Int.j.pathol.2016;14(4)154-158

Original Article

Comparison of Ultrasound Therapy and Local Steroid Injection for Treatment of Carpal Tunnel Syndrome using Electrodiagnostics

Omer Jamshed Khan[1], Naveed Mumtaz[2] and Wafa Munir Ansari[3]

[1] Combined Military Hospital, Muzaffarabad, [2] Combined Military Hospital, Lahore, [3] Azad Jammu & Kashmir Medical College, Muzaffarabad

Introduction: To determine the efficacy of ultrasound therapy as compared to intra lesional steroid injection in Carpal Tunnel Syndrome (CTS) using visual analogue scale (VAS) and electrodiagnostic parameters.

Study Design: Randomized Controlled Trial

Duration and Setting: 4months' study at carried out at Armed Forces Institute of Rehabilitation Medicine.

Methods: Patients diagnosed with CTS on Nerve Conduction Studies (NCS) /Electromyography (EMG) were divided into two groups, A and B. Group A received ultrasound therapy for 5 days a week for a 4-week period. Group B received local steroid injections. Major outcome measures were VAS scores and electrodiagnostic parameters which were checked after before and after 4 weeks of treatment for both groups.

Results: In group A, the average age was 43.47 ± 10.9 years. About 73 % (n=11) were females out of which 2 were pregnant. 80 % of all the patients were matriculate with 80 % citing house work as the probable cause of CTS. 93 % of all the patients were married and out of the 11 females, 7 were housewives. In group B, the average age was 44.0 ± 9.9 years. About 86 % (n=13) were females out of which 2 were pregnant. 73 % of all the patients were matriculate with 80 % citing house work as the probable cause of CTS. 100 % of all the patients were married and out of the 13 females, 10 were housewives. In group A, before treatment with ultrasound therapy, the mean VAS was 5.27 ± 1.90; mean Distal motor latency (DML) of median nerve was 4.25 ± 0.40 and the mean Sensory conduction velocity of median nerve (SVC) was 32.37 ± 2.98. After treatment these parameters improved with the mean VAS being 3.87 ± 1.24; mean DML became 4.04 ± 0.28 and mean SVC improving to 40.40 ± 1.84. In group B, mean VAS improved from 5.47 ± 1.72 to 3.53 ± 0.83, DML from 4.29 ± 0.41 to 4.07 ± 0.33 and SCV from 32.93 ± 4.14 to 40.20 ± 2.75.

Conclusion: Both treatment modalities showed almost similar results. Where ultrasound therapy showed slightly better improvement in DML, steroid injections edged out in VAS scores. Effect on SVC was almost identical for both modalities. Thus ultrasound therapy and steroid injections both showed similar efficacy in treatment of CTS, against the common belief that injections have better efficacy.

Key Words: CTS, Intralesional injection, NCS/EMG, Ultrasound therapy

Introduction

Carpal tunnel syndrome (CTS) is one of the most common upper limb entrapment syndromes prevalent worldwide. Its prevalence proven clinically and electro diagnostically is 2.7 %[1]. CTS is part of the spectrum of cumulative trauma disorders (CTDs) resulting due to over use of the involved hands; although other causes like diabetes mellitus, hypothyroidism and pregnancy may also be at work.

AUTHOR'S CORRESPONDENCE
Dr. Omer Jamshed
Combined Military Hospital, Muzaffarabad
omerjkhan@gmail.com

Housewives performing regular household chores, stenographers and computer operators are especially at risk. Infact an Indian study found the prevalence in computer workers to be as high as13.1%[2].

Carpal Tunnel Syndrome is the entrapment of median nerve within the carpal tunnel at the wrist. CTS is diagnosed by using the values of 'latency' of median nerve and amplitude and velocity of sensory potential of median nerve using NCS/EMG. Any median nerve distal motor latency (DML) of more than 4.0 ms, sensory conduction velocity (SCV)of less than 40 m/s or sensory nerve potential action (SNAP) amplitude less than 20 µvolts is indicative of CTS[3].

