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Original Article

Evaluation of Carpal Tunnel Syndrome by Laser Doppler Flowmetry

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Abstract

Background: Autonomic disturbance can leads to blood flow changes that can be studied by various methods.

Objective: To assess the blood flow changes in patients with severe carpal tunnel syndrome by laser Doppler flowmetry

Methods: Ten patients with severe unilateral carpal tunnel syndrome confirmed by electrodiagnostic examination enrolled in this study. Patients comprised one man and nine women with mean age of 37 years, an average duration of symptoms for 29 weeks. Unaffected hand and little finger of affected hand were used as control. Skin blood flow was measured in neutral, flexed and extended positions of hands.

Results: There was significant reduction of skin blood flow of median nerve territory as compared to control (unaffected hand) ($p<0.05$). There was also significant ($p<0.05$) reduction of blood flow of median nerve territory as compare to ulnar nerve territory of affected hand except in extended position.

Conclusion: Circulatory disturbances are seen in hand skin of CTS patients. This change depends on the type and severity of CTS. This study showed a reduction of skin blood flow in severe form of CTS.
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Keywords • Carpal tunnel syndrome• laser Doppler flowmetry • skin blood flow • autonomic disturbance

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Introduction

Carpal tunnel syndrome (CTS) is the most common nerve entrapment syndrome.[1,2] Many tests have been used for diagnosis of CTS.[3-6] Although the diagnosis of CTS is often made only on clinical ground,[1,2,7,8] electrodiagnostic studies are usually done to confirm the clinical diagnosis, to assess the severity of median nerve compression and to rule out more proximal compression sites.[9-11] In spite of good sensitivity of electrodiagnostic methods, normal findings are still observed in a number of patients with mild type of CTS.[1,6,11,12] Indirect blood flow measurement has been used as a diagnostic test in CTS.[13-15] These tests are based on sympathetic activity.[1] Based on sympathetic activity, two patterns of CTS

Table 1: Clinical Data of 10 Patients with CTS

NO.	Duration	Age	Sex	Site
1	2 weeks	37	F	Rt
2	7 weeks	53	M	Rt
3	3 months	33	F	Lt
4	1 year	39	F	Rt
5	5 months	33	F	Lt
6	3 year	50	F	Lt
7	2 months	51	F	Rt
8	3-4 weeks	39	F	Rt
9	6 months	32	F	Lt
10	4 weeks	27	F	Rt

(cold, hot) have been reported.[16] Recently, laser Doppler flowmetry (LDF) has been used as a diagnostic test.[15,17-19] We used the LDF to determine the blood circulation changes and severity of CTS.

Patients and Methods

A total of ten patients with diagnosis of idiopathic severe unilateral CTS were studied. The diagnosis of CTS was based on clinical findings and electrodiagnostic studies that revealed absence of sensory and distal motor latency. [20] All patients suffered from severe symptoms including numbness, tingling, nocturnal burning pain in the distribution of median nerve. Subjects had no known systemic disease or skin disease on their hands. They had no history of trauma to their hands. The participants (nine women and one man) aged between 27 and 53years (mean: 37 years). The average duration of their symptoms was about 29 weeks (Table 1). All patients gave informed consent and the examination was performed in the same position and the room temperature was kept between 18 and 20˚c. The skin LDF probe was placed on the skin of distal phalynx of finger at the center of the circular digital marking. Measurements were recorded during three separate positions of wrist; each position lasting about one minute with one-minute interval between trials. The measurement of blood flow in the affected hand (experimental hand) was compared with the control hand. Little finger of the affected hand (ulnar nerve innervated area) and all fingers of the unaffected hand served as control. All tests were completed by one examiner. Data were analyzed by Student t-test. A p value < 0.05 was regarded as statistically significant. The results were expressed as mean±SEM.

Results

Age, sex, involved hand and duration of symptoms are shown in Table 1. In each setting the following results were obtained.

Table 2: Comparison of mean±SEM blood flow between median (fingers 1-3) and ulnar (small finger) nerve territories of affected hands

Position	Ulnar N.	Median N.
Neutral	290±64*	208±46
Extension	235±57	177±38
Flexion	242±56*	172±35

*Significantly different ($p<0.05$) from records of median nerve territory.

Median nerve territory (fingers 1-3), vs *ulnar nerve territory (finger 5); affected hand.*

In neutral and flexion positions, the blood flow in fingers 1-3 was significantly lower than that of finger 5 ($p<0.005$). It extension, there was no difference between blood flow measured in fingers 1-3 and finger 5 (Table 2).

Median nerve territory; affected vs *unaffected hand.*

In all above- mentioned positions, the blood flow measured in the median nerve territory of the affected hands was significantly ($p<0.005$) lower than that of normal hands (Table 3).

Median vs *ulnar nerve territories; unaffected hand.*

No difference in blood flow was observed between the median ulnar nerve terrtories of the normal hands.

Discussion

This study shows that in sever CTS there is a reduction in skin blood flow in the territory of median nerve. In this study we used LDF as a diagnostic test and also for evaluation of CTS. The reduction in blood flow, perhaps, is attributed to changes in sympathetic activity.

Sympathetic fiber innervates virtually all part of the circulatory system.. A relatively large number of sympathetic fibers innervate small arteries and arterioles of the skin. This sympathetic supply to the vessels corresponds to the cutaneous nerve supply. [14]

The median nerve distribution has apparently a greater sympathetic innervation than does the ulnar distribution. The position of the fibers seems to make them vulnerable to external pressure applied

Table 3: Comparison of mean±SEM blood flow in median nerve territory of affected and unaffected hands (fingers 1-3)

Position	Affected*	Unaffected
Neutral	208±46	264±49
Extension	177±35	243±47
Flexion	172±35	245±47

*Significantly different ($p<0.05$) from records of unaffected hands for all positions.

to the median nerve.[21] Jordan and Greider have documented definite sympathetic changes and a temperature rise in the affected index finger of patients with CTS, when galvanic skin response and skin temperature were measured. Their work present a more concrete evidence of the potential diagnostic value of thermography in CTS.[14] The study of Tchou et al, revealed an increase in skin temperature in most patients with CTS. Their results are not however, at variance with ours. In their study the two groups were not identical in regard to sex, and age and therefor, it is not clear whether the elctrodiagnostic studies in their two groups are comparable or not. On the other hand, two patterns of thermography have been proposed: cold and hot pattern.[16] With acute compression of the nerve, there is usually a loss of vasomotor control similar to that occurring after the application of a sympathetic nerve blockade.[19] Chronic interruption of sympathetic neural activity, however, leads to reduced blood flow. [16] And increase galvanic skin response.[22,23]

Our findings suggest that the change in blood flow in the territory of the affected median nerve depends on the type of injury (hot or cold pattern) and severity of CTS. Further investigation may help in diagnosis of CTS by LDF.

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