Paper

The randomized prospective study of non-surgical management of patients with mild to moderate carpel tunnel syndrome

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Abstract

***Objective*:** To evaluate effectiveness of used oral medications such as diuretics, steroids and local steroid injections in the treatment of mild to moderate CTS.

***Methods*:** Prospective randomized study of patients with clinical symptoms and signs of CTS, confirmed by standard electrodiagnosis. Baseline assessments included a standardized Boston questionnaire to assess symptom severity score, functional severity score, total score, relevant clinical examination and necessary nerve conduction studies (NCS). After the baseline assessment, patients were randomized to following treatment arms:

1. Steroid local injection (n = 64)
2. Oral steroid for 28 days (n = 64)
3. Oral steroid + diuretics for 28 days (n = 69)

Boston questionnaire symptom severity score, functional severity score, total score and the NCS results were analyzed after 28 days of treatment.

***Results*:** Boston questionnaire scores (symptom severity score, functional severity score and total score) were significantly improved with all three treatment modalities after 4 weeks of treatment $p < 0.05$ the values of each indicator was more or less similar in each group at the baseline.

The percentage of improvement is highest with steroid injection and lowest with oral steroids and steroids + diuretic group falling in between. Sensory nerve conduction studies showed an improvement in all three treatment modalities. But a statistically significant improvement was seen in steroid injection and oral steroid + diuretic groups only $p < 0.05$.

***Conclusion*:** All three treatment modalities i.e. steroid injections, oral steroids, and oral steroid and diuretics are effective in treating mild to moderate CTS. The improvement seen with steroid injection is more than that is seen in the other two interventions.

Introduction

Carpal tunnel syndrome (CTS), an entrapment neuropathy of the median nerve at the wrist, is the most common peripheral nerve disorder, with a population prevalence of 9.2% in women and 6% in men[1,3]. This is because the anatomy of our wrists is less than ideal. The median nerve at the wrist travels through the carpal tunnel, and shares this space with 9 flexor tendons. The 'tunnel' is formed by the bones of the wrist posteriorly and laterally and the transverse carpal ligament anteriorly. Due to the limited space within the tunnel, swelling of the tendons, arthritic changes in the wrist, swelling or infiltration of the median nerve itself can compress the nerve[8,9,21]. The classic symptoms of CTS are numbness and paraesthesia in the first three fingers of the hand, which is commonly exacerbated at night. The diagnostic signs include sensory loss along the lateral aspect of the hand, motor weakness and wasting of abductor pollicis brevis (APB) muscle, and eliciting Tinel's and Phalen's sign at the wrist. The nerve conduction study (NCS) study is a definitive diagnostic test for CTS with high degree of sensitivity and specificity[2,6,7]. This test demonstrates a distal lesion of the median nerve at the wrist and excludes other peripheral conditions resulting in similar symptoms[2].

Non-surgical treatment options such as local steroid injections, oral steroids, diuretics, and splinting have been used to treat mild to moderate CTS[10,11,12]. However, there is no uniform consensus on the ideal treatment options.

Therefore we decided to compare the efficacy of the following treatment options.

1. Steroid local injection, Depo-Medrol (Methylprednisolone acetate) 40mg at the level of the carpal tunnel.
2. Oral steroid for 28 days, oral prednisolone 20mg daily for 14 days and 10mg daily for 14 days.
3. Oral steroid and diuretics, oral prednisolone 20mg daily for 14 days and 10mg daily for 14 days and oral frusemide 40mg daily for 28 days.

Methods

This study was conducted at the General Hospital,

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Matara. All consecutive patients referred for evaluation of suspected CTS to the neurology unit from 1st of July to 31st September 2012, were clinically assessed using the following inclusion and exclusion criteria proposed by the AAN Quality Standards Subcommittee (1993) by a designated medical officer attached to the neurology unit.

