ROLE OF ANTIOXIDANTS AND EXERCISES THERAPY PROGRAM IN MODULATION OF HAND FUNCTIONS IN DIABETIC NEUROPATHY.

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ABSTRACT

The purpose of the study was designed to clarify the role of antioxidants and exercises therapy program on modulation of hand functions in diabetic neuropathy. In this respect, the muscles power of both flexors and extensors in wrist and fingers, the range of their motion of wrist and fingers flexion and extension and their effect of motor nerve conduction velocities and electromyography study of median nerve in both sexes. Subjects Sixty males and females were insulin dependent diabetic patients , their age ranged from 40-60years old and their weight ranged from 60-90Kg. They were randomly divided into three equal groups (G1,G2 and G3). **G1**cosists of 20 type2 insulin dependent diabetic patients of both sexes and was treated by antioxidants only without any exercises therapy program, G2 consists of 20 type1 insulin dependent diabetic patients of both sexes and was treated by exercises therapy program only without antioxidant and G3 consists of 20 type1 insulin dependent diabetic patients of both sexes and was treated by antioxidants and exercises therapy program. Vital signs as blood pressure, body temperature, pulse rate and respiratory rate were measured before and after the treatment sessions. Assessments, in all group studied, Tensiometer was used to measure the muscle power of flexors and extensors in wrist and fingers, the digital goniometer was used to investigate the range of their movement either during flexion and extension, Purdue beg board was used to measure of hand functions either prehension or counting. Moreover, by the use of standard nerve conduction velocity and electromyography (NCV-EMG) to measure motor nerve conduction velocity, AP amplitude and their latencies and compound muscle action potentials of median nerve. Statistically the results for all groups were analyzed by ANOVA to compare the differences between the three groups. The statistical package of social sciences (SPSS, version10) was used for data processing using the p-value 0.05 as a level of significance. Results, showed that there was significant improvements in all variables in G3 only. However, there was a little improvement but not significant in both G1and G2 with best results for G2 regarding to clinical and electrophysiological parameters. Therefore, it could be concluded that the use of antioxidants combined with exercises program were the good method to improve hand function, increase muscle power of flexors and extensors of wrist and fingers and the range of their movements together with determination of motor nerve conduction velocities and electromyography. Our results open a new link to manage the motor deterioration of hand function in diabetic neuropathies via the use of antioxidants combined with exercises program.

Keywords: Antioxidants , Diabetic neuropathy, nerve conduction velocity, electromyography, Tensiometer, Goniometer, Purdue beg board and range of motion.

INTRODUCTION

Diabetes mellitus is a chronic metabolic condition characterized by persistent hyperglycemia with resultant morbidity and mortality related to its micro vascular and macro vascular complications[1]. Moreover, diabetes whether of type$_1$ or type $_2$ is also associated with several musculoskeletal disorders [2] .

The hand affection occupies a point of interest in this respect and can be debilitating[3]. The incidence of hand affection in diabetes is related to disease duration not to the age or sex [4]. Diabetic hand may be represented clinically as

palmer flexor tenosynovitis [5]. Dupytren's contracture [6] , syndrome of limited joint mobility [7], carpal tunnel syndrome [8], Charcot arthropathy and [9], reflex sympathetic dystrophy [10].

Following a good glycaemic control in parallel with exercise and diet regime and drugs therapy can improves or even prevents or delays the development of these hand complications [11].Long-standing diabetes complicated with neuropathy stands for one of the major causes of morbidity across the globe [12].

It is postulated that excessive production of reactive oxygen species is a key component in the development and progression of diabetic neuropathy and other complications [13]. The dramatic increase in the incidence and prevalence of diabetes pay attention to understand properly what is known as chronic sensorimotor diabetic neuropathy, the most common and problematic of chronic diabetic complications [14].

Oxidative damage and oxidative stress are the links in the primary pathway for various pathogenic mechanisms of neuronal injury in diabetic neuropathy [15]. Antioxidants whether endogenous or exogenous can neutralize the free radicals that can do serious damage to cells and tissues which can eventually lead to most of diabetic complications [16].

Nowadays, the use of antioxidants as an adjuvant and supportive treatment in management of diabetic cases is widely spread and of increasing interest, they play an important role in controlling diabetic complications through protection against lipid per oxidation [17]. Moreover, the antioxidants can delay or prevent the oxidative stress and widely used in the hope of maintain the health [3].

Of the most commonly used antioxidants, beta carotene (a carotenoid which is a form of Vitamin A), Vitamin C, Vitamin E, and selenium [18]. Long-term effects of regular exercise are particularly advantageous for type 2 diabetic patients. It was apparent that exercise reduces visceral fat mass and body weight without decreasing lean body mass [19]. Moreover, regular exercise increases insulin sensitivity [20] .Strictly control blood glucose and blood pressure, lipid profile and reduces the cardiovascular risk [21].

So, regular physical exercises must be considered as an essential component of the proper management of type 2 diabetes mellitus [18]. In this regard, individual behavioral strategies have been documented to be effective in motivating sedentary type 2 diabetic subjects to the adoption and the maintenance of regular physical activity [14].

On the other hand, exercise is a well-recognized model of oxidative stress and also an important therapeutic tool in diabetes management. Therefore, the relationship between oxidative stress and exercise in diabetic patients implies an interesting biochemical paradox due to some of the negative effects of exercise principally by the increase of oxidative species in plasma [22] .

The effect of oxidative stress during an acute exercise and after an aerobic training period on those patients remains unknown and needs to be studied [23]. On contrary, it is well known that physical therapy exercises promote glucose uptake into skeletal muscles and makes the working muscles more sensitive to insulin [24].

In diabetic neuropathy there is contracture of wrist flexors. Contraction of these muscles does not result in reciprocal relaxation of its antagonist because of co-contraction [25]. Therefore, the patients are unable to perform isolated movements of the hand and fingers, this means that selective movements necessary for manipulative skills are impaired [26].

It is clear that, the wrist flexors contracture is a primary and obvious feature of diabetic patients [27]. A secondary involvement includes shortening of intrinsic hand musculature due to

prolonged immobilization and impaired reciprocal innervations between wrist flexors and extensors [28] .

As regard to, the principle function of the hand in grasping and manipulation objects, the position of the digits must be highly controlled prior to contraction. Moreover both position and force must be controlled when grasping complaint objects [29].

Hand exercise potentiates the blood glucose lowering effect of subcutaneously injected insulin; therefore precautions have to be taken in order to avoid hypoglycemia in insulin-dependent diabetics especially during and after more strenuous exercise [2].

In juvenile-type diabetes, physical activity can be used as an efficient therapeutic adjunct only in cooperative, well-instructed patients who are used to check their metabolic situation on a regular basis [30].

EMG has been used effectively in evaluating and following up most musculoskeletal and neurological disorders. EMG can be used to assess amplitude and onset of the supporting muscle group's activity in order to describe pattern of movement Moreover, EMG is of great helpful in study muscle activity. during gait with simultaneous and coordinated movement [25].

It is apparent that, EMG activity of the muscles performing the task before arrival of sensory feedback information from the muscles, joints and skin could modify the centrally generated movement program. These changes in neuronal activity occurred 50 to 200 m/sec before EMG activity changes and there were enough overlap of the onset of these changes [4].

Moreover, It is well known that the complementary action of balanced diet, suitable exercise regime, antioxidants as well as other important nutrients to your health program are of great beneficial effects in proper management of diabetic case [31].

Although we are provided by endogenous antioxidants [32], exogenous from food [33], it may not be enough as many foods are depleted of beneficial antioxidants
on cooking and your ability to use these antioxidants might be compromised if you have diabetes or are elderly [34].

