Radial Nerve Supracondylar Block Versus Fracture Hematoma Block. Comparison of Their Efficacy in Cases of Fractures of the Distal Third of the Radius*

Bloqueio supracondilar de nervo radial versus bloqueio de hematoma de fratura. Comparativo de sua eficácia em casos de fraturas do terço distal do rádio

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Abstract

Objective The present study compares the analgesic efficacy of two techniques to perform non-surgical reduction: fracture hematoma block and radial nerve supracondylar block.

Methods Forty patients with fractures of the distal third of the radius, who required reduction, were selected in a quasi-randomized clinical trial to receive one of the anesthetic techniques. All patients signed the informed consent form, except for those who did not wish to participate in the study, had neurological injury, had contraindication to the procedure in the emergency room, or with contraindication to the use of lidocaine. To measure analgesia, the numerical pain rate scale was used at four different moments: preblock, postblock, during reduction, and after reduction; then three differences were calculated: the first between before and after blocking; the second between during reduction and after blockade; and the third between before blocking and after reduction.

Keywords
- anesthesia, local
- closed fracture reduction
- nerve block
- radius fractures
- pain measurement

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Results The fracture hematoma and supracondylar block groups showed the following mean values, respectively: 3.90 (1–10) and 3.50 (-6–10) in difference 1; 4.35 (-5–10) and 5.00 (-3–10) in difference 2; and 4.65 (1–10) and 3.80 (-3–10) in difference 3.
Conclusion Both techniques proved to be efficient for analgesia, with mild superiority of hematoma block, but without statistical significance.

Resumo

Objetivo O estudo compara a eficácia analgésica de duas técnicas para realizar redução incruenta: o bloqueio de hematoma da fratura e o bloqueio supracondilar de nervo radial.
Métodos Quarenta pacientes com fraturas do terço distal do rádio, que necessitassem redução, foram selecionados em um ensaio clínico quasi-randomizado, para receber uma das técnicas anestésicas. Todos os pacientes assinaram o termo de consentimento ou assentimento, com exceção daqueles que não desejassem participar do estudo, tivessem lesão neurológica, com contraindicação ao procedimento na sala de emergências, ou com contraindicação ao uso da lidocaína. Para aferir a analgesia foi utilizada a escala numérica da dor em quatro momentos distintos: pré-bloqueio, pós-bloqueio, durante a redução e após a redução; em seguida, foram calculadas três diferenças: a primeira entre antes e após o bloqueio; a segunda entre durante a redução e após o bloqueio; e a terceira entre antes do bloqueio e após a redução.
Resultados Os grupos do bloqueio de hematoma de fratura e bloqueio supracondilar apresentaram respectivamente os seguintes valores médios: 3.90 (1–10) e 3.50 (-6–10) na diferença 1; 4.35 (-5–10) e 5.00 (-3–10) na diferença 2; e 4.65 (1–10) e 3.80 (-3–10) na diferença 3.
Conclusão As duas técnicas se provaram eficientes para analgesia, com discreta superioridade do bloqueio de hematoma, mas sem significância estatística.

Palavras-chave
- anestesia local
- bloqueio nervoso
- fraturas do rádio
- medição da dor
- redução fechada

Introduction

Fractures of the distal third of the radius occur very frequently, being the most prevalent in the upper limbs.[1] Studies indicate an estimated 600,000 cases annually,[2] with an incidence in children of approximately 1.5 forearm fractures in every 100 emergency room visits.[3]

Despite happening in patients of all ages, fractures of the distal third of the radius have a great distinction regarding the mechanism of trauma, as it may vary according to age range.[1,2] In young adults, it is usually related to high-energy trauma, and in the elderly to low-energy trauma.[1,2] It is also important to highlight that studies indicate that the number of cases in the elderly should increase due to the increasing life expectancy of the population; and in children due to increased body mass index (BMI), and increasingly early onset of sports activities and risk.[3]

The treatment of distalic fractures of the radius can range from immobilization with orthosis to surgical treatment with internal fixation.[1–3] In addition, part of the fractures requires a non-surgical reduction early on admission, either for definitive treatment, or for improvement of bone alignment to preserve soft tissues and to provide pain relief while awaiting definitive surgical treatment.[1,2] Thus, analgesia planning is necessary to perform these procedures.[4–7]

In the medical literature, several techniques have been described with the purpose of analgesia to aid in the non-surgical reduction of the radius' distal fractures.[8] Among them, some stand out: fracture hematoma block,[6] Bier block,[9] sedation with venous drugs,[10] brachial plexus block,[11] and supracondylar block of the radial nerve.[7]

It is possible to find several studies in the medical literature in which different analgesia techniques are described, but there are few that are comparative, and none was found to compare two techniques which was possible to perform easily outside the operating room.

