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COMPARISON BETWEEN HEMATOMA BLOCK AND PROCEDURAL SEDATION FOR REDUCTION OF DISTAL RADIUS FRACTURES IN EMERGENY DEPARTMENT

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Abstract

BACKGROUND /INTRODUCTION: *Distal radius fractures (DRFs) are among the most common injuries treated in the Emergency Department (ED). A significant proportion of these fractures are displaced or angulated, requiring manipulation and reduction. Traditionally, this procedure is performed using intravenous (IV) procedural sedation and analgesia (PSA) or by giving hematoma block (HB). This study aims to evaluate the effectiveness of HB over IV-PSA, as it is less time-consuming, easier to administer, and more cost-effective.*

OBJECTIVE: *The primary objective of this study is to compare the effectiveness of HB and IV-PSA in the reduction of DRFs. Efficacy is assessed by comparing the two methods in terms of average time taken to achieve adequate analgesia, changes in pain score during the procedure, ED LoS, adverse reactions, need for additional analgesia and overall outcome.*

MATERIAL AND METHODS: *This is a quantitative prospective cohort comparative study involving 228 patients presenting to the ED with uncomplicated displaced DRF. Systematic nonprobability consecutive sampling was employed to recruit participants. The study participants were divided into two groups. The patients in Group A were administered HB while the patients in Group B received IV-PSA. Pain was recorded at various intervals before and after the procedure using the Visual Analog Scale (VAS). Outcomes of interest were average time taken to achieve adequate analgesia, delta change in pain score during the procedure, ED LoS, adverse reaction, need for further analgesia, and procedure success rate.*

RESULTS: *Of the 228 patients, 109 (47.8%) were male and 119 (52.2%) were female. The mean age of the study participants was 38.16 ± 13.79 years,*

with ages ranging between 15 and 60 years. The mean pain score before treatment (VAS T1) was 5.29±2.25 in both groups. Thirty minutes after treatment (VAS T2), the median pain scores were 3 in the HB group and 4 in the IV PSA group, with a p-value of < 0.001, indicating statistical significance. The average time taken to achieve analgesia in the HB and IV-PSA groups was 10.2 min and 18.5 min, respectively. Seven patients required a second attempt at the HB, while nine patients needed a second attempt at IV-PSA. None of the patients in either group suffered from any adverse reactions. Procedure success rate was 95.48% and 88.31% In the HB and IV-PSA groups, respectively.

CONCLUSION: *Our study demonstrates that HB is more efficient than IV-PSA as quicker and long-lasting analgesia is achieved by this method. The ED LoS and rates of complication are also much lower. Procedure success rate is the same in both groups.*

INTRODUCTION

Distal radius fractures (DRFs) represent a significant portion of skeletal injuries encountered in the emergency departments (ED), accounting for 17.5% of all fractures (1). These injuries are particularly common among those aged over 60 years, with DRFs making up approximately 16% of all fractures in the elderly. Females are predominantly affected due to their higher predisposition to osteoporosis (2). DRFs typically result from low-energy trauma. Notably, in developed countries, women over 50 face a 15% lifetime risk of DRFs, compared to just over 2% for men (3). In children, DRFs account for 20-30% of all pediatric orthopedic fractures, with boys being more commonly affected due to falls at home or during sports (4). In most cases, fractures managed with closed reduction and casting heal without complications, allowing for the restoration of normal function. However, complete fractures following reduction can carry a risk of re-dislocation, with rates reaching as high as 34% (5). To mitigate this risk, the use of K-wires in conjunction with closed reduction has become a standard approach (6).

A comprehensive understanding of the etiology, pathophysiology, and treatment progression, both non-operative and operative, highlights the importance of prompt and appropriate care for DRFs (7). This underscores the need for effective ED management, focused on early reduction to alleviate pain and improve patient outcomes, reflecting a nuanced approach tailored to the patient's specific condition and risks (17). Before establishing an appropriate treatment plan for a completely displaced fracture, evaluation of angulation, alignment, and rotation is essential. In many developing countries, majority of these fractures are treated without surgery, with casts for about 4 to 6 weeks, resulting in a variable range of outcomes (8). The definitive management of DRFs may sometimes require sophisticated treatment approaches to ensure the best possible healing and restoration of function (9). However, in the ED following acute trauma, providing adequate analgesia and realigning the fracture to ensure a neutral position is crucial to prevent secondary injury and complications (11). Several analgesic techniques are available in the ED for managing DRFs, with standard interventions including closed reduction to address significant displacement, relieve soft tissue tension, improve radiographic alignment, and promote successful non-operative recovery. These include ketamine sedation, manipulation under short general anesthesia ie. procedural sedation, Bier's blocks, and hematoma block (HB) (3). All of these are effective compassionate approaches for managing pain during DRF treatment (13). Each of these methods has its own specific requirements, expertise, skill level, and potential side effects. The two most used procedures for DRF management in the ED are intravenous procedural sedation and analgesia (IV-PSA) and HB. Both carry distinct risk-benefit profiles, cost-effectiveness, and overall efficacy. Utilizing local anesthetics like plain lidocaine, HB provide targeted anesthesia of the fracture site, facilitating closed reductions with minimal discomfort while preserving hand functionality. Rarely, they may cause transient neurological effects (16). HB is easy to administer and

