

Incidence of Regional Pain Syndrome after Carpal Tunnel Release. Is there a Correlation with the Anesthetic Technique?

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Summary: Costa VV, Oliveira SB, Fernandes MCB, Saraiva RA – Incidence of Regional Pain Syndrome after Carpal Tunnel Release. Is there a Correlation with the Anesthetic Technique?

Background and objectives: Complex regional pain syndrome (CRPS) previously known as reflex sympathetic dystrophy refers to a set of signs and symptoms that include pain, increased sweating, and vasomotor instability. Pain is usually triggered by a noxious stimulus in a peripheral nerve, which is disproportionate to the triggering stimulus. Its development after surgery is not uncommon varying with the type of intervention. An incidence of 2.1 to 5% has been reported after carpal tunnel release (CTR). Sympathetic blockade may prevent the onset of CRPS. However, there is no study validating this technique to prevent CRPS after CTR. The objective of the present study was to define the incidence of CRPS after CTR and its relationship with four anesthetic techniques.

Methods: Patients were randomly distributed to undergo one of the following techniques: general anesthesia, regional intravenous anesthesia with lidocaine, regional intravenous anesthesia with lidocaine and clonidine, or axillary plexus block. Postoperatively, they were followed-up by a nurse who was unaware of the anesthetic technique used, and follow-up was done through electronic patient records for up to 6 months after the anesthesia. During this period signs and symptoms typical of CRPS were investigated and, if positive, treatment was instituted. A descriptive evaluation using the chi-square test was performed.

Results: Three-hundred and one patients were investigated. Twenty-five of them developed CRPS, an incidence of 8.3%. Predominance was not observed among the anesthetic techniques used. Other factors such as smoking, profession, and other concomitant diseases were also investigated, and none showed a relationship with the development of post-CTR CRPS.

Conclusions: Complex regional pain syndrome has an incidence of 8.3% after CTR surgery without association with the anesthetic techniques investigated.

Keywords: Complex Regional Pain Syndromes; Carpal Tunnel Syndrome; Anesthesia, General; Nerve Block; Brachial Plexus; Clonidine.

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INTRODUCTION

Complex Regional Pain Syndrome (CRPS), previously known as Reflex Sympathetic Dystrophy, describes a painful regional condition associated with sensorial changes secondary to a noxious event ¹. Pain is the main symptom that can be associated with abnormal skin discoloration, changes in limb temperature, and increased sweating or edema. Pain is usually triggered by a noxious event, but it is not limited to the

distribution of a single nerve, and it is disproportional to the triggering event ².

According to consensus criteria of the International Association for the Study of Pain (IASP), signs and symptoms affect more commonly the extremity of the affected limb irradiating to the rest of the same limb. A characteristic presentation is burning pain, which may be triggered by physical contact, changes in temperature, and emotional stress. Vasomotor changes manifest as difference in temperature and discoloration between limbs. Edema varies in intensity, and increased sweating or anhidrosis can be seen in the affected limb. Motility changes are characterized by weakness, dystonia, muscle spasms, tremors, and difficulty to move the limb ¹.

The epidemiology of CRPS is not well defined, but it is known to usually develop after a surgical procedure, and its incidence varies according to the type and site of surgery. The literature reports an incidence of 2.1% to 5% after carpal tunnel release (CTR) ³. According to Veldman the mean age of greater incidence is 41 years old with a female predominance of 3:1 ⁴.

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There is no evidence of risk factors that predispose the development of CRPS, although prolonged immobilization can be a risk factor for the injury¹. It has been described that the sympathetic blockade as an anesthetic technique can prevent the development of CRPS^{5,6}. However, previous studies validating it as a preventive technique for CRPS after carpal tunnel release do not exist.

The objective of the present study was to define the incidence of CRPS after CTR with pneumatic garroting and its relationship with four distinct anesthesia techniques.

