

Original Research Article

Early Detection of Sensorimotor Changes in Upper Limb in Type 2 Diabetes

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ABSTRACT

India is going to become Diabetes capital of the world by 2020. Peripheral neuropathy is the most common complication which is affecting millions of people throughout the world. The aim of the research is to detect the earliest sensory motor changes in type 2 diabetes. Two point discrimination was measured using AESTHESIOMETER and grip strength was measured using JAMAR dynamometer for the subjects who fulfilled the inclusion and exclusion criteria. Type II diabetic patients had a reduction in grip strength and decrease sensation.

Keywords: Diabetes, Grip strength, two point discrimination.

INTRODUCTION

International diabetes federation declared as India is the diabetes capital of the world (Mohan V et al, 2007). Diabetes may become a cause of severe impairment and disability due to diabetic neuropathy approximately all of the patients turned upto physiotherapist after confirmation of diabetic neuropathy and in that condition physiotherapist has least to offer them. Early detection of sensory nerve impairment is an important issue and a great challenge in evaluating diabetic neuropathy (Shun C.T, 2004). In sensory nerve damage, as the sensory loss ascends and reaches approximately mid-calf, it appears in the hands. This gradual evocation causes the typical 'stocking glove' sensory loss which reflects preferential damage according to axon length, the longest axons being affected first (Sarkar S et al, 2011). Unfortunately the signs of neuropathy start appear when the neuropathy has already developed. Diabetes neuropathy may

happen due to gradual deterioration of neuromuscular tissues so effort should be made to rule out the earliest time duration to start this process. The aim of the study is to detect the sensorimotor changes as early as possible

METHODOLOGY

A total of 60 subjects with diabetic (30) and non-diabetic (30) both males and females of age group 40-60 years were included. Type II diabetic subject included was diagnosed by physicians. Patients with Type II Diabetes who are taking insulin, with neurological disorder such as multiple sclerosis, stroke etc., fracture from last 6 months or any leading deformity, trauma or disease affecting the upper extremity, conditions interfering with motor function such as Rheumatoid Arthritis, Gout, any amputation, cancer or any surgery, any systemic, metabolic, endocrinal, infectious, gastrointestinal diseases except diabetes mellitus were excluded. Subjects were

recruited from rehabilitation centre JamiaHamdard and Diabetic OPD of HAHC hospital after the approval from institutional research committee and ethical committee was sought.

Procedure

Patients was assessed and screened to fulfill inclusion and exclusion criteria. Subjects fulfilling the inclusion and exclusion criteria were signed to informed consent. Selected

subjects were assigned into group 1 (diabetic) and group 2 (non-diabetic). The demographic variables including age, height, weight, BMI, Blood Sugar fasting (FBS) and postprandial (PP) were recorded. Instruments used were Grip strength dynamometer (JAMAR dynamometer) (figure 1), two point aesthesiometer (figure 2), Standardized height measuring scale, Weighing Machine (Omron).



Figure 1: Hand Jamar Dynamometer



Figure 2: Two Point Aesthesiometer

Grip Strength Measurement: Procedure was explained to the patient.

Patient position: Sitting with knee flexed 90 degrees in an adjustable chair. Shoulder adducted with the elbow flexed to 90 degree. Forearm and wrist in neutral position. The patient was asked to press as hard as possible and relax.

Trial: patient was given a trial to get accustomed to the procedure.

Measurement: The grip strength of diabetics and non-diabetics was measured using hand JAMAR dynamometer.

Average: Mean of three readings was taken.

Two point discrimination: Procedure was explained to the patient

Patient position: Sitting straight with hands by the side.

Trial: Patient will be given a trial to get accustomed to the procedure

Measurement: The Two point discrimination of diabetics will be measured for dominant hand using aesthesiometer. Sensation was tested on a sensory

dermatome of the palm, two point was tested on each dermatome c6,c7,c8. Two points of c6 on thumb, two points of c7 on middle finger, two points of c8 on little finger (figure 3). The two points of the caliper were applied at the same time (stationary two point discrimination test) using weight of the caliper alone. Subjects were asked whether they felt the point as two or one. The minimal distance at which two point were discriminated was measured. the distance between two points of the caliper with which testing was started was 4cms.the distance was decreased further if the subject was responded correctly at least three times out of five .the distance of two point was progressively decreased till the subject started perceiving as one. The scores for two point discrimination test were recorded and analyzed for the comparisons.