does not require prolonged post-procedure observation. In contrast, IV-PSA involves the use of short-acting anesthetic agents (eg. propofol) and sedation (eg. midazolam), along with opiate analgesics (eg. nalbuphine, morphine, or fentanyl). This method requires additional resources, including peripheral venous access, trained personnel to manage the airway, and increased staffing, typically a seditionist, a proceduralist, and an airway expert, along with constant close monitoring throughout and after the procedure. As EDs become busier and resources are often limited in developing countries, the need for efficient, secure, and patient-friendly pain management techniques becomes even more critical underscoring the importance of comparing HB and IV-PSA for managing DRFs. Thus, the primary aim of this study was to evaluate the efficacy of HB and IV-PSA in reducing pain and ensuring successful fracture reduction in patients with uncomplicated displaced DRFs. The study assesses pain scores upon arrival and at various intervals before, during, and after the procedure, along with the need for additional rescue analgesia. It also compares recovery times and overall outcomes following fracture reduction using either approach, including any need for supplementary analgesia. Additionally, patient comfort and satisfaction throughout the treatment process were also observed.

METHODOLOGY:

Study process:

This prospective quasi experimental study was conducted at the ED of Combined Military Hospital (CMH) Rawalpindi between August 2023 and April 2024 . CMH is an 1100-bedded Tertiary Care Teaching Hospital (TCTH) with an annual ED attendance of over 200,000 patients. The 47-bedded ED caters to all age groups and a wide spectrum of emergencies including medical, surgical, trauma, palliative and gynecological emergencies. All the patients presenting to the ED for the duration of the study with DRF were screened for suitability. Included in the study were patients over the age of 10 years who had sustained an acute upper limb injury within the last 48 hours and a radiologically confirmed displaced DRF. Patients were excluded from the study in case of (i) previous unsuccessful attempts at reduction, (ii) concomitant head injury or any other life-threatening injuries, (iii) reduced Glasgow Coma Scale (GCS), (iv) unable to give or refusing consent, (v) mechanically intubated and ventilated patients, and (vi) allergies to any of the pharmacological agents used for HB or IV-PSA. Additionally, complex, compound and unstable fractures requiring definitive inpatient management were excluded from the study. A sample size of 228 was calculated using the WHO calculator, keeping the margin of error at 5%, confidence interval at 95%, and prevalence at 18%. Non-probability consecutive sampling was done using a simple lottery method

Operational Definitions:

For this study, minimally displaced fractures were defined as those with no initial radiographic displacement and those that could be stabilized by a splint without forceful manipulative reduction (18). Extra articular DRFs were identified as fractures located within 2.5cm of the radiocarpal joint and diagnosed based on standard anteroposterior (PA) and lateral radiographs of the wrist joint (10).Radiographic interpretation was performed by the on-site duty senior emergency residents (REM) or consultants, as formal radiology reporting could take several weeks.

Procedure Technique: The 228 patients involved in the study were divided into two groups: Group A (n =151) given HB, while Group B (n = 77) received IV-PSA. Patients who did not consent for one group were shifted to the other group, if they consented.

(i) Hematoma Block (HB):

- Pharmacological agent: Plain Lidocaine 2%, maximum dose 3ml/Kg body weight
- Location: The procedure was carried out in a clinical area equipped with a cardiac monitor and oxygen backup, in case required.
- Technique: The appropriately calculated dose lidocaine was infiltrated into the fracture site using standard technique.
- Human Resource (at least two):
  - The HB was administered by senior REM, who had received satisfactory training prior to commencement of the study.
  - The reduction was done by the same REM and at least one assistant who was either another REM, an orthopedic resident or a nurse.

