Gender Differences in Biochemical and Electroneurographic Parameters of Median and Ulnar Nerve

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1. INTRODUCTION

The first component of the metabolic syndrome (MSy) is central obesity defined by waist circumference, associated with at least two of the four following parameters: elevated triglycerides (TGL) decreased HDL cholesterol, elevated blood pressure and elevated fasting glycemia.

There are evidences that the incidence of MSy and its distribution in its components in men and women differ. Studies of the working population in Spain indicate prevalence of MSy 11.5% among men and 4.1% among women with an increase in old age, and it actually varies in the different professions (1). Among persons in adulthood in Turkey MSy was present in 26.9% of respondents, from which 31.3% of women and 21.7% of men (2). About the possible consequences of this syndrome speaks the fact that in patients with acute ischemic syndromes MS was found even at 70.2% women and 52.6% of men (3).

Even in adolescence age, accumulation of intra-abdominal adipose tissue may start the development of MSy, involving metabolic and inflammatory component, which has a serious impact on blood pressure in men, which can be added to increased sympathetic activity also seen only in men (4). Overweight and obesity are strongly associated with MSy, and obesity has a stronger association with the insulin resistance risk in women (5).

There is an inverse association of adiponectin levels and insulin resistance. Subclinical inflammation is present in MSy with evidence of a difference in

Key words: metabolic syndrome, median nerve, ulnar nerve, motor velocity, sensory velocity.

ABSTRACT

Introduction: In this article are demonstrated differences in the aspects of the metabolic syndrome (MSy) between genders, as well as the association of MSy and neuropathy. The aim: The aim of our study was that in patients with newly discovered metabolic syndrome of both sexes make comparison of fasting blood glucose levels and after oral glucose tolerance test, as well as neurophysiological parameters of n.medianus and n.ulnaris. Patients and methods: All participants were examined dermatologically. The analysis included the 36 male and 36 female respondents with a newly discovered MSy. Results: The average age of men was 52.75±7.5 (40-65) years and women 52.1±7.7 (38-67) years. The average value of fasting blood glucose in women was 5.86±0.87 (4.5-6) mmol/L, and non significantly higher in men (p=0.0969) as 6.19±0.8 (4.7-8) mmol/L. Average values of blood sugar 120 minutes after oral glucose tolerance test were not significantly different (p=0.7052), and was 5.41±1.63 (3.3-9.7) mmol/L in women and 5.27±1.52 (2.7-9.8) mmol/L in men. Median motor velocity were significantly higher in women for n.medianus on the left (p=0.0024), n.ulnaris on the right (p=0.0001) and n.ulnaris on the right side (p=0.0293), and the median motor terminal latency were significantly longer in n.ulnaris on the left (p=0.0034) and n.ulnaris on the right side (p=0.011). Conclusion: The results indicate that there are differences in neurophysiological parameters of the investigated nerves between the genders, and that tested nerve structures in the course of MSy are affected slightly more in men. There were no significant differences in skin changes between genders.

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the level and expression of various inflammation-sensitive biomarkers between genders. For example, in non-diabetic population, smoking combined with decreased levels of adiponectin, increased levels of high sensitive C-reactive protein (hs-CRP) and higher levels of receptor antagonists of interleukin-1 (IL-1Ra) in women (6, 7, 8).

In persons with acute ischemic syndromes and MSy men had more frequently increase in the concentration of TGL, and women decrease in the concentration of cholesterol–high density lipoprotein (HDL–C) (5). As a confirmation of a genetic predisposition in women according to the increase risk for low HDL–C, dyslipidemia and MSy alleles are associated with the apolipoprotein A5 gene (APOA5), namely APOA5 SNPs (9). According to a study performed in Sweden, women with MSy had higher Body Mass Index (BMI) and levels of C-reactive protein, and have a better chance to meet criteria for waist-hips ratio, and among them was more prevalent the syndrome characterized by obesity and low grade inflammation (10).

There is a great interest in the role of free radicals and oxidative stress in the pathogenesis of MSy. Studies in Japan have shown that cellular antioxidant enzymes as glutathione peroxidase 1 (GPX1) play a central role in controlling an oxygen reactive species and GPX1 polymorphism (Pro198Leu) is associated with MSy in men but not in women (11).

Metabolic syndrome is, in fact, often present in patients with neuropathy, and with impaired glucose tolerance (IGT–impaired glucose tolerance) and normal glucose tolerance (NGT–normal glucose tolerance) compared with the prevalence in the general population (12). It is known that polyneuropathy of longer nerves is frequent complication of diabetes mellitus. However, intermittent hyperglycemia or insulin resistance associated with prediabetes may be sufficient to damage the distal parts of the nerves. Preferred small non myelinated nerve damage suggests the existence of prominent neuropathy pain, predominantly sensory impairment and early autonomic dysfunction (13).