METHODS

After approval by the Medical Ethics Committee of the Hospital and signing of the informed consent, patients with diagnosis of carpal tunnel syndrome scheduled for surgical treatment were included in this study. All patients received oral diazepam 10 mg the night before surgery and 15 mg 40 minutes before surgery as premedication.

Initially, the different techniques of anesthesia were divided into general anesthesia (A), intravenous regional anesthesia with lidocaine (B), intravenous regional anesthesia with lidocaine associated with clonidine (C), and axillary plexus block (D). The first patient with carpal tunnel syndrome was selected for one of the techniques, and the same was done for the next three patients until each one of the anesthesia techniques were chosen. The remaining patients followed the order of the first four patients until the last patient had been entered in a group.

In the general anesthesia group, propofol (2.5 mg.kg⁻¹) was used for induction after the intravenous administration of 0.5% lidocaine (1 mL.10 kg⁻¹), followed by the insertion of a laryngeal mask. Sevoflurane and nitrous oxide diluted in 50% oxygen were used for maintenance.

Axillary plexus block was guided by a peripheral nerve stimulator, looking for multiple peripheral nerve stimuli of the axillary plexus. A total of 30 mL of 2% lidocaine with adrenaline at 1:200,000 were administered.

Regional intravenous anesthesia was performed with 0.5% lidocaine for a total volume of 40 mL associated or not with clonidine 1 µg.kg⁻¹. Peroperatively, intravenous ketorolac (30 mg) and dypirone (30 mg.kg⁻¹) were administered to help postoperative analgesia.

All patients remained with pneumatic tourniquet on the operated limb during surgery to maintain the surgical field free of blood. The stimulated cuff pressure was 110 mmHg above the systolic blood pressure of the patient at the time of insufflation.

In all groups, 1% lidocaine without adrenaline was used to infiltrate the incision (before closing the skin) for analgesia in the immediate postoperative period.

On the first and second postoperative days, as well as in the first outpatient dressing change (approximately eight days

after the surgery), patients were evaluated by a nurse who was unaware of the anesthetic technique used in search for occasional complications, such as hematomas or signs of inflammation at the surgery site. Subsequently, patients were followed-up through their electronic medical charts for up to six months after anesthesia. Throughout this time typical signs and symptoms of CRPS were investigated according to the consensus criteria of the IASP proposed in 1993¹. The cases that besides the typical symptoms also presented at least two more characteristic signs of CRPS were considered CRPS cases. Cases diagnosed by the surgeon and confirmed by a neurologist were considered positive for CRPS.

Patients undergoing retinaculothomy of flexor carpi muscles randomly selected from January 2006 to November 2007 in the Brasília unit of Rede Sarah were enrolled in this study.

Sample Calculation: with the sample of this study (301 patients) Pearson's chi-square test has a power of 80% (1 – "type II error") to detect intergroup differences considering Cohen's w (effect size) equal to 0.19. Differences between groups could be confirmed with a significance level of 5% ("type I error")^{8,9}.

Besides the association between CRPS and anesthetic techniques the association with gender, age, body mass index (BMI), systolic hypertension, diabetes mellitus, hypothyroidism, migraine, smoking, and duration of pneumatic tourniquet were also investigated.

Because the duration of pneumatic tourniquet is modified according to factors inherent to the anesthetic technique, such as regional venous anesthesia in which a long duration tourniquet is necessary⁷, analysis of this variable was performed according to the anesthetic technique used.

Descriptive statistical and exploratory analysis of data was performed. To assess the association between CRPS and the nominal variables evaluated, Pearson chi-square test was used (asymptotic and, whenever necessary, exact). When continuous variables were evaluated, inferences were made using the non-parametric Mann-Whitney test. The statistical software SPSS version 13 was used.

RESULTS

Three-hundred and one patients undergoing retinaculothomy of flexor carpi were investigated. Two-hundred and eighty-eight patients corresponding to 96% of the cases were females (Table I). The mean age of patients was 51.2 years.