• Monitoring: Clinical vigilance during and post-procedure

(ii) Intravenous Procedural sedation and analgesia (IV-PSA):

• IV Pharmacological agents:
○ Sedation: Midazolam preparation (1mg/mL), maximum dose 0.1 mg/Kg body weight
○ Analgesia: Nalbuphine preparation (1mg/ml), maximum dose 0.1 mg/Kg body weight
• Location: The procedure was done in a high acuity area, the Resuscitation Room, well-equipped with a cardiac monitor, central oxygen, reversal agents, and an airway trolley.
• Human Resource (at least four):
○ Sedation and Airway: The sedation was provided by senior REM trained for sedation and able to manage any complications, assisted by an airway trained nurse / assistant.
○ Proceduralist: The reduction was done by a second REM assisted by either the orthopedic colleague or a nursing assistant.
• Monitoring: Continuous monitoring (cardiac monitor) during procedure, followed by one hourly monitoring for at least four hours post-procedure.

(iii) All patients in both the HB and IV-PSA Groups:

• Underwent a preliminary pre-procedure assessment that included:

i. AMPLE (Allergies, Medication, Past Med-Sur History, Last Oral Intake,
Events) History

ii. Airway assessment using the LEMON (Look externally, Evaluate the 3-3-2 rule, Mallampati, Obstruction, Neck Mobility) method.

iii. In both groups, the patients were immobilized in a below-elbow plaster of paris (POP) backslab and discharged home with OPD follow-up within 3-5 days as per institute policy.

• Standard below-elbow (POP) back slab was applied while maintaining reduction.
• Kept under observation for at least 4 hrs in the ED.
• Post-procedure check x-ray was done to ensure adequate reduction, suitability for discharge and outpatient (OPD) follow-up
• Discharge prescription of oral paracetamol and NSAID was given along with POP-care advise.

Comprehensive data collection was conducted to gather demographic information including age and gender as well as specific details such as the time and mechanism of injury, pain scores (measured on visual analogue scale -VAS), pre- and post-reduction, and reduction time, using a self-completing proforma (Annexure 1). The proforma was created using the secure online survey application SurveyHeart (v3.1). Survey link was shared with all the REM who completed it in real-time. Responses were automatically transmitted to the researcher via the app's built-in mechanism.

Data Synthesis & Data Analysis: The study evaluated outcomes by examining the average reduction in pain scores and the average duration of the procedure. Reduction in pain scores was determined by calculating the change in the VAS score (ΔVAS) from pre- reduction (VAS-T_1) to post- reduction (VAS-T_2). The mean duration of reduction was measured in hours, starting from the initiation of X-ray acquisition in the radiology department to the completion of the reduction procedure. "Completion of procedure" refers to application of back slab, and radiological confirmation of adequate reduction. Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 23.00. Descriptive statistics, including mean ± standard deviation (SD) was calculated for continuous variable, while frequency and percentage were used for categorical variables.

RESULTS:

Of the 232 patients, 113 (48.7%) were male and 119 (51.2%) were female. The mean age of the study participants was 38.16 ± 13.79 years, with ages ranging from a minimum of 15 to a maximum of 60 years (Table 1).

The average time taken to achieve analgesia in the HB and IV-PSA groups was 10.2 minutes and 18.5 minutes, respectively. None of the patients in either group suffered from any adverse reactions. Procedure success rate was 95.48% and 88.31% In the HB and IV-PSA groups, respectively. Due to various reasons, a formal staff and patient survey could not be done. However, most patients in the HB group needed convincing to remain under observation for four hours, as they felt ready to go home quite early. Table 2 and 3 demonstrates the time interval taken for

patients of both groups to become pain free and number of attempts taken.

The mean pain score before treatment (VAS T1) was 5.29±2.25 in both groups. Thirty minutes after treatment (VAS T2), the median pain scores were 3 in the HB group and 4 in the IV-PSA group, with a p-value of < 0.001, indicating statistical significance (Table 4).

Table-1: Demographic features of patients included in the study (n=232)

Demographic Features		Group A (HB) n=155 Median (IQR)	Group B IV-PSA n=77 Median (IQR)	p-Value
Gender	Male	72 (46.4%)	41 (53.2%)	0.318
	Female	81 (52.2%)	38 (49.3%)	
Age In Years (Median, IQR)		36.00 (46.0-25.0)	41.00 (53.0-30.0)	0.015

Key: HB (Hematoma Block); IV-PSA (Intravenous procedural sedation and analgesia); IQR (interquartile range). P-value of < 0.05 was considered statistically significant.

