Evaluation of the relationship between hemoglobin A1C and the severity of carpal tunnel syndrome in diabetic patients

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Abstract

Purpose

The aim of this study was to evaluation the relationship between hemoglobin A1C levels and the severity of carpal tunnel syndrome in diabetic patients.

Methods

In this cross-sectional study, 60 patients referred to endocrine and internal medicine clinics of Baqiyatallah Hospital who were diagnosed with diabetes and were receiving drug or insulin therapy were studied according to the Diagnostic criteria by the American Diabetes Association (ADA criteria). Patients' CTS severity was assessed according to HbA1C laboratory results and EMG / NCV test. Three questionnaires were completed for all participants: demographic information (height, weight, age, BMI, duration of diabetes, history of smoking and alcohol use, and history of other underlying diseases), Neuropathy disability score (NDS) (to assess nerve fiber damage, muscle strength, reflex loss, and loss of sensation), and Diabetic neuropathy symptoms (DNS) (for pain, numbness, tingling). The results were statistically analyzed.

Results

The study group consisted of 44 men and 16 women. 47 had type 2 diabetes and 13 had type 1 diabetes. The mean age of participants was 53.22 ± 7.28 years, the mean duration of diabetes was 11.2 ± 8.8 years, the mean duration of neuropathic symptoms was 2.9 ± 3.8 years, and the mean serum Hb A1C level of the subjects was 6.91 ± 1.38. The majority of subjects had mild CTS severity (30 out of 60). There was a statistically significant relationship between CTS severity and hemoglobin A1C levels in diabetic patients ($P = 0.014$).

Conclusion

The results of the study showed that the level of hemoglobin A1C has an effect on the severity of CTS. There was a statistically significant relationship between serum Hb A1C levels and CTS severity. The intensity of CTS increases with increasing hemoglobin A1C levels.

Introduction

Carpal tunnel syndrome (CTS) is a compression neuropathy caused by involvement of the median nerve at the surface of the carpal tunnel in the wrist. This syndrome is characterized by symptoms such as paraesthesia, numbness, loss of sensation and eventually weakness and atrophy of the thenar muscle. Various factors can be effective in creating it, such as: jobs (occupations that are excessive use of hands

and wrists), physical problems (such as pregnancy, diabetes, hypothyroidism and obesity) (1). This damage usually begins in the form of demyelination, and progresses to axonal destruction. The disease first affects the sensory fibers and then the motor fibers (2). The estimated prevalence of CTS is between 4 and 5 percent, which particularly affects people between the ages of 40 and 60. CTS is etiologically called idiopathic in most cases (3). Compression neuropathy is a combination of compression and tension phenomena. Nerve compression and tension may cause circulatory disturbances in vivo, lesions in the myelin sheath and axons, as well as changes in supporting connective tissue. Peripheral nerve entrapment occurs as a result of its passage through an anatomical chamber that has become so rigid that it leads to a change in function in the nerve or nerve damage from the compression site and beyond. Pressure on the median nerve in the carpal tunnel in the wrist is the most common example of this type of neuropathy (4). Gender, age, smoking, wrist injury, diabetes, hypothyroidism, and excessive pressure and work on the wrist are all risk factors for CTS. (5). HbA1c with a normal level of 4–6 is one of the factors that indicates the level of blood sugar control over a period of three months. HbA1c is also called glycated hemoglobin and glycohemoglobin. It has been show that high levels indicate that the sufferer is exposed to microvascular complications. With proper blood sugar control, many of the dangerous complications of diabetes can be prevented (it is estimated that with each 1% reduction in HbA1C, 37% of the microvascular complications and 21% of the macrovascular complications of diabetes are reduced) (6). Compression neuropathies of the upper extremities (such as carpal tunnel syndrome and ulnar nerve entrapment) are common in patients with diabetes mellitus. Some studies have suggested that higher HbA1c and plasma glucose levels are associated with increased CTS intensity (7). People with diabetic neuropathy with CTS have significantly higher BMI, fasting blood sugar, and HbA1c than patients without CTS. However, there is no mean difference in motor action potential between patients with and without CTS (8). Demirel et al. In their study, while dividing patients in terms of CTS severity into three groups: mild, moderate and severe, reported that in patients with CTS, fasting blood glucose and HbA1c levels were significantly higher than those without CTS. They also stated that there was a significant positive correlation between age, HbA1c, and CTS severity (9). Lack of diabetes control leads to the development of neuropathic symptoms, which creates certain problems for patients and their families. In addition it brings a lot of costs to the affected people and the health system. Given the above and the high limitations of finding related articles, we sought to investigate the relationship between HbA1C levels and CTS severity (by reviewing laboratory results of HbA1C levels and studying the EMG / NCV test). Therefore, the aim of this study was to evaluation of the relationship between HbA1C levels and the severity of carpal tunnel syndrome in diabetic patients.

