Original Article

Effect of hypertension on diabetic peripheral neuropathy

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Fac Med Baghdad 2008; Vol.50, No.2
Received Oct. 2007
Accepted April.2008

Summary:

Back ground: Two groups of diabetic patients ((the first include 20 patients complaining from diabetes mellitus alone, and the second include patients that complain from both hypertension and diabetes mellitus)) were included in this study. These patients were chosen((from a large number of patients, with a proved diagnosis, that are referred to the neurophysiology unit from the department of medicine)) to be of the same age group and gender, so that any of these two factors can no longer be a source of any possible error in the results.

Patients & methods: The electrophysiological tests that were done to all of our patients include: sensory latency and sensory amplitude for the ulnar and sural nerves, also the distal motor latency, motor conduction velocity and motor amplitude for both ulnar and common peroneal nerves.

Results: The results show that the second patient group is affected more by the peripheral neuropathy and their neuropathy was widely spread and its underlying cause is the worse.

Conclusions: results indicate that hypertensive disease increase the deterioration of the peripheral nerve function in diabetic patients.

Key words :Hypertension, peripheral neuropathy

Introduction:

It has been known since long time that diabetic patients suffer from peripheral neuropathy of variable extent and severity, and that about 15 % of all patients with diabetes mellitus develop a significant degree of peripheral neuropathy [1,2] that is, most commonly, distally and symmetrically distributed. These firstly involve sensory fibers [3,4], yet other types of peripheral neuropathies might take place as mononeuropathy and entrapment neuropathy in addition to autonomic and central nervous system neuropathies [2,3,5] and also some researches showed that central neuronal segments are also involved [6]. It is proved that hypertension could, by itself, be the cause of some neuropathies [7,8,9] that when affect the peripheral nerves, the sensory fibers become the worse [10].

The electrophysiological assessment of the peripheral nerves are very important for the accurate diagnosis of peripheral neuropathy and for the determination of its distribution, severity and their possible underlying pathology [11,12].

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It is well known that the latency and conduction velocity of the response, whether sensory of motor, reflect the speed of conduction and subsequently the state of the myelin sheath, while the amplitude of the response reflects the number of the functioning axons within the tested fiber [13,14].

The aim of this study is to evaluate the effect of hypertension on the peripheral neuropathy in diabetic patients.

PATIENT AND METHOD

This study includes 40 diabetic patients with a duration of the disease ranges from seven to eleven years, divided into two groups, the first group includes 20 patients suffering from diabetes mellitus alone and are free from hypertension, while the second group includes 20 patients suffering from both hypertension and diabetes mellitus. Each group consist of ten males and ten females and all of them belong to about the same age group ((group one range from 36 to 45 years old, and group two range from 35 to 45 years old)). The diabetic patients that are included in this study were free from any other diseases that might be the cause of the neuropathy or of its aggravation. All of them were referred to the neurophysiology unit from the department of medicine after their diagnosis being proved.

To all of the patients, the purpose of the research and the nature of the neurophysiological tests that will be done were explained so that a full cooperation is obtained. All of the patients were examined in a comfortable supine position with their upper and lower limbs flexed 10 -15 ^{o} at the elbow and the knee joints respectively. The temperature of the examination room varied from 27 to 30 C^{o} ((in which the patient was kept for at least 30 minutes before being examined)).

System plus micromed EMG machine was used for the electrophysiological analysis.

For the ulnar and sural nerves, All the latency, conduction velocity and amplitude of the compound sensory action potential were measured for only the ulnar and sural nerves ((using antidromic procedure)), together with the distal motor latency, conduction velocity and amplitude of the compound motor action potential for only the ulnar and common peroneal nerves ((using orthodromic procedure)). For both of the sensory and the motor fibers, surface electrodes were used for the stimulation as well as for the recording.

for both ulnar and sural sensory fibers, and on 6 cm for both ulnar and common peroneal motor fibers. Using the Statistical Package for the Social Sciences ((SPSS)), the arithmetic mean and standard deviation of distribution of each of the parameters were calculated. The independent sample T-test program was used to get the significance level ((P – value)) for all of the parameters tested. A P-value less than 0.05 is considered significant, less than 0.001 is very significant, and more than 0.05 is non-significant.

RESULTS

The result of comparing the patients' characteristics of the two groups with each other regarding the age, gender, body temperature, fasting blood sugar and mean blood pressure, together with the level of significance are shown in Table ((1)).

The results of assessment of the neurophysiological parameters for the sensory nerve fibers, together with their level of significance are shown in Figures (1) and (2). The results of assessment of the neurophysiological parameters for the motor nerve fibers, together with their level of significance are shown in Figures (3) and (4).

