The Radiographic Quality of Distal Radius Fracture Reduction Using Sedation Versus Hematoma Block

La qualité radiographique de la réduction des fractures distales du radius après une sédation ou une anesthésie locorégionale

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Abstract

Introduction: Distal radius fractures (DRFs) are treated in the emergency department (ED) with a closed reduction in order to decrease neurovascular and soft tissue injury and as a first definitive step in conservative treatment. The type of anesthesia used may affect the ability to reduce the fracture and remains controversial. **Objective:** The purpose of this study was to compare the quality of radiographic reduction achieved in the ED of DRF reduced using sedation anesthesia to those reduced with hematoma block anesthesia. **Methods:** A retrospective case-control study of 240 DRF reductions, 30 treated with sedation and 210 with a hematoma block, was performed. Complications and time spent in the ED were documented. Pre- and postreduction radiographs were reviewed for volar tilt, radial angulation, radial height, and ulnar variance. **Results:** Both groups were similar in gender, background illnesses, concomitant injuries, surgeon experience, and fracture radiographic classification. Postreduction values of volar tilt were better in the sedation group ($P = .03$). Volar tilt and ulnar variance improved more in the sedation group ($P = .001$). The sedation group spent more time in the ED ($P = .001$). **Discussion:** Sedation seemed to be more efficient than hematoma block in supporting closed reduction of distal radius fractures in the ED. However, this method requires specialized personnel and more time spent in the ED. **Conclusion:** We suggest using this method when the patient is planned to continue with conservative treatment.

Résumé

Historique : Les fractures distales du radius (FDR) sont traitées en salle d'urgence (SU) au moyen d'une réduction fermée afin de réduire les lésions neurovasculaires et celles des tissus mous. Cette technique représente la première étape décisive d'un traitement prudent. Le type d'anesthésie privilégié demeure controversé, car il peut influencer sur la capacité de réduire la fracture. **Objectif :** La présente étude visait à comparer la qualité des réductions radiographiques des FDR par sédation obtenues en SU à celles effectuées sous anesthésie locorégionale. **Méthodologie :** Les chercheurs ont effectué une étude rétrospective cas-témoins de 240 réductions de FDR, dont 30 traitées sous sédation et 210, sous anesthésie locorégionale. Ils ont consigné les complications et le temps passé en SU. Ils ont examiné les radiographies avant et après la réduction pour déterminer l'inclinaison palmaire, la déviation radiale, la hauteur radiale et la variance ulnaire. **Résultats :** Le sexe, les maladies antérieures, les lésions concomitantes, l'expérience du chirurgien et la classification radiographique des fractures étaient semblables dans les deux groupes. Les valeurs de l'inclinaison palmaire après la réduction étaient supérieures dans le groupe sous sédation ($p=0,03$). L'inclinaison palmaire et la variance ulnaire s'amélioraient également davantage dans ce groupe ($p=0,001$), qui passait toutefois

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plus de temps en SU ($p=0,001$). **Exposé :** La sédation semblait plus efficace que l'anesthésie locorégionale lors de la réduction fermée des fractures distales du radius en SU. Cependant, cette méthode exige la présence de personnel spécialisé et une période plus longue en SU. **Conclusion :** Les chercheurs suggèrent d'utiliser la sédation lorsqu'il est prévu que le patient poursuive un traitement prudent.

Keywords

anesthesia, closed reduction, distal radius fracture, emergency department, hematoma block, sedation

Introduction

Displaced distal radius fractures are treated initially with closed reduction in the emergency department (ED). The reduction is performed as the first step in the conservative management of the fracture and often in order to reduce pressure on the median nerve and to decrease pain. The type of anesthesia used is still controversial.¹ A range of options is available for anesthesia in the ED: intravenous regional anesthesia (Bier block) and regional nerve blocks that can be more distal or proximal at the brachial plexus.² Another method is sedation or conscious sedation where a drug induces depression of consciousness. No interventions are required to maintain a patent airway, and spontaneous ventilation is adequate. Cardiovascular function is maintained. These usually require an anesthesiologist. A local technique is a hematoma block in which a local anesthetic is injected into the fracture site. In our ED, either hematoma block or conscious sedation is performed. Both techniques have advantages and concerns. Although hematoma block is a relatively straightforward procedure that can be easily mastered, it does not induce muscle relaxation, thus possibly increasing the difficulty of manipulation and decreasing the ability to achieve an adequate reduction. Sedation on the other hand does have the advantage of muscle relaxation but requires more time, resources, knowledge, and experience with the technique in order to avoid airway and cardiovascular difficulties.