Patients underwent the following anesthetic techniques: general anesthesia (24%), pure intravenous regional anesthesia (30%), intravenous regional anesthesia associated with clonidine (22%), and brachial plexus block (24%) (Table I).

Twenty-five out of 301 patients in the study developed CRPS representing an incidence of 8.3%. This incidence was equally distributed without predominance of any of the anesthetic techniques used.

INCIDENCE OF REGIONAL PAIN SYNDROME AFTER CARPAL TUNNEL RELEASE.
IS THERE A CORRELATION WITH THE ANESTHETIC TECHNIQUE?

Table I – Demographic Characteristics

	n = 301
Gender*	
Female	288 (96%)
Male	13 (4%)
Anesthetic technique*	
Axillary brachial plexus block	71 (24%)
General	73 (24%)
Bier	90 (30%)
Bier + clonidine	67 (22%)
Associated diseases*	
Hypertension	114 (38%)
Diabetes <i>mellitus</i>	39 (13%)
Hypothyroidism	47 (16%)
Migraine	37 (12%)
Smoking*	78 (26%)
Age (years)**	51.2 ± 9.4
BMI**	28.8 ± 5.0
Tourniquet time (min)**	30 ± 17

*Results expressed as number of patients (%); **mean ± standard deviation. Bier: intravenous regional anesthesia; BMI: body mass index.

The most common associated diseases were hypertension present in 38% of patients; hypothyroidism (16%); diabetes mellitus (13%); and migraine (12%) (Table I).

An association between CRPS and hypertension, hypothyroidism, diabetes mellitus, and migraine was not observed. An association between CRPS and gender, age, and body mass index was not observed either (Table II).

Regarding the duration of pneumatic tourniquet, a statistically significant difference was observed between patients who underwent intravenous regional anesthesia and those who underwent other anesthetic techniques ($p < 0.001$).

The duration of pneumatic tourniquet between patients who underwent intravenous regional anesthesia with lidocaine or

Table II – Prevalence of Complex regional pain syndrome (CRPS)

	Without CRPS, n = 276	With CRPS, n = 25	p
Gender*			0.399
Female	263 (91.3%)	25 (8.7%)	
Male	13 (100.0%)	0 (-)	
Anesthetic technique*			0.263
Axillary brachial plexus block	63 (88.7%)	8 (11.3%)	
General	70 (95.9%)	3 (6.7%)	
Bier	84 (93.3%)	6 (4.1%)	
Bier + clonidine	59 (88.1%)	8 (4.1%)	
Hypertension*			0.840
No	171 (91.4%)	16 (8.6%)	
Yes	105 (92.1%)	9 (7.9%)	
Diabetes <i>mellitus</i> *			0.754
No	241 (92.0%)	21 (8.0%)	
Yes	35 (89.7%)	4 (10.3%)	
Hypothyroidism*			0.778
No	232 (91.3%)	22 (8.7%)	
Yes	44 (93.6%)	3 (6.4%)	
Migraine*			1.000
No	242 (91.7%)	22 (8.3%)	
Yes	34 (91.9%)	3 (8.1%)	
Smoking*			0.229
No	207 (92.8%)	16 (7.2%)	
Yes	69 (88.5%)	9 (11.5%)	
Age (years)**	51.2 ± 9.6	50.6 ± 7.2	0.967
BMI**	28.8 ± 5.1	29.1 ± 4.8	0.722
Garroting time (min)**	30.9 ± 17.4	32.4 ± 12.6	0.633

*Results expressed as number of patients (%); **mean ± standard deviation; Bier: intravenous regional anesthesia; BMI: body mass index.

associated with clonidine and developed CRPS was similar to those who did not develop this complication ($p = 0.153$), while those who underwent general anesthesia and axillary plexus block and developed CRPS had long duration of pneumatic tourniquet than those who underwent the same anesthetic techniques and did not develop CRPS ($p = 0.025$) (Table III).