Table ((1))
The result of comparison of different non-neurophysiological characteristics between the two patient groups with their level of significance

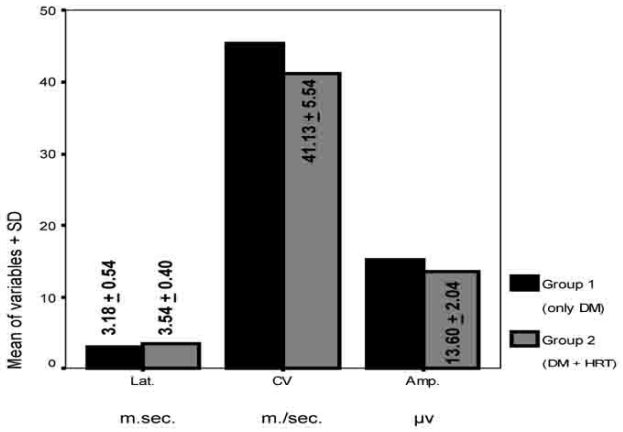
Patient group / Parameter ((mean ± SD))	Group one ((20 patient))	Group two ((20 patient))	Level of significance
Age ((years ± SD))	40.70 ± 2.72	39.50 ± 2.95	NS
Gender	10 males 10 females	10 males 10 females	NS
Body temp. ((C^{o} ± SD))	37.12 ± 0.21	37.03 ± 0.17	NS
Fasting Blood Sugar((mg/dl ± SD))	174.40 ± 18.09	163 ± 16.42	NS
Mean Blood Pressure((mmHg ± SD))	100.43 ± 4.37	117.87 ± 6.51	HS
Duration of the … DM **… HRT** ((year ± SD))	8.13 ± 0.84	8.80 ± 1.23 4.48 ± 1.04	NS

C^{o} = degree centigrade, DM = Diabetes Mellitus, HRT = Hypertension

mmHg = millimeter mercury, mg/dl = milligram per deciliter

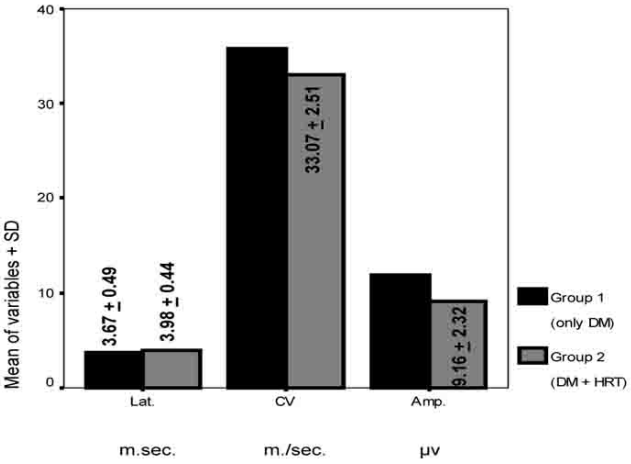
HS = Highly significant, NS = non significant, SD = Standard deviation

Figure ((1))
The result of comparison of different ulnar nerve sensory parameters between the two patient groups



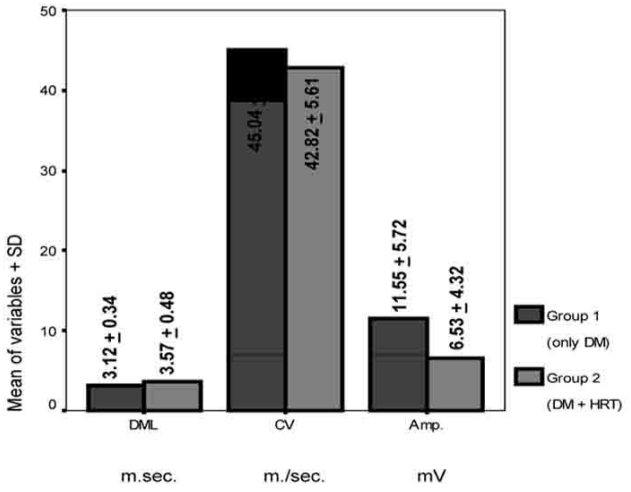
All of the sensory latency ((Lat.)), sensory conduction velocity ((CV)) and sensory amplitude ((Amp.)) are significantly ((P-value < 0.05)) changed ((Lat. decreased and CV and Amp. Both decreased)) in the second patient group when compared with the first one.