Inclusion criteria

1. Sensory symptoms (numbness and/or tingling) in at least 2 of digits 1, 2, 3, and 4 for at least 1 month. The sensory symptoms may be intermittent or constant, but if constant, there must have been a period of time during which the symptoms were intermittent. The numbness and tingling may be accompanied by pain, but pain alone is not sufficient to meet this first inclusion criteria.
2. Sensory symptoms (numbness and/or tingling) aggravated by at least 1 of the following: sleep, sustained hand or arm positioning, or repetitive actions of the hand.
3. Sensory symptoms (numbness and/or tingling) mitigated by at least 1 of the following: changes in hand posture, shaking the hand, or use of a wrist splint.
4. If pain is present, the wrist, hand, and finger pain is greater than elbow, shoulder, or neck pain if there is pain in any or all of those locations.

Exclusion criteria

1. Sensory symptoms exclusively or predominantly in the digit 5 (little finger) (ulnar neuropathy).
2. Neck pain or shoulder pain preceded the paresthesia in the digits (cervical radiculopathy and/or brachial plexopathy).
3. Numbness and/or tingling in the feet which preceded or accompanied the sensory symptoms in the hands (polyneuropathy).
4. Findings on the problem focused history and physical examination which indicate an explanation for the sensory symptoms which is more probable than CTS, for example, digital neuropathy, median nerve pathology proximal to the carpal tunnel, ulna neuropathy, radial neuropathy, brachial plexopathy, cervical radiculopathy, spinal cord, brainstem or brain pathology, or a polyneuropathy.
5. History of carpel tunnel decompression in the past.

Those who had signs and symptoms compatible with CTS had nerve conduction studies performed on both hands by the consultant neurologist.

The temperature was maintained at >32°C during the procedure. For motor NCS, the median and ulnar motor nerves were stimulated at wrist 7 cm proximal to the active recording electrode. The sensory responses were obtained at digit II and digit V for the median and ulnar nerves, stimulating antidromically at 13 cm and 11 cm, respectively. Following were recorded.

1. Median-D2 sensory nerve action potential (SNAP).
2. Ulnar-D5 SNAP.
3. Median-APB compound muscle action potential (CMAP), stimulating at wrist and ante-cubital fossa.
4. Ulnar-ADM CMAP, stimulating at the wrist and elbow.

If the median studies show slowing across the wrist (prolonged peak SNAP latency, prolonged distal latency of CMAP), and ulnar studies are normal, then this is clear evidence of a median neuropathy at or distal to the wrist, as can be seen in carpal tunnel syndrome. When this is the case, no further nerve conduction studies are needed.

When the above studies are normal, or inconclusive, we performed additional studies such as the following median-ulnar comparisons:

1. Median-ulnar palmar comparison. This is a mixed nerve action potential (MNAP) study, in which stimulation is in the palm and recording is at the wrist. This study is more sensitive than the median-D2 Ulnar D5 SNAP. (In our laboratory, we consider a difference in peak latency of greater than or equal to 0.4 msec abnormal.)
2. Median-lumbrical and ulnar-interosseous CMAP comparison. The median and ulnar nerves are stimulated at the wrist, with a single recording electrode over the lumbrical-interosseous space between digits 2 and 3. This study is often obtainable even in very severe CTS, so it is most useful when a routine median-APB CMAP is unobtainable. (In our laboratory, a difference in distal motor latency of 0.4 msec or greater is considered abnormal.)
3. Median-ulnar-D4 SNAP comparison. Median and ulnar nerves are stimulated at the wrist, recording from digit 4 using ring electrodes.

Needle EMG is performed when the above NCS were not suggestive of CTS or suspect a proximal lesion (such as a C6-7 radiculopathy).

The following muscles were sampled

1. APB.
2. Two or more C6-7 muscles (e.g. Pronator Teres, Extensor Digitorum Communis) to exclude a C6-7 radiculopathy – a common cause of sensory disturbance in the radial hand/fingers. If PT is chosen, this also helps to exclude a proximal median neuropathy.