The present study aimed to compare the results of analgesia of fracture hematoma block with that of the supracondylar block (SCB) of the radial nerve in non-surgical treatment in patients with radius distal fracture.

Materials and Methods

The work followed the determinations of the declaration of Helsinki with the guidelines for studies with human beings, being submitted and approved by the research ethics committee (CAAE 37896620.8.0000.5378). All participants agreed to their participation by signing a free and informed consent form (TCLE) or consent form.

The study consisted of a near-randomized clinical trial, which compared two analgesia techniques used to aid in the non-surgical reduction of fractures of the distal third of the radius. The inclusion criteria in the study were: patients diagnosed with fracture of the distal third of the radius with

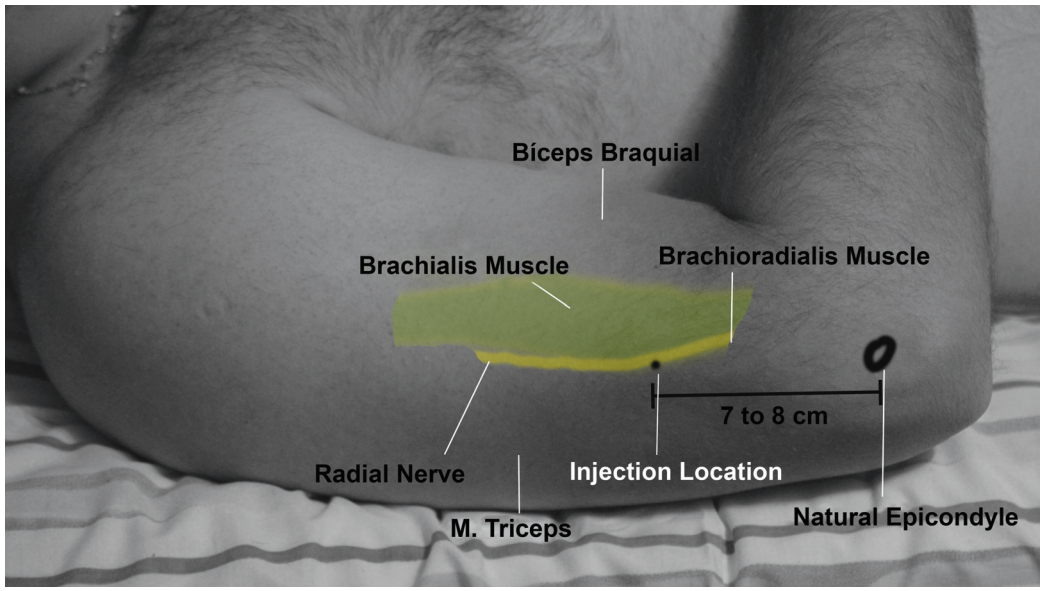

Fig. 1 Radial nerve block technique.

indication of non-surgical reduction, agreement in the participation by part of the patient or guardian, patient with cognitive capacity that would allow the procedure and answering the questionnaire. The exclusion criteria of the study involved patients with previous neurological injury or due to current trauma; as well as those who had some contraindication to perform the procedure in the emergency room, or contraindication to the use of lidocaine.

Forty patients were involved in the study with the diagnosis of fracture of the distal third of the radius, which were divided into 2 groups, 20 patients allocated in the radial nerve SCB group, and 20 patients allocated in the fracture focus infiltration (FFI) group. The randomization of the patients was performed on a first-come, first-served basis, and the data collected were: age, gender, joint involvement, presence or not of comminution and associated ulna fracture.

Anesthetic block was performed with a sterile syringe kit and sterile needle, and lidocaine 2% (Xylestesin 2% without vasoconstrictor, Cristália, SP, Brazil) was injected[12,13] in both groups. No auxiliary imaging methods were used in either group. All procedures were performed by two of the study researchers and, for radial nerve block, training was used before the beginning of the study, using anatomical models and ultrasound, with the objective of better localization, based on anatomical points.

To perform radial nerve SCB, we used the lateral epicondyle as an anatomical parameter, inserting the needle into the lateral face of the arm at a point approximately 7 to 8 cm proximal to it, near the distal limit of the radial sulcus of the humerus and the origin of the brachioradial muscle. The correct location was confirmed by paresthesia along the nerve path (►**Fig. 1**).

Palpation of the anatomical defect resulting from the fracture and the insertion of the needle at this point was used for the FFI. The location was confirmed by aspiration of the hematoma from the fracture focus.