It gives rise to symptoms such as paresthesias, pain and weakness in the hands, all of which are normally aggravated in the night. The most common clinical sign is the 'phalen's test' comprising palmar flexion of the wrists causing aggravation of the symptoms[4]. However, the gold standard in diagnosis remains nerve conduction study and electromyography.

CTS management has a multidimensional approach. Its treatment modalities range from activity modification to bracing,from physical modalities to steroid injections and surgery. Where surgical procedures are a well known method of treatment, it is the other management options which need to be highlighted and presented as viable options[5]. Ultrasound therapy employs production of thermal and non thermal affects using ultrasound waves to create therapeutic effects[6]. It requires that the patient complete the prescribed course of therapy. Steroid injections comprising triamcinalone/depomederol with lignocaine/bupivacaine, into the carpal tunnel help reduce inflammation and provide an almost immediate pain relief to the patient[7]. It requires expertise of technique on part of the physician to administer this injection.

The purpose of this study was to compare these two management options and grade them objectively using pre and post management electro diagnostic parameters and visual analogue scale (VAS) to comment on the physically calculable differences and patient's pain perception respectively.

Materials and Methods

The randomized controlled trial was carried out at the Armed Forces Institute of Rehabilitation Medicine for a duration of 4 months. A total of 30 subjects were recruited in the study. Patients of all ages and of both genders suffering from CTS as per clinical and electro diagnostic criteria laid down were included. Patients with involvement of radial or ulnar nerve lesions, traumatic lesion to the wrist or median nerve, Patients receiving any other therapeutic modality and patients having undergone surgery for CTS were excluded. Patients suspected of having CTS on clinical examination were referred for electro diagnostic studies. Neuromax 1004 NCS/EMG machine was used for this purpose. The median nerve was stimulated and distal motor latency (DML) was calculated for its motor component. Then the sensory fibers of median nerve were stimulated and conduction velocity (SCV) along with amplitude of the sensory nerve action potential (SNAP) was noted. Cut off values of more than 4.0 m/s for DML, less than 20μv for SNAP amplitude and less than 40m/s for sensory conduction velocity were used to diagnose CTS. Patients thus being labeled as having CTS were then randomized into two groups of 15 patients each, A and B. Randomization was performed by using sequentially numbered and sealed opaque envelopes. Visual analogue score (VAS) for severity of pain and electro diagnostic values for each patient and average for each group were noted. Patient's demographic data was noted, as well as their occupation.

Group A was prescribed ultrasound therapy for 5 days a week for a 4 week period, at a dose of 1.5 W/m^2 . Group B received local steroid injections within the carpal tunnel comprising 10mg of Triamcinalone mixed with 2-3 ml of bupivacaine. After 4 weeks, VAS scores and electrodiagnostic parameters were checked for both groups. The data was analyzed with the help of statistical program SPSS V.17. Mean and SD were calculated for age. Frequencies along with percentages were calculated and means were compared. Values were calculated for comparing the different parameters in both groups. The information shared by the patient during the interview was kept confidential. No information was shared with the hospital staff or the patient's family.

Results

In group A, the average age was 43.47 ± 10.9 years. About 73 % (n=11) were females out of which 2 were pregnant. 80 % of all the patients were matriculate with 80 % citing house work as the probable cause of CTS. 93 % of all the patients were married and out of the 11 females, 7 were housewives. Females had a mean VAS of 5.00 ± 2.04 which improved to 3.73 ± 1.348; whereas the males had a mean VAS of 6.00 ± 1.41 which improved to 4.25 ± 0.957.

In group B, the average age was 44.0 ± 9.9 years. About 86 % (N=13) were females out of which 2 were pregnant. 73 % of all the patients were matriculate with 80 % citing house work as the probable cause of CTS. 100 % of all the patients were married and out of the 13 females, 10 were housewives. Females had a mean VAS of 5.31 ± 1.79 which improved to 5.00 ± 1.85; whereas the males had a mean VAS of 6.50 ± 0.707 which improved to 3.50 ± 0.707.

