm. Before any procedure, written informed consent was obtained and the procedural steps and the complications and advantages of each technique were explained.

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Participants

The subjects of the present clinical trial were selected from the patients suffering from distal radius fracture (age range: 18-70 years) and referred to the emergency department of Imam Hossein Hospital, Tehran, Iran in March 2011 to March 2012. The random number table was used to assign patients to NSAB or PSA groups. Patients with the following criteria were excluded from the study: severe trauma to other body organs, dislocations, cerebral or visceral hemorrhage, pulmonary trauma; cardiac and pulmonary diseases, chronic use of any medications; drug or alcohol abuse, any neuropathy or history of neuropathy, and patients not willing to take part in the study.

Intervention

After a definite diagnosis of distal radius fracture (based on radiography and confirmation of the need for reduction by orthopedic consultation), patients were randomly assigned to NSAB and PSA groups. They received instructions how to present their pain severity using visual analog scale (VAS) (10) before, during and after reduction. Neurovascular examination was performed in NSAB group before and after the procedure.

The nerve block was carried out by a trained emergency physician, using 1% lidocaine under sterile condition. The arm was abducted up to a right angle (90°) from the trunk, the elbow was supinated and flexed up to 90°, and the dorsum of the hand was placed on a cushion. After palpation of the axillary artery, the 35-mm needle of the nerve stimulator was passed through it under local anesthesia. A total of 5-8 mL (maximum of 4 mg/kg) of 1% lidocaine was injected at the sites of median, radial, and ulnar nerves under the guidance of nerve stimulator at the frequency of 2 Hz, a current of 3 mA for 0.1 second, which gradually decreased until it reached 0.5 mA and produced an appropriate nerve response. When adequate analgesia achieved, reduction carried out.

In the PSA group, midazolam and fentanyl were used for intravenous sedation. Midazolam was used at an approximate dose of 0.05-0.1 mg/kg (body weight reported by the patient) and fentanyl at a dose of 1-3 µg/kg. The procedures were carried out under cardiac monitoring, pulse oximetry, and all the necessary equipment to keep the airway open. After intravenous sedation and facture reduction, the patients were monitored until full recovery. Discharge criteria was consisted of the following: patency of airways, returning to the baseline level of consciousness, the patient's ability to sit and talk, stable cardiovascular function, and full implementation of gave orders.

Outcome

Basic characteristic of patients, pain score before, during and after reduction, total procedure time, onset of analgesia, and duration of analgesic effect were collected for each patients.

Total procedure time was defined as duration of time from the initiation of the analgesic procedure to the patients' full recovery (when the patient status is suitable for sending to take control radiography). *Onset of analgesia* was the period from beginning of analgesic procedure to adequate analgesia. In addition, duration of analgesic effect was defined as duration of time from the initiation to end of analgesia.

Statistical analysis

Statistical analysis was carried out using SPSS version 20.0. Student t and chi-squared test were performed for quantities and qualitative variables, respectively. A probability level of < 0.05 was taken to indicate statistical significance.

Results:

Sixty patients were randomly divided into two groups of 30 (83.3% male). The mean ages and weight of patients were 31 ±0.7 years and 66.5±5 kg respectively. Table 1 compares the basic characteristic of patients between two groups. Table 2 compares pain scores of PSA and NSAB groups before, during and after procedure. The means of total times of procedures in the PSA and NSAB groups were 29±4 and 26±3 minutes, respectively ($P<0.001$). The onset of analgesia was significantly shorter in the PSA group; 8±1 versus 15±2 minutes in NSAB ($P<0.001$). The mean duration of analgesic effect for PSA and block group were 22±4 and 11±2 minutes, respectively ($P<0.001$). The mean arterial blood pressure and pulse rates after the procedure in the PSA and NSAB were the same and no patients in each groups show significant change in vital sign during analgesic procedure ($P>0.05$). None of the subjects exhibited any cardio-vascular, respiratory, and gastro-intestinal complications. In addition, in the nerve block group, no cases of convulsions, and drug reaction were observed.

Discussion:

Based on the results of present study, while the onset of analgesia was significantly longer in the NSAB group, the mean total time of procedure was shorter ($p<0.001$). It might be because of a longer period of full recovery in PSA group ($p<0.001$). None of the patients exhibited cardiac, vascular, neurologic and respiratory complications as well as drug reaction. Considering the crowdedness of emergency departments and limited facilities, NSAB can be helpful in efficient use of resources by decreasing the need for close monitoring during and after induction of analgesia.

The technique is relatively easy to use and has a favorable safety. It may significantly reduce the need for deep sedation and systemic opiate analgesia in patients with fractures. Cramer et al depicted a success rate of 95% with this technique in forearm fracture reduction (11). Also, Wedel et al showed a 92.4% success rate of NSAB

Table 1: Basic characteristic of patients

Variables	NSAB[3]	PSA[4]	P
Age (year)	31±10	31±6	0.707
Weight (kg)	67±6	66±6	0.263
Gender (%)			
Female	3 (10)	7 (23.3)	0.166
Male	27 (90)	23 (76.7)	
MAP[1](mmHg)	99±8	98±7	0.27
PR[2](per minute)	77±6	72±7	0.32

1: Mean arterial blood pressure, 2: Pulse rate, 3: Nerve stimulator guided axillary nerve block, 4: Procedural sedation and analgesia

Table 2: Comparison of pain severity before, during and after reduction of fractures based on visual analogue scale (mean ± standard deviation)

Pain severity	NSAB[1]	PSA[2]	P
Before reduction	9±1	10±1	0.90
During reduction	1±1	1±1	0.85
After reduction	1±0	1±0	0.16

1: Nerve stimulator guided axillary nerve block, 2: Procedural sedation and analgesia

(12). They observed that the occurrence of emesis and the use of narcotics were reduced by NSAB than general anesthesia. Kriwanek et al reported that NSAB is an effective option for upper extremity procedure during reduction of forearm fractures (13). Stone et al by performing two study stated that ultrasound-guided supraclavicular brachial plexus nerve blocks reduce emergency department length of stay compared with procedural sedation for the treatment of upper extremity fractures, dislocations, or abscesses (3, 14). Numerous complications have been pronounced after NSAB, including hematoma, systemic toxicity, transient dysesthesias, infection, and temporary neuralgia (15, 16), none of which occurred in present study. Application of a smaller needle, proper patient selection, and exercising extra care to avoid intra-arterial injection by frequent aspiration during administration minimized the risks of this procedure.

The small number of patients is one of the most important limitation of present study because it may lead to underestimation of complication in both groups. In addition, convenience-sample strategy used in this study decreases enrollment of eligible subjects and may increase potential enrollment bias. However, the authors believe that this issue did not against the findings because randomization guaranteed that the two groups were similar with respect to demographic characteristics and fracture types. Finally, due to performing the study in a busy urban emergency department, generalization of it is impossible. It is unknown whether an NSAB would result in considerably reduce mean total procedure time in other settings or not.

Conclusion:

It seems that shorter post-operative monitoring time and consequently lesser total time of procedure make nerve stimulator guided axillary block as an appropriate alternative for procedural sedation and analgesia in painless reduction of distal radius fractures in emergency department.

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Conflict of interest:

None

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Author's contributions:

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