To quantify and classify pain, we used the numerical pain rate scale (NPRS), which is a variant of the visual analog scale (VAS),[14] measured in four moments: before blockade, after block, during reduction, and after reduction. To calculate the analgesic effect of the techniques, we used the differences between the NPRS values obtained at each moment: we called NPRS1 the difference between the values obtained before and after the blockade, NPRS2 the difference between the values obtained during the reduction and after the blockade, and NPRS3 the difference between the values obtained before the blockade and after the reduction.

Statistical Analysis

All data were analyzed using the statistical analysis software Jamovi 2.2.2 (Library R 4.0.2). The hypothesis of nullity of absence of difference was rejected if the p-value was < 0.05. To evaluate the SCB and FFI's groups homogeneity, we used the Chi-squared and Fisher tests for the nominal variables.

The normal distribution of parametric variable data was evaluated using the Shapiro-Wilk test, histograms, and mean and median comparisons. Thus, the results of the means that presented normal distribution were evaluated using the Student t test. On the other hand, the results considered as nonparametric were evaluated with the Mann-Whitney test.

Results

The study included 40 patients with the diagnosis of fracture of the distal third of the radius, who were divided into 2 groups, 20 patients allocated in the FFI group, and 20 patients allocated in the radial nerve SCB group.

The age of the patients ranged from 8 to 87 years, with an average of 50 years in the FFI group; and it ranged from 9 to 90 years, with an average of 41 years in the SCB group (►**Fig. 2**). The distribution between genders showed a higher female prevalence in both groups, being 15 (75%) patients in the FFI group and 11 (55%) patients in the SCB group (►**Fig. 3**).

Associated ulna fracture was present in 7 (35%) patients in the FFI group, and in 5 (25%) patients in the SCB group (►**Fig. 4**); joint involvement occurred in 6 (30%) patients in the FFI group and 7 (35%) in the SCB group (►**Fig. 5**); and in both groups we found 6 patients with fracture comminution (►**Fig. 6**). The characteristics of the fracture in relation to the presence of ulna involvement, comminution and joint involvement were homogeneous in the two groups studied, when evaluated with the Chi-squared and Fisher tests.

There were no complications during the execution of both anesthetic block techniques, neither in the FFI nor in the SCB group.

The NPRS values found before blockade ranged from 2 to 10 in the FFI group, with an average of 6.9; and from 0 to 10 in the SCB group, with an average of 6.1. There was no statistical difference between means of NPRS values before the block. Numerical pain rate scale values after block ranged from 0 to 8 in the FFI group, with an average of 3.0; and from 0 to 8 in the SCB group, with an average of 2.6 (►**Table 1**). There was no statistical difference between means of NPRS values after the block (Table 2).

The NPRS values found during reduction ranged from 2 to 10 in the FFI group, with an average of 7.35; and from 0 to 10 in the SCB group, with an average of 7.6. There was no statistical difference between means of NPRS values during block The NPRS values after reduction ranged from 0 to 6 in the FFI group, with an average of 2.25; and from 0 to 10 in the SCB group, with an average of 2.3. There was no statistical difference between means of NPRS values after block (►**Table 2**)

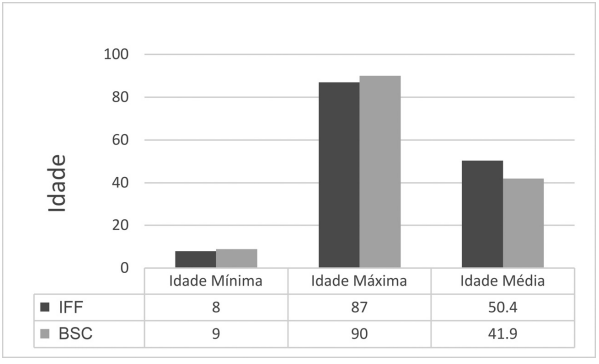

Fig. 2 Distribution by age group.

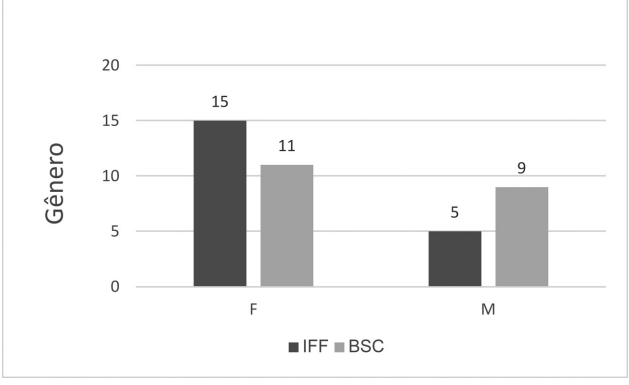

Fig. 3 Distribution by gender.