In group A, before treatment with ultrasound therapy, the mean VAS was 5.27 ± 1.90; mean Distal motor latency (DML) of median nerve was 4.25 ± 0.40 and the mean Sensory conduction velocity of median nerve(SVC) was 32.37 ± 2.98. After treatment these parameters improved with the mean VAS being 3.87 ± 1.24 (Figure 1); mean DML became 4.04 ± 0.28

(Figure2) and mean SVC improving to 40.40 ± 1.84 (Figure 3). In group B, mean VAS improved from 5.47 ± 1.72 to 3.53 ± 0.83 (Figure 1), DML from 4.29 ± 0.41 to 4.07 ± 0.33 (Figure 2) and SCV from 32.93 ± 4.14 to 40.20 ± 2.75 (Figure 3). The p value calculated for these two treatment options was 0.242 in VAS, 0.384 in DML and 0.170 for SCV; all of which are more than 0.05 and therefore not significant

Table-1: Baseline Characteristics of patients (n=30)

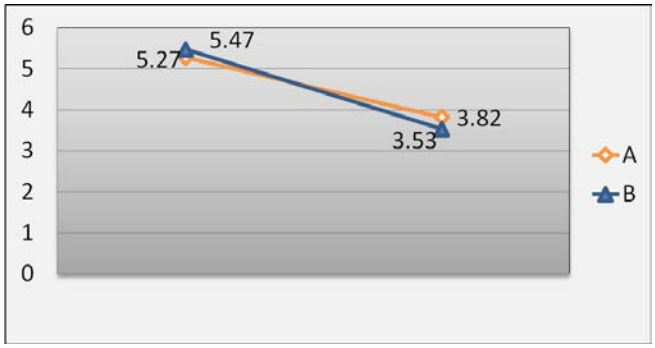
Parameters	Group A n=15 Mean ± SD	Group B n=15 Mean ± SD	p-value
Age (years)	43.47 ± 10.9	44.0 ± 9.9	>0.05
Gender M/F	4/11	2/13	>0.05
Educational status n (%)			
Matriculate	12 (80%)	11 (73%)	>0.05
Below Matriculate	3 (20%)	4 (27%)	
Marital Status n (%)			
Married	14 (93%)	15 (100%)	>0.05
Unmarried	1 (7%)	0 (0%)	
Employment status n (%)			
Employed	7 (50%)	5 (33%)	>0.05
Housewives	7 (50%)	10 (67%)	

Variables were compared using Independent t-tests p<0.05 is considered statistically significant

Table-2: Comparison of outcome measures before and after treatment in the two groups

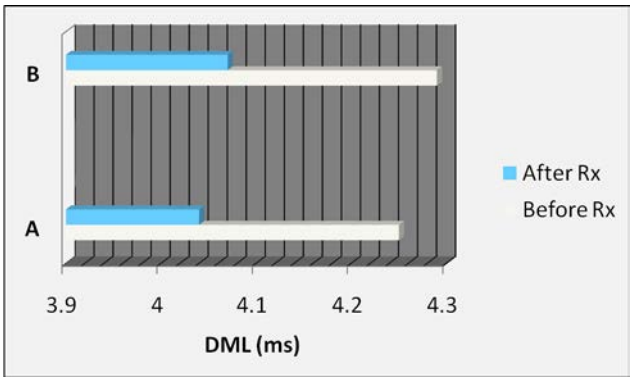
Outcome measures	Before Treatment	After 4-week Treatment	p-value
VAS (mean ± SD)			
Group A	5.27 ± 1.90	3.87 ± 1.24	0.018*
Group B	5.47 ± 1.72	3.53 ± 0.83	0.016*
DML (mean ± SD)			
Group A	4.25 ± 0.40	4.04 ± 0.28	0.02*
Group B	4.29 ± 0.41	4.07 ± 0.33	0.019*
SCV (mean ± SD)			
Group A	32.37 ± 2.98	40.40 ± 1.84	<0.001**
Group B	32.93 ± 4.14	40.20 ± 2.05	<0.001**