The quality of closed reduction of distal radius fractures in the ED is important. Better reductions give the patient more pain relief, less pressure on the median nerve, and they allow for appropriate conservative management. Conservative treatment may be necessary in patients with conditions that prohibit surgery, patients who refuse surgery, and in facilities with limited operative means. Some patients require more time before making a treatment decision and should be reduced as anatomically as possible to allow for conservative treatment in case they decide against surgery.

The purpose of this study was to compare the quality of reduction in the ED of adult distal radius fractures using the 2 common anesthetic procedures, hematoma block and conscious sedation.

Methods

This was a retrospective case-control study. All patients seen in our ED and treated for a displaced distal radius fracture with closed reduction by either hematoma block or conscious

sedation between January 2010 and April 2013 were eligible for the study. Their charts and radiographs were retrospectively reviewed. Institutional review board approval was obtained prior to study commencement. Inclusion criteria were age >18 years and availability of adequate radiographic series including pre- and postreduction true posteroanterior (PA) and lateral radiographs. Exclusion criteria were immediate hospitalization for operative reduction and fixation, pregnancy, and chronic cognitive impairment (dementia and retardation).

The choice of anesthesia was determined by the orthopedic resident on call at the time of patient admission. Hematoma block was obtained by injecting 1 to 2 mg/kg of 1% lidocaine into the fracture site through the dorsal aspect of the wrist. Manipulation was performed 5 to 10 minutes after injection in order to make sure the anesthesia had taken effect. An internal medicine specialist certified in sedation gave conscious sedation anesthesia. Sedation was obtained using 1 to 10 mg of midazolam plus 50 to 100 µg of fentanyl intravenously until the patient was felt to be sedated. Airway patency, respiration, and pulse rates were monitored. Pulse oximetry and masked oxygen were provided.

Demographic information was documented, including age, gender, other injuries, and other background illnesses, as well as years of experience of the orthopedic resident performing the reduction. Any complications related to the reduction procedure such as documented nerve injury or complications related to anesthesia were documented.

The quality of reduction was assessed on postreduction radiographs. Radiographs were reviewed for fracture classification according to the Frykman and the Arbeitsgemeinschaft für Osteosynthesefragen (AO) classification systems.^{3,4} Measurements included volar tilt, radial inclination, and radial height on each pre- and postreduction film. These were recorded in degrees or millimeters according to the methods described by Mann et al.⁵ Volar tilt was measured on a lateral radiograph by determining the angle formed between the long axis of the radius and a line drawn along the articular surface. Normal volar tilt was considered to be $-11^\circ \pm 5^\circ$.⁶ We measured radial inclination on a PA radiograph by determining the angle formed between the long axis of the radius and a line drawn from the distal tip of the radial styloid to the ulnar corner of the lunate fossa. Ulnar variance was described as ulna plus, minus, or neutral. The difference in axial length between the ulnar corner of the distal radius and the most distal extent of the ulnar head was measured in millimeter difference.⁷ Radial

Table 1. Demographic and Radiologic Characteristics.

Demographic	Hematoma Block (n = 210)	Sedation (n = 30)	P Value
Age	59.6 ± 17.7	53.8 ± 18.6	.09
Gender (female)%	70.4% (148)	70.0% (21)	.84
Concomitant injuries	11.0% (23)	10.0% (3)	1.00
Background illness	22.0% (46)	26.6% (8)	.65
Years experience (reducing surgeon)	3.4 ± 1.3	3.7 ± 1.3	.11
AO 23A	58.6% (123)	63.3% (19)	.84
AO 23B	9.5% (20)	10.0% (3)	1.00
AO 23C	36.2% (76)	33.3% (10)	.84
Frykman 1+2	45.7% (96)	60.0% (18)	.25
Frykman 3+4	30.4% (64)	30.0% (9)	1.00
Frykman 5+6	12.3% (26)	6.7% (2)	.54
Frykman 7+8	15.7% (33)	10.0% (3)	.58