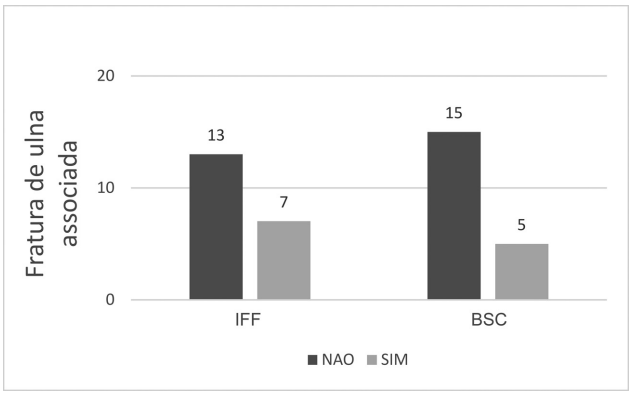

Fig. 4 Association with ulna fracture.

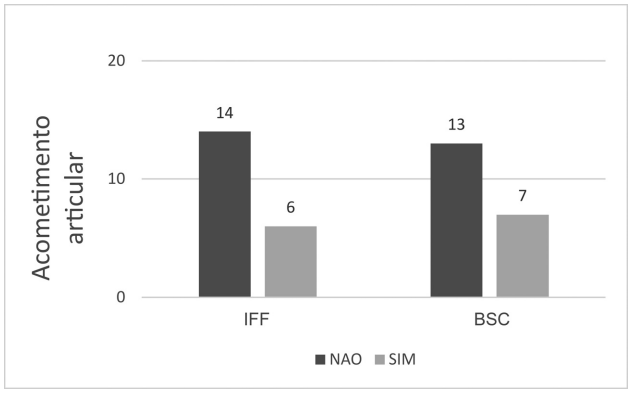

Fig. 5 Joint involvement.

The results obtained from NPRS1 (difference between the values obtained before and after blockade) ranged from 1 to 10 in the FFI group, with an average of 3.9; and from -6 to 10 in the SCB group, with an average of 3.5. There was no statistical difference between the means of NPRS1 values (►**Tables 3** and **4**). The values found in NPRS2 (difference between the values obtained during reduction and after blockade) ranged from -5 to 10 in the FFI group, with an average of 4.35; and from -3 to 10 in the SCB group, with an average of 5.0. There was no statistical difference between the means of NPRS2 values (►**Tables 3** and **4**). Finally, NPRS3 (difference between the values obtained before block and

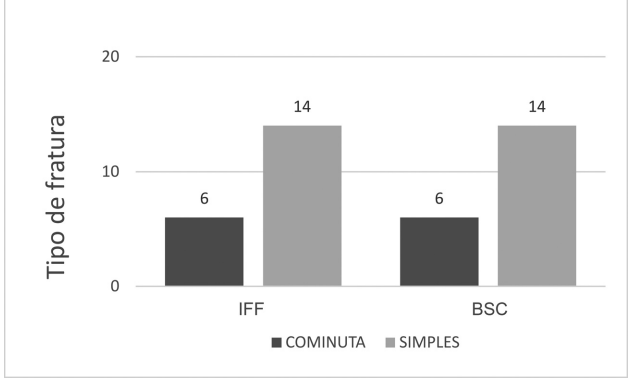

Fig. 6 Comminution of the radius fracture.

Table 1 Numerical pain rate scale measured values

	Technique	Preblock	Postblock	Reduction	Postreduction
Average	FFI	6.90	3.00	7.35	2.25
	SCB	6.10	2.60	7.60	2.30
Standard deviation	FFI	2.59	2.66	2.46	2.17
	SCB	3.31	2.39	3.10	2.90
Minimum	FFI	2	0	2	0
	SCB	0	0	0	0
Maximum	FFI	10	8	10	6
	SCB	10	8	10	10

Abbreviations: SCB, supracondylar block; FFI, fracture focus infiltration.

Table 2 Numerical pain rate scale comparison between the two analgesia techniques

	Preblock	Postblock	Reduction	Postreduction
Shapiro-Wilk	0.022	0.007	< 0.001	< 0.001
Mann-Whitney U	0.494	0.710	0.453	0.776

after reduction) results ranged from 1 to 10 in the FFI group, with an average of 4.65; and from -3 to 10 in the SCB group, with an average of 3.8. There was no statistical difference between the means of NPRS3 values (►**Tables 3** and **4**).