Therefore, new strategies with classic as well as new antioxidants should be implemented in the treatment of diabetes.

In this respect, we design our study in trial to find out a synergistic effect between antioxidants and regular exercise se regime incorporating the muscles of hand to limit and control the small muscles complications of hand in diabetic patients.

SUBJECTS, MATERIAL AND METHODS

Selection criteria

Diabetic subjects were selected from the outpatient department Endocrine ,Metabolic Disorder and Neurological Rehabilitation .King Khalid hospital , Najran University. Sixty patients diagnosed type 1insulin dependent diabetes mellitus with neuropathy , they were diagnosed on laboratory and clinical bases by their own specialists , their ages ranged from 40 – 60 years , they had the same degree of impairment of motor and sensation , fasting blood glucose level >7.0mmol/dl, having pain, paraesthesia, numbness and burning sensation in limbs all patient's otherwise clinically and medically stable , they were otherwise medically fit to participate in the study according to procedure , they had sufficient cognition to understand the requirements of the study , they had no surgical interference . They had no signs of aphasia , they had sufficient vision and hearing , the patients were randomly and equally divided into three groups :**Group (1)** : Consists of 20 patients of both sexes who received antioxidants drugs only, **Group (2)** : Consists of 20 patients of both sexes who received stretching exercises of wrist and fingers , relaxation technique,

strengthening exercises of wrist and fingers and hand function exercises. Time of exercises 45 min, repetition10 times, stretching equal strengthening and rest inbetween , three times per week, day after day. **Group (3)** : Consists of 20 patients of both sexes who received antioxidants drugs and stretching exercises of wrist and fingers , relaxation technique, strengthening exercises of wrist and fingers and hand function exercises. They were subjected to the **following assessment** : Muscle tension(power) assessment , hand function (dexterity) assessment , range of motion assessment .**Inclusion criteria**: Bilateral type1 insulin dependent diabetic patients were diagnosed clinically based on the presence of at least one of the following symptoms; 1) numbness, tingling pain or paraesthesia 2) precipitation of these symptoms by repetitive hand movement 3) nocturnal awaking by such sensory symptoms confirmed by electrophysiological criteria 1) prolonged distal motor latency ≥ 4.4 ms to abductor pollicis brevis 2) prolonged distal sensory latency ≥ 1.9 ms to abductor pollicis brevis (30). Including data for at least are median nerve. **Exclusion criteria:** Severe diabetic patients ,diabetic patients having complications, psychological unstable , non co-operative patients during assessment of the research and Persons having history of diabetes up to second degree relations were excluded.

Evaluation procedures: Patient's preparation before putting EMG electrodes over the skin for each patient, it should be shaving the hair at the picking areas and cleaning it by alcohol to remove the dead layers of the skin in site of EMG electrodes (abductor pollicis brevis). **Electrodes testing procedures**: Recording surface electrode was placed on the belly of abductor pollicis brevis muscle. Ring electrode was placed on the proximal interphalangeal joint of the index or thumb for anti-dramic sensory studies. Ground electrode was placed on the level of wrist joint between stimulating and recording electrodes. Reference electrode was placed on distal interphalangeal joint. Stimulating electrode was placed at two different sites on median nerve. Distal on medial part immediately in the groove postero-medial above elbow joint (14 cm above wrist) and proximal on the median nerve above the wrist (8cm above wrist). The duration of the stimulation impulse was 0.2 ms. The latency from the stimulation site to the onset of the negative deflection of the sensory potential was determined while the anti-dramic sensory nerve conduction velocity was measured automatically by the device based on the distance between the stimulating site and the recording site. **Electrodiagnostic Test:** Nerve conduction study measures how quickly electrical impulses move along the median nerve from the wrist to the hand and fingers. Technical steps of application NCV including; electrode placement, skin temperature correction, determination of nerve stimulation intensity and analysis of the evoked neuro- electrical response . The system comprises an electronic monitor and a report generation system. The registry stores all electro physiological data including raw wave forms and limited demographic information (age, height, weight and gender). The NCV tests are typically performed by official clinical staffs that undergo training by the manufacture. The instrument and the data registry have automated quality assurance software that confirms and tracts ongoing staff competence. Each study is coded with the primary clinical indication for the evaluations.

Instrumentation: A-EMG Neuropac unit. B-Digital goniometer. C-Lafayette tensiometer. D-Purdupeg board.

Electromyography (EMG) Unit: It contains of EMG apparatus, Disposable surface EMG electrodes and Data processing computer unit. The neuro pack S1 MEC-9400K, 4 channel EMG/EP

system. Disposable and radiolucent electrodes. **Electrodes:** Vitrode F Disposable Electrodes, G210DPart No. F-150M, Adult, solid tape, 25×45 mm, 3 pcs × 50 packs/box. Vitrode V Disposable Electrodes, G272APart No. V-09OM3, Adult/Child, 3 lead, DIN, lead length 1 m, 25×45 mm, 3 colors × 30 packs/box. The electrodes were self adhesive with active surface area of 1cm2 in diameter. The electrodes consist of plastic foam material with a silver plate disc on one side and silver plate snap in the center on the other side. Early released protective sheet is placed over the electrode side to keep the electrolyte part of the disc in its position. The electrodes were connected to EMG apparatus channel.

Materials and methods : The study was carried out in King Khalid Hospital , Department of physical therapy and rehabilitation , Najran University. Sixty patients were diagnosed type-1 insulin dependent diabetic patients suffering from neuropathy , their ages ranged from 40-60years old and their weight ranged from 60-90Kg.They were randomly divided into three equal groups (G1,G2 and G3). G1 was treated by antioxidants(Vit E, C and D) only without any exercises therapy program, G2 was treated by exercises therapy program only without antioxidant The exercise training group performed aerobic training for 6 months (3 days/week , 45 min, 50-80%VO2max) and G3 was treated by antioxidants and exercises therapy program. Before and after the treatment sessions the variables metabolic control (glycaemia, HbA1c, daily insulin injected), aerobic capacity (peak Vo(2), peak power, peak heart rate), Vital signs as blood pressure, body temperature, pulse rate and respiratory rate was measured before and after the treatment sessions. All patients will be assessed by electromyography, Nerve conduction velocity, Digital goniometer for wrist and fingers range of motion, Lafayette Tensiometer and Purdue beg board for measurement of hand functions.

Detailed socio-demographic data, family history and medical history were taken from all the subjects and their physical and clinical examinations were done on very first day of the visit to physical therapy department .Informed consent was taken from each of the subjects. On the day of experiment, fasting blood glucose sample was collected and the nerve conduction study was carried out. Anthropometric measurements were taken before and after the treatment sessions, serum glucose was estimated by glucose oxidase (GOD/PAP) method and percentage of HbA1c was measured in whole blood by variant haemoglobin testing system (Bio-Rad model) using a modified HPLC method. Neurological parameters of median nerve were measured by a standard EMG machine, nerve conduction parameters were included according to the protocol recommended by San Antonio Conference on diabetic neuropathy :Motor nerve conduction velocities, action potential amplitude and latencies of median nerve were measured by standard Nerve Conduction Velocity-Electromyography(NCV-EMG) equipment . Range of motion of wrist and hand (flexion-extension) were measured by electronic goniometer(digital) .Muscle power (tension) of wrist and hand (flexors- extensors) were measured byTensiometer. Fine movements of hand (dexterity) or hand functions were measured by purduebeg board.

Statistical analysis : The results of three groups were statistically analyzed by to compare the differences within each group and between the three groups. The statistical package of social science (SPSS version 10) was used for data processing the P-value 0.05 level significance.

