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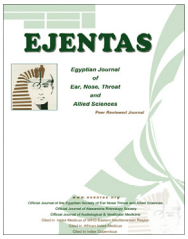

ORIGINAL ARTICLE

Monitoring of motor function affection and postural sway in patients with type 2 diabetes mellitus

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KEYWORDS

Diabetic neuropathy;
Diabetes complications;
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Abstract *Background:* Diabetes is a chronic metabolic disease with impaired glucose tolerance. Diabetic neuropathy affects sensory, autonomic, and motor neurons of the peripheral nervous system so that nearly every type of nerve fiber in the body is vulnerable.

Objectives: Evaluation of variation in motor functions and postural sway in patients with type 2 diabetes mellitus (DM) and comparing the results with those obtained from the control group. This will help in rehabilitation programs for diabetic patients to avoid postural instability and risk of falling.

Methodology: Forty patients with the diagnosis of type 2 DM (group 1) participated in this study and twenty subjects who had no diagnosis of type 2 DM were evaluated as a control group (group 2). Blood glucose level of patients was measured then they referred to audiovestibular assessment. Computerized dynamic posturography (CDP) was done in the form of motor control test and functional limitation assessment; Tandem walk.

Results: Findings showed a statistically significant difference between the study group and control group as regards response latency, speed of the forward progression and endpoint sway velocity. A statistically significant correlation was found between response latency and speed of the forward progression with FBS level in the study group.

Conclusions: Speed of the forward progression was less, however response latency and endpoint sway velocity were more in diabetic patients in comparison with normal subjects. Response latency and speed of the forward progression showed a statistically significant correlation with FBS level in diabetic patients.

1. Introduction

Diabetes mellitus (DM) is more common in elderly population indicating that almost one sixth of elderly population has type 2 DM in the world.[1,2] Therefore, clarifying the contribution of diabetes to disability in elderly populations is important. Diabetes is a chronic metabolic disease with impaired glucose tolerance that may increase the risk of cardiovascular diseases

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related primarily to its associated long-term microvascular and macrovascular complications.[3] Neuropathies and musculoskeletal complications such as limited joint range and insufficient muscle strength are among the most common of all the long-term complications of diabetes. The metabolic changes in diabetes (microvascular abnormalities with damage to blood vessels and nerves; and collagen accumulation in skin and periarticular structures) result in changes in the connective tissue and structure of a muscle.[4] These changes cause a decline in muscular functions. Decline in muscular function together with peripheral neuropathies may increase risk for functional dependency and frailty in type 2 diabetic people.[5] A frequent source of polyneuropathy is diabetes mellitus. Diabetic peripheral neuropathy is initially characterized by a reduction in somesthesic sensitivity due to the sensitive nerve damage, and with progression motor nerves are damaged.[6]

Diabetic neuropathy affects sensory, autonomic, and motor neurons of the peripheral nervous system, which is to say that nearly every type of nerve fiber in the body is vulnerable. Moreover, every organ system in the body that relies on innervation for function is consequently subject to pathology. Therefore, diabetic neuropathy describes a number of unique syndromes that are primarily classified by the nerve fibers affected. As for the disease course, it is fortunate that only a minority of patients experience neuropathic pain but tragic that a majority do not report symptoms until the complications are severe or irreversible.[7]

Cédrick et al. (2009) found that among the complications associated with diabetes mellitus is postural control. The general observation is that postural sway is greater for people with diabetes, especially if their condition includes neuropathy. Peripheral sensory neuropathy seems to be the primary factor, but the available evidence does not rule out diabetes per se, other neuropathies (central, autonomic, motor), or an inability to exploit fully optical and inertial information about posture.[8]

Automatic postural response system, rapid involuntary reactions to support surface translation are triggered primarily by proprioceptive stimuli. Vestibular and visual inputs modulate but are not likely to initiate these responses in isolation.[9] Motor control test (MCT) measures the patient ability to adapt increasing anterior and posterior rocking and body sway through measuring weight symmetry, latency and amplitude of the response. As regards functional limitation assessment; Tandem walk quantifies characteristics of gait as the patient walks heel to toe from one end of the forceplate to the other.

2. Aim of the work

Evaluation of variation in motor functions and postural sway in patients with type 2 diabetes mellitus (DM) and comparing the results with those obtained from normal adults subjects as a control group. This will help in rehabilitation programs for diabetic patients by improving the performance of those patients to avoid postural instability and decrease risk of falling.

3. Method

3.1. Subjects

- *Study group:* (group 1) consisted of forty patients with the diagnosis of type 2 DM (for at least five years) with Fasting Blood Sugar (FBS) test results more than 110 mg/dl, selected randomly from the outpatient clinic of hearing and speech institute. Their age ranged from 40 to 60 years (with mean age = 54 years). None of them had a chronic or acute illness that may affect balance. They had no muscular pathology, gait or balance disorders. They were all able to see adequately and follow instructions.
- *Control group:* (group 2) twenty normal adult individuals of same age (with mean age = 48 years) and had no diagnosis of type 2 DM.

Each subject received information about the study and gave written consent to participate. The research was approved by the ethics committee of the general organization of teaching hospitals and institutes.

4. Equipments

(1) Two Channel Audiometer (Interacoustics, model AC40).
(2) Sound treated room (I.A.C model 1602).
(3) Middle ear analyzer (Interacoustics model Az26).
(4) Computerized Dynamic Posturography long forceplate: (Neurocom version 4 Smart Balance Master).
(5) Spectrophotometer blood chemistry analyzer (Erba Diagnostics-Chem 7 Germany.)

5. Testing procedures

All participants in this study were subjected to the following:

- Fasting blood glucose level determination (kit provided by Human, Germany):

Glucose in the sample originates by means of the coupled reactions described below, a colored complex that can be measured by spectrophotometry.

$$\text{Glucose} + 1/2O_2 + H_2O \xrightarrow{\text{Glucose oxides}} \text{Glyconate} + H_2O$$

$$2H_2O + 4 - \text{aminophenazone} + \text{phenol} \xrightarrow{\text{peroxidase}} \text{quinoneimine} + 4H_2O$$

Then they referred to audiovestibular assessment in the form of:

Table 1 Mean and standard deviation of motor control test parameters in both groups.

Group	Weight symmetry (scores)	Latency (msec)	Strength symmetry (scores)
Group 1	102.275 ± 1.907	150.785 ± 12.760	99.540 ± 14.541
Group 2	104.05 ± 3.975	135.70 ± 10.934	98.90 ± 10.545