Diagnostics algorithm of diabetic polyneuropathy in prediction of clinical course

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ABSTRACT

Aim: to estimate the importance of new algorithm introducing of PDP diagnostics in practice of NEFU medical institute Clinic in detection of severity level and predicting of clinical course.

Materials and methods: 50 people with sensory-motor PDP form among patients with 2 type diabetes were examined on the basis of Clinic of NEFU medical institute. Patients have been divided into 2 groups by disease duration: the first groups were patients with duration of disease till 10 years, the second group – more than 10 years. Diagnostics methods: clinical neurologic, neurophysiological.

Results: patients underwent polymodal sensitivity analysis, computer pallesteziometry, stabilometry, electroneuromyography. The dependence of clinical neurophysiological PDP parametres from severity of the duration of type 2 diabetes has been revealed.

Conclusion: thus, dependence of clinical-neurophysiological parametres of PDP severity from the duration of 2 type diabetes has been revealed. The new algorithm raised efficacy of clinical-neurophysiological PDP diagnostics and helped the predicting of the clinical course.

Key words: diabetic polyneuropathy, diagnostics, computer pallestesiometry, stabilometrics, electroneuromyography.

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INTRODUCTION

Prevalence of diabetes mellitus (DM) all over the world last years has compounded 2,8 %. By 2030 the quantity of patients with DM will reach 366 million persons (4,4 % of the general population) [1]. In Russia for the last 15 years the number of patients with DM has reached 2-4 % of population in some regions [2]. Approximately 30-60 % of patients with DM develop peripheric diabetic polyneuropathy (PDP)[3]. Distal symmetric polyneuropathy is most often met PDP form and compounds 75 % of all diabetic neuropathy [4], 30 % of patients with DM are diagnosed with it in-patient department and 25% of the patients are observed it in out-patient department [5, 6].

Among neurophysiological methods of PDP diagnostics the most significant are electroneuromyography (ENMG) and computer pallestesiometry [7-12] which allow to verify degree and character of affection of peripheral nerves and also to estimate efficacy of therapeutic treatment.

In 2012-2013 new advanced algorithm of polyneuropathy diagnostics with modern highly informative neurophysiological methods, including computer pallestesiometry, stabilometrics, ENMG was developed on the basis of the neurologic centre of University clinic in Krasnoyarsk state medical university (Krasnoyarsk) together with colleagues from the North-Eastern federal university (Yakutsk) and scientific Centre of neurology (Moscow) [7, 9-12]. **Aim:** to estimate the importance of new algorithm introducing PDP diagnostics in practice of NEFU medical institute Clinic for severity level detection and predicting of clinical course.

MATERIALS AND METHODS

Clinical-laboratory researches were made on the basis of Clinic of medical institute of «The North-Eastern federal university named after M.K.Ammosov» (Yakutsk) from January till April, 2015 within the partner complex researches with employees of Krasnoyarsk state medical university named after Prof. V.F.Voino-Yasenetsky (Krasnoyarsk) with the topic: «Epidemiological, genetic and neurophysiologic aspects of diseases of the nervous system (central, peripheral and vegetative) and preventive medicine» (rregistration 0120.0807480). The object of research was a group of patients with PDP with 2 type DM. All patients passed careful preliminary anamnestic and clinical selection which was carried out by stratified randomization method with the use of criteria of incorporation and exception, developed according to the purpose and problems of the present research.

The volume of neurophysiological examination included computer pallestesiometry, stabilometrics, ENMG. Computer pallestesiometry was made on domestic diagnostic equipment "Vibrotester-MBN" VT-02-1 with the use of the original device for mount "Vibrotester-MBN" VT-02-1 (patent №83906 in 6/27/2009) [2, 9]; stabilometrics – by means of diagnostic platform "Mera" (Moscow) in Romberg's posture by European variant of feet installation in 2 phases: with opened (OE) and closed (CE)

eyes [13]; stimulation ENMG – on device "Neirosoft" (Ivanovo), including research of speed impulses by motor fibers (SI) and SI by sensitive fibers (SIs) of median, fibular and tibial nerves.

