Research Article

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International Journal of Anesthesiology & Pain Medicine
ISSN 2471-982X

2022
Vol.8 No.2:66

A Comparative Study of the Analgesic Effect of Haematoma Block Versus Intravenous Sedation for Reduction of Distal Radius Fractures in Adults

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Received date: January 03, 2022, Manuscript No. IPAPM-22-12017; **Editor assigned date:** January 05, 2022, PreQC No. IPAPM-22-12017(PQ); **Reviewed date:** January 19, 2022, QC No IPAPM-22-12017; **Revised date:** January 26, 2022, Manuscript No. IPAPM-22-12017(R); **Published date:** March 30, 2022, DOI:10.35841/2471-982X.8.2.66

Citation: Alatishe KA, Ajiboye LO, Choji C, Idowu OS, Olanrewaju OS (2022) A Comparative Study of the Analgesic Effect of Haematoma Block Versus Intravenous Sedation for Reduction of Distal Radius Fractures in Adults. Int J Anesth Pain Med. Vol.8 No.2: 66.

Abstract

Objective: The pain levels during and after fracture reduction were compared between haematoma block and sedation for closed reduction of distal radius fractures in adults. The adverse events were highlighted.

Methods: A prospective study carried out at the accident and emergency unit of our hospital between 1st September, 2017 and 31st August 2018. Thirty six patients each were consecutively recruited into Haematoma Block (HB) and Sedation(S) groups using the simple balloting method. Five minutes after anaesthesia, the fracture was reduced and immobilized in a below-to-elbow Plaster of Paris (P.O.P) cast for 6 weeks.

Results: Sixty-seven patients completed the study with 33 patients in HB group and 34 patients in S group. The mean age of patients in the study population was 48.9 ± 16.2 (18 years-82 years) with a slightly higher female preponderance (M:F ratio of 1:1.8). The commonest cause of injury was domestic fall. There was significant reduction in the mean pain level during fracture reduction in patients who had haematoma block compared to sedation. There was no significant difference in the mean pain level after fracture reduction in both groups. There were mild gastrointestinal adverse events in sedated group.

Conclusion: Our study revealed that haematoma block was more effective than intravenous sedation in terms of pain control during fracture reduction. However, there was no difference in the pain level after reduction.

Keywords: Analgesia; Distal radius fracture; Haematoma block; Intravenous sedation; Conscious sedation

Introduction

Distal radius fractures are one of the most common injuries treated by orthopaedic surgeons, accounting for 16% of all fractures treated in emergency rooms in the U.S and 75% of fractures of the forearm. The term, distal radius fractures are fractures of the distal end of radius within an inch of its distal articulating surfaces **[1]**. Most of these fractures are still being managed non-operatively in developing countries with castings for around 4 weeks-6 weeks with spectrum of outcomes. The analgesia used to decrease pain perception during closed reduction include intravenous regional anesthesia (Bier's block), Haematoma Block (HB), regional nerve blocks (such as axillary or brachial plexus nerve blocks), intramuscular sedation, conscious sedation and general anesthesia **[2,3]**.

We commonly use conscious sedation with intravenous cocktail preparations of benzodiazepine and narcotics to reduce distal radius fractures. However, some orthopaedic surgeons have observed the unpredictability of the outcomes of conscious sedation and their preferred alternative for reduction of these fractures in our very busy emergency room is haematoma block. They argued that haematoma block has excellent analgesic property, is safe and relatively cheap in terms of cost, personnel involved and waiting time in the emergency unit **[4-7]**. The superiority of haematoma block over intravenous conscious sedation for reduction of distal radius fracture is controversial in the literature **[8]**.

We compared the analgesic effect of haematoma block and intravenous sedation for closed reduction of distal radius fractures in adults. We hypothesized that HB provides a greater pain control during and after closed reduction for distal radius fractures in adults.

Materials and Methods

It was a prospective comparative study carried out at the Accident and Emergency unit of our hospital between 1st September 2017 and 31st December 2018. Seventy-two out of One hundred and nine patients met the eligibility criteria and were consecutively recruited after written informed consent was obtained. Thirty-six patients each were allocated into

Haematoma Block (HB) and intravenous sedation (S) groups using simple balloting technique.

Adult patients (18 years and above) with closed stable distal radius fractures, presenting within 72 hours of injury and requiring closed reduction and cast immobilization were recruited for this study. Exclusion criteria were patients who had open distal radius fracture, patients with bilateral distal radius fractures, patients with associated ulna shaft fracture, patients who has previous manipulation(s) for distal radius fractures, patients with allergy to any of the medications, patients with neurovascular compromise or multiply injured, patients with poor cognitive functions and those who declined consent.