Methods

Study protocol and subjects

In this cross-sectional study, 60 patients referred to the endocrine and internal medicine clinics of Baqiyatallah Hospital who were diagnosed with diabetes according to the Diagnostic criteria by the American Diabetes Association (ADA) and were receiving drug treatment or Insulin therapy were included

in the study. Inclusion criteria included: complaints of tingling, numbness and pain in the hands, exacerbation of the symptoms at night (so as to wake the person), the spread of pain to higher parts, reduced strength of hands and fingers, at least 5 years from type 1 diabetes or new onset of type 2 diabetes, the presence of CTS symptoms on the nerve and muscle strip test (EMG / NCV).

Exclusion criteria included: clinical signs of CTS without electrodiagnostic changes, deformity or bone fracture anywhere in the upper limb, signs of radiculopathy, plexopathy and neuropathy on clinical examination and nerve and muscle strip test, history of previous CTS surgery Existence of specific disorders (renal, hepatic, rheumatological, HLP and hypothyroid anemia), presence of inflammatory diseases, monoclonal gammopathies, or endocrine, metabolic or nutritional disorders, alcohol consumption.

Patients were given a history and clinical examination, and for all of them, three questionnaires were filled in: demographic information (height, weight, age, BMI, duration of diabetes, history of smoking and alcohol use, and history of other underlying diseases), NDS (for nerve fiber damage, muscle strength, reflex loss, and loss of sensation) and DNS (4-point scoring system for pain, numbness, tingling), and HbA1C testing was requested. Patients with complaints of tingling and numbness of the limbs and clinical signs of CTS were referred for EMG / NCV testing.

EMG / NCV test was performed by machine NIHON KODEN factory of japan and all measurements were recorded using standard laboratory methods. All EMG / NCV cases were performed in the form of surface recording and stimulation. belly-tendon assembly and supra-maximal stimulation were used in this work. All tests were performed by an experienced person in a consistent manner. Sensory (medial, ulnar) and motor (median, ulnar, tibial, peroneal) nerves were checked, and amplitude factors, distal latency, and nerve conduction velocity (NCV) were recorded. Serum Hb A1C levels were assessed at three levels: normal (4 to 5.6%), weak (5.7 to 6.4% in people at high risk of diabetes), and poor (equal to or greater than 6.5% in (Individuals with diabetes), and the severity of CTS was considered based on clinical signs and standard electrophysiological criteria at three levels: mild, moderate, and severe. CTS severity was matched with HbA1C laboratory results.

Ethical Considerations

The present study is the result of Dr. Movahed Amirzadeh's residency course in physical medicine and rehabilitation with ethical code number IR.BMSU.BAQ.REC.1398.031.

Statistical analysis

The results were analyzed using 20PSPSS software. Descriptive analysis including frequency and percentage for qualitative variables, mean and standard deviation for quantitative data was used, and analytical analysis for quantitative data including Chi-square tests, correlation analysis, and linear regression were used. Significance level was considered 0.05.

Results

The study group consisted of 44 men and 16 women. From this population forty-seven had type 2 diabetes and thirteen had type 1 diabetes. The mean age of participants was 53.22 ± 7.28 years, the mean duration of diabetes was 11.2 ± 8.8 years, the mean duration of neuropathic symptoms was 2.9 ± 3.8 years, and the mean serum Hb A1C level in the subjects was 6.91 ± 1.38.

The frequency of CTS severity in the participants was respectively 30 (50%) mild, 15 (25%) moderate and 15 (25%) severe. The frequency of serum Hb A1C level in the subjects was 7 (11.6%) with normal Hb A1C level, 28 (46.8%) with low level, and 25 (41.6) with bad level. In patients with higher CTS intensities, Hb A1C levels also showed an increase. Hb A1C values in mild, moderate, and severe CTS were respectively 6.55, 6.85, and 7.68. There was a statistically significant relationship between serum Hb A1C level and CTS severity (P = 0.014).

Discussion

This study was performed to investigate the relationship between Hb A1C level and carpal tunnel syndrome severity in diabetic patients (using laboratory results of HbA1C level and EMG / NCV test study).Based on the results of the major study, patients with higher CTS intensities showed higher Hb A1C levels.Hb A1C values in mild, moderate, and severe CTS intensities were respectively 6.55, 6.85, and 7.68 .There was a statistically significant relationship between serum Hb A1C level and CTS severity (P = 0.014).