The critical level of tests' importance has been defined at $p \leq 0,05$. Statistical processing of results was made by means of applied programs packages Statistica 7.0 (StatSoft, USA). Statistical data processing and interpretation of the received results considered modern international requirements to representation of results of statistical analysis in articles and dissertations.

RESULTS AND DISCUSSION

The clinical characteristic of patients with PDP

In total 50 persons with 2 type DM at the age from 36 till 77 years old, median age – 57 [50,75; 64] years old. All examined patients have been divided into 2 groups depending on 2 type DM duration: the first group – patients with duration of disease till 10 years; the second group – patients with duration of disease over 10 years.

The 1st group included 27 patients, median age of 56 years old [50; 61], males – 8 (29,6 %), females – 19 (70,4 %); the 2d group – 23 patients, median age of 62 years old [55; 66], males – 5 (21,7 %) and females – 18 (78,3 %) . Prevailed persons of the Yakut ethnic group: in the 1st group – 81,5 %; in the 2 group – 74 %. The median age of a debut has compounded in the 1st group – 50 years old [42; 56], in the 2d group – 40 years old [35; 50] (*p=0,003*). In the 1st group there were 6 people (22,2 %), in the 2d group – 13 people (31,6 %) (*p <0,001*) had physical inability.

Insulin in the 1st group was received by 13 people (48,1 %), in 2 group – 17 people (73,9 %); peroral hypoglycemia drugs – the 1st group – 14 people (51,9 %), and in the 2d group – 6 people (26,1 %). Level of glycemia on empty stomach in the 1st group has compounded 8,6 [6,98; 12] mmol/l and in the 2d group – 9,1 [7; 11,6] mmol/l (*p=0,94*). Level of glycemia haemoglobin was 7,3 [6,1; 8,7] and 7,3 [6,7; 9,7] (in the 1st and 2d groups accordingly) *(p=0,72)*.

The sensitive disorders of polyneurotic type dominated in clinical PDP pattern, paresthesia were most often marked (in the 1st group –74,1 %, in the 2d group – 82,6 %) and hyperesthesia (55,6 % and 78,3 % accordingly). Tactile sensitivity has been reduced among 22 (81,5 %) patients of the 1st group and 23 (100 %) patients of the 2d group. Muscle strength decrease in the 1st group has been revealed in 1 patient (3,7 %), in the second –2 (8,6 %). Thus, patients with PDP mainly were noted sensitive neuropathy type, more expressed in the 2d group of the examined. Vegetative PDP manifestations were revealed in 1/3 patients.

Computer pallestesiometry

The comparison of indexes of vibrating sensitivity from outside anklebones and styloid processes among PDP patients with reference corridors norms for healthy volunteers of middle age has given the data testifying the vibrating sensitivity damage that was caused by development of demyelination of thick myelinated fibres Aβ type of peripheral nerves (fig. 1-2).

The comparative analysis of pallestesiometry results from outside anklebones has revealed that patients suffering from DM for more than 10 years, statistically significant increase of corridor borders in all investigated frequencies that testified damage progressing of vibrating sensitivity has been noticed. At the same time the similar analysis of pallestesiometry results didn't have statistically different distinctions from styloid processes that could be a cause of later involving of nerves of the upper extremities.