Table-2: Pain relief timeline among the two groups (n=232)

Group (n=Number of patient)	Time taken for pain relief (minutes)	No. of patients being pain free (n, %)	Average time (minutes)
Group A: Hematoma block (n: 155)	5 min	80 (51.6)	**10.2**
	10 min	25 (16.1)	
	15 min	25 (16.1)	
	20 min	13 (8.3)	
	25 min	10 (6.4)	
	30 min	0 (0.0)	
Group B: IV sedation & analgesia (n:77)	5 min	10 (12.9)	**18.5**
	10 min	10 (12.9)	
	15 min	13 (16.8)	
	20 min	17 (22.0)	
	25 min	12 (15.5)	
	30	15 (19.4)	

Table-3: Pain relief timeline among the two groups (n=232)

Type of Analgesia	Patients requiring single attempt (n)	Patients requiring double attempt (n)	Success rate of single attempt (%) (1st attempt/total in group) x 100
Hematoma block	148	07	95.48
IV Sedation & analgesia	68	09	88.31

Table-4: Table demonstrating various outcomes among the two groups

Assessment	Group A (HB) n=155 Median (IQR)	Group B IV-PSA n=77 Median (IQR)	p-Value
Pain Score Before Treatment (VAS T1)	5.00 (7.0-4.0)	5.00 (7.0-4.0)	0.540
Pain Score 30-min after Treatment (VAS T2)	3.00 (4.0-1.0)	4.00 (7.0-2.0)	<0.001
Reduction in Pain Score (ΔVAS)	2.00 (4.0-1.0)	2.00 (4.0 -1.0)	0.005

Ie. (VAS T1) – (VAS T2)			
Time taken to achieve pain-free status	10.2 (10)	18.5 (15)	<0.001
No of patients requiring break-through analgesia	07	09	0.001
No. of patients with complications	Nil	Nil	-
No of unsuccessful procedures	Nil	Nil	-
No of Patients shifted to the other group	Nil	Nil	-

Key: HB (Hematoma Block); IV-PSA (Intravenous procedural sedation and analgesia); IQR (interquartile range). VAS (visual analogue scale). P-value of < 0.05 was considered statistically significant.

DISCUSSION:

DRFs are a common presentation in the ED, often requiring prompt manipulation and analgesia to prevent permanent disability and other complications. Our study shows a female predominance (52.2%) among patients presenting to the ED with DRFs, with a mean age of 38–40 years. These findings align with earlier research, which also reported a higher incidence of DRFs in females, with most patients falling within the 25- 45-year age range (14). The increased prevalence of DRFs in females in Pakistan may be attributed to several factors, including greater susceptibility to osteoporosis due to multiparity, nutritional deficiencies (such as vitamin D and calcium), and social factors like lower literacy rates and poor economic status (15).

Our study also demonstrated that greater and earlier pain relief was achieved in the HB group compared to the IV-PSA group. Additionally, the mean pain score at the completion of treatment was lower in the HB group than in the IV-PSA group. The significant difference between the two groups was reflected by a p-value of less than 0.001, which is consistent with the findings of Alatishe et al,2022 , who reported a lower pain score in the HB group (3.4 ± 1.6) compared to the sedation group (3.8 ± 1.6), though this difference was not statistically significant (2). Similarly, a study by Munshi et al., 2023, involving 70 patients found that 34.29% experienced mild pain and 51.43% experienced no pain following reduction in the HB group (19). The results of this study are comparable to our study, showing that HB provides more effective post-reduction pain relief than PSA in the adult population. These findings suggest that HB is advantageous over PSA for maintaining the analgesic effect during and after the reduction.

Our study also shows although that both groups were kept and observed in ED for 4 hrs., those in group A were pain-free and comfortable within 30 minutes. This suggests that they could be discharged home early, potentially reducing the ED LoS, reducing ED overcrowding, improving ED efficiency and better patient satisfaction.

The authors suggested that the preferable option for manipulating DRF would be HB. In accordance with a study comparing HB with IV-PSA in the reduction of DRF, patients with HB reported considerably less pain on the VAS (1.5 vs. 5.8, p<0.01) (20). HB also proved to be particularly helpful in the older population, according to a 2016 study (12). As a result, the HB group felt far less pain during closed reductions than the group under procedural sedation.

LIMITATIONS:

This is a single-center study with a relatively small sample size, which may not fully represent the broader population. While pain was assessed at various intervals during the ED stay, no follow-up mechanism was established to evaluate pain scores at 12-24 hours post-treatment. Further multicenter randomized controlled trials are needed to validate the findings of our study.

CONCLUSION

In conclusion, the findings of our study support the growing body of evidence that highlights the superiority of HB over IV-PSA for the reduction of DRFs in adults. HB not only provides more effective and faster pain relief but also allows for earlier patient comfort and potential early discharge, contributing to improved ED efficiency. While our results align with previous studies, further large-scale, randomized trials in diverse local settings are necessary to validate these

findings and assess the broader applicability of HB in routine clinical practice. Continued investigation will help to establish standardized protocols that optimize both patient outcomes and healthcare resource utilization.

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