VAS= Visual analogue |Scale; DML= Distal Motor Latency; SCV=Sensory conduction velocity of median nerve (*p<0.05 | **p<0.01 | Student t-test)



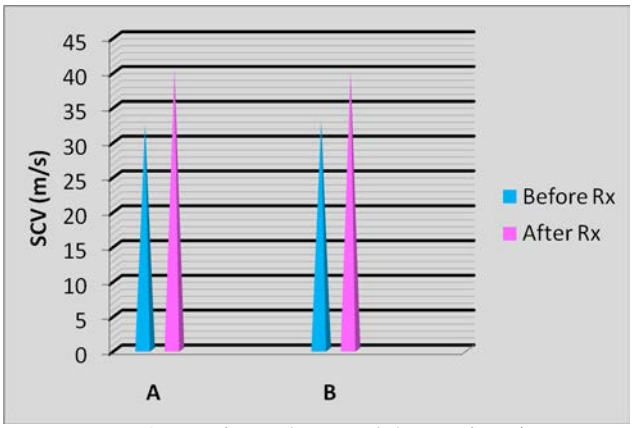
A= Group given Ultrasound therapy (n=15)
B= Group given local steroid injection (n=15)
P^{A-B}= >0.05 (Student t-test)

Figure 1: Improvement in Visual Analogue Scale (VAS) after treatment in study groups



A= Group given Ultrasound therapy (n=15)
B= Group given local steroid injection (n=15)
P^{A-B}= >0.05 (Student t-test)

Figure 2: Improvement in Distal Motor Latency (DML) after treatment in study groups



A= Group given Ultrasound therapy (n=15)
B= Group given local steroid injection (n=15)
P^{A-B}= >0.05 (Student t-test)

Figure 3: Improvement in Sensory conduction velocity of median nerve (SCV) after treatment in study groups

Discussion

Our study showed that the over whelming majority of patients was female which is consistent with most of the published data. As expected, house wives suffered more from this disease as household chores are known to aggravate the symptoms of CTS. A 4 year longepidemiological Iranian study showed that 74% of the patients with CTS were female and 60% were housewives[8]. Interestingly, individuals who were working and not particularly involved in house work also cited it as a major cause for developing CTS. This means that rather than the quantity of time spent in doing housework, it is the way that work is performed which can exacerbate CTS symptoms.Pregnancy is a

known cause for CTS and both groups had 2 females each who were pregnant.

Overall, the results showed that both ultrasound and steroid injections are viable options for CTS treatment. Scores in VAS, DML and SCV all improved significantly with either of the treatments. Studies carried out around the world support such conservative interventions. Piravej K and colleagues determined the efficacy of therapeutic ultrasound for CTS as did Huesstede BM et al, while studying 20 RCTs to determine the efficacy of non surgical treatment for CTS[9, 10]. Another study compared ultrasound therapy with steroid injection therapy and proved in favour of ultrasound[11]. Marshal S and colleagues studied over a 12 different articles (including RCTs) and concluded the efficacy of steroid injections for the treatment of CTS[12]. In support of steroid injections. Armstrong et al injected 81 subjects and found positive results as did Gurcay et al[13.14].

Comparison between the two treatment modalities showed that in group A the mean VAS score decreased by a factor of 1.4 and in group B by a factor of 1.94, thus patients responded slightly better to the steroid injection as far as pain relief was concerned. This can be explained by the fact that the effect of the local anesthetic coupled with the 'needle effect' help in alleviating the perception of pain. This is also supported by Lee JH and colleagues who found that steroid injections produced better clinical results than electro diagnostic ones[15].

DML improved by a factor of 0.21 in group A and 0.22 in group B. This almost identical result proves that the difference between the two modes of treatment on the motor component of median nerve is negligible.

In group A, SCV improved by 8.03 and in group B by 7.27. Here we see that ultrasound therapy actually edges out the effect of the steroid injection, but only very slightly.