Figure ((2))
The result of comparison of different sural nerve sensory parameters between the two patient groups



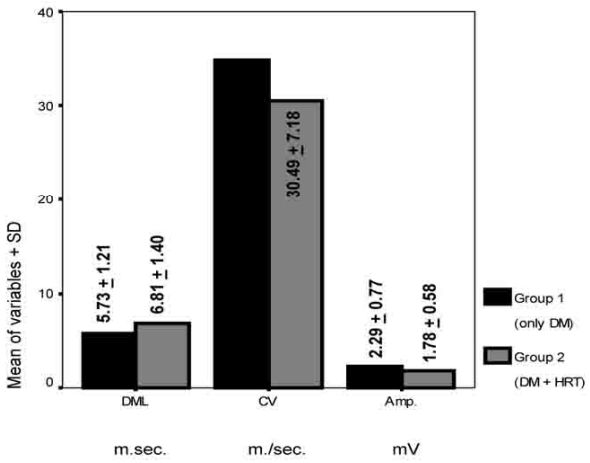
Both the sensory latency ((Lat.)) and conduction velocity ((CV)) are significantly ((P-value < 0.05)) changed ((Lat. prolonged and CV decreased)), while the sensory amplitude ((Amp.)) is highly significantly ((P-value < 0.001)) decreased in the second patient group when compared with the first one.

Figure ((3))
The result of comparison of different ulnar nerve motor parameters between the two patient groups



Both the distal motor latency ((Lat.)) and motor amplitude ((Amp.)) are significantly ((P-value < 0.05)) changed ((the Lat. Prolonged and the Amp. Decreased)), while the motor conduction velocity ((CV)) shows no any significant change ((P-value > 0.05)).

Figure ((4))
The result of comparison of different common peroneal nerve motor parameters between the two patient groups



All of the distal motor latency ((Lat.)), motor conduction velocity ((CV)) and motor amplitude ((Amp.)) are significantly ((P-value < 0.05)) changed ((the Lat. Prolonged, the CV and Amp. Both decreased)) in the second patient group when compared with the first one.

Discussion:

The diabetic patients that are included in this study were chosen to be free from any other diseases that might be the cause of the neuropathy or of its aggravation [14,15] which is so vital for the accuracy of the results. The patients in the two groups tested were selected to fall within the same age group and were of similar gender and their temperature were within normal levels, also the duration of the diabetes mellitus diagnosis is about the same, as shown in Table ((1)), so any possible neurophysiological changes seen in this study, they will be hardly due to any of these factors [5,17].

The nerve fibers that were investigated included the sensory fibers of the ulnar and sural nerves and the motor fibers of the ulnar and common peroneal nerves so that any possible interference by entrapment neuropathy that commonly involve median and posterior tibial nerves [18], as this type of neuropathy is so common in diabetic patients [19].

As the distal segments of the peripheral nerves are the first to be affected in diabetic patients [3], so only the traditional sensory and motor nerve conduction parameters were tested. Of these parameters, the latency and conduction velocity determine the state of myelination in the distal and proximal nerve segments while the amplitude reflects the number of the still participating axons [14,19,20,21].

In addition to what is mentioned above, Table ((1)) shows a highly significant increment in the mean blood pressure in the second patient group [22,23].

Figure ((1)) shows that there is a statistically significant change in all of the tested sensory parameters of the ulnar nerve when comparing the results of the first and second groups together. Also, Figure ((2)) shows same significance regarding the sensory latency and conduction velocity of the sural nerve and a highly significant change in the sensory amplitude. The absence of a significant change in the motor conduction velocity of the ulnar nerve as shown in Figure ((3)) indicate that the involvement of the common peroneal nerve is more than that of the ulnar nerve, a finding greatly strengthen by the results of many other scientists, such as Karsidag et al., 2005 [24] who reported that peroneal nerve was affected in 83.3% of diabetic patients while ulnar nerve was affected only in 63.3%. Also, this finding goes with the general role that longer nerves are affected more with neuropathy [25, 26]. The above findings indicate that hypertension could significantly deteriorate diabetic peripheral neuropathy and that both axonal degeneration and demyelination are affected. Such findings greatly supported by Tesfaye et al., 2005 who stated that hypertension is among some other factors is significantly associated with the cumulative incidence of neuropathy [8]. Other researchers proved that diabetic neuropathy is associated with risk factors for macrovascular disease, as hypertension, and that good blood pressure control may be helpful in preventing or delaying the onset of distal symmetrical peripheral neuropathy is diabetic patients [27,28]. Also, Sibal et al, (2006) reported that people who developed neuropathy have higher systolic blood pressure than those who remained free of neuropathy [7]. At the same time some studies showed that cardiovascular risk factors such as hypertension and some types of neuropathy are often coexist, and therefore hypertensive disease may be a cofactor in the development of such neuropathies [9,29].

From all these results we conclude that good control of patient blood pressure is so vital in ameliorating peripheral neuropathy in diabetic patients and that chronic hypertensive patients should have their peripheral nerves electrophysiologically checked regularly.

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