After resuscitation, patients had plain radiography of the injured wrist to define the fracture pattern. Patients also rated their wrist pain using a Visual Analogue Scale (VAS) from 0-to-10; 0-for no pain and 10-for most severe pain.

For HB group, 10 mL of local anaesthetic, plain lidocaine hydrochloride injection 2% (20 mg/mL) was drawn up into a syringe and the fracture site was identified by palpation of the wrist. The wrist was cleansed with a disinfecting solution and draped in a sterile manner. The entry into the fracture haematoma was gained via a dorsal approach with a 21 G needle inserted transcutaneously into the fracture site at a 30° angle, pointing from proximal to distal. Prior to injection of the local anesthetic agent into the haematoma, small amount of altered blood was aspirated from the fracture site. Four-fifth of the dose was injected into the fracture haematoma and the remaining one-fifth around the ulnar styloid which was identified by palpation. After 5 minutes, the efficacy of the block was tested by initial gentle movement of the injured wrist and pain scoring was done before manipulation. Patients with failed block (VAS>7) were sedated and excluded from the study.

For S group, 30 mg of fortwin brand of intravenous pentazocine and 10 mg of intravenous diazepam (Roche®) was administered. The mixture was diluted with water for injection before injecting into the forearm veins. Vital signs were closely monitored and 5 minute waiting time was also observed before reduction of the distal radius fractures. Pain level by initial gentle movement of the wrist was assessed at this time. Patients with severe pain (VAS>7) were observed for another 5 mins-10 mins, a second dose was given as deemed necessary and they were excluded from the study.

Thereafter, fracture reduction was achieved using Robert Jones maneuver as described by Fernandez **[9]** and immobilization of the reduced fracture in both groups was accomplished with a below-elbow Plaster of Paris (P.O.P) cast with the forearm in mid-prone position. Oral analgesics, broad arm sling for elevation, active finger exercises were prescribed to all patients. They were discharged home when patients were clinically stable and the fracture reduction was adjudged acceptable. The cast was removed at 6 weeks post reduction when fracture was observed to have healed. Comparing the mean pain levels during and after fracture reduction was the primary outcome measure and to highlight adverse drug events in both groups was the secondary outcome. The pain assessment for 'during reduction' and 'post- reduction' was determined by one of the researcher using VAS in both groups at 60 mins post-reduction.

Statistical Analyses

All statistical analyses were done using IBM-Statistical package for the social science software version 20 (IBM Corp; Armonk, NY, USA). In determining the statistical significance between the two groups, confidence level was set at 95% and P value was less than 0.05. Chi-squared test was used to compare fracture pattern, injury time interval and mechanism of injury between the groups. Fisher's exact probability test was used for ordinal categorical variables like laterality of the injury and gender. Student T-test was used to compare the mean difference in age, pain scores and duration of manipulation between the groups.

Results

A total of sixty-seven patients completed the study; with thirty-three patients in HB and 34 patients in S groups. The age range of the patients was 18 years-82 years with mean age range of 48.9 years ± 16.2 years. The two groups were comparable in terms of their baseline demographics **(Table 1)**.

Variables	HB(n=33)	S(n=34)	Total(n=67)	p value
Age (Mean ± S.D) years	46.6 ± 15.9	51.2 ± 16.6	48.9 ± 16.2	0.341
(range)	(24-82)	(18-77)	(18-82)	
Gender				
Male:Female	1:2.3	1:1.4	1:1.8	1.000
Laterality of injury				
Right	19(57.6%)	6(17.6%)	25(37.3%)	
Left	14(42.4%)	28(82.4%)	42(62.7%)	0.639

Fracture angulation				
Dorsal	25(75.8%)	28(82.4%)	53(79.1%)	
Volar	8(24.2%)	6(17.6%)	14(20.9%)	0.618
Mechanism of injury				
Domestic fall (from standing height)	23(69.6%)	25(73.5%)	48(71.6%)	
Sporting activities				
Fall at work(from height)	2(6.1%)	0(0%)	2(3.0%)	
Road traffic crash	0(0.0%)	4(11.8%)	4(6.0%)	0.892
Assault	6(18.2%)	5(14.7%)	11(16.4%)	
	2(6.1%)	0(0%)	2(3.0%)	
Duration of injury to reduction				
Less than 6 hours	6(18.2%)	9(26.5%)	15(22.4%)	
6 hours-24 hours	15(45.5%)	17 (50.0%)	32(47.8%)	0.67
24 hours-48 hours	7(21.2%)	5(14.7%)	12(17.9%)	
48 hours-72 hours	5(15.1%)	3(8.8%)	8(11.9%)	

Table 1: Demographic characteristics.