The insignificant p value for the different parameters proves that both modalities have similar efficacy in the treatment of CTS and there is negligible difference in the desired results.Bilgici A et al compared the effect of ultrasound therapy with that of local steroid injections on 34 patients with CTS and concluded that where both modes of treatment were effective, neither proved to be better than the other and in fact could be used as an alternative to each other[16]. Gokuglu Fet al compared iontophoresis with steroid injections and discovered the efficacy of injections over iontophoresis[17]. However local injections into the carpal tunnel alsopose a risk of complications like damaging the neural sheath or the median nerve itself[18,19,20,21]. Authors have compared the efficacy of other conservative treatments like low level LASER therapy, splinting, acupuncture etc. and presented them as options for CTS management too.[22,23,24]

As is evident from the results both treatments have tangible efficacy in the treatment of CTS. Where one may edge slightly over the other in a particular parameter, the p value clearly places both these treatment options in an equal sphere.

Conclusion

Although surgical management is the common treatment for CTS, many individuals shy away from getting treated. Conservative management thus needs to be encouraged and modalities like ultrasound therapy and local steroid injections provide an effective alternative to surgery. The fact that we find them equally effective means that individuals who are not keen on getting injected and wish to avoid complications or those who are unable to comply with multiple therapy sessions for ultrasound now have a chance to choose the treatment option that suits them best.

References

1. Dale AM, Harris-Adamson C, Rempel D, Gerr F, Hegmann K, Silverstein Bet al.Prevalence and incidence of carpal tunnel syndrome in US working populations: pooled analysis of six prospective studies.Scand J Work Environ Health 2013;39(5):495-505
2. Atroshi I, Gummeson C, Johnsson R, Ornstein E, Rantam J, Rosen I. Prevalence of carpal tunnel syndrome in a general population. J Amer Med Ass 1999;282:153-158.
3. KeivanBasiri and Bashar Katirji1Practical approach to electrodiagnosis of the carpal tunnel syndrome: A review.Adv Biomed Res. 2015; 4: 50.
4. Ali Km, Sathiyaseekaran BWC. Computer professionals and carpal tunnel syndrome. JOSE 2006;12: 319-325
5. Lo JK, Finestone HM, Gilbert K, Woodburg MG. Community based referrals for electro diagnostic studies in patients with possible carpal tunnel syndrome; what is the diagnosis. Am J Phys med Rehabil2002;83:598-603.
6. Cherian A, Kuruvilla A. Electrodiagnostic approach to carpal tunnel syndrome. Ann Indian Acad Neurol 2006;9:177-82
7. Carlson H, Colbert A, Frydl J, Arnall E, Elliot M, N Current. Options for nonsurgical management of carpal tunnel syndrome. Int J Clin Rheumtol 2010 ; 5: 129–42.
8. Osterman AL, Whitman M, Porta LD. Nonoperative carpal tunnel syndrome treatment. Hand Clin. 2002;18:279–89