Stabilometrics

The pressure centre position in frontal plane was not displaced, in sagittal – was displaced forward (anteropulsion) by stabilometrics results in both examined groups. Indexes of speed of pressure centre displacement did not exceed standard sizes as a whole. The statokineziogram area in both groups exceeded standard sizes in both phases of research that was caused by presence of

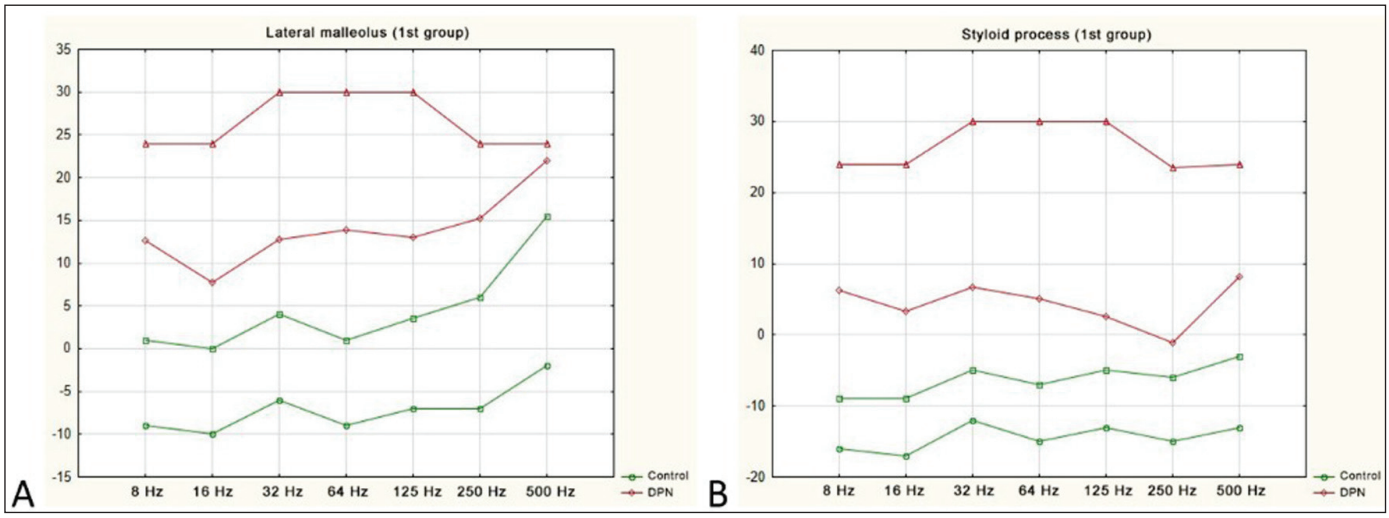

Fig. 1. esults of computer pallestesiometry among PDP patients of the1st group in distal departments of the lower and upper extremities (A - outside anklebone, B – styloid process) in comparison with control (red line– patients with chronic inflammatory demyelinated polyneuropathy; green line– healthy volunteers).