Table III – Tourniquet Time, in Minutes, According to the Anesthetic Technique

	n	Tourniquet time	Without CRPS*	With CRPS*	p*
Axillary brachial plexus block	71	16.0 ± 8.4			
General	73	16.7 ± 10.0			
Bier	90	44.0 ± 9.4			
Bier + clonidine	67	44.9 ± 10.7			
Technique without Bier	144	16.4 ± 9.2	16.1 ± 9.4	19.8 ± 6.2	0.025
Technique with Bier	157	44.4 ± 10.0	44.6 ± 10.3	42.3 ± 6.2	0.153

*Non-parametric Mann-Whitney test. Bier: intravenous regional anesthesia. Pearson's exact chi-square test; Mann-Whitney test.

DISCUSSION

The development of CRPS after surgical trauma is not uncommon, and the incidence varies according to the intervention, site of surgical trauma, and time of evaluation⁶. The incidence reported in the literature also varies according to the place where the study was undertaken¹⁰.

Although the epidemiology of CRPS is still not well defined, in the present study a greater prevalence in adult females as described by Veldman et al.¹¹, with mean age a little more elevated and in greater proportion regarding males than that referred by that author was observed. These differences were most likely secondary to the fact that in the present study the incidence was assessed after a specific surgical procedure, which is much more common in females over 50 years of age.

In the present study an incidence of 8.3% was observed, which differ from that reported by another study that estimated incidence of 2.1% to 5%. There are probably several reasons to explain the reported variability in incidence. The incorrect use of diagnostic criteria may increase or decrease the incidence. Inflammatory signs of pain, edema, and changes in temperature may be clinically indistinct between patients with CRPS and patients in early recovery phases of a surgery⁶.

In the present study, cases that presented at least two signs and symptoms, such as burning pain, hyperesthesia, local warmth, edema, change in temperature and/or skin discoloration, reduced motility, tremors, muscle spasms, increase sweating or anhidrosis, and trophic changes in the skin and appendages were considered cases of CRPS. Diagnosis was initially made by the surgeon and confirmed by the neurologist.

In the literature reports, the incidence of postoperative CRPS may vary according to the period of the follow-up and consequently the diagnosis. In prospective studies, the incidence of CRPS has a tendency to decrease over the first three postoperative months with stabilization approximately after six months. Thus, studies that evaluate the development of CRPS early in the postoperative period can detect a higher incidence of the disease when compared to those that make this evaluation later in the postoperative period¹⁰. In the present study, follow-up was performed since the first dressing and was maintained throughout all return visits (monthly) until the 6th postoperative month, as well as during the appointments requested by the patient outside the calculated date. This factor could be responsible for the higher incidence observed in this study.

Regarding the anesthetic techniques used a predominance of the development of CRPS was not observed with any of them, and the prevalence showed a uniform distribution. In the literature the reduced incidence of CRPS after fasciotomy for the treatment of Dupuytren's contracture has been reported when axillary brachial plexus block and regional intravenous anesthesia with lidocaine associated with clonidine are

used¹². The author hypothesizes that this incidence is lower probably due to the fact that axillary plexus block promotes a sympathetic blockade before surgery or more prolonged pain relief in postoperative period, and he believes that these factors reduce the incidence of postoperative CRPS. In the present study it was not possible to confirm this finding probably because the study population had underlying disease different from that of Dupuytren's contracture.

Regarding the duration of tourniquet in the affected limb, an association was observed between patients who received general anesthesia and axillary plexus block when compared to those who received intravenous regional anesthesia associated or not with clonidine. In patients who underwent general anesthesia and axillary plexus block and developed CRPS the duration of tourniquet was greater than that of patients who underwent the same anesthetic technique and did not develop this complication. The situation was different in patients who underwent intravenous regional anesthesia with or without clonidine, since a difference on the duration of tourniquet was not observed between patients who developed CRPS and those who did not. It seems that the duration of ischemia was an important factor for the development of CRPS, but in patients who underwent intravenous regional anesthesia in which there are drugs acting on the site the ischemia was less significant.