Data Summarized by using : The arithmetic mean average describing the central tendency of observation where The standard deviation (S.D) used to measure

to described the results around mean where Paired t-test was performed to determine the significance difference pre and post within the same group . Analysis of variance (ANOVA) was used to compare the differences between the three groups.

RESULTS

A. ***Characteristics (age, BMI) and glycaemic status of the study subjects***:

The subjects were of similar age (where P value was 0.81) and BMI (where P value was 0.87). Glycaemic status among the three groups does not show any significant differences (where P value was 0.82). Fasting serum in meter /um glucose level were found to be of the same level before the treatment program between the three groups , also HbA1c levels were found to be same, differences in HbA1and fasting serum glucose values between the groups showed no significant differences as *shown in Table (1) and Figure (1)*

Table (1*): Shows characteristics and glycaemic status of the study subjects.*

Groups	Age(years) Mean ±SD	BMI(kg/m^2 Mean ±SD	FSG (mm01/L) Mean ±SD
G1(N+20)	48.72±4.72	25.19±45.80	8.92±0.80
G2(N+20)	49.45±6.10	25.41±2.99	9.02±3.76
G3(N+20)	48.48±4.83	24.212.97	8.89±3.31

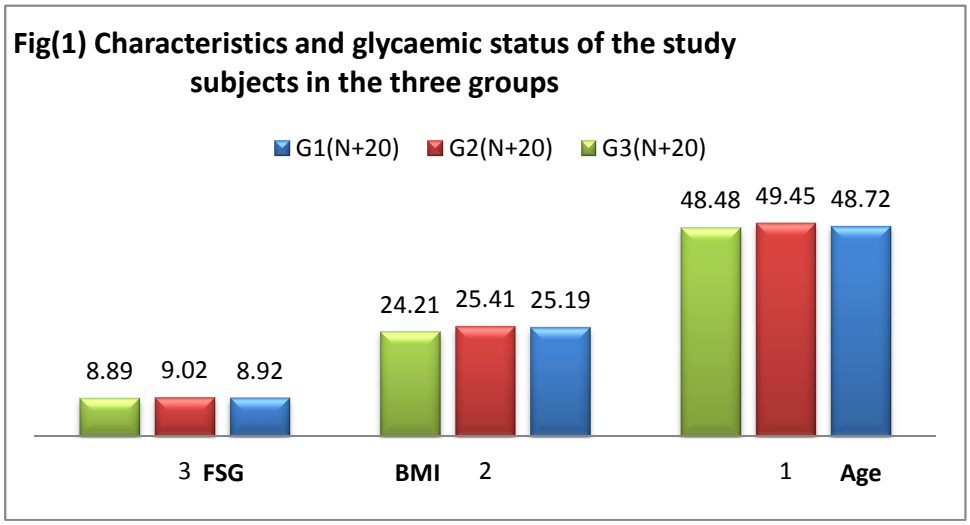
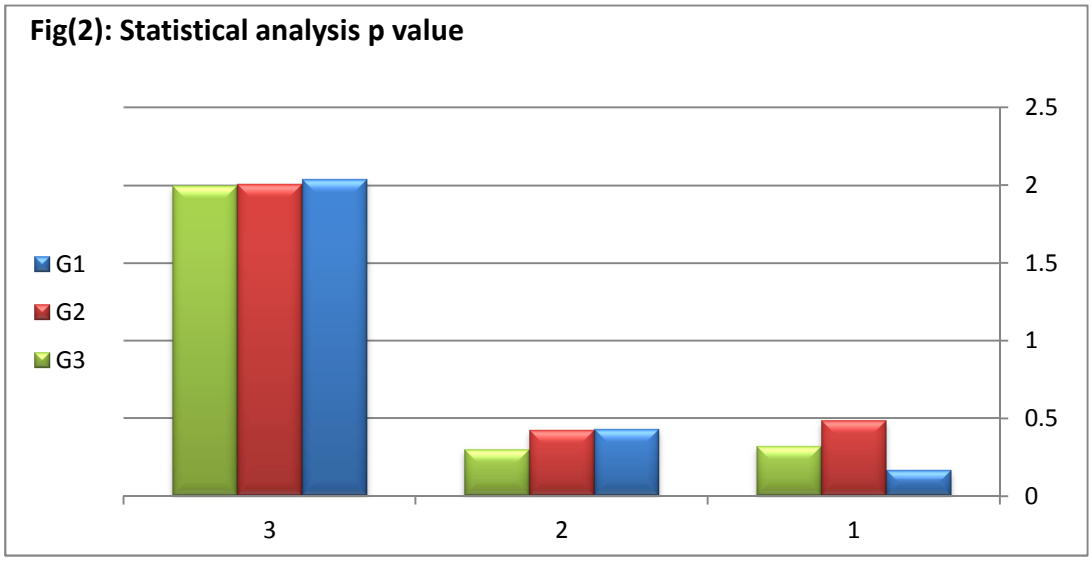


Table (2): Statistical analysis p value

G1	0.168	NS	0.430	NS	2.04	NS
G2	0.486	NS	0.424	NS	2.01	NS
G3	0.321	NS	0.300	NS	2.00	NS

G1= group1 G2= group2 G3= group3 N= Number of subjects *= Significant**
FSG= Fasting serum glucose P= probability NS= Not significant

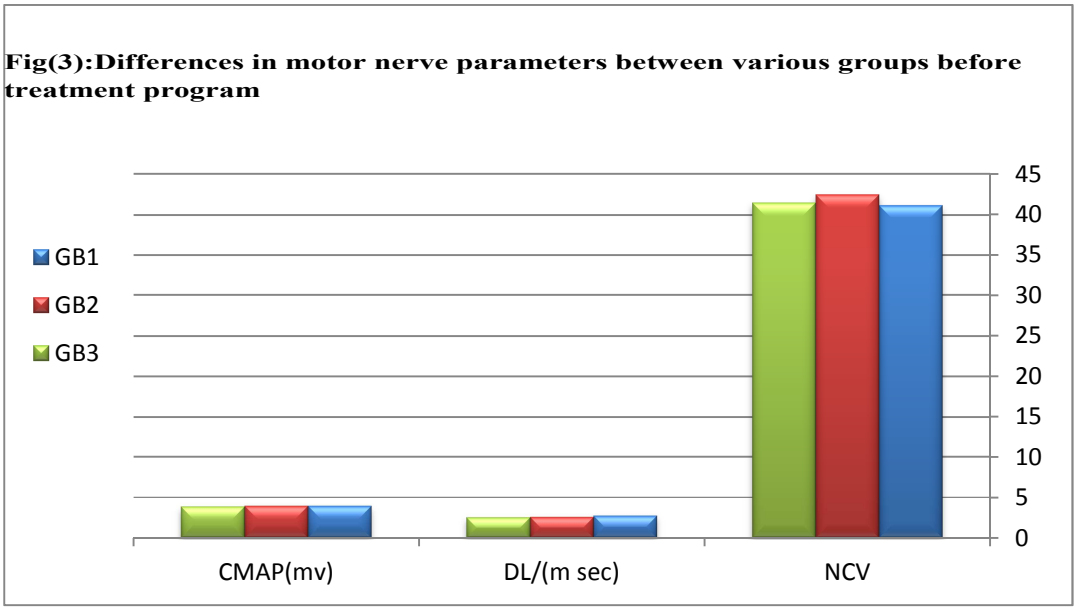


B) The results of nerve conduction parameters of motor nerves within group1, group2 and group3 before the treatment program revealed that:

There were no significant differences of nerve conduction velocity (NCV) , distal latency(DL), compound muscle action potentials (CMAP) were expressed in meter / second (m / sec),in mili second (m sec) and in mili volt (m v) respectively (where P value was 0.07,0.08 and 0.06) As shown in Table (3) and Fig (3).**Table (3):**

Shows differences of nerve conduction parameters of motor nerves between Group1, Group2 and Group3 before treatment.