Abbreviation: AO = Arbeitsgemeinschaft für Osteosynthesefragen.

height was measured by finding the long axis of the radius and then extending a line perpendicular to it at the tip of the radial styloid on a PA radiograph. We recorded the distance between this line and the distal most point of the ulnar dome.⁸ A measured postreduction volar tilt of less than -20° or above 15° signified a failure of reduction.

Statistical Analysis

The distribution of the quantitative parameters was tested using the Kolmogorov-Smirnov tests. The *t* test was used for continuous normally distributed variables. For quantitative parameters that were not normally distributed, the Mann-Whitney *U* test was used. Fisher exact test was used to evaluate categorical parameters. $P < .05$ was considered significant.

Results

Three hundred eighty five adults underwent closed reduction of distal radius fractures in our ED from January 2010 to April 2013. Two hundred forty eight patients met the inclusion criteria and were eligible for the study. Of these 1 had bilateral reductions, 6 had 2 reductions, and 1 had 3. All of these patients were treated with a hematoma block. These were not used in the analysis. Thus, 240 closed reductions were analyzed. The hematoma block group comprised 210 patients and the sedation group 30 patients. There was no difference between the 2 groups in regard to age, gender, other injuries, background illness, and the experience of the orthopedic personnel performing the reduction (Tables 1 and 2). The radiological characteristics of the groups were similar with respect to the AO and Frykman classifications (Table 1).

There were no differences between the radiographic parameters in the prereduction radiographs (Table 3). In both groups, we did not observe any significant improvements in intraarticular step-off. The sedation group had a statistically significant lower rate of reduction failures—volar tilt of less

Table 2. Population Background Disease.

Disease	Hematoma Block (n = 210)	Sedation (n = 30)	P Value
Background disease total	46 (21.1%)	8 (25%)	46 (21.1%)
Ischemic heart disease	16 (7%)	1 (3.1%)	16 (7%)
Pulmonary disease	3 (1%)		3 (1%)
Arrhythmia	6 (2.7%)	3 (9.3%)	6 (2.7%)
Cancer	8 (3.6%)	1 (3.1%)	8 (3.6%)
Cerebrovascular accident (CVA)	4 (1.8%)		4 (1.8%)
Substance abuse	4 (1.8%)	1 (3.1%)	4 (1.8%)
Epilepsy	1 (0.45%)	1 (3.1%)	1 (0.45%)
Mental illness	1 (0.45%)		1 (0.45%)
Renal disease	2 (0.9%)	1 (3.1%)	2 (0.9%)
Congestive heart failure	1 (0.45%)		1 (0.45%)
Other	14 (6.3%)		5 (2.2%)

than -20° or above 15° (0% vs 13%; $P = .03$). The amount of change (improvement) achieved with sedation was greater with volar tilt and ulnar variance (Table 4). The ED visit time was longer in the sedation group (5.0 vs 4.1 hours; $P < .001$). No complications were noted in both groups in the ED records.

Discussion

A recent meta-analysis concluded that there is insufficient evidence to establish the relative effectiveness of different methods of anesthesia in closed reduction of distal radius fractures.¹ Although this procedure is common practice, few studies compared the effect of the 2 anesthesia forms, hematoma block and sedation, on the radiographic quality of the reduction.

Singh et al compared 33 patients who underwent sedation to 33 patients who underwent hematoma block.⁹ They found that there were no significant differences in the number of reduction failures or deformity between the 2 groups at 8 weeks of follow-up.