9. Phalen GS. The carpal-tunnel syndrome. Seventeen years' experience in diagnosis and treatment of six hundred fifty-four hands. J. Bone Joint Surg. Am. 1966;48:211–228
10. Choobineh A ; Rahimi K ; Manesh ST; Hosaini SM ; Tabatabaei SH. Epidemiological study of carpal tunnel syndrome among paitents refering to Shiraz Chamran and Nemazi hospitals from 2002 to 2006. IOH 2009;6:20-6.
11. Ustün N1, Tok F, Yagz AE, Kizil N, Korkmaz I, Karazincir S, Okuyucu E, Turhanoglu AD.Ultrasound-guided vs. blind steroid injections in carpal tunnel syndrome: A single-blind randomized prospective study.Am J Phys Med Rehabil. 2013 Nov;92(11):999-1004.
12. Piravej K, Boonhong J. Effect of ultrasound thermotherapy in mild to moderate carpal tunnel syndrome. J Med Assoc Thai2004 ;87:100-6.
13. Huisstede BM, Hoogvliet P, Randsdorp MS, Glerum S, van Middelkoop M, Koes BW. Carpal tunnel syndrome. Part I: effectiveness of nonsurgical treatments--a systematic review. Arch Phys Med Rehabil. 2010l;91:981-1004.
14. Ebenbichler GR, Resch KL, Nicolakis P, Wiesinger GF, Uhl F, Ghanem A, Fialka V. Ultrasound treatment for treating the carpal tunnel syndrome: randomized "sham" controlled trial. BMJ 1998;316:731-5.
15. Marshall S, Tardif G, Ashworth N. Local corticosteroid injection for carpal tunnel syndrome. Cochrane Database Syst Rev. 2007;(2):CD001554.
16. Armstrong T, Devor W, Borschel L, Contreras R. Intracarpal steroid injection is safe and effective for short-term management of carpal tunnel syndrome. Muscle Nerve. 2004;29:82–88
17. Gurcay E, Unlu E, Gurcay AG, Tuncay R, Cakci A. Evaluation of the effect of local corticosteroid injection and anti-inflammatory medication in carpal tunnel syndrome. Scott. Med. J. 2009;54:4–6.
18. Lee JH, An JH, Lee SH, Hwang EY. Effectiveness of steroid injection in treating patients with moderate and severe degree of carpal tunnel syndrome measured by clinical and electrodiagnostic assessment. Clin. J. Pain. 2009;25:111–115.
19. Biglici A, Ulosoy H, Kuru O, Canturk F. The comparison of ultrasound treatment and local steroid injection plus splinting in the carpal tunnel syndrome: a randomized control trial. Bratisl Lek Listy 2010;111:659-665.
20. Gokoglu F, Fndkoglu G, Yorgancoglu ZR, Okumus M, Ceceli E, Kocaoglu S. Evaluation of iontophoresis and local corticosteroid injection in the treatment of carpal tunnel syndrome. Am. J. Phys. Med. Rehabil. 2005;84:92–96
21. Tavares SP, Giddins GE. Nerve injury following steroid injection for carpal tunnel syndrome. A report of two cases. J. Hand Surg. Br. 1996;21:208–209.
22. Frederick HA, Carter PR, Littler JW. Injection injuries to the median and ulnar nerves at the wrist. J. Hand Surg. Am. 1992;17:645–647
23. Wilbourn AJ. Iatrogenic nerve injuries. Neurol. Clin. 1998;16:55–82
24. Linskey ME, Segal R. Median nerve injury from local steroid injection in carpal tunnel syndrome. Neurosurgery. 1990;26:512–515
25. 25. Elwakil TF, Elazzazi A, Shokeir H. Treatment of carpal tunnel syndrome by low-level laser versus open carpal tunnel release. Lasers Med. Sci. 2007;22:265–270
26. De Angelis MV, Pierfelice F, Di Giovanni P, Staniscia T, Uncini A. Efficacy of a soft hand brace and a wrist splint for carpal tunnel syndrome: a randomized controlled study. Acta Neurol. Scand. 2009;119:68–74
27. NIH Consensus Conference. Acupuncture. JAMA. 1998;280:1518–1524

.HISTORY	
Date Received:	10-NOV-2016
Date Sent for Reviewer:	20-NOV-2016
Date Received Reviewers' Comments:	5-DEC-2016
Date Received Revised Manuscript:	22-DEC-2016
Date Accepted:	1-JAN-2017

CONTRIBUTION OF AUTHORS	
Author	**CONTRIBUTION**
Omer Jamshed Khan	A – B – C – D
Naveed Mumtaz	E – F
Wafa Munir Ansari	B – E – F

KEY FOR CONTRIBUTION OF AUTHORS:

A. Conception/Study Designing/Planning
B. Experimentation/Study Conduction
C. Analysis/Interpretation/Discussion
D. Manuscript Writing
E. Critical Review
F. Facilitated for Reagents/Material/Analysis