A prospective, randomized, double-blind study evaluated 84 patients with CRPS who underwent hand surgery and received intravenous regional anesthesia. One group received pure lidocaine while the other received lidocaine associated with 1 $\mu\text{g.kg}^{-1}$ of clonidine. The development of CRPS was much lower in the group of patients who received clonidine (10%) than in the group of patients who received pure lidocaine (70%)¹³. Clonidine has analgesic properties in patients with sympathetic-induced pain, possibly because it reduces the release of norepinephrine to peripheral prejunctional α -adrenergic receptors¹².

One of the pathophysiologic mechanisms leading to CRPS is the continuous passage of the noxious stimulus from the periphery to the central nervous system, leading to a state of central excitability. Thus, the concern with control of postoperative pain and operative complications that can affect the operated extremity and consequent development of CRPS is important¹².

The results of the present study differ from those found by this author, since we did not find differences between the group who only received lidocaine and the group who received lidocaine associated with clonidine. Although there were no observed differences regarding anesthetic techniques and development of CRPS, the duration of tourniquet was an important factor for the development of this complication in patients who underwent general anesthesia and brachial plexus block. We conclude that the incidence of CRPS in patients undergoing retinaculothomy of flexor carpi is 8.3%, without correlation with the anesthetic techniques investigated.

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Resumen: Costa VV, Oliveira SB, Fernandes MCB, Saraiva RA – Incidencia del Síndrome Doloroso Regional posterior a la Cirugía para la Descompresión del Túnel del Carpo. ¿Existe una Correlación con la Técnica Anestésica Realizada?

Justificativa y objetivos: El síndrome doloroso complejo regional (SDCR), anteriormente conocido como distrofia simpático refleja, es un conjunto de señales y de síntomas que incluyen dolor, sudoresis e inestabilidad vasomotora. El dolor generalmente se desencadena por un estímulo nocivo en un nervio periférico, y no es proporcional al estímulo que lo desencadena. Su aparición después de la cirugía no es algo poco frecuente, variando con la intervención. Posteriormente a la descompresión del túnel del carpo (DTC), vemos una incidencia de 2,1-5%. El bloqueo simpático puede prevenir la aparición de SDCR. Pero ningún estudio ha refrendado esa técnica como prevención de la SCR después de una cirugía para DTC. El objetivo del estudio fue definir la incidencia de SDCR después de una cirugía de DTC y su relación con cuatro técnicas de anestesia.

Método: Los pacientes se distribuyeron aleatoriamente y recibieron una de las siguientes técnicas: anestesia general, anestesia venosa regional con lidocaína, anestesia venosa regional con lidocaína y clonidina o bloqueo del plexo axilar. En el postoperatorio, estuvieron acompañados por una enfermera que no conocía la técnica utilizada, y se hizo el seguimiento por medio de los datos de la historia clínica electrónica hasta 6 meses después de la anestesia. En ese período, se investigaron las señales y los síntomas típicos de SDCR y en caso positivo, se inició el tratamiento. Fue realizada una evaluación descriptiva, usando el Xi-Cuadrado (χ^2).

Resultados: Se estudiaron 301 pacientes. De ellos, 25 desarrollaron SDCR, configurando una incidencia de un 8,3%. No hubo una predominancia entre las técnicas de anestesia. Se investigaron otros factores, como el tabaquismo, la profesión y otras enfermedades concomitantes, y ningún caso se registró con relación al desarrollo de SDCR posterior a la DTC.

Conclusiones: La incidencia de SDCR después de la cirugía para DTC está en el umbral del 8,3% sin que exista una relación con las técnicas anestésicas estudiadas.

Descriptor: TÉCNICAS ANESTÉSICAS: General, Regional, bloqueo plexo braquial, nervios periféricos y ganglios.