In HB group, the average duration of reduction was 9.8(± 3.8) minutes with a range of 5 mins-21 mins while in S group, an average of 9.6(± 2.3) minutes with a range of 6 mins-15 mins was recorded. The difference of the average time between the two groups was subjected to analysis using T-test and found to be statistically insignificant (T-test=-0.267; df 45 and P value of 0.790).

The mean score of the pain perceived before fracture reduction was almost the same in both groups. There was no statistically significant difference between the two groups (p=0.315) (Table 2).

VAS	HB group (n=33)	S group (n=34)	p-value
Pain level before reduction			
M ± S.D	7.6 ± 1.3	7.2 ± 1.3	0.315
Pain level during reduction			
M ± S.D	2.9 ± 1.2	4.6 ± 1.0	0
Pain level after reduction			
M ± S.D	3.4 ± 1.6	3.8 ± 1.6	0.362

Table 2: Pain Levels between the groups. VAS means Visual analogue scale; M ± S.D: Mean ± Standard Deviation, n: number of patients in each group and p-value is the 2-tailed significance calculated using student T-test.

Participants in S group were fully conscious and alert at about 30 mins-60 mins after reduction. Pain perception during fracture reduction was significantly lower in HB group compared to S group ($p<0.05$) (Table 2). There was no significant difference between the groups in terms of pain level after fracture reduction **(Table 2)**. There were gastrointestinal adverse reactions among S group in 5 cases, failed sedation in 2 cases and failed haematoma block in 3 cases. There was no case of

cardiopulmonary arrest in both groups and no single case of compartment syndrome and no infection in HB group.

Discussion

Age and gender distribution of our patients was closely similar to those of previous researchers **[5]** but was contrary to reports of Singh et al. **[10]** who showed a lower age range with male to female ratio of 2.3:1. The high incidence of these fractures in elderly females has been linked to the estrogen withdrawal effect and consequent osteoporosis **[11]**.

Pain perception was assessed using the Visual Analogue Scale, which is the most commonly used tool in measuring severity of pain **[12]**. Our study showed that there was a marked reduction in the average pain score during fracture reduction in HB group compared to S group (2.9 ± 1.2 versus 4.6 ± 1.0). This difference was found to be statistically significant with p=0.000. The lower pain perception reported in HB group in our study could not have been ascribed to a selectively more gentle reduction in this group since the reduction time was similar in both groups. A lower pain threshold in S group could have been a reason for the higher pain perception during fracture reduction but the pre-reduction mean pain score was lower in them compared to HB group. There was also no significant difference between the two groups with respect to the suspected confounding variables such as age, gender, and fracture duration, mechanism of injury, fracture pattern and injury duration(p value>0.05). Singh et al. **[10]** concluded that there was statistically significant difference in the pain perception during reduction between the two groups; with acceptably low pain scores <3 (median=1.8) in the hematoma block group as compared to sedation group which has unacceptably high, that is >3 pain scores (median =8.7). It is pertinent to note that the pain assessment for 'during reduction' was done 12 hours-15 hours after reduction in their study while the readings were taken 60 minutes after fracture reduction in our study. A recall bias may be of concern but the recall was done in both groups at about the same time. Ogunlade et al. **[5]** reported significant pain relief with haematoma block during reduction of distal radius fracture. The pain assessment was at 10 mins after local anesthetic agent was administered and there was dramatic reduction of the mean VAS from 6.6 ± 1.6 to 1.79 ± 0.66. The researchers evaluated the efficacy of haematoma block with no comparison with any other anaesthetic method such as conscious sedation. Muhammed et al. **[13]** compared the effectiveness of both anaesthetic methods in 76 patients with distal radius fracture using VAS measurement taken five minutes after administration of anaesthesia. Patients in both groups with VAS ≤ 3 were categorized as effective cases while those with VAS>3 were regarded as non-effective cases. They concluded that heamatoma block is more effective than conscious sedation (effective cases: 68% versus 28%; p= 0.01). The authors compared the effectiveness of both methods but did not report any challenges in VAS measurement among conscious sedation group. Pain perception during fracture reduction under conscious sedation was sparsely reported in the literature. This may be due to some difficulties in pain assessment while patients are not fully conscious of their environment. A recent meta-analysis revealed that there was no difference in the pain severity during fracture reduction between the two groups with significant heterogeneity (Hedges' g 0.356, 95% Confidence Interval (CI)–1.101 to 1.812, p=0.632), but the authors noted some potential sources of bias such as inadequate methods to conceal random allocation, lack of blinding, varying regimen of interventions between the groups and smaller sample sizes **[9]**.

