

Electrophysiological response to local steroid injection in carpal tunnel syndrome

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) is a common entrapment neuropathy. Local steroid injections are used for its treatment, which is usually associated with improvement in different electrophysiologic parameters of the median nerve. However, evidence for its efficacy has not been established in our community.

Objective: The aim of this study is to evaluate the changes in electrophysiological parameters after local steroid injection for mild and moderate idiopathic CTS.

Material and methods: The study is a prospective clinical trial assessing the electrophysiological parameters following local steroid injection (Depomedrol-80 mg methylprednisolone acetate) in the treatment of mild and moderate idiopathic CTS. The study was carried out in Mosul Teaching Hospitals during a period from December 2010 to December 2011. The total number of patients was 54 (46 females and 8 males), their mean age was 36.13 ± 9.32 years. Patients with idiopathic CTS were included after clinical confirmation of diagnosis electro-physiologically at preinjection, and electro physiological evaluation repeated 1 and 6 months after local steroid injection.

Results: All electrophysiological parameters showed significant improvement (P value is < 0.05) one month after injection except sensory nerve action potential. All median nerve electrophysiological parameters in 6 months post injection showed no significant changes except, compound motor action potential, motor nerve conduction velocity, and sensory nerve action potential which showed significant deterioration (P value is < 0.05). All electrophysiological parameters showed significant deterioration (P value is < 0.05) in comparing results of one month and 6 months after injection.

Conclusion: Local steroid injection for CTS provides transient improvement in electrophysiological parameters while causes deterioration in these parameters 6 months after injection.

Keywords: Carpal tunnel syndrome, steroid injection electrophysiology.

الإستجابة الكهروفسيولوجية للزرق الموضعي بالستيرويد في متلازمة النفق الرسغي

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الخلاصة

الخلفية: متلازمة النفق الرسغي حالة شائعة والزرق الموضعي بالستيرويد يستخدم في علاجها وعادة ما يرتبط بتحسين في المتغيرات الكهروفسيولوجية للعصب الوسطي ومع هذا فان دلائل فعاليته لم تثبت في مجتمعنا.

الأهداف: تهدف الدراسة لتقييم التغيرات الكهروفسيولوجية بعد الزرق الموضعي للستيرويدات في متلازمة النفق الرسغي الخفيفة والمتوسطة.

المواد وطريقة العمل: أجريت هذه الدراسة السريرية لتقييم المتغيرات الكهروفسيولوجية بعد زرق ٨٠ ملغم من الميثيل پردنيزولون استيت في معالجة متلازمة النفق الرسغي الخفيفة والمتوسطة غير المعالجين سابقا. أجريت الدراسة في مستشفيات الموصل التعليمية من كانون الأول ٢٠١٠ إلى كانون الأول ٢٠١١. كان العدد الكلي للمرضى ٥٤ منهم ٤٦ أنثى وكان معدل أعمارهم ٣٦ سنة. شمل بالدراسة مرضى متلازمة النفق الرسغي الخفيفة والمتوسطة بعد تأكيد التشخيص كهروفسيولوجيا للأعصاب وتمت إعادة الفحص كهروفسيولوجيا للعصب الوسطي والزندى بعد شهر و ٦ أشهر من زرق الستيرويد الموضعي.

النتائج: كل المتغيرات الكهروفسيولوجية أظهرت فرقا معنويا بعد شهر من الزرق الموضعي للاستيرويدات عدا الفعل الجهدي الحسي العصبي. وبعد ستة أشهر تبين وجود تدهور في بعض المتغيرات الكهروفسيولوجية عند المقارنة مع ما قبل الزرق الموضعي للاستيرويدات. عند المقارنة بين النتائج بعد شهر من الزرق الموضعي للاستيرويد وبعد ٦ أشهر من الزرق الموضعي للاستيرويد المتغيرات الكهروفسيولوجية أظهرت فرقا معنويا بشكل تدهور في كل المتغيرات الكهروفسيولوجية.