Studies, therefore, confirm some differences in the gender aspects of MSy, as well as the association of MSy and neuropathy, but relatively few of them deals with this syndrome and electroneurography parameters in differences between genders. Therefore, the aim of our research is, to at least partially, to attempt to explain this problem.

The research goal is to examine in patients with newly discovered metabolic syndrome of both sexes comparable levels of fasting blood glucose levels and after the glucose tolerance test, as well as neurophysiological parameters of median and ulnar nerves.

2. PATIENTS AND METHODS

The analysis included 36 respondents of both sexes with a newly discovered MSy. The average age of men was 52.75 ± 7.5 (40–65) years and women 52.1 ± 7.7 (38–67) years. Eleven female and 9 male respondents had symptoms of sensory neuropathy in the hand. For all patients with MSy was determined the fasting level of glucose in the blood and oral glucose tolerance test (OGTT).

Neurophysiological tests were performed at room temperature, and the “physiological” temperature of the skin of the respondents lying on the back. For the measurement of parameters is used neurography EMNG machine Medelec Synergy (EMG and EP Systems OXFORD INSTRUMENTS 2004). Used was the superficial stimulating and registration bipolar (also called large touch proof) electrodes. Sensory conduction velocity in median and ulnar nerve was measured by stimulating the wrist and registration on thenar and hypotenar, precisely at 6 cm proximal from the registration electrodes on the stomach abductor pollicis brevis muscle for median nerve and m. adductor digiti minimi for ulnar nerve. Proximal measurement for both nerves was done in the area just above the elbow. In electroneurography (ENG) processing were analyzed the sensory nerve conducting velocity (from stimulus artifact to the primary deflection on isolectric line) with an amplitude of sensory nerve action potential (SNAP), terminal motor latency of median and ulnar nerve on both sides with the highest amplitude of a complex motor action potential (CMAP) measured from the center of the primary divergence at isolectric line after stimulus artifact to the final return to the isolectric line. Stimulation in the determination of motor and sensory responses was performed until stop of the CMAP and SNAP amplitudes increase.

Levels of blood glucose and glucose tolerance after 120 min. are presented by the mean value with standard deviation, and in statistical analysis of differences of these parameters between genders we were using the Student’s T test and chi square test. In the statistical analysis of neurophysiological parameters were assessed median values by the non-parametric Mann-Whitney U test, and differences at level of p<0.05 were considered as statistically significant.

3. RESULTS

The mean value of blood glucose in women was 5.86±0.87 (4.5 to 8) mmol/L, and not significantly higher in men (p=0.0969) with 6.19±0.8 (4.0.7 to 8) mmol/L. Most of the 27 female and 20 male subjects had glucose levels within the standard range (3.9 to 6.1 mmol/L), while values above this range had 9 women and 16 men, which was significantly different distribution by gender (p=0.0189).

Mean values of blood sugar after 120 minutes at the oral glucose tolerance test were not significantly different (p=0.7052), and was 5.41±1.63 (3.3 to 9.7) mmol/L in women.
and 5.27±1.52 (2.7-9.8) mmol/L in male. By 23 persons of both sexes had a blood glucose within a standard, 8 women and 9 men above, and 5 women and 4 men below the standard range, so there were no significant differences in the distribution of these values among groups (p=0.8348).

Parameters of motor and sensory electroneurography analysis in n. medianus and n. ulnaris of males and females with metabolic syndrome are shown in Tables 1-4. Median velocity of motor conductivity tends to have higher values in women, while the terminal motor latency was lower.

Statistical analysis showed that the medians of the motor velocity n. medianus on the left, n. ulnaris on the left and n. ulnaris on the right side were significantly higher in women, while the terminal motor latency was lower.

Table 1. Parameters of motor neurography analysis of n. medianus and n. ulnaris of 36 female respondents with metabolic syndrome. TML: terminal motor latency

| Motor velocity (m/s) | Median | Percentile (25-75) | Min. | Max. |
|----------------------|--------|--------------------|------|------|
| Lt. n.medianus | 57.95 | 55.60-61.35 | 51.6 | 66.8 |
| Rt. n.medianus | 57.20 | 53.75-59.70 | 48.0 | 65.3 |
| Lt. n.ulnaris | 53.20 | 51.00-55.70 | 46.6 | 63.2 |
| Rt. n.ulnaris | 55.85 | 53.65-58.025 | 50.0 | 63.4 |
| Motor latency (msec) | Median | Percentile (25-75) | Min. | Max. |
|----------------------|--------|--------------------|------|------|
| Lt. n.medianus | 3.4 | 3.15-3.67 | 2.6 | 4.9 |
| Rt. n.medianus | 3.27 | 2.85-3.66 | 2.6 | 5.8 |
| Lt. n.ulnaris | 2.75 | 2.4075-3.0125 | 2.1 | 3.7 |
| Rt. n.ulnaris | 2.65 | 2.3675-3.1 | 1.9 | 3.75 |