Parameters	Median nerve			
	Gp1(n=20) Mean ±SD	Gp2(n=20) Mean ±SD	Gp3(n=20) Mean ±SD	P
MNCV/ (m/sec)	41.20±4.6	42.50±4.8	41.50±4.7	0.07 NS
DL/ (m sec)	2.68±1.7	2.54±1.4	2.50±1.6	0.08 NS
CMAP (mv)	3.86±2.1	3.88±2.2	3.80±2.3	0.06 NS



C) The results of patients compared between the three groups for median nerve (Motor conduction parameters namely U CMAP,P CMAP and P NCV) of the three groups pre and post the treatment program showed that:

In group1and 2 there were no significant improvements of results (where P value was 0.9), (where P value 0.7) respectively. **However in group3**: there were significant improvements of results (where P value was 0.001) as shown in Table (4) and Fig (4).

Table (4): ***Shows the differences of motor nerve conduction parameters between various groups pre and post treatment***

	Median nerve							
	NCV (m/sec) Mean ± S.D		DL (m/sec) Mean ± S.D		CMA (mv) Mean ± S.D		T	P
	Pre.	post	Pre	post	Pre	post		
G1	41.20±4.6	45.3± 4.5 NS	2.68± 1.7 NS	2.98± 1.5	3.86± 2.1 NS	4.59± 22.3	2.81	0.9
G 2	42.50± 4.8 NS	46.20±4.9	2.54± 1.4 NS	3.01± 1.6	3.88 ± 2.2 NS	4.86±2.1	19.2	o.7
G 3	41.50±4.7 <0.05*	50.8±4.8	2.50±1.6 <0.001**	3.60±1.5	3.80± 2.3 <0.001**	5.2± 2.4	7.1	0.001**

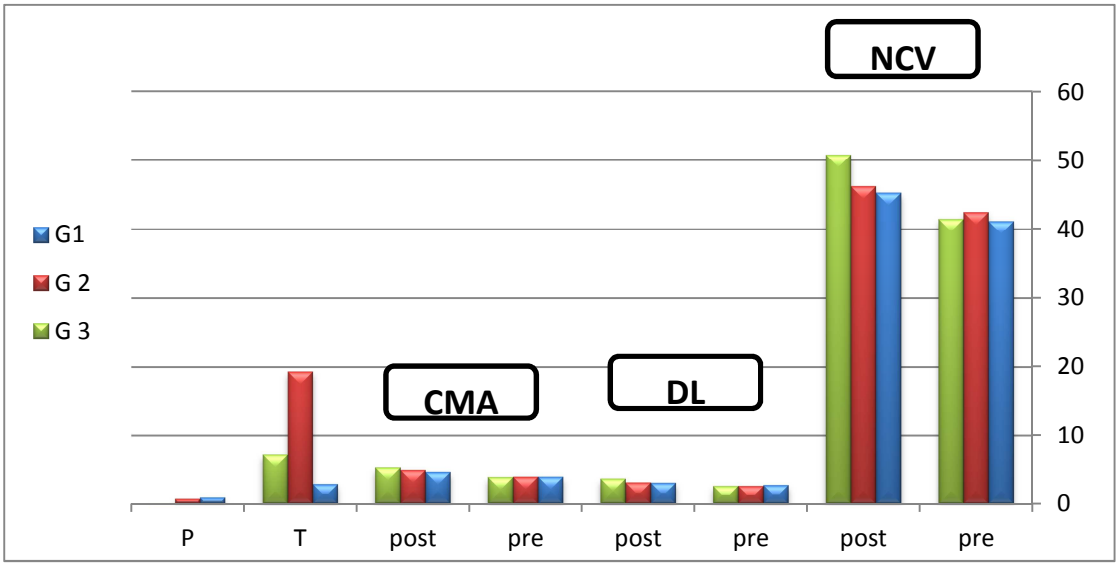


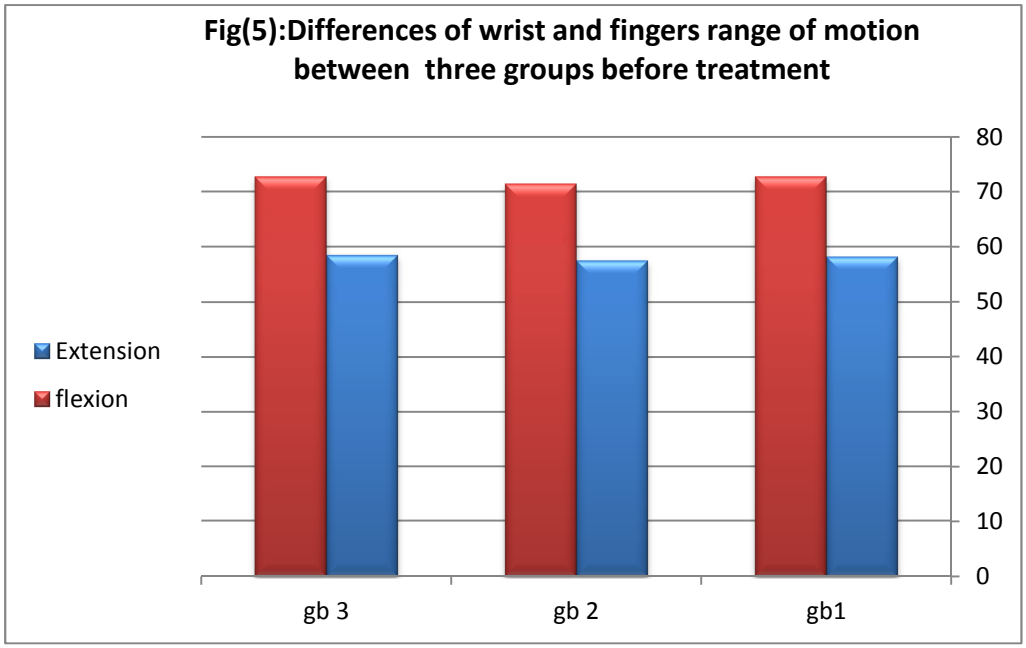
Fig (4): ***Differences of motor nerve conduction parameters between various groups pre and post treatment.***

D) ***The results of range of motion of wrist flexion and extension between the three groups before the treatment program showed that***:

There were no significant differences (where the P value was 0.08) as shown in Table (5) and Fig (5).

Table (5): ***Shows the differences of range of motion of wrist and fingers between Group1, Group2 and Group3 before treatment***:

Wrist Joint	Groups G1(n=20) Mean ±SD	G2(n=20) Mean ±SD	G3(n=20) Mean ±SD	P
Extension	58.20±3.7	57.50±3.5	58.50±3.4	0.08 NS
Flexion	72.68±4.5	71.44±4.7	72.70±4.9	0.07 NS



E) The results of patients compared between the three groups for range of motion of wrist extension of the three groups pre and post the treatment program showed that: In group1and 2 there were insignificant improvements of results (where P values was 0.09, 0.001 respectively) as shown in Table (6) and Fig (6).but in group3 there were significant improvements of results (where P value was 0.001) as shown in Table (6) and Fig (6).