الخلاصة: الزرق الموضعي للاستيرويدات في متلازمة النفق الرسغي يؤدي إلى تحسن مؤقت في المتغيرات الكهروفسيولوجية بينما يسبب تدهور في أكثر هذه المتغيرات بعد ٦ أشهر من الزرق.

INTRODUCTION

Carpal tunnel syndrome CTS results from entrapment and compression of the median nerve in the wrist, it is the most common variety of the entrapment neuropathies.¹ The common symptoms are tingling, numbness, and pain in the hand that may radiate to the forearm or shoulder.¹⁻³ The non-surgical treatment options of CTS include splinting, steroids, activity modification, and others.¹⁻⁴ Corticosteroid injections are frequently used to treat CTS, and are considered to be both safe and effective for short-term.¹⁻⁶ The traditional approach is to use a trial of local steroid injection in patients with mild and moderate or transient CTS.^{7,8} Most complications of steroid injection in CTS are mild.⁸ Electrophysiological measurements are the gold standard diagnostic tests and are integral components in the diagnosis of CTS and provide an objective measurement of the function of the studied nerve.^{3,6} The electrophysiologic parameters may improve over the short term after steroid injection, and these improvements decrease as the severity of CTS increases.^{7,8}

By reviewing the available literatures, there were no registered studies on effect of local steroid injection in treatment of idiopathic CTS in our community. The aim of this study is to evaluate the changes in electrophysiological parameters one month and six months after local steroid (Depomedrol- 80 mg methylprednisolone acetate) injection for mild and moderate idiopathic CTS.

MATERIAL AND METHODS

This study was approved by the scientific committee at the College of Medicine, University of Mosul. Formal consent was taken from patients after explanations of the trial to them. The patients were collected from the Rheumatology, Orthopedic, and Neurophysiology outpatient clinics in Mosul Teaching Hospitals between December 2010 and December 2011. The total number of

patients with mild and moderate CTS included was 54 (46 females and 8 males), unilateral in 41 patients (37 right and 4 left), and bilateral in 13 patients, their mean age was 36.13 ± 9.32 years (ranged between 20 and 55 years).

Inclusion criteria were clinical diagnosis of mild to moderate primary idiopathic CTS confirmed and evaluated electro-physiologically, and symptom severity of such magnitude that the patient is willing the steroid injection.^{9,10} In patients with bilateral symptoms the most symptomatic hand or dominant hand (as reported by the patient) will be included.

The patients with history of previous steroid injection for CTS in the same wrist, inflammatory joint disease, presence of contraindications for corticosteroid injection, polyneuropathy, pregnancy, fractures of the affected wrist in the previous year, previous surgery for CTS in the affected hand, and severe type electrophysiologically were excluded from the study. Eleven patients were excluded because they didn't complete electrophysiological evaluations.

The mixture of 2 ml 80 mg Methylprednisolone acetate (Depomedrol 40 mg/ml) +1 ml 10 Xylocaine (10 mg/ml) was injected just to the ulnar side of the palmaris longus tendon, proximal to the wrist crease. The needle was aimed toward the carpal tunnel at a 10- to 20-degree angle of entry. If there were no parasthesia during insertion of the needle, the mixture was injected.⁹ After injection, patients are instructed to use their hands normally as tolerated; no instructions are given regarding specific activity modifications or splint use.

At preinjection and after one and six months electrophysiological study was performed according to the guidelines of the American Association of Neuromuscular and Electrodiagnostic Medicine for CTS for median and ulnar nerves of the injected hand.¹¹ Electrophysiological parameters were measured by a machine (system 98- MyoQuik micromed USA). The procedure was

explained for the patients, the skin was prepared before the application of electrodes. The active electrode is placed on the muscle belly for motor study and the reference electrode was placed on the tendon of the same muscle, while the grounding electrode was placed on the wrist between the stimulator and active parameters electrode. The sensory parameters were measured by placing active electrode at the base of the index and the reference electrode was placed at the tip of the index, while the stimulator electrode was placed at the wrist. Electrophysiological parameters included distal motor latency (DML), compound motor action potential (CMAP), motor nerve conduction velocity (MNCV), F-Wave minimal latency (FWML), distal sensory latency (DSL), sensory nerve action potential (SNAP), and sensory nerve conduction velocity (SNCV). The ulnar nerve was studied in the same way. The diagnostic criteria for CTS include: distal motor latency of more than 4.3 m/sec, motor or sensory nerve conduction of less than 45 m/sec, and more than 0.5 m/sec latency difference in comparative test between median and ulnar nerves.^{10,11} The patients were grouped as having mild, moderate and severe CTS.¹¹

Statistical analysis: We used the SPSS package 11 for Windows XP. The mean, standard deviation (SD) was calculated in patients for each parameter. The student (t) test was used to calculate the differences between the two means. ANOVA Test and Post Hoc (Duncan) test were used in analysis of results. The p value was considered as significant if it was less than 0.05.

RESULTS

The total number of patients was 54 (females to males ratio 5.75:1), 41 patients with unilateral lesion, all were dominant hand (37 right and 4 left), and 13 patients with bilateral lesions, the total number of hands for study was 67 (Dominant hand involvement was present in 80.6%). The mean age was 36.13 ± 9.32 years (ranged between 20 and 55 years), most of patients were between 30 & 50 years. The severity was mild in 28 (52%) and moderate in 26 (48%). Duration of symptoms was of more than 3 months in 34 patients (63%) and less than 3 months in 20 patients (37%). The body

mass index of patients was normal in 6 patients (11.1%), overweight in 45 (83.3%), and obese in 3 patients (5.6%). None of the patients experienced any significant complications or pain exacerbation after injection or electrophysiological abnormalities.

(Table 1)

All median nerve electrophysiological parameters (DML, CMAP, MNCV, FWML, DSL, and SNCV), in comparing preinjection and one month post injection showed significant changes (P value is < 0.05) in pattern of improvement in functions (P value is < 0.05) except SNAP, which showed no significant changes. All median nerve electrophysiological parameters in comparing preinjection and 6 months post injection showed no significant changes except, CMAP, MNCV, and SNCV (showed deterioration). All median nerve showed significant changes (P value is <0.05) in form of deterioration in electrophysiological parameters in comparing one month and 6 months post injection nerve functions. The electrophysiological parameters for ulnar nerve in the same hand of CTS in preinjection and post injection studies showed no significant changes (P value is > 0.05).

(Table 2).

Table 1. Criteria of patient's age, gender, severity of CTS, site of affection, duration of symptoms, patient's body mass index.

Parameters	Number of patients and percentage (total number of patients are 54)
Age	
20 -29	13 (24.1)
30 -39	18 (33.3)
40 -49	20 (37.0)
>50	3 (5.6)
Gender	
Male	8 (14.8)
Female	46 (85.2)
Severity	
Mild CTS	28 (51.9)
Moderate CTS	26 (48.1)
Site	
Right	37 (68.5)
Left	4 (7.4)
Bilateral	13 (24.1)
Duration (months)	
≤ 3	20 (37.0)
> 3	34 (63.0)
BMI	
≤ 25	6 (11.1)
26-30	45 (83.3)
> 30	3 (5.6)

Table 2. The median nerve electrophysiological parameters in preinjection and post injection.

Parameters in median nerve in preinjection and post injection study	Pre injection	One month after injection	Six months after injection	P*-value
	Mean \pm SD	Mean \pm SD	Mean \pm SD	
Distal motor latency (DML) (ms)	5.55 \pm 1.19 (a)	4.52 \pm 1.32 (b)	5.49 \pm 1.03 (ac)	0.000
Compound motor action potential (CMAP) (mv)	8.24 \pm 2.60 (a)	11.91 \pm 4.35 (b)	6.80 \pm 1.55 (c)	0.000
Nerve conduction velocity- motor (MNCV) (m/s).	41.08 \pm 5.42 (a)	46.44 \pm 7.53 (b)	38.65 \pm 3.96 (c)	0.000
F-Wave minimal latency (FWML) (ms)	29.59 \pm 3.14 (a)	26.92 \pm 3.51 (b)	29.40 \pm 2.25 (ac)	0.000
Distal sensory latency (DSL)(ms)	5.44 \pm 1.23 (a)	4.48 \pm 1.30 (b)	5.51 \pm 0.95 (ac)	0.000
Sensory nerve action potential (SNAP) \ (\muV).	545.6 \pm 205.8 (abc)	604.0 \pm 218.8 (b)	519.8 \pm 186.2 (c)	0.093
Nerve conduction velocity (sensory) (SNCV). (m/s).	38.98 \pm 4.62 (a)	47.09 \pm 7.12 (b)	37.49 \pm 3.80 (ac)	0.000

* ANOVA Test was used

** Post Hoc test (Duncan)

Single litters mean that there are significant differences between variant.

Combined litters mean that there is no significant difference between variances.

DISCUSSION

In our study the demographic and clinical criteria of patients were similar to other studies except the mean age at presentation which was 36.13 years. Other studies reported higher mean age,^{1,3,5,8,12} which might be explained by early child bearing and overwork of housewives in our community. Electrophysiological testing remains an essential technique for quantifying median nerve function in CTS due to its inherent reliability, reproducibility, and objectivity.^{3,13} According to the findings after steroid injection, the electrophysiological parameters of median nerve (sensory and motor) improved one month after injection except SNAP (sensory nerve action potential), which showed no significant changes. This might be explained by the fact that the sensory component of the median nerve is affected much earlier than the motor component and in early stages of CTS.^{3,14,15} It seemed that the local steroid injection could lead to a transient improvement in electrophysiological parameters one month after injection by the anti-inflammatory and anti-edema effects of the corticosteroid or by inhibiting the spontaneous discharge ability of excitable cells.^{16,17} No special complication occurred in our patients following steroid injection. The improvement of electrophysiological parameters even transient, supports the results of other researchers on effectiveness of steroid injection therapy in CTS one month after injection.^{15,17-19} The patients with mild and moderate CTS can be managed with

local injection of steroids but its effect is transient and still controversial.^{3,17,20}

Electrophysiological parameters of median nerve six months after local steroid injection showed no significant changes in DML, FWML, and DSL, when compared with results of preinjection, while CAMP, MNCV, and SNCV showed significant deterioration. This indicates that there was some deterioration 6 months after injection despite the transient improvement. This pattern was also noticed by other investigators.^{13,15,16}

All electrophysiological parameters of median nerve six months after local steroid injection showed significant deterioration in comparison with the results of one month after injection. Our finding is in the direction of others from Singapore which showed partial worsening of electrophysiological parameters 6 months after steroid injection in mild and moderate CTS.¹² Many studies failed to demonstrate significant electrophysiological parameters improvement beyond one month and the relapse or worsening of changes is possible.^{12,16,22} However, our results differ from those of others, who found that a single steroid injection to the carpal tunnel may result in long term improvement.^{3, 6,14,23,24}

We could not find significant changes in electrophysiological parameters in ulnar nerve, which indicates that, there was no systemic deterioration in nerves function and there was no generalized effect of local steroid injection on ulnar nerve of the same hand in post injection follow-

ups. Comparative tests of electrophysiological parameters between the median and the ulnar nerves in the same hand are well documented in the literatures.^{9-11,13,25}

We conclude that steroid injection into the carpal tunnel causes temporary improvement one month after injection and causes significant deterioration 6 months later. Steroid injection in CTS should be used with caution, to prevent deterioration of median nerve function.

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