The patients were categorised to mild, moderate and severe depending on the NCS findings as given below.

Mild CTS: Median Motor – Sensory latency difference between median andulnar 0.5-0.9ms.

Moderate CTS: Sensory latency difference between median and ulnar> 1ms.

Severe CTS: Median motor TL> 5.0ms with normal ulnar nerve NCS.

Those who had severe CTS according to NCS criteria were excluded and referred for surgery. Those who had symptoms compatible with CTS and NCS evidence of mild to moderate CTS were recruited and informed written consent was obtained. Prior to treatment, the severity of symptoms was assessed using the Boston questionnaire translated into Sinhala. The form was filled by the interviewing medical officer after explaining and clarifying each question and examining both hands. Thereafter they were randomized to the three treatment options. All were evaluated after 4 weeks of treatment using the Boston questionnaire and a repeat nerve conduction study.

Statistical analysis

Data were processed using excel and later converted SPSS sav files for analysis. The treatment outcome, the severity of illness was assessed using Boston questionnaire and the nerve conduction study results. Paired T test was used to evaluate the difference in outcome indicators at the baseline and end line. The difference of values of each patient in symptom severity score, functional severity score and total score given by the Boston questionnaire[18,19,20] and Medial TL and sensory difference as given by nerve conduction tests across 3 treatment groups were compared using One Way Anova tests. Bonferroni method of post hoc assessments were used to compare subgroup differences. IBM SPSS version 20 was used.

Results

A total of 197 patients were randomized to steroid injection group (n=64), oral steroid group (n=64), and oral steroid and diuretics group (n=69). Patients age ranged from 17 years to 76 years and the age distribution between the treatment groups were comparable (p>0.05). The majority of patients were females (76.6%) and sex composition between treatment groups was similar. The outcomes were assessed for patients irrespective of which hand is affected. If both hands were affected (in 34% of cases), the hand which had mild to moderate CTS was considered for the analysis. Table 1 compares the pre and post test level measurements of each outcome indicator based on the Boston questionnaire.

Table 1. Pre and post levels of Boston Questionnaire and NCS indicators by 3 treatment types

Treatment type and outcome		*Pre*		*Post*		*P values (Pre past difference)*
		Mean	*Standard Deviation*	*Mean*	*Standard Deviation*	
Steroid injection	Symptom severity score	2.17	.85	1.41	.59	t= 6.4, df= 61, p <0.05
	Functional severity score	2.03	.84	1.35	.33	t= 7.3, df= 39, p <0.05
	Total score	4.21	1.52	2.78	.95	t= 7.4, df= 60, p <0.05
	Medial TL	4.2	0.48	3.9	0.66	t= 3.6, df= 54, p <0.001
	Sensory difference	1.2	0.41	0.91	0.35	t= 5.03, df= 40, p <0.001
Oral steroid	Symptom severity score	1.96	.61	1.53	.54	t= 6.3, df= 62, p <0.05
	Functional severity score	1.86	.68	1.60	.58	t= 3.7, df= 36, p <0.05
	Total score	3.85	1.22	3.04	1.14	t= 5.5, df= 62, p <0.05

(Continued)

Treatment type and outcome		*Pre*		*Post*		*P values (Pre past difference)*
		Mean	*Standard Deviation*	*Mean*	*Standard Deviation*	
	Medial TL	4.12	0.50	4.03	0.51	t= 1.07, df= 57, p > 0.05
	Sensory difference	1.1	0.43	0.94	0.54	t= 1.92, df=47, p > 0.05
Oral steroid & diuretics	Symptom severity score	2.16	.90	1.64	.70	t= 5.6, df= 63, p <0.05
	Functional severity score	2.11	.86	1.63	.58	t= 4.8, df= 38, p <0.05
	Total score	4.20	1.55	3.21	1.14	t= 7.8, df= 62, p <0.05
	Medial TL	4.2	0.43	4.1	0.50	t= 4.5, df= 61, p <0.001
	Sensory difference	1.12	0.33	0.99	0.29	t= 4.5, df=48, p <0.001

This table reveals that the Boston questionnaire scores (symptom severity score, functional severity score and total score) were significantly improved with all three treatment modalities after 4 weeks of treatment p <0.05 the values of each indicator was more or less similar in each group at the baseline.