Compression neuropathies in the upper extremities (such as carpal tunnel syndrome (CTS) and ulnar nerve entrapment (UNE)) are common in patients with diabetes mellitus (DM). Higher levels of HbA1c and plasma glucose are associated with an increased risk of CTS, and diabetes mellitus is a major risk factor for CTS and UNE (7). There is a correlation between the presence of electrophysiological peripheral diabetic sensorimotor polynecuropathy (DSP) with parameters such as male age and sex, glycohemoglobin (GHb), duration of diabetes, hypertension, smoking, hypertriglyceridemia and low HDL cholesterol, and height. (10). A large, longitudinal cohort study has identified the mean glycohemoglobin mean as the strongest independent risk factor for neuropathic severity (11). The Tkac and Bril study also showed that glycohemoglobin (GHb) is a modifiable risk factor for the electrophysiological severity of peripheral diabetic motor sensorineural neuropathy (DSP). They also stated that glycohemoglobin (GHb) is a risk factor for the intensity of fiber density(FD) loss in peripheral diabetic motor sensorineural neuropathy (DSP) (12). Diabetes control is the most important factor associated with the severity of peripheral diabetic motor sensory polyneuropathy (DSP) in patients with type 1 and type 2 diabetes. Given that effective control of type 1 diabetes has a positive effect on increasing nerve conduction velocity and improving its abnormalities, it can be assumed that this type of intervention will have similar benefits in fiber density (FD). Accordingly, (using neurotransmission studies (NCS)) it has been stated that strict control of blood sugar can reduce the risk of DSP onset by up to 60%. (13, 10). Glycemic variability (GV) is a term used to describe impaired glycemic control. Complications of diabetes may be

associated with time-dependent impairment of glycemic control. Thus, long-term glycemic variability (assessed by changes in HbA1c) may be a potential risk factor for microvascular complications such as Diabetic peripheral neuropathy (DPN). Long-term assessment of glycemic variability (GV) is significantly associated with the presence of diabetic sensorimotor polyneuropathy (DSPN). Therefore, increased HbA1c variability is closely related to DPN in type 2 diabetic patients, and can be considered as a strong indicator for DPN in these patients (13). Diabetic peripheral neuropathy (DPN) (including autonomic and somatic neuropathy) is one of the most important microvascular complications of diabetes. The most common somatic neuropathy is diabetic sensorimotor polyneuropathy (DSPN), which is one of the leading causes of foot ulcers and amputations in diabetic patients (14). Regarding the results of this study and comparing it with other studies, Lai et al. In their study stated that people with higher SD-HbA1c had lower amplitude, decreased motor nerve conduction velocity (in tested nerves) and sensory (In the sural nerve), and had higher composite scores of nerve conduction (as the severity of peripheral neuropathy) in the upper limbs than in the lower limbs. They also stated that HbA1c variability plus chronic glycemic disorder is strongly associated with the severity of peripheral neuropathy in patients with type 2 diabetes (15). The results of this study were in agreement with the findings of our study. Rydberg et al. Also found in their study that in people with CTS, higher levels of HbA1c and plasma glucose are both associated with increased CTS severity (7). Bin-Jaliah et al. Also stated that people with CTS have a HbA1c greater than seven (compared to groups equal to or less than seven HbA1c) have a reduced NCV (≈ 22m / s), amplitude (≈ 4.2mV), And an increase in latency (ms6ms), which suggests a relationship between HbA1c levels and CTS severity (16). Islam et al. Also found in their study that people with diabetic neuropathy with CTS (compared to patients without CTS) had significantly higher BMI, fasting blood sugar, and HbA1c. But there is no significant difference in the mean potential of combined motor action between the two groups (8). Demirel et al. In their study divided patients into three groups in terms of CTS severity: mild, moderate and severe. They reported that fasting blood glucose and HbA1c levels were significantly higher in patients with CTS than in those without CTS. They also stated that there was a significant positive correlation between age, HbA1c, and CTS severity (9). Nazish et al. Also stated that factors such as age, BMI, systolic BP, low serum high-density lipoprotein (HDL), high triglycerides, high fasting blood sugar, and high glycohemoglobin (Hba1c) levels affect the electrophysiological severity of CTS and have a significant association with diabetes (17). In general, the results of the above research confirm the results of this study. This indicates the need for more attention and control of Hb A1C levels.

Conclusion

The results of this study showed that the severity of neuropathy is associated with high variability of HbA1c, and there is a significant relationship between serum Hb A1C levels and CTS severity (with increasing HbA1c levels, the severity of CTS also increases). Given that HbA1c variability is a prognostic factor in the severity of neuropathy, blood glucose levels should be controlled to an acceptable level to prevent further nerve damage.

Limitations

The limitation of this study was consist of: low sample size, the presence of Covid 19 epidemic, and lack of cooperation of participants to refer, more sampling, and follow them.

Recommendations

Due to the limitations of the study, it is recommended. For more citation results, a similar study with a larger sample size should be done. The relationship between gender and Hb A1C level with CTS severity should also be examined.

Declarations

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Conflict of interest

The authors hereby declare that they have no conflict of interest in writing this article.

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Authors' Contributions

All authors pass the four criteria for authorship contribution based on the international committee of medical journal editors (ICMJE) recommendations.

Ethical Statement

The present study is the result of Dr. Movahed Amirzadeh's residency course in physical medicine and rehabilitation with ethical code number IR.BMSU.BAQ.REC.1398.031.

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