Discussion

Fractures of the distal third of the radius are extremely common in emergency orthopedic care and affect patients of all ages.[1,2] Reducing and immobilizing in the emergency room can reduce costs, wait time, and length of hospital stay.[15,16]

For the study, two analgesia methods used in non-surgical treatment of fractures of the distal third of the radius were chosen, which could be reproduced without major difficulties, without the use of special equipment or requiring monitoring during the procedure. Thus, they are applicable in the reality of most emergency care units. In addition, to quantify pain, we used the NPRS, which is a variant of the VAS, because it is simple to understand and easy to reproduce.[14]

In the institution where the study was conducted, the analgesia pattern used is the FFI, with good acceptance and effective analgesia.[6,17] Radial nerve block was chosen for the possibility of performing the procedure without creating communication between the fracture and the external environment, and because it theoretically facilitates local manipulation, not expanding the volume of the manipulation site.[18]

During the anesthetic procedure, a greater ease was observed in the execution of hematoma block, requiring less time to perform the procedure due to the fracture deformity being palpable and the presence of blood on aspiration confirming the correct location. However, we did not use any evaluation measure for this variable. In radial nerve block, more specific training was required before the beginning of the study, using anatomical models and

Table 3 Values obtained from NPRS1, NPRS2, and NPRS3 in analgesia techniques

	Block	NPRS2	NPRS2	NPRS3
Average	FFI	3.90	4.35	4.65
	SCB	3.50	5.00	3.80
Minimum	FFI	1	-5	1
	SCB	-6	-3	-3
Maximum	FFI	10	10	10
	SCB	10	10	10

Abbreviations: SCB, supracondylar block; NPRS1, difference between values obtained before and after block; NPRS2, difference between values obtained during reduction and after block; NPRS3, difference between values obtained before block and after reduction; FFI, fracture focus infiltration.

Table 4 Comparison of NPRS1, NPRS2 and NPRS3 values between analgesia techniques

			95% confidence interval	
		p	Inferior	Superior
NPRS2	Shapiro-Wilk	0.026		
	Mann-Whitney	0.880	-1.00	2.00
NPRS2	Shapiro-Wilk	0.269		
	Student T	0.583	-3.02	1.72
NPRS3	Shapiro-Wilke	0.267		
	Student T	0.407	-1.20	2.90

Abbreviations: NPRS1, difference between values obtained before and after block; NPRS2, difference between values obtained during reduction and after block; NPRS3, difference between values obtained before block and after reduction.

ultrasonography, with the aim of better localization, based on anatomical points. In addition, we believe that greater collaboration of the patient is necessary, informing the sensation of paresthesia in the nerve path.

The anesthetic chosen was lidocaine at 2% without vasoconstrictor, because it is easily accessible, it has low price, low latency, and it provides sufficient effect time to perform the entire procedure.[19] The volume of anesthetic in the SCB group was higher (on average, used 3 to 4mL more), with consequent higher latency for this purpose, since patients needed a few minutes to report improvement of pain, while in the FFI group, improvement was almost immediate.

The study was carried out without major complications, and patients had no complications or sequelae due to the application of anesthetic methods. The main possible complications were infection at the infiltration site, administration of anesthetic in the vascular structure, or nerve injury by intraneural application.[20] Although possible, they are rare events when following the hygiene and safety protocols,[17] and we did not identify the occurrence in any patient involved in our study.

The results obtained in this study were compatible with those previously published in the literature, both in terms of analgesic effectiveness of the method and in the rate of complications.[6,7] Nevertheless, even with the aid of ultrasound, Frenkel et al.[5] did not obtain complete anesthesia, and Bear et al.[21] had 2 cases (7.69%) of paresthesia. These data are reinforced by the methodology used in this study, in which no complications were reported with the two analgesia techniques employed.

Three comparisons were made, and hematoma block was better in all, but statistical analysis was not significant. Although we obtained effective analgesia, radial nerve block did not produce complete anesthesia for the procedure, and this can be explained by the fact the radio region is not completely innervated by the radial nerve.[21]

Thus, although both methods were effective in reducing patients' pain before reduction, as evidenced by the statistical evaluation of means of NPRS measured before and after the block, none promoted complete anesthesia. Thus, the choice of the technique to be used should be up to the executing professional, always respecting the autonomy of the patient, opening the possibility of reduction under sedation in the operating room, if they so wish, after explaining the risks and benefits.

Conclusion

The study showed that both methods have similar analgesic efficacy, with both showing improvement. Despite a slight superiority of the hematoma fracture block in the comparisons, no statistical significance was observed in any of them.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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