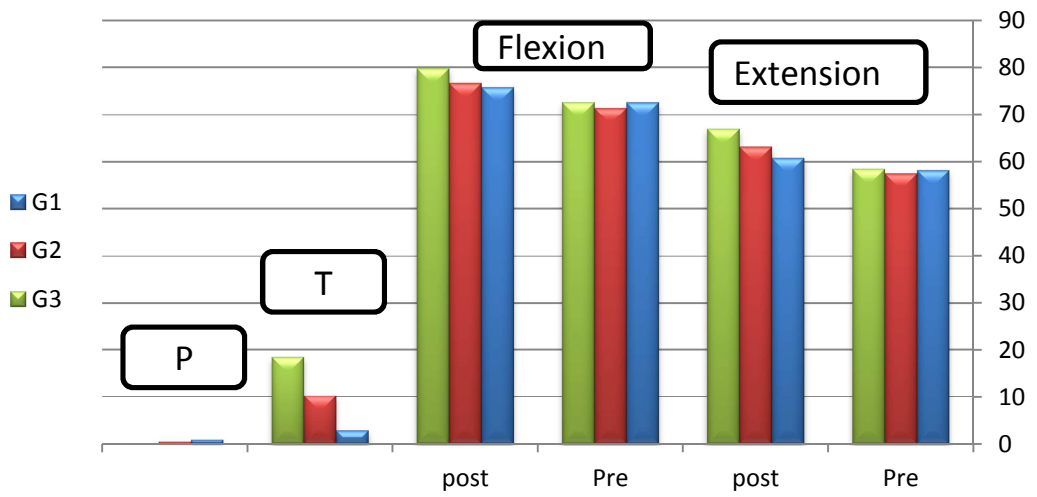
F) The results of patients compared between the three groups for range of motion of wrist flexion of the three groups pre and post the treatment program showed that:

In group1and 2 there were insignificant improvements of results (**where P values was 0.09,** 0.05 respectively). However in group3 there were significant improvements of results from (72.70) to (79.8) (where P value was 0.001) as shown in Table (5) and Fig (5).

Table (6): ***Shows the differences of wrist and fingers range of motion (flexion-extension) pre and post treatment of various groups:***

	Wrist					
	Extension Mean± SD		Flexion Mean± SD		T	P
	Pre	Post	Pre	Post		
G1	58.20±3.7	60.8± 0.9 NS	72.68± 4.5	75.8±0.8 NS	2.82	0.09 NS
G2	57.50± 3.5	63.2± 0.7 NS	71.44± 4.7	76.7±0.6N S	10.2	0.05 NS
G3	58.50±3.4	66.9± <0.001**	72.70±4.9	79.8± 0.001**	18.4	0.001**

Fig(6):Differences of wrist and fingers range of motion between various groups pre and post treatment.



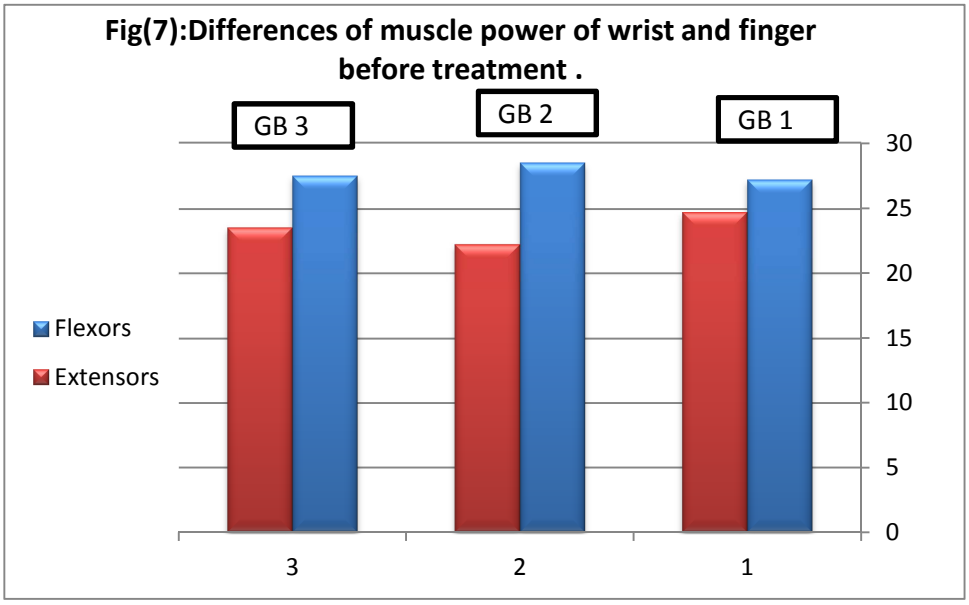
G) The results of muscle power of wrist, fingers flexors and extensors in the three groups studied before the treatment program

showed that: There were insignificant differences where the P value was 0.07, also there were in significant differences between the three groups in muscle power of wrist extensors where the P value was 0.06 as shown in Table (7) and Fig (7).

Table (7): *Shows the differences of muscle power between Group1, Group2 and Group3 before treatment*

:

	Groups			
Wrist joint	**G1(n=20) Mean ±SD**	**G2(n=20) Mean ±SD**	**G3(n=20) Mean ±SD**	**P**
Flexors	**27.20±0.5**	**28.50±0.6**	**27.50±0.7**	**0.07 NS**
Extensors	**24.68±0.6**	**25.22±0.5**	**23.50±0.6**	**0.06 NS**



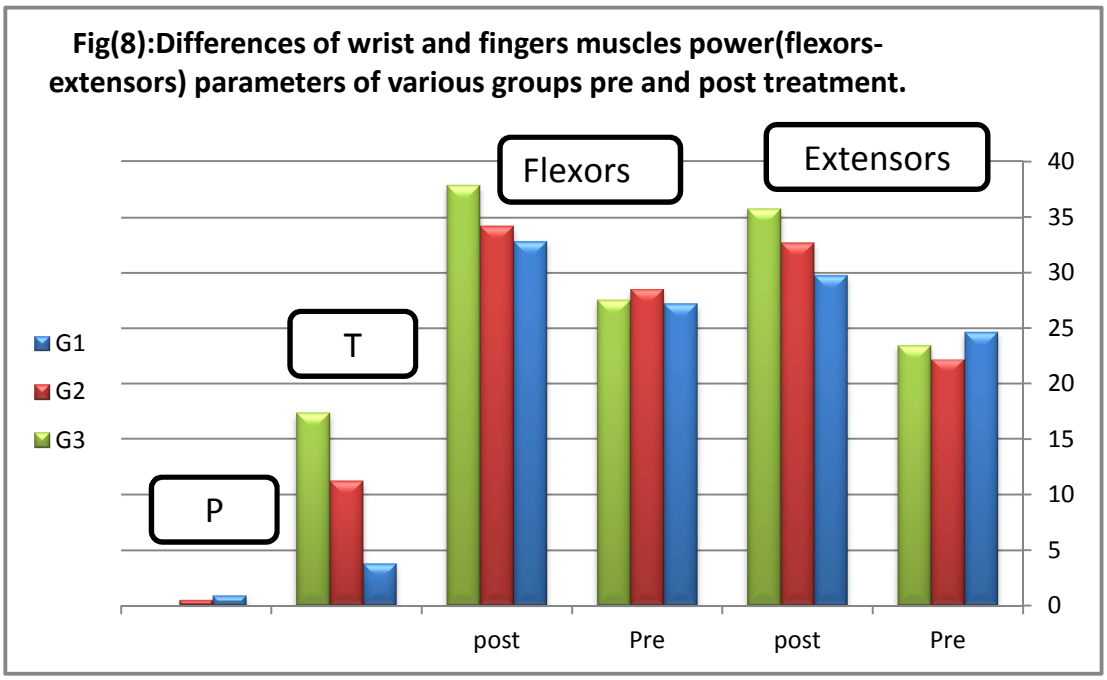
H) The results of patients compared between the three groups for muscle power of wrist and fingers extensors between the three groups pre and post the treatment program

showed that **:** In group1and 2 there were insignificant improvements of results (where P values were 0.09, 0.05respectively). However, in group3 there were significant improvements of results from (23.50) to (35.50) where P value was 0.001) as shown in table (8) and Fig (8).

