



ELECTRONEUROGRAPHY OF RIGHT MEDIAN AND ULNAR NERVES IN DIABETIC PATIENTS WITH AND WITHOUT RETINOPATHY

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ABSTRACT

In this study we examined motor and sensory conduction velocities in right median and ulnar nerves in diabetic patients. Control group consisted of 25 healthy volunteers (13 males) with average age of 52 years. The first examined group consisted of 25 diabetic patients (13 males) without retinal changes, 59,6 years old on average, and the second group consisted of 40 patients (15 males) 59,4 years old on average: 22 of them with type 1, and 18 with type 2 retinal changes. The motor and sensory conduction velocities in right median nerve in the control group were significantly higher than those measured in the first group ($p < 0,0005$ for motor; and $p = 0,0027$ for sensory velocity), and the second group ($p < 0,0001$ for motor; and $p = 0,0001$ for sensory velocity). Significantly higher conduction velocities in sensory median nerve were compared between the examined groups ($p < 0,001$), but motor conduction velocity was not significantly higher ($p = 0,09$). The motor conduction velocity in ulnar nerve in the control group was significantly higher in comparison with the patients of first ($p = 0,0027$) and second examined group ($p = 0,0001$). The sensory conduction velocity in ulnar nerve was not significantly higher compared with the first ($p = 0,081$), and significantly higher compared with the second examined group ($p < 0,0001$). The sensory conduction velocity of ulnar nerve was significantly higher ($p = 0,019$) in diabetic patients without retinopathy compared with patients with retinopathy.

Diabetic patients with retinal changes have higher risk of developing more severe neurophysiologic signs of neuropathy. So, simple observation with ophthalmoscope may be useful diagnostic tool in its determination and may be the target of further therapeutic strategy.

KEY WORDS: diabetic neuropathy, diabetic retinopathy, n.medianus, n.ulnaris, motoric and sensory velocity

INTRODUCTION

Diabetes mellitus (DM) is metabolic disorder with numerous and serious complications. Basic metabolic disorder in this disease is breach in tissue oxygenation, which is very important factor for the appearance and progression of microangiopathy (1). Autonomous nervous system and peripheral nervous system (PNS) are included as one of four main DM complications together with retinopathy, nephropathy and vascular disease (2). In diabetic neuropathy metabolic mechanisms cause neural degeneration with regeneration problems, especially in tiny myelinic fibers, as opposed to microvascular changes that are essential in diabetic retinopathy (3). Therefore, the time, importance and microangiopathy stadium are controversial in diabetic neuropathy development. There is no generally accepted standard definition of diabetic neuropathy or even diagnostic criteria. Therefore, the prevalence among diabetics is ranges from 0% to 93% (4, 5). Electrophysiological criteria are basic in its evaluation. Diabetic retinopathy is ocular manifestation of this systemic disease, being the primary cause of blindness at the age from 20 to 65 years in United States (6). The basic changes are in pre-capillary and capillary vascular net. Usual vascular changes include microvascular occlusion with increased vascular. According to histopathological changes in diabetic retinopathy there are three stadiums:

1. unproliferative diabetic retinopathy
2. praeproliferative diabetic retinopathy
3. proliferative diabetic retinopathy (7).

In one study, diabetic retinopathy prevalence was 39,9% with 5,4% in proliferative diabetic retinopathy (8). In Chinese study on 219 diabetics, retinopathy prevalence was 24%, neuropathy 23,5% (9) with obvious time of disease and glicaeamic control. Research results of Schmid et al. showed connection between cardiovascular autonomic neuropathy with diabetic retinopathy. There are too many studies that separately target diabetic retinopathy and neuropathy, but there are less studies that target the connections between these two diseases. Therefore the aim of this study is to understand this problem.

AIMS OF STUDY

The first aim was to evaluate right n. medianus and n. ulnaris motoric and sensory velocities in diabetic patients with and without retinopathy and to compare the results with those in the control group of healthy patients. The second aim was to analyze correlation

in neurophysiological parameters between the diabetics without retinopathy and diabetics with retinopathy.