In our study, the average post-reduction pain score was relatively lower in HB group than S group (3.4 ± 1.6 versus 3.8 ± 1.6) but there was no significant difference between the two groups (P=0.362). Singh et al. **[10]** reported higher percentage of patients with effective post- reduction pain relief in haematoma block than sedation group but failed to show any significant difference between the two groups. In their study, this outcome measure was evaluated at about 12 hours-15 hours post-reduction. Hence, the authors relied on the ability of the patients to recall vividly their pain perception after reduction. A comparable outcome was reported in a study conducted by Onuoha et al. **[14]** where all their sedated patients were fully awake at about 20 mins after reduction and the post-reduction pain assessment was done at this time in both haematoma block and conscious sedation groups. This ruled out the issue of recall bias. In our study, most of the sedated patients were fully awake and conscious at about 30 mins-60 mins but the VAS scoring was done in both groups at 60 minutes post-reduction by one of the researchers. Pain perception automatically reduces once the fractured bone has been reduced back to its anatomic position. Severity and intensity of post-reduction pain perception may be multi-factorial; with anesthetic agents, fracture characteristics, patient's pain threshold, duration and gentility of reduction all playing a role. Myderrizi and Mema **[5]** compared haematoma block and general anesthesia in 96 adult patients who had closed reduction for distal radius fractures and reported no statistically significant difference in the post-reduction pain perception in both groups. However, a recent meta-analysis concluded that the effect of HB on post-reduction pain severity was better than that of Procedural Sedation and Analgesia (PSA) with significant heterogeneity (Hedges' g-0.600, 95% Confidence Interval (CI)-1.170 to -0.029, p=0.039) **[8]**.

We had three cases of failed haematoma block which were excluded from our study. These patients presented within 48 hours-72 hours of injury with impacted fractures and we had some challenges gaining access into the haematoma. Fernandez argued that a dorsally impacted cortex may not permit easy entrance of the needle through the dorsal aspect of the fractured distal radius and he preferred gaining access into the fracture haematoma via the volar aspect **[9]**. Some authors advised direct visualization of the haematoma with ultrasound guidance to improve the efficacy of the block and avoid damaging the neurovascular structures **[15,16]**. The injection of local anesthetic agent into haematoma has a theoretical risk of converting a closed fracture into an open fracture but the rate of infection is negligible. Ismatullah however reported a single case of infection out of 70 patients that had haematoma block for reduction of colles' fractures **[17]**. In our study, there was no single case of infection in HB group This could be explained by exclusion of patients with open fracture and strict compliance with aseptic technique during injection.

This outcome is comparable with previous studies on haematoma block **[5]**. Five patients in S group had anti-emetic therapy for gastro-intestinal side effects like nausea and vomiting. None of the patients in both groups developed cardiopulmonary arrest. This side-effect was mitigated by avoiding intravascular injection of lidocaine in HB group and by diluting the sedative-analgesic cocktail up to 10 mls before slowly injecting into the venous system in S group. The exclusion of patients with severe wrist swelling and comminuted fracture might be responsible for zero incidence of compartment syndrome in HB group.

Our study had some limitations. First, small sample size was studied. This was partly due to low patronage of tertiary centers for distal radius fracture treatment and partly due to strict inclusion criteria to eliminate confounding variables. Caution must be taken in drawing conclusion from our study because of the small sample size which might have decreased the statistical reliability. A multi-center study with a larger sample size could provide more accurate result. Second, we had challenges with VAS assessment at 5 minutes after anaesthesia in patients who had conscious sedation; and as such we were unable to objectively determine the pain level before commencement of reduction. Hence, the VAS scores before anaesthesia were used as the “control” in both groups. Third, we were unable to blind the patients and the surgeons who were actively involved in the reduction process. This might have led to a bias in the reduction technique and gentility of the procedure.

Conclusion

In conclusion, our study revealed that the analgesic effect of HB was superior to sedation during fracture reduction but there was no significant difference between the groups in terms of post-reduction pain. The adverse reactions were mild gastrointestinal symptoms in sedated patients.

Conflicts of Interest

None

Ethical Statement

Institutional ethical board approved this study.

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