I) The results of patients compared between the three groups for muscle power of wrist and fingers flexors between the three groups pre and post the treatment program showed that: In group1and 2 there were insignificant improvements of results (where P values were 0.09, 0.05respectively). However, in group3 there were significant improvements of the results from (27.50) to (37.9) .

Table (8): *It shows the differences of muscles power of wrist and fingers (flexors-extensors) pre and post treatment between various groups.*

	Muscles						
	Flexors Mean± SD		extensors Mean± SD		T	P	
	Pre	Post	Pre	post			
G1	27.20±0.5	32.8± 0.9 NS	24.68± 4.5	29.8±0.8 NS	3.84	0.09	NS
G2	28.50±0.6	34.2± 0.7 NS	25.22± 4.7	32.7±0.6NS	11.25	0.05	NS
G3	27.50±0.7	37.9± <0.001**	23.50±4.9	35.8± 0.001**	17.41	0.001**	



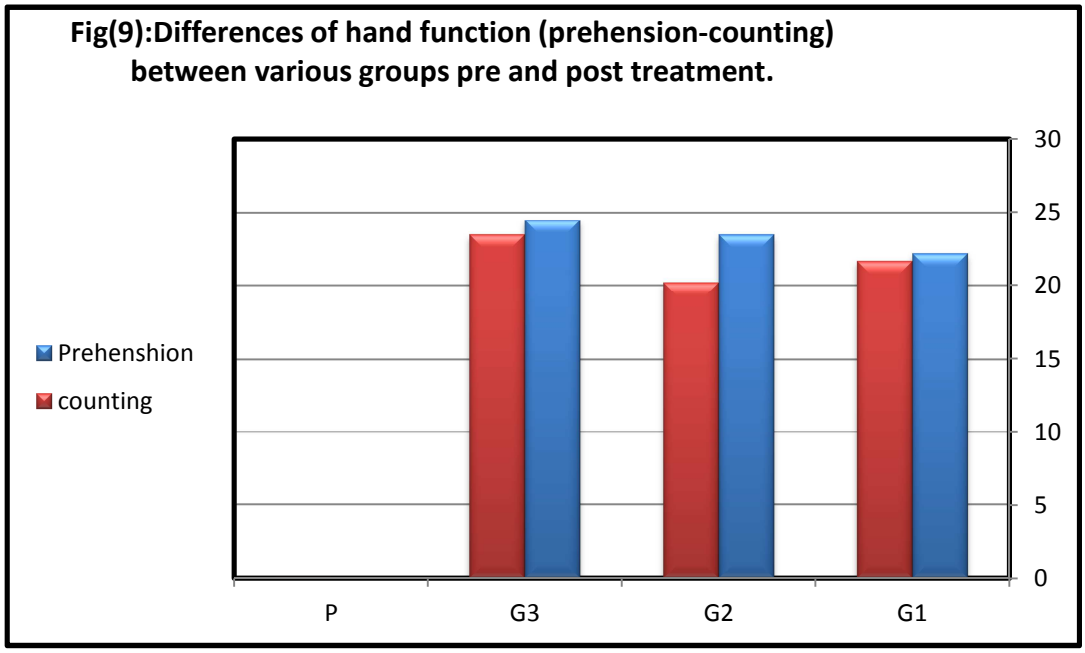
Fig(8):Differences of wrist and fingers muscles power(flexors-extensors) parameters of various groups pre and post treatment.

J) The results of hand dexterity (prehension) between the three groups before the treatment program showed that:

There were insignificant differences where the P value was 0.06. as shown in Table (8) and Fig(8). Moreover there were insignificant differences between the three groups in hand dexterity (counting) where the P value was 0.07 as shown in Table (9) and Fig(9) .

Table (9): *It shows the differences of hand dexterity between Group1, Group2 and Group3 before treatment*.

	Groups			
Dexterity	**G1(n=20) Mean ±SD**	**G2(n=20) Mean ±SD**	**G3(n=20) Mean ±SD**	**P**
Prehenshion	**22.20±0.5**	**23.50±0.6**	**24.50±0.7**	**0.06 NS**
Counting	**21.68±0.6**	**20.22±0.5**	**23.50±0.6**	**0.07 NS**

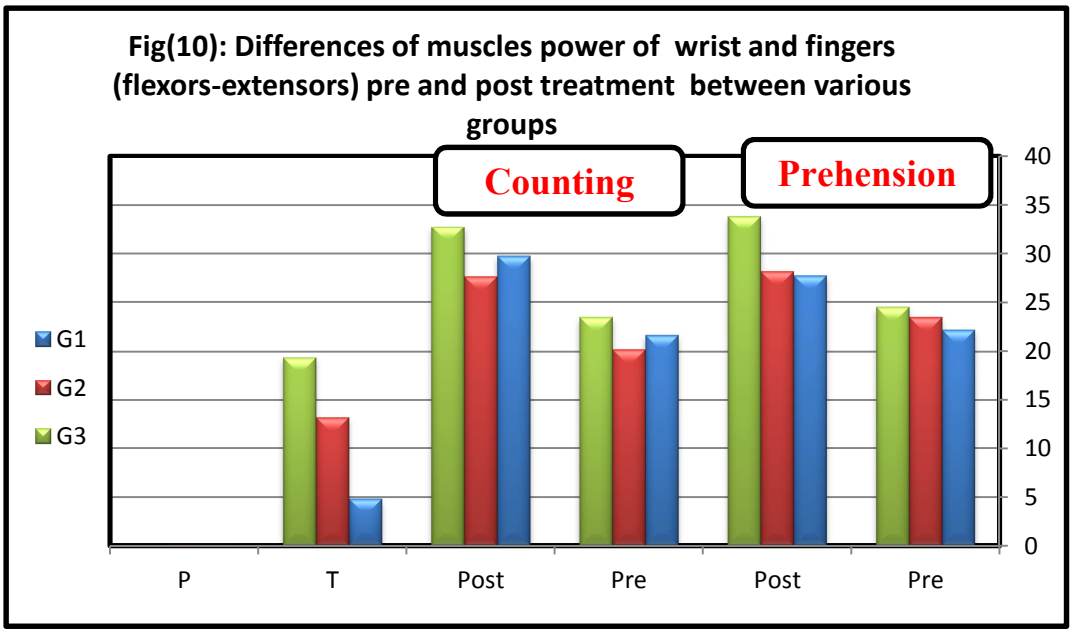


K) The results of patients compared between the three groups of hand prehension between the three groups pre and post the treatment program showed that: In group1and 2 there were insignificant improvements of results (P value was 0.06, P value 0.07 respectively). However in group3 there were significant improvements of results from (24.50) to (33.90) (where P value was 0.001) as shown in table (10) and Fig (10) .

L) The results of patients compared between the three groups of hand counting between the three groups pre and post the treatment program showed that: In group1 and 2 there were insignificant improvements of results from (where P value was 0.06, P 0.07 respectively). However in group3 there were significant differences where the improvements of results from (23.50) to (32.8) (where P value 0.001).

