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Original Article

Comparing indices of median nerve among diabetic patients with or without metabolic syndrome

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ABSTRACT

Background: Metabolic syndrome is highly prevalent among patients with type II diabetes and is reported as a strong risk factor for cardiovascular diseases as well as carpal tunnel syndrome (CTS). The aim of the current study was to compare median nerve indices among diabetic patients with and without metabolic syndrome.

Methods: This cross-sectional study was conducted on 105 patients with type II diabetes whom participated in the coronary artery disease risk factor study in Kerman, Iran (KERCARDS). Patients with type II diabetes were called and those with clinical symptoms of CTS were included in the study, and median nerve indices were measured according to standard electro diagnosis tests. GEE statistical model was used to compare median nerve indices among diabetic patients with and without metabolic syndrome. All statistical analysis was done using SPSS 20.0.

Results: The mean age of participants was 57.57 ± 9.53. There was no significant difference between the left and right hand regarding median nerve indices except median nerve motor amplitude (MA). Furthermore, components of metabolic syndrome including BMI and LDL were determined as risk factors for CTS according to several indices.

Conclusion: Components of metabolic syndrome had more influence on sensory indices than motor indices and primary control of these components might prevent dysfunction of sensory neurons and also motor neurons in advanced stages among diabetic patients.

1. Introduction

Carpal Tunnel Syndrome (CTS) is the most prevalent congestive neuropathy and is defined as compression of the median nerve in the carpal tunnel and is the most prevalent congestive neuropathy that involves upper extremities. Tingling, numbness, and pain in the median nerve area are the primary symptoms of CTS and finally leads to weakness and hand dysfunction [1]. CTS signs emerge gradually which include numbness, burning, tingling in the fingers and palm of the hand, pain sensation in the wrist, hand and forearm, decreased grip strength, weakness in the thumb, feeling of swelling in fingers with no obvious swelling, and difficulty in distinguishing between heat and cold [2].

The prevalence of CTS is not similar among different societies [3]. The disease usually occurs between the ages of 30 to 60 years and affects women more than men (women to men ratio is variant from 3.1 to 10.1). Studies demonstrate that 14.4% of people are affected by the clinical symptoms of CTS. In electro physiological tests, 2.7% of the general population are clinically affected by this disease. The prevalence of CTS is variant from 14% in diabetic patients without neuropathy to 30% in diabetic patients with neuropathy. Currently, no precise information is available regarding this disease in Iran [1,4].

In order to diagnose these patients, clinical history and physical examination including Tinel, Phalen, two point discrimination, and Weinstein tests along with other paraclinical experiments such as sonography and MRI are used to diagnose the disease, but electro diagnostic tests are the most suitable method for diagnosis, severity determination, and also ruling out other causes leading to

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similar symptoms [5]. Currently, the gold standard for diagnosing suspected cases of carpal tunnel syndrome, is electro diagnosis tests [6].

Researchers had detected various factors contributing to or assisting in the development of CTS. These factors are working conditions (such as using hands frequently) and health conditions (including non-inflammatory synovial fibrosis, diabetes, metabolic syndrome, pregnancy, menopause and rheumatoid arthritis as well as personal factors such as obesity, female gender, heredity, age, smoking and alcohol). Currently, it is widely agreed that the main cause of CTS is unknown [5].

Metabolic disorders are closely associated with CTS. These disorders affect the median nerve via exerting direct pressure. Metabolic syndrome is characterized with abdominal obesity, high blood pressure, elevated blood sugar and blood fats. This syndrome is usually related to the presence of CTS. The incidence of metabolic syndrome is found to be higher among patients with CTS. Furthermore, CTS is more severe in patients with metabolic syndrome. [2,7].

Various definitions are available for metabolic syndrome [8], but there is no accepted index for diagnosis of this syndrome. Currently, most studies use Adult Treatment Panel III (ATPIII) to detect patients with metabolic syndrome [9]. The International Diabetes Federation (IDF) also declared a definition in 2005 to detect patients with metabolic syndrome which is executable among various ethnical populations [10].

Metabolic syndrome is highly prevalent among patients with type II diabetes [11]. Conducted studies in Iran reported that the prevalence of this syndrome among diabetic patients is 73.1 and 69.4% according to ATPIII and IDF criteria, respectively [12]. According to a conducted study in England, the prevalence of this syndrome based on IDF criterion is 91.7 and 94.8% for men and women respectively. Furthermore, the prevalence of this syndrome based on ATPIII criterion for men and women is 87.6 and 94.2%, respectively [13].