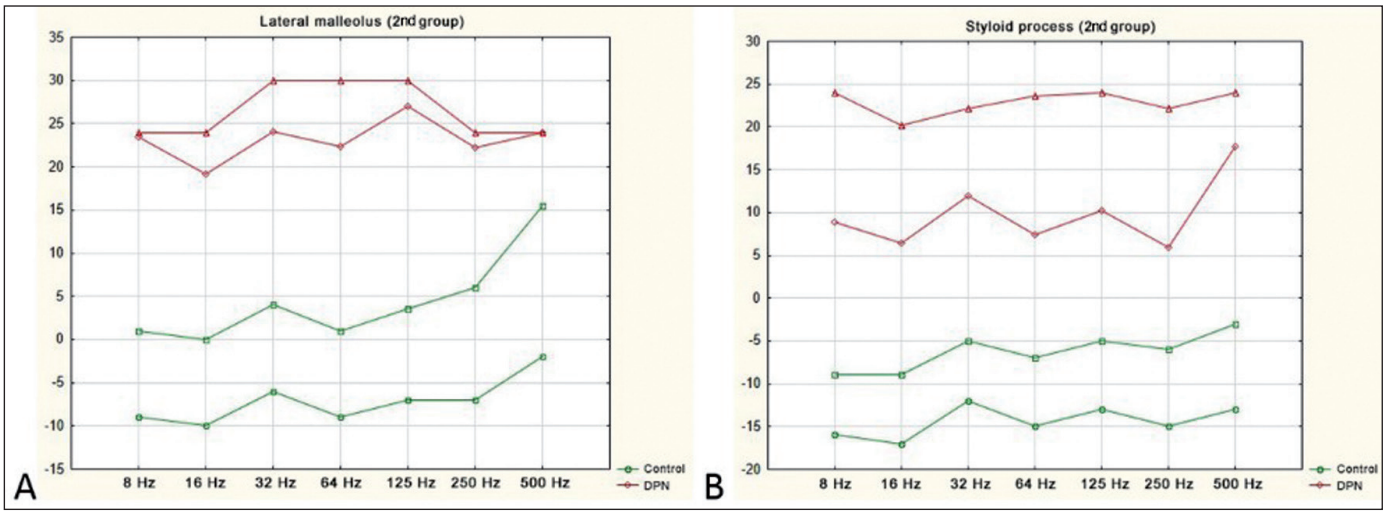

Fig. 2. Results of computer pallestesiometry among PDP patients of the 2dgroup in distal departments of the lower and upper extremities (A - outside anklebone, B – styloid process) in comparison with control (red line– patients with chronic inflammatory demyelinated polyneuropathy; green line– healthy volunteers).

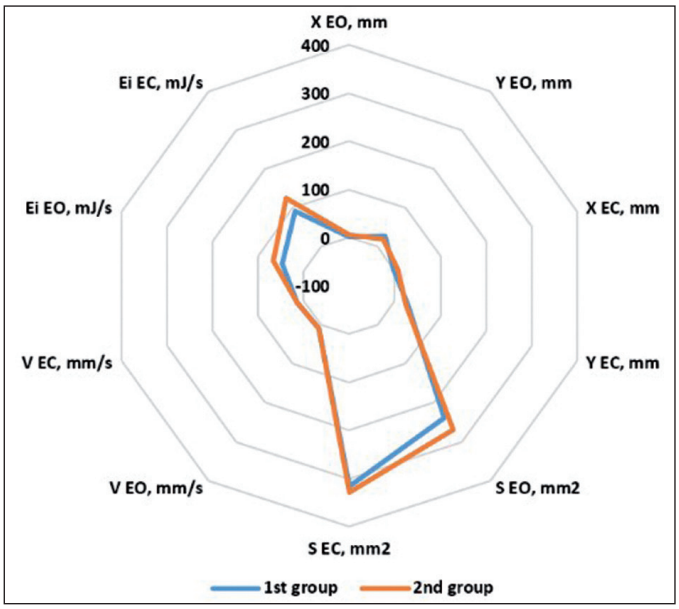

Fig. 3. Indexes of stabilogrammas with PDP in two examined groups in comparison with standard indexes.

patients with DM of both cortical and sensitive ataxia. Power inputs exceeded standard values in both phases of research, especially among patients of the 2d group. However statistically significant distinctions between two examined groups has not been revealed by all stabilometric indexes during research.

Notations: X – centre position of pressure centre in frontal plane; Y – centre position of pressure centre in sagittal plane; S – statokineziogram area; Ei – power index; V – speed of pressure centre moving per 1 sec; QR –Romberg's quotient; OE – data for a phase with open eyes; CE –data for a phase with close eyes.

Stimulation electroneuromyography

The signs of axoanalis – demyelinated affection in both groups were revealed in research of motor and sensitive fibers of median nerves and demyelinated changes have been expressed in the 2d group in a greater degree. The analyses of motor fibers of fibular nerves also revealed presence of axoanalis – demyelinated affection in both groups, however the big expressiveness of both axoanalis and demyelinated changes was marked in the2d group. Similar changes, but to a lesser degree, were observed and in sensitive fibers of fibular nerves. The axoanalis – demyelinated affections were found in motor and sensitive fibers of tