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Relationship Between Cubital Tunnel Syndrome and Chronic Hemodialysis via Forearm Arteriovenous Fistula

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Abstract

Background: Ischemic neuropathy is a major complication in patients undergoing hemodialysis (HD) with arteriovenous (AV) fistula.
Objectives: The aim of this study was to investigate the relationship between cubital tunnel syndrome and chronic HD via forearm AV fistula.
Methods: All HD patients with forearm AV fistulas, who were referred to the hemodialysis ward of Rasoul-e-Akram and Hasheminejad hospitals from February 2014 to February 2015 and met the inclusion criteria, were enrolled in the study. They were asked about ulnar neuropathy symptoms and were under physical examination and electrophysiological studies for cubital tunnel syndrome at the time of recruitment and 1-year follow-up.
Results: A total of 90 HD patients were included in the study. The mean age of the participants was 53.65 $\pm$ 17.89 years (range, 22 - 86 years), and 53 (59%) patients were male. Cubital tunnel syndrome was not detected in the patients. There was a significant difference in tingling and muscle weakness of the hand and forearm under chronic HD via forearm AV fistulas ($P < 0.05$). There was no significant relationship between chronic HD via forearm AV fistula and neurological symptoms, including pain and muscle atrophy of the hand and forearm ($P > 0.05$).
Conclusions: This research concludes that chronic HD via forearm AV fistula does not lead to cubital tunnel syndrome in HD patients.

Keywords: Cubital Tunnel Syndrome, Forearm Arteriovenous Fistulas, Hemodialysis

1. Background

There has been an increase of 3% - 4% in the number of patients undergoing dialysis every year as a result of the high incidence of chronic kidney disease (CKD) secondary to different medical problems, such as diabetes and hypertension (1). Application of arteriovenous (AV) fistulas has increased from 27.9% to 62.5% between 1998 and 2013 (1).

Although about 60% of patients with renal failure develop peripheral neuropathy as numbness, tingling, and extreme sensitivity to normally unpainful stimuli, there are some mononeuropathies, such as carpal tunnel syndrome (CTS), ulnar neuropathy at the elbow, and peroneal nerve neuropathy at the fibular head in patients with CKD (2). The hemodynamic effects of AV fistula or repeated inflation of the blood pressure cuff during HD may lead to ischemic peripheral neuropathy (2). In addition, tumoral calcinosis, amyloid deposition, and increased extracellular fluid volume may affect peripheral nerves in this population (2).

Patients undergoing HD are prone to ulnar neuropathy because of polyneuropathy secondary to underlying diseases, such as diabetes or renal failure, vascular access, and upper extremity position during HD (3). Studies have reported an increase in ulnar neuropathy among HD patients (4). The ulnar nerve may be entrapped along the sulcus behind the medial condyle of humerus or between the heads of the flexor carpi ulnaris muscle; therefore, symptoms of ulnar nerve palsy (delayed or gradual) can appear similar to median nerve entrapment in carpal tunnel (5). If ulnar neuropathy is not diagnosed or treated properly, it leads to functional impairment because of prolonged axonal degeneration (4).

Patients with mild symptoms can be treated conservatively, especially through steroid injections. However, in case of moderate and severe entrapment, surgical treatment (transposition of the ulnar nerve) is the only definitive solution (6). The main complaints of patients with CTS include pain, loss of power in the hands, and paresthe-

sia in the fourth and fifth fingers (7). On physical examination, hypothenar muscles are atrophic in prolonged entrapments. The fifth finger and medial half of the fourth finger have some grade of hypoesthesia (8). The definitive diagnosis of CTS and lesion localization are accomplished via physical examination, as well as electrodiagnostic studies (9).

2. Objectives

We conducted this study to evaluate the relationship between CTS and chronic HD via AV fistula.

3. Methods

1. The present study was approved by the institutional review board of Iran University of Medical Sciences (code, 2076). All subjects gave written consents to participate in the study. Patients who referred to the HD ward of Rasoul-e-Akram and Hasheminejad hospitals, Tehran, Iran, from February 2014 to February 2015 were included in this prospective study.

2. The inclusion criteria were as follows: 1) age above 18 years; 2) AV fistula in the cubital or forearm area in only 1 upper extremity for at least 1 year under HD (3 sessions per week); 3) medical stability; and 4) elbow extension with a lateral pad during HD sessions. On the other hand, patients with a history of upper limb surgery, fracture and deformity, and lack of written consent were excluded.

3. All the patients were asked about the symptoms of CTS, including sensory or motor symptoms related to the ulnar nerve (numbness, tingling, pain, muscle weakness, and muscle wasting) during the study and after at least 1 year of dialysis. One investigator (S.T.) performed the following physical examinations at the specified intervals: elbow flexion test (10), tunnel test (11), and compression test (11).

4. Electrodiagnostic study of the upper extremity was performed for all patients in the mentioned periods at the neurology department of Rasoul-e-Akram hospital. Ulnar neuropathy in the elbow (CTS) was diagnosed based on the following criteria: $\geq$ 10 ms drop in ulnar motor conduction velocity (MCV) across the elbow, ulnar MCV across the elbow $\leq$ 45 ms, ulnar sensory nerve action potential (SNAP) $\leq$ 12 μv, and ulnar compound muscle action potential (CMAP) $<$ 5 mv (2).

5. Data were analyzed using SPSS version 22. P value less than 0.05 was considered statistically significant.

4. Results

In this study, 90 HD patients met the inclusion criteria and were enrolled in the study. The mean age of the patients was 53.65 $\pm$ 17.89 years (range, 22 - 86 years), and 53 (59%) were male. The mean duration of HD in patients was 5.44 $\pm$ 5 years (range, 1 - 31 years). In 70 (78%) patients, the left hand had vascular access.

In total, 33 patients had at least 1 symptom of ulnar nerve disorder, including numbness, tingling, pain, muscle weakness, and muscle wasting. None of the patients had CTS according to the mentioned electrodiagnostic criteria. Since we did not detect CTS in this study, we decided to evaluate the association between the symptoms of ulnar nerve disorder (tingling, pain, atrophy, and muscle weakness) before and after at least 1 year of dialysis.

There was a significant difference in tingling and muscle weakness of the hand and forearm before and after HD. On the other hand, there was no significant difference in the number of patients with forearm pain and muscle atrophy of the hand and forearm before and after HD (Table 1).

Table 1. Association Between Forearm AV Fistulas and Symptoms of Ulnar Nerve Disorder

Variables	Stages		P Value
	Baseline	After at least 1 year of HD	
Tingling	35	14	0.001
Muscle weakness of the hand and forearm	43	23	0.001
Forearm pain	25	15	0.089
Muscle atrophy of the hand and forearm	19	15	0.629

Abbreviation: HD, Hemodialysis.

5. Discussion

CTS is the second most common neurological peripheral neuropathy of the upper extremities (12). It has been shown that development of granulation tissues in the elbow, the consequent effect of pressure on the ulnar nerve, and nerve displacement produce the symptoms of CTS in HD patients (13). Peripheral neuropathy is the most common complication of end-stage renal failure, especially when HD is started with major delay (14).

Large myelinated fibers tolerate more pressure from biological changes, associated with renal failure. Reduced nerve conduction is quite common in this situation (14).

Various studies have demonstrated that increasing the number of dialysis sessions per week can improve nerve conduction velocity and neuropathy in patients with renal diseases (15). Besides, it can change nerve fibers in the process of dialysis from the passive and off mode to the active mode and participate in neurotransmission (16).

Recent studies have shown the high prevalence of ulnar neuropathy in HD patients (2, 4). In the present study, we did not detect any cases of CTS. To the best of our knowledge, only one study has exactly evaluated CTS in HD patients (17). There are also few case reports about this condition (18, 19). The present study showed that in carefully selected patients (no history of fracture, surgery, or deformity) with optimal elbow position during HD (elbow extension with a lateral pad), the prevalence of CTS is not high. In other words, chronic HD with AV fistula is not a risk factor for CTS in patients with HD. Our finding was compatible with a study by Jung et al. (17), which evaluated CTS in HD patients.

In the present study, we also found that symptoms of ulnar nerve disorder, including tingling and muscle weakness, significantly decreased after applying HD via AV fistula for at least 1 year. In other words, taking advantage of HD via forearm AV fistula reduces the symptoms of ulnar nerve disorder, such as tingling and muscle weakness in the hand and forearm. However, no relationship was observed between chronic HD via forearm AV fistula and neurological symptoms, including pain and muscle atrophy of the hand and forearm.

Vahdatpour et al. similarly reported that the incidence of ulnar neuropathy in patients undergoing HD via fistula was not significantly different from that of peritoneal dialysis patients (4). Talebi et al., using electrophysiological assessment after AV fistula placement (after 1 week and 3 months), found that all the nerves of the upper limbs (radial, median, and ulnar) were affected by the structure of HD vascular access in patients with chronic renal damage (20). Also, Salgado et al. concluded that no damage to the ulnar nerve was found in HD patients after vascular access (21).

Finally, in this study, after evaluating patients with at least 1 year of HD via AV fistula, symptoms of ulnar neuropathy not only did not increase, but also reduced. Therefore, chronic HD with forearm AV fistula does not increase the risk of CTS.

The present study had some limitations. First, we did not detect any cases of CTS in this study; therefore, our analyses may not be sufficiently precise. Second, we evaluated all patients under chronic HD, while evaluation of patients before and after applying AV fistulas is more desirable. Third, the sample size of this study was not relatively large, and absence of significant differences in some symptoms of ulnar nerve can be related to the low sample size. Fourth, this study was conducted only in 2 hospitals of Tehran. Therefore, it is not generalizable to other locations, and we propose a multicenter study with a large sample size to overcome these limitations.

In brief, this study concludes that chronic HD via forearm AV fistula in HD patients does not lead to an increase in CTS. On the contrary, it causes a reduction in the symptoms of ulnar nerve disorder, including paresthesia and muscle weakness.

Footnotes

Authors' Contribution: Study concept and design, Alireza Pahlevansabbagh; acquisition of data, Shayan Tavabi, Alireza Pahlevansabbagh, and Mohsen Motalebi; analysis and interpretation of data, Mohsen Motalebi and Marzieh Nojomi; drafting of the manuscript and critical revision, Shayan Tavabi, Alireza Pahlevansabbagh, Hossein Farahini, Mohsen Motalebi, and Marzieh Nojomi; study supervision, Alireza Pahlevansabbagh and Hossein Farahini.

Conflicts of Interests: The authors declare no conflicts of interest.

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