MATERIAL AND METHODS

This study was realized at the Neurophysiological and Ophthalmological Departments in Public Health Service Tuzla from January 2005 to December 2006. The control group consisted of 25 healthy patients (13 males) 52 years old on average free of diabetes mellitus and clinical signs of neuropathy. Based on ophthalmological examinations two groups of patients were formed without consideration of diabetes mellitus type or neuropathy symptoms. The first examined group included 25 patients (13 males) without retinal changes 59,6 years old on average suffering from diabetes for $8,2 \pm 4,8$ years. The second examined group included 40 patients (15 males) 59,4 years of average age suffering from diabetes for $12,5 \pm 5,5$ years: 22 with type I and 18 with type II retinopathy. The type of retinopathy was diagnosed at Ophthalmology Department Public Health Service Tuzla following ophthalmoscopic examination. The patients in the control group were not ophthalmologically examined. All patients were electroneurologically (ENG) tested. Electroneurological evaluation was conducted at room temperature and physiological skin temperature in resting position. EMNG apparatus Medelec Synergy (EMNG and EP Systems-OXFORD INSTRUMENTS 2004) was used for neurograph parameters evaluation. Superficial stimulated and bipolar registration electrodes were used (Large touchproof). Measurement of n. medianus motor conduction velocity was done with n. medianus stimulation in wrist and elbow with m. abductor pollicis brevis registration. N. medianus sensory velocity was measured with n. medianus stimulation in wrist and in connection between the first and second phalanges of the second finger. N. ulnaris motoric speed was measured with wrist and elbow stimulation and with m.abductor pollicis brevis registration. N. ulnaris sensory speed was measured with wrist stimulation and registration in place of the first and second phalanges connection. Therefore, in ENG analysis, sensory velocity in wrist and motor velocity in upper hand was registered in meter per seconds (m/s) from the primary place of sensory nerve action potential (SNAP) and complex motoric action potential (CMAP) to isoelectric line after so called stimulation artifact. Stimulation with registration of motoric and sensory response was done until increased amplitude was stopped (CMAP and SNAP). If there was no response in sensory reaction velocity evaluation was accepted as 0 m/s. Standard statistical

MOTORIC NERVE	Control	Without retinopathy	With retinopathy
N. MEDIANUS			
Speed (m/sec)	56,8	51,9	49,4
SD	3,7	5,4	6,0
N.ULNARIS			
Speed (m/sec)	53,5	49,7	46,2
SD	3,0	5,0	8,6

TABLE 1. Mean values of motoric velocity in right n. medianus and n. ulnaris in the control group and diabetic patients, with and without retinopathy

parameters were used: statistic means, standard deviation with t-test, χ^2 -test and linear correlation analysis.

RESULTS AND DISCUSSION

It was expected that patients with retinopathy have longer history of diabetes mellitus, in comparison with the diabetic patients without it considering the fact that the period of suffering from the disease is one of the risk factors for neuropathy and retinopathy. The quoted published results show that patients with diabetes mellitus type 1 develop retinopathy after ten years as well as almost 60% of patients with diabetes mellitus type 2. The duration of the disease is probably the strongest factor in the prediction of development and progression of retinopathy. Among patients suffering from diabetes mellitus for shorter period prevalence of retinopathy any type was 8% for three years, 25% for 5 years, 60% for ten years and 80% for 15 years (11).

The patients with diabetes mellitus have lower motoric and sensory velocity in n. medianus and n.ulnaris compared with healthy persons (Table 1 and 2).

Results from literature show: diabetic neuropathy is the second most common cause of PNS damage following the traumatic neuropathy (12).