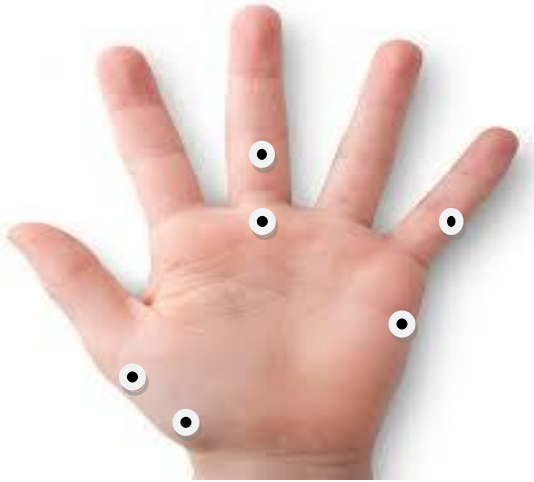


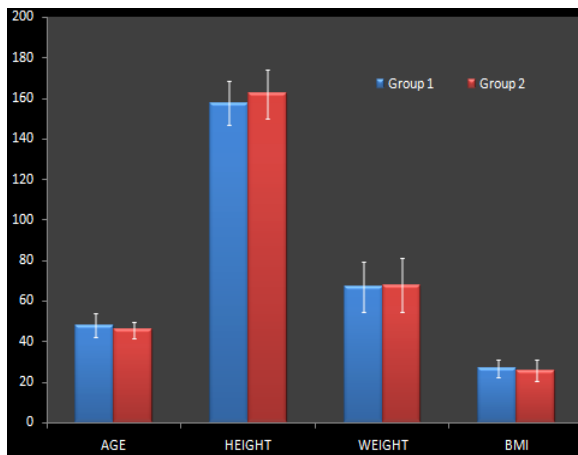
Figure 3: Dermatomes tested for two- point discrimination.

Statistical analysis

All the data are presented as Mean±SD. Independent 2 tailed t test is used to find the differences in two point discrimination and grip strength among diabetic and non-diabetic.

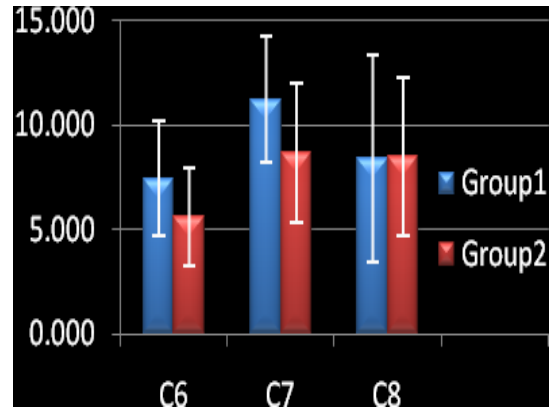
RESULT

A total of 60 patients (44 males and 16 females) were included for the study. The mean values in diabetic group for age, weight, height and BMI 48.03 ±6.0 years, 67.10±12.5kg, 157.7±10.65 cm and 26.97±4.38 respectively. The mean values in Non-diabetic group for age, weight, height, and BMI were 45.87±4.12 years, 67.90±13.52 Kg, 162.40±12.13 cm and 25.8±5.2 respectively. The age, weight, height, and BMI showed no difference between the two groups and have the $P \leq 0.05$ as mentioned in Graph 1.



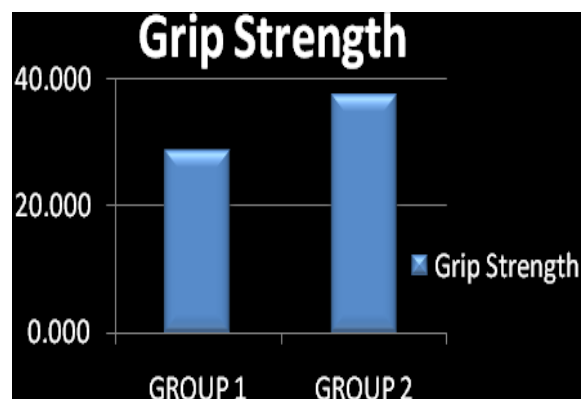
Graph 1: shows demographic variables of the participants

The two point discrimination was analysed using Independent 2 tailed t-test. The mean values for two point discrimination at c6, c7 and c8 of group 1 was 7.43±3 mm, 11.23±3mm and 8.4± 5mm and group 2 was 5.6±2mm, 8.6±3mm and 8.4±3mm. The result showed statistically significant difference between the groups ($t_{(1, 11)} = 2.79, 2.74, -0.06$) as mention in the Graph 2.



Graph 2: shows difference in two point discrimination among diabetic and non-diabetic

There was shown statistically significant difference between the two groups (group 1 and group 2). The mean values for grip strength of group 1 are (28.74± 9.63) and group 2 (37.5± 15.02) was significant at $p \leq 0.05$ as mention in the Graph 3.



Graph 3: shows grip strength among diabetic and non-diabetic

DISCUSSION

The significant changes in sensory and motor status of diabetic group due to reduce rate of glycogen synthesis in the muscle thereby decrease in the hand grip strength sensory changes in the status of the

cutaneous receptors is due to disturb fluid exchange mechanics between the capillaries and small cutaneous receptors.

The Objective of this study was to see the difference in measure between two point discrimination and grip strength among diabetic and non-diabetic. Result revealed that statistically difference was found between two groups. The present study included 30 type II diabetic patients (experimental group) and 30 non diabetic (control group) including 44 males and 16 females. Two point discrimination and grip strength of the dominant hand of each group was measured. Difference of values between each group was calculated. The result of the study showed that there was significant difference ($p=0.01$) found in the grip strength of diabetic and non-diabetic.