The percentage of improvement was highest with steroid injection and lowest with oral steroids and steroids + diuretic group falling in between. Improvement in the NCS sensory difference was seen in all three treatment modalities. But statistically significant improvement was presentonly in the steroid injection and oral steroid + diuretic groups (p <0.05).

In order to assess the most effective treatment option the differences of the values of each outcome indicator were compared using One Way Anova test. Post hoc test with Bonferroni corrections were used to get the between group differences.

Steroid injections were more effective compared to oral steroids which was statistically significant. However, the difference between the steroid injection and combination of steroids and diuretics failed to show a statistically significant difference in outcomes.

Discussion

Any condition that reduces the cross-sectional area of the carpal tunnel or increases the volume of its contents will compress the median nerve against the flexor retinaculum and will result in distal motor and sensory dysfunction. Therefore, any medication that reduces the swelling of structures within the carpal tunnel may be effective in the treatment of CTS. Diuretics, oral steroids and steroid injections are commonly used to reduce the volume of the swollen tissue, resulting in the improvement of symptoms and signs of CTS.

Although surgical decompression offers the most effective management for CTS, conservative non-operative therapies are effective in the management of mild to moderate CTS.

The study showed that the Boston questionnaire scores (symptom severity score, functional severity score and total score) significantly improved with all three treatment modalities after 4 weeks of treatment. We used a short-term, low-dose oral steroid regimen to avert any possible side effects and used once daily dosing to improve patient compliance.

The repeat NCS at 28 days revealed an improvement in all three treatment modalities. But statistically significant improvement was present in steroid injection and oral steroid + diuretic groups only. Although the oral steroid group showed an improving trend it lacked the statistical power probably due to the inadequate sample size.

The comparison of the three treatment modalities using One Way Anova test revealed that there was a significant superiority of steroid injections over oral steroid as treatment for CTS. However the difference between the steroid injection and combination of steroids

Table 2. Average improvements of outcome indicators in different treatment groups

Indicator	*Treatment type*	*Mean improvement (reduction of score)*	*Significance*
Symptom Severity score	Steroid injection	0.770	F=3.871, df(2,186), p <0.05
	Oral steroid	0.437	
	Oral steroid & Diuretics	0.469	Post hoc comparison shows that difference is only between Steroid injection and oral steroids (p <0.05)
Functional severity score	Steroid injection	0.8543	F=4.03, df(2,113), p <0.05
	Oral steroid	0.3758	
	Oral steroid & Diuretics	0.6456	Post hoc comparison shows that difference is only between Steroid injection and oral steroids (p <0.05)
Total score	Steroid injection	1.5005	F=4.9, df(2,184), p <0.05
	Oral steroid	0.8047	
	Oral steroid & Diuretics	1.0016	Post hoc comparison shows that difference is only between Steroid injection and oral steroids (p <0.05)
Medial TL	Steroid injection	0.24	F=2.73, df(2,172), p > 0.05
	Oral steroid	0.06	
	Oral steroid & Diuretics	0.18	
Sensory difference	Steroid injection	0.32	F=1.109, df (2,137), p > 0.05
	Oral steroid	0.17	
	Oral steroid & Diuretics	0.22	

and diuretics failed to show a statistical significance. But it is likely that given a larger sample size, this difference is likely to reach statistical significance.

This study showed that all three treatment modalities i.e. steroid injections, oral steroids, and oral steroid and diuretics are effective in treating mild to moderate CTS. The most significant improvement was seen with the steroid injection group.

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