It is obvious that the decrease in motoric and sensory velocity is the greatest in patients with retinopathy. Therefore it is logical to assume that among various risk factors for diabetic neuropathy development, retinopathy is one of the most important, much more than

SPEED	Control / Without retinopathy	Control/ With retinopathy	Without retinopathy/ With retinopathy
MOTORIC	p	p	p
n.medianus	<0,0005	<0,0001	0,09
n.ulnaris	0,0027	0,0001	0,06
SENSORY	p	p	p
n.medianus	0,0005	<0,0001	<0,0001
n.ulnaris	0,081	<0,0001	0,019

TABLE 3. Important difference in motoric and sensory velocity in n.medianus and n. ulnaris in the control group and diabetic patients, with and without retinopathy

SENSORY NERVE	Control	Without retinopathy	With retinopathy
N. MEDIANUS			
Speed (m/sec)	49,8	45,1	30,1
SD	3,8	4,8	16,3
N.ULNARIS			
Speed (m/sec)	47,2	43,2	36,7
SD	3,8	10,1	11

TABLE 2. Mean values of sensory velocity in right n. medianus and n. ulnaris in the control group and diabetic patients, with and without retinopathy

nephropathy for example. As many as 8 patients in the group with retinopathy (5 with type I and 3 with type II) had no n. medianus sensory response. It means that if ENG shows lack of n. medianus sensory response, these patients already have retinal changes. Two patients in the group with retinopathy, and one without retinopathy could not obtain n. ulnaris sensory response. Statistically, motoric and sensory velocities are much higher in n.medianus, motoric velocity in n. ulnaris in the control group comparing with diabetics group without retinopathy. Comparing control group with retinopathy group showed that both measured velocities (motoric and sensory) of the two nerves were significantly higher. Diabetic patients with retinopathy have significantly lower sensory velocity comparing with patients without retinopathy (Table 3).

Correlative analyze of diabetes disease treatment period in patients with and without retinopathy shows weak expecting negative connection motoric speed velocity of n. medianus in patients without retinopathy and motoric and sensory speed velocity n. medianus in patients with retinopathy (Table 4).

Analysis of the group of patients with retinopathy and comparison with the groups with type I and type II changes in retina did not show significant change in motoric and sensory velocity in n.medianus and n.

PATIENTS WITHOUT RETINOPATHY

DOB/ MOTORIC SPEED	Correlation coefficient (r)
n.medianus	-0,282
n.ulnaris	-0,071
DOB/ SENSORY SPEED	
n.medianus	0,147
n.ulnaris	0,186

PATIENTS WITH RETINOPATHY

DOB/ MOTORIC SPEED	Correlation coefficient (r)
n.medianus	-0,204
n.ulnaris	0,076
DOB/ SENSORY SPEED	
n.medianus	-0,246
n.ulnaris	-0,071

TABLE 4. Correlation between the duration of treatment in diabetes mellitus and motoric and sensory velocity in right n. medianus and n. ulnaris in patients with and without retinopathy

MOTORIC NERVE	Type I	Type II	p
N. MEDIANUS			
Speed (m/sec)	49,5	49,3	0,905
SD	6,2	5,9	
N.ULNARIS			
Speed (m/sec)	47,25	45	0,414
SD	4,3	12	

TABLE 5. Mean values and motoric velocity in n. medianus and n. ulnaris in diabetic patients with retinopathy correlated with types of changes in eye fundus.

ulnaris (Table 5 and 6). There was no significant difference between patients without sensory reaction n. medianus in different retinopathy types ($p=0,205$). Although study on larger sample is necessary, it is evident that retinal examination (retinoscopy) may be simple, fast and useful diagnostic procedure and

SENSORY NERVE	Type I	Type II	p
N. MEDIANUS			
Speed (m/sec)	29,15	31,25	0,690
SD	17,5	15,1	
N.ULNARIS			
Speed (m/sec)	35,8	37,7	0,587
SD	10,5	11,9	

TABLE 6. Mean values and sensory velocity in right n. medianus and n. ulnaris in diabetic patients with retinopathy correlated with types of changes in eye fundus.

therapeutical approach to retinopathy and neuropathy as well. Simple, fast and almost painless procedure of evaluation in motoric and sensory conduction velocity in one hand may provide information about peripheral nervous system and diabetics' retina. All this facts may be important in diagnostic and therapeutic strategy.

CONCLUSION

- ◇ Motoric and sensory conduction velocity in n. medianus and n. ulnaris in diabetes mellitus patients are lower in patients with retinal changes.
- ◇ Retinal changes in diabetes mellitus patients may indicate existence of neuropathy as well.
- ◇ If it is impossible to get n. medianus sensory potential in the patient with diabetes mellitus the retinal changes already exist.

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