The final position of the fracture (at the time of union) may be influenced by many parameters and not only by the immediate postreduction position. Some of these parameters include the method and quality of casting, whether the cast was replaced at follow-up, patient adherence, and in general the inherent stability of the fracture. Funk et al obtained results similar to ours.¹⁰ They compared 21 patients who had general anesthesia to 19 who had a hematoma block and to 19 who had hematoma block with sedation. Volar tilt deviation from neutral was better in the general anesthesia group than in the hematoma block group. We found better improvement in both volar tilt and ulnar variance in the anesthesia group. Both of these parameters are dependent on our ability to employ ligamentotaxis. This differs from intraarticular step-off, for example, where many fragments are not connected to ligaments and cannot be manipulated in this manner. These parameters (volar tilt and ulnar variance) perhaps better reflect our true ability to

Table 3. Radiologic Measurements Comparing the Sedation Group to the Hematoma Block Group Prereduction and Postreduction Values.

Radiographic Measurement	Prereduction			Postreduction		
	Hematoma Block (n = 210)	Sedation (n = 30)	P Value	Hematoma Block (n = 210)	Sedation (n = 30)	P Value
Volar tilt deformity (from -11°)	27.5 ± 15.6	22.6 ± 20.7	.21	11.7 ± 8.8	10.6 ± 6.8	.67
Radial height	7.1 ± 4.4	6.8 ± 5.6	.73	10.3 ± 3.3	10.5 ± 3.1	.9
Radial inclination	17.3 ± 8.9	16.4 ± 10.4	.64	22.5 ± 8.9	23.7 ± 9.3	.92
Ulnar variance (mm)	2.4 ± 2.7	2.6 ± 2.7	.15	1.2 ± 2.2	0.6 ± 9.3	.13
Volar tilt less than -20° or above 15° , percentage (n)	61% (134)	63% (20)	1.00	13% (28)	0% (0)	.03

Table 4. Amount of Change Achieved by the Reduction.^a

Radiographic Measurement	Change Block	Change Sedation	P Value
Volar tilt (degrees, (SD))	20.4 (13.7)	26.1 (14.7)	.03
Radial height (SD) mm	3.6 (3.4)	4.6 (4.2)	.13
Radial inclination	5.2 (0.6)	6.2 (1.7)	.8
Ulnar variance	1.7 (1.7)	2.6 (2.1)	.03

^aThe values are means (standard deviation, SD).

achieve reduction with ED maneuvers. Funk et al also found that general anesthesia was safe and produced significantly less pain during the reduction.¹⁰

Another study by Myderrizi and Mema compared 48 patients who had general anesthesia to 48 patients reduced using a hematoma block.¹¹ They compared the difference in the position of the fracture immediately after the reduction to the position a week later. There were no differences between both groups in all parameters. This study did not provide details regarding the quality of reduction and did not compare the position of the fracture immediately following reduction between the groups. In our population, all of the patients who had more than 1 reduction were in the hematoma block group. The numbers were too small to derive statistical significance, but perhaps this supports sedation as being able to obtain better immediate reduction.

Fracture reduction manipulations differ from other ED procedures such as debridement and suture of wounds in that they require muscle relaxation for a more effective reduction. The improvement in reduction in the sedation group could be related to the use of midazolam and fentanyl. This combination has the advantage of amnesia and anxiolysis, as well as muscle relaxation. Despite being more effective, sedation was more time consuming. We did not measure the exact time it took to obtain sedation, but we believe the added time was spent waiting for the anesthesiologist as well as in recovery from anesthesia.

Limitations of this study include limitations of a retrospective study. Specifically, we did not control the decision-making of the reducing surgeon in choosing the type of anesthesia performed. There may have been an undetected bias toward sedating certain types of patients and/or fracture types over others.

In summary, both forms of anesthesia are acceptable in the ED since they carry minimal risks and do allow for a significant reduction to be obtained. Our study suggests that sedation has a lower rate of radiologic failure than hematoma block and other studies support the more “comfortable” experience for the patient with sedation. However, sedation requires certified personnel to perform and is more time consuming. We suggest therefore choosing the method of anesthesia based on the intent for fracture treatment. In patients who are most likely to be treated conservatively, the reduction should be performed under sedation. This has the potential to improve the quality of reduction and is less traumatic for the patient. A prospective randomized controlled trial can further strengthen the findings allowing for clearer guidelines for the management of fractures of the distal radius in the ED.

Declaration of Conflicting Interests

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