Since patients with diabetes and metabolic syndrome are a population at risk for CTS, the current study was conducted to compare median nerve indices among diabetic patients with or without metabolic syndrome and based on various diagnostic criteria.

2. Methods

This cross-sectional study was conducted on 105 patients with type II diabetes and symptoms of CTS in the first phase of the coronary artery disease risk factor study in Kerman (KERCARDS) [14]. Patients with type II diabetes; participating in this study; were called and if they had CTS symptoms including numbness, burning, tingling in the fingers and palm of the hand, pain in the wrist, hand and forearm, decreased grip strength, weakness in the thumb and also if their disease was verified by the Boston questionnaire; they were referred to a neurologist for further diagnosis and performing an electro diagnosis test.

In the current study, any neurologic disease affecting the median nerve (such as uremic neuropathy), any fracture contributing to deformity or denervation, as well as those patients with obvious neuropathy including those patients diagnosed clinically or diagnosed during performing electro diagnosis tests, were excluded.

Demographic and basic metabolic data (BMI, systolic and diastolic blood pressure, cardiovascular diseases, fasting blood sugar, HDL, and LDL) and other information from KERCARDS, were collected. Measurement of median nerve indices (median nerve motor distal latency, median nerve motor amplitude, median nerve motor conduction velocity, median nerve sensory onset latency, median nerve sensory amplitude, median nerve sensory conduction velocity) as well as measurement of wrist dimensions were done by a neurologist.

The ATPIII and IDF criteria as well as a new criteria validated in Kerman (Gozashti et al) were used to diagnose metabolic syndrome (Table 1).

Electro diagnosis tests using an EMG neon device made in Japan was used to diagnose CTS. This test was done on skin surface with the temperature of 32 to 34 °C and in a room with normal temperature. This test was performed as following. The Abductor Pollicis Brevis muscle was the receiving location of median nerve's motor potential and the stimulation location of the median nerve was located in the wrist and with 6.5 cm distance from the location of receiving stimulation. The wrist horizontal creases were the assessment location for the sensory stimulation of median nerve and the proximal of the index finger was the receiving location for the sensory potential which was located at 13 cm of the stimulation receiving location. Categorization of disease severity is presented in Table 2.

Furthermore, a calipers with 1 mm measurement accuracy was used to measure wrist dimensions. AP is the anterior-posterior size and ML is the ML is the median-lateral size of the wrist. Dimension of the wrist is calculated through division of AP to ML which is normally ≤ 0.7.

Since median nerve indices are correlated in the right and left hand, therefore linear regression models cannot be used to analysis these variables. Therefore, the GEE model was used in the current study.

Each median nerve index was considered separately as a dependent variable and the right and left hand of each participant was considered as a cluster. In addition to the main independent

Table 1
Diagnosis of metabolic syndrome as per different criteria.

ATPIII	IDF	NEW
Presence of ≥3 of the following: (*i*) Waist circumference (>90 cm in men,>80 cm in women) (*ii*) SBP ≥130 mmHg and/or DBP ≥85 mmHg or medical treatment of previously diagnosed hypertension (*iii*) TG ≥ 150 mg/dl (*iv*) HDL-C <40 mg/dl in men, <50 mg/dl in women (*v*) Fasting glucose >110 mg/d	Presence of central obesity with waist circumference >90 cm (men) and >80 cm (women) plus any 2 of the following: (*i*) TG >150 mg/dl or specific treatment for this lipid abnormality (*ii*) HDL-C <40 mg/dl (men), <50 mg/dl (women) or specific treatment for this lipid abnormality (*iii*) SBP >130 mmHg and/or DBP >85 mmHg or medical treatment for previously diagnosed hypertension (*iv*) Fasting plasma glucose (> 100 mg/dl) or previously diagnosed type 2 diabetes	Presence of central obesity with waist circumference >86 cm (men) and >83 cm (women) plus any 2 of the following: (*i*) TG >150 mg/dl or specific treatment for this lipid abnormality (*ii*) HDL-C <40 mg/dl (men), <50 mg/dl (women) or specific treatment for this lipid abnormality (*iii*) SBP >130 mmHg and/or DBP >85 mmHg or medical treatment for previously diagnosed hypertension (*iv*) Fasting plasma glucose (> 100 mg/dl) or previously diagnosed type 2 diabetes

ATPIII: Adult Treatment Panel III, **IDF:** International Diabetes Federation, **NEW:** New criteria for Kerman.

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