Table (10): ***It shows the differences of muscles power of wrist and fingers (flexors-extensors) pre and post treatment between various groups.***

	Muscles						
	Prehension Mean± SD		counting SD		Mean±	T	P
	Pre	Post	Pre	Post			
G1	22.20±0.5	27.8± 0.9 NS	21.68± 4.5	29.8±0.8 NS	4.84	0.06	NS
G2	23.50±0.6	28.2± 0.7 NS	20.22± 4.7	27.7±0.6NS	13.25	0.07	NS
G3	24.50±0.7	33.9± <0.001**	23.50±4.9	32.8± 0.001**	19.41	0.001**	



Fig(10): Differences of muscles power of wrist and fingers (flexors-extensors) pre and post treatment between various groups

DISCUSSION

The purpose of this study was to evaluate the influence of antioxidants and exercises therapy program on modulation of hand function in diabetic neuropathies patients, and the possible controlling the degree of muscle weakness , increasing range of motion of wrist joint and improving hand function. It was performed by comparing the results achieved in various groups of patients, group1 receiving antioxidants only, group2 receiving exercise program only and group3receiving antioxidants and the same exercises therapy program as group2 .

It was widely accepted that, the hand functions of diabetic patients have been related to the functions of wrist flexors muscles , the greater control weakness of wrist muscles , the more improvement of delect fine movement of the hand [19] .

In our study, we used exercises therapy techniques similar to different techniques used by [4] to improve the hand function of diabetic patients as firmed prolonged stretch to control contractures of wrist flexors muscles followed by strengthening exercises , isotonic movement and isometric contraction of the muscles to improve grasping a different objects of different size and shape.

The beneficial effect of antioxidant supplementation substances can decrease lipid peroxidation, LDL-cholesterol particles oxidation and improve endothelial function and endothelial dependent vasodilatation with improvement in the metabolic control of these patients [1].

It was found that the preparations producing prooxidant effect in vitro (α-lipoic acid and reamberin) are characterized by pronounced insulin-potentiating activity, but only slightly increase (α-lipoic acid) or even decrease (reamberin) tolerance to glucose load. 3-Hydroxypyridine derivatives (emoxipin and mexidol) producing an antioxidant effect in vitro increase glucose tolerance, but exhibit relatively weak insulin-potentiating activity [35] .

Exercises cause profound changes in glucose homeostasis for people with type 2 diabetes, aerobic exercise usually causes blood glucose concentration to drop , while anaerobic exercise may cause it to rise, thereby making glycemic control challenging, having the capacity to know

their glucose levels and the direction of change during exercise increases self-efficacy in these persons who are prone to hypo- and hyperglycemia [36].

Moreover, exercises for people with type 2 diabetes, learning first hand that regular exercise improves glucose levels may be a motivating factor in getting them to be more active. Continuous glucose monitoring is a potentially useful adjunct to diabetes management for the active person with either forms of diabetes [38] .

In this study, we postulated that, strengthening exercises improve control of muscles rapidly to overcome the weakness of wrist flexors consequently utilization of another exercise and technique which help the therapist to strength the ability of the patient to use hand function not only the power but also the hand dexterity.

Reportedly, the stretching exercises used in wrist flexors contractures and isometric exercises utilized in cases of atrophy of wrist flexors in diabetic patients [38]. The selection of stretching exercises are considered convenient to overcome the tightness of wrist flexors, as this responsible for limited range of motion and impaired function of the hand [29].

In addition, the selection of strengthening exercises of the wrist extensors in this study, conforms with the strength and flexability findings that indicate tightness of wrist flexors limiting extension, and weakness of the wrist extensors are considered one of main factors in the pathogenesis of typical pattern of wrist deformity in diabetic patients [39].

Our results in accordance with the results of [40] who attempted to clarify the effects of aging and the difference between heavy and mild exercise training on the fat and amino acid (AA) systems of streptozotocin diabetic Sprague Dawley rats in vivo.

In our study, we stated that, there were decreased triglyceride (TG) levels in the serum, liver and intraskeletal muscles in the diabetic group undergoing insulin treatment with exercise training. These results similar to the results achieved by [41] who observed, there was a clear decrease of TG in the rats subjected to exercise training and this decrease was particularly significant in the aged rats.

However, there were no significant change in the TG levels in the intra heart muscles of either the juvenile or aged rats, including the diabetic ones. Although, exercise training in the normal person produced decreases in total AA, glycogenic AA, branched chain AA and ketogenic AA, and there was no significant decrease in the TG levels in the serum[42].

Our findings agree with [43] when reported that, motor defects were common in diabetes with neuropathy and increase in frequency with the duration of the disease. Though not significant, tendency for reduction in MNCV and increase in median distal latency were observed in diabetic group . No significant changes were observed regarding these parameters between diabetic groups.

The present study also showed significant improvements in amplitude and conduction velocity in motor nerves of diabetic group3 which were more pronounced in median nerves. This findings supports the observation of [44] who mentioned that, in diabetic group the CMAP amplitude and conduction velocity were found to be variably affected in motor nerves.

Our present study were in accordance with the results of [45] who suggested that, increasing muscle strength may increase forces on the hand power and function and may contribute to increased ulceration risk via increased dexterity of fingers .

This was demonstrated through observations of [46] stated that, there was positive correlation between muscle strength of wrist and fingers and hand functions in individuals with peripheral

neuropathy as compared to aged-matched controls, these findings were important in determining that persons with limited muscle function may increase passive torque (stiffness) to increase muscle strength.

Our study agree with [47] who stated that, hand functions deficits such as decreased prehensions and counting , muscle strength and wrist range of motion seen in the diabetic peripheral neuropathy population are associated with contractures and deformities risks.

Patients with diabetic peripheral neuropathy have decreased proprioceptive input that normally plays a role in adjusting irregularities in movements and maintaining fine functions. To compensate for the sensory loss, subjects with diabetic peripheral neuropathy require increased cognitive control and increase their exercises programs and strength to improve hand functions [25].

Also, our study is in accordance with the work of [48] whom stated that, the reduced of muscle power was attributed to diminished proprioception, wrist range of motion and muscle strength in patients with diabetic peripheral neuropathy.

Similarly, the differences in hand functions to decreased wrist strength and mobility in persons with diabetic peripheral neuropathy and history of muscle atrophy[11].

Antioxidants prevent rancidity deterioration and are thought to inhibit the effects of free radicals, effective in preventing neuropathy and diabetes-related heart disease because it blocks the process by which AGEs become self-perpetuating. Clinical trials of pimagedine are currently under way and are expected to last several years [33].

Our study agree with the [49] who found that, exercise increased parameters of insulin sensitivity (GIR and plasma adiponectin) only in the absence of antioxidants in both previously untrained ($P < 0.001$) and pretrained ($P < 0.001$) individuals." Since it is a mantra repeated throughout Diabetes research that ROS are strongly associated with the damage done by diabetes to our organs. Also, the exercises were effective in reducing insulin resistance when antioxidants were present and ROS was not produced[45].

In this study , our results similar to results obtained by[24] when stated, after a 16-week of aerobic exercise program the mean A1c value significantly reduced in the exercise training group in comparison with the control group (-0.73±1.4% vs. +0.28±0.60%, $P<0.001$). No serious adverse event was observed in the training sessions. As secondary outcomes, changes of baseline parameters (fasting blood glucose, body mass index, and blood pressure) were statistically significant. The reduction of blood pressure in control group was also significant.

Moreover, our study agree with [50] who demonstrated that, there was significant increase in hand dexterity practice was observed after the 10-week program, and more importantly was maintained during the 6-month follow-up. Significant increases in aerobic capacity, muscular strength at the hand, and high-density lipoprotein cholesterol were also observed post-intervention. After the program, significant reductions in body weight, waist circumference, skin folds thickness, resting heart rate, and systolic blood pressure were reported.

Overall, a reduction in the prevalence of metabolic syndrome was measured post-intervention. Hand grip strength was measured in 1,960 patients with coronary heart disease. Other measures obtained included oxygen consumption/ unit time (peak VO2), body composition, physical function and depression [51] .