Table 2. Parameters of motor neurography analysis of n. medianus and n. ulnaris of 36 male respondents with metabolic syndrome. TML: terminal motor latency

| Motor velocity (m/s) | Median | Percentile (25-75) | Min. | Max. |
|----------------------|--------|--------------------|------|------|
| Lt. n.medianus | 54.6 | 51.325-58.825 | 44.0 | 62.9 |
| Rt. n.medianus | 55.6 | 52.05-58.0 | 34.0 | 62.4 |
| Lt. n.ulnaris | 50.9 | 48.05-53.975 | 32.4 | 61.3 |
| Rt. n.ulnaris | 52.8 | 50.7-58.7 | 46.8 | 61.5 |
| Motor latency (msec) | Median | Percentile (25-75) | Min. | Max. |
|----------------------|--------|--------------------|------|------|
| Lt. n.medianus | 3.55 | 3.35-3.912 | 2.85 | 4.9 |
| Rt. n.medianus | 3.525 | 3.2375-3.825 | 2.6 | 5.2 |
| Lt. n.ulnaris | 2.925 | 2.8-3.05 | 2.3 | 3.65 |
| Rt. n.ulnaris | 3.05 | 2.7-3.25 | 2.05 | 4.1 |

Table 3. Parameters of sensory neurography analysis of n. medianus and n. ulnaris of 36 female respondents with metabolic syndrome. SNAP: sensory nerve action potential

| Sensory velocity (m/s) | Median | Percentile (25-75) | Min. | Max. |
|-----------------------|--------|--------------------|------|------|
| Lt. n.medianus | 49.45 | 45.975-53.8 | 0 | 57.7 |
| Rt. n.medianus | 49.1 | 43.675-52.225 | 0 | 58.9 |
| Lt. n.ulnaris | 48.9 | 45.2-51.45 | 39.7 | 54.9 |
| Rt. n.ulnaris | 49.05 | 46.475-51.025 | 41.5 | 56.2 |

Table 4. Parameters of sensory neurography analysis of n. medianus and n. ulnaris of 36 male respondents with metabolic syndrome. TML: terminal motor latency

| Motor latency (msec) | Median | Percentile (25-75) | Min. | Max. |
|----------------------|--------|--------------------|------|------|
| Lt. n.medianus | 3.5 | 3.35-3.912 | 2.85 | 4.9 |
| Rt. n.medianus | 3.525 | 3.2375-3.825 | 2.6 | 5.2 |
| Lt. n.ulnaris | 2.925 | 2.8-3.05 | 2.3 | 3.65 |
| Rt. n.ulnaris | 3.05 | 2.7-3.25 | 2.05 | 4.1 |

Table 5. Significance of differences in motor conduction velocity of n. medianus and n. ulnaris of the male and female respondents with metabolic syndrome. TML: terminal motor latency

| MOTOR NERVE | PARAMETER | p |
|-------------|-----------|---|
| Lt. n.medianus | Velocity | 0.0024 |
| Rt. n.medianus | Velocity | 0.0085 |
| Lt. n.ulnaris | Velocity | 0.0001 |
| Rt. n.ulnaris | Velocity | 0.0029 |

4. DISCUSSION

From our results it is clear that there are no significant differences in age of occurrence and diagnosis of metabolic syndrome between the male and female respondents. According to a study by Zaliūnas and associates (2008) on patients with acute ischemic syndrome, women with metabolic syndrome...
were significantly older than men (68.1 compared to 60.2 year of age) (3).

Although in our study, we have a higher percentage of men with glucose levels above the reference values, however, there are no differences in blood glucose levels between the sexes 120 minutes after oral glucose tolerance test. There are interesting researches that, for example, a low level of total testosterone and sex hormone binding globulin (SHBG) are independent risk factor for developing metabolic syndrome and diabetes mellitus in middle-aged men. So hyperandrogenism is an early marker for insulin disorders and glucose metabolism, which can progress to metabolic syndrome or the risk of diabetes and may contribute to pathogenesis. However, in a study of individuals in late adolescence and early adult age, it was noted that among male respondents there is more obesity, have higher rates of hypertension and hypertriglyceridemia than women, but all cases of glucose intolerance were registered among men (15).

Men and women showed differences in neurophysiological parameters of n. medianus and n. ulnaris. Median values of motor conductivity velocity in our study were generally lower and terminal motor latency of n. ulnaris on both sides are significantly longer and the amplitude of the highest tip of the sensory responses were significantly higher in n. medianus on the left and n. ulnaris left among women, suggesting that the tested neural structure during the metabolic syndrome are slightly more pronounced in men.

5. CONCLUSION

Motor velocity of n. medianus on the left, n. ulnaris on the left and n. ulnaris on the right side are significantly higher, terminal motor latency of n. ulnaris on both sides are significantly longer and the amplitude of the highest tip of the sensory responses were significantly higher in n. medianus on the left and n. ulnaris left among women, suggesting that the tested neural structure during the metabolic syndrome are slightly more pronounced in men.

CONFLICT OF INTEREST: NONE DECLARED.

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