Peterson K. F. et al stated that the possible reason for muscle weakness may be insulin resistance as it reduces the rate of glycogen synthesis in muscle (Petersen K.F et al, 2002). Muscle glycogen is used in type II b fibres, using anaerobic pathway and in type II a fibres using both aerobic and anaerobic metabolism (Pette D et al, 1999) and the highly potent type II a fibre permit sustained efforts, due to oxidation of glycogen by the mitochondrion. Therefore muscle glycogen content may be particularly decreased in type II a fibres in diabetes (Ezema C.I et al, 2002). Fuel disposal is also of poorer quality due to insulin resistance and is associated with lower muscle performance (He J, Kelley DE, 2004)

However it contradicts the study of Anderson et al (1997) and Anderson et al (2004) who opposed this view and insisted that grip strength is not compromised in long standing type2 diabetes (Marchasson I. B et al, 2007). Upper extremity grip strength evaluation is important as it is required for the basic functions such as manipulating and holding objects. Grip strength is the pre requisite for upper limb functions. Grip strength plays important role in daily activities in working age population. There is very important role of stable grip in every

day to day activities of life such as opening a jar, driving a car, driving scooter, riding bike, writing, riding bicycle, carrying a bag of groceries and holding a book, holding a comb etc.

The result of this study also showed that there is significant difference in two point discrimination in the dermatomes of hand which is responsible for sensation in hand among the diabetic and non-diabetic. Sensations are very important for grip it is the role of sensation which gives the information to the nervous system that how much force is require for gripping an object. Sensations are important for grip as they bring about accuracy in the grip by giving sensory feedback to the nervous system. In this study the two point discrimination was tested because it is the only sensation which can be quantified. The evaluation of sensibility in the hand of the diabetic patient is of great importance in order to provide proper identification of the group that to what extent the sensory changes are coming. Sensory changes in the hand would help to detect the involvement of upper limb neuropathy. A shift in the age of onset of type2 diabetics has been observed in the population with sedentary life style. A huge number of the working population has shifted from manual labour associated with the agriculture sector to physically less demanding office jobs.

Various studies have been done in older population but there is lack of literature focusing on skeletal muscle strength of diabetes in middle age group. It is important to evaluate muscle strength of this age group so that appropriate remedial measures can be taken as from the time of diagnosis because the physical disability or functional dependence is difficult or nearly impossible to rehabilitate later.

The present study took into account the middle aged type II diabetics because currently the greatest number of individuals affected with type II diabetics in between age group of 40-59 years. In this study, two point discrimination sensations which are provided by the dermatomes C6, C7 and C8.

C6 dermatome is for thumb, thumb which is the most important because of its relation with other digits, its mobility and force it can bring to bear, its loss can affect hand function greatly and C7 is for the middle finger, in flexion middle finger is the strongest and it is important for precision and power grip. Two point discrimination in C7 shows significant difference ($p=0.01$) among the diabetic and non-diabetic. But there was no significant difference ($p=0.95$) in two point discrimination which is provided by dermatomes of C8 that is the little finger. In terms of functional impairment there is only 10% role of little finger which is very less even in normal population (Magee, David J, 2014)

Clinical relevance

If grip strength and two point discrimination are assessed at the time of diagnosis and routine assessments are done during clinical follow up, deterioration in grip strength and development of disability in the later stage can be prevented. Preventive modalities like resistance training can be incorporated to decrease the rate of deterioration of muscle strength. Strength training from time of diagnosis will help in maintaining the insulin level. Thus it will be helpful in delaying the late musculoskeletal complications occurring in type II diabetes patients due to deterioration in muscle strength. Latest research conducted by Adrienne Visocchi et al (2010) show that handgrip exercises make blood vessels more flexible, improve blood vessel function, and lower high blood pressure. The hand exercises performed in this study significantly helped to lower systolic blood pressure but Diastolic blood pressure did not change (Cassandra Stiller-Moldovan, 2010)

Limitation of the study

1. Duration of diabetes has been taken into account from time of diagnosis however individual may have subclinical type II diabetes for many years without knowing until hyperglycaemic and neuropathic symptoms manifest thus

posing great difficulty in tracking the effect response trend between the duration of diabetes and muscle strength.

2. Study was performed on a relatively small sample size. (n=60)
3. Data collected was from a specific geographical region hence the result could not be generalized.

Future Research

1. Future research with larger sample size can be undertaken.
2. Data for two point discrimination can be generated for various cutaneous areas of the body.
3. Correlation with level of hyperglycemia affecting grip strength and sensations in type 2 diabetes.

CONCLUSION

This result of this study showed that there is difference in two point discrimination and decrease in grip strength in type II diabetes patients as compared to non-diabetics. The present study will be helpful for type II diabetics to prevent further deterioration in sensation and muscle strength.

ACKNOWLEDGEMENT

The authors are grateful to the Vice Chancellor of Jamia Hamdard for considering this research as well as clinical work for betterment to the patients. The authors wish to acknowledge patients for their supportive nature and cooperation.

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How to cite this article: Siddiqui HA, Khan SA, Aafreen et al. Early detection of sensorimotor changes in upper limb in type 2 diabetes. *Int J Health Sci Res.* 2018; 8(3):113-118.