There was some hope that supplementing with these vitamins might be of some use specifically in people with diabetes after studies showed that the beta cell was uniquely vulnerable to oxidative

stress because it is poor in the production of antioxidant substances[52].

So, exercise training play a major role in the treatment of diabetes in consideration not only of serum, but also transitions of the whole body's metabolic phases, including the intra organic systems[53].

SUMMARY AND CONCLUSION

Wrist and fingers muscles weakness in diabetic neuropathies patients have been reported in literature as the most primary cause affecting range of motion of wrist joint, function and skills of wrist and hand. This study was designed to put a plane to strength the wrist muscles and the possible relation to tension of wrist flexors and extensors, range of motion of wrist joint, functional skills of wrist and hand, and power of hand through using antioxidants and exercises therapy program .

Sixty diagnosed type 2 diabetes mellitus with neuropathy patients were selecting from outpatient clinic , department of neurology, King Khalid hospital, Najran University, they were diagnosed on clinical bases by their own neurologist, their ages were ranged from 40 – 60 years , they had the same degree of impairment of motor and sensation , fasting blood glucose level >7.0mmol/dl, having pain, paraesthesia, numbness and burning sensation in limbs all patient's otherwise clinically and medically stable , they were otherwise medically fit to participate in the study according to procedure , they had sufficient cognition to understand the requirements of the study , they had no surgical interference . They had no signs of aphasia , they had sufficient vision and hearing .

The patients were randomly and equally divided into three groups : **Group (1)** : Consists of 20 patients who received antioxidants drugs only . **Group (2)** : Consists of 20 patients who received stretching exercises of wrist and fingers , relaxation technique, strengthening exercises of wrist and fingers and hand function exercises. Time of exercises 45 min ,repetition10 times, stretching equal strengthening and rest inbetween , three times per week, day after day. **Group (3)** : Consists of 20 patients who received antioxidants drugs and stretching exercises of wrist and fingers , relaxation technique, strengthening exercises of wrist and fingers and hand function exercises. They were subjected to the following assessment : range of motion of wrist flexion and extension by digital goniometer, tension of wrist flexors and extensor by tensiometer, dexterity of hand by Purdue pegboard and hand grip by dynamometer. Therapeutically, subjects in both groups received eighteen sessions (one session day after day for six months).

Results in Group 1 and 2 concerning with range of motion of wrist flexion and extension, tension of wrist flexors and extensors, hand dexterity and hand grip showed that, there were no significant improvements of all variables in performance, in comparing before treatment, post I and post II in a favor to Group II showed improvements in all variables than group1.While in groupe3 the results showed that there were significant differences in comparing pre and post treatment in all variables

RECOMMENDATION

It will be recommended to investigate the effects of both antioxidants and exercises therapy program on various pathological body parts in diabetic patients as foot or back.

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دور مضادات الأكسدة وبرنامج التمرينات العلاجية في تعديل وظائف اليد في مرضى اعتلال العصب السكري

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أستاذ مساعد بقسم العلاج الطبيعي جامعة نجران ، أستاذ دكتور بقسم وظائف الأعضاء جامعة نجران ، استشاري الأمراض العصبية والنفسية بمستشفى الملك خالد نجران.

الغرض من هذه الدراسة هو توضيح دور مضادات الأكسدة وبرنامج التمرينات العلاجية في تعديل وظائف اليد في مرضى اعتلال العصب السكري وتأثيرها على قوة عضلات فرد وثنى مفصل الرسغ والأصابع ، مدى حركة فرد وثنى الرسغ والأصابع ، وظائف اليد الدقيقة وتأثيرها على سرعة توصيل الومضات العصبية للعصب المتوسط لمفصل الرسغ مع تحليل الرسم الكهربي للعضلات في كلا الجنسين.المرضى لقد أدرج في هذه الدراسة ستون مريضا من كلا الجنسين من مرضى البول السكري المنتمين للنوع الأول المعتمدين على الأنسولين حيث تراوحت أعمارهم من ٤٠ – ٦٠سنة ، وزنهم بين ٦٠ – ٩٠كجم ٠ المجموعات قسموعشوائيا إلى ثلاث مجموعات متساوية (الأولى ،الثانية ، الثالثة) المجموعة الأولى مكونة من عشرين مريضا من مرضى البول السكري المنتمين للنوع الثاني المعتمدين على الأنسولين السكري من كلا الجنسين حيث تم علاجها بالمواد المضادة للأكسدة فقط دون أي تمارين علاجية ، المجموعة الثانية تتكون من عشرين مريضا بالبول السكري المنتمين للنوع الثاني المعتمدين على الأنسولين من كلا الجنسين حيث تم علاجهم ببرنامج التمارين العلاجية فقط دون استخدام مضادات الأكسدة ،أما المجموعة الثالثة تتكون من عشرين مريضا بالبول السكري المنتمين للنوع الثاني المعتمدين على الأنسولين من كلا الجنسين حيث تم علاجهم بكلا من المواد المضادة للأكسدة و برنامج التمرينات العلاجية. تم قياس العلامات الحيوية مثل ضغط الدم وحرارة الجسم ومعدل النبض ومعدل التنفس قبل وبعد جلسات العلاج. التقييم في كل مجموعات الدراسة ، تم استخدام جهاز توتر العضلات لقياس قوة عضلات فرد وثنى الرسغ والأصابع ، واستخدام جهاز الجونيوميتر الرقمي لقياس مدى حركة فرد وثنى مفصل الرسغ ، وجهاز قياس وظائف اليد مثل المسك أو العد. وعلاوة على ذلك ، استخدام جهاز رسم العضلات الكهربي و سرعة توصيل الومضات العصبية لقياس سرعة توصيل الومضات العصبية ورسم العضلات للعصب المتوسط لمفصل الرسغ. وقد تم تحليل النتائج إحصائيا لجميع المجموعات لمقارنة الاختلافات بين المجموعات الثلاث قبل وبعد العلاج حيث تم استخدام الحزمة الإحصائية للعلوم لمعالجة البيانات باستخدام ف قيمة ٠،٠٥ في مستوى من الأهمية. النتائج أظهرت أن هناك تحسنا ملحوظا في جميع المتغيرات ذات الدلالة الإحصائية في المجموعة الثالثة فقط. ومع ذلك كان هناك تحسن قليل ولكن ليس ذو دلالة إحصائية في كلا من المجموعة الأولى والثانية مع أن أفضل النتائج للمجموعة الثانية . ولذلك يمكن استنتاج أن استخدام مضادات الأكسدة جنبا إلى جنب مع برنامج التمرينات العلاجية كانت طريقة جيدة لتحسين وظيفة اليد ، وزيادة قوة عضلات فرد وثنى الرسغ والأصابع ، زيادة مدى حركة فرد وثنى الرسغ والأصابع ، تحسن وظائف اليد الدقيقة وتأثيرها على زيادة سرعة توصيل الومضات العصبية للعصب المتوسط مع تحسن في تحليل الرسم الكهربي للعضلات في كلا الجنسين.لذا نتائجنا فتحت نافذة جديدة لعلاج التدهور الحركي لوظائف اليد في اعتلال العصب السكري عن طريق استخدام المواد المضادة للأكسدة جنبا إلى جنب مع برنامج التمارين العلاجية الملائم.

الكلمات الدالة :مضادة الأكسدة ، الاعتلال العصبي السكري ، سرعة التوصيل العصبي ، رسم العضلات الكهربي ، التوتر العضلي ، الجونيوميتر، قياس حركات اليد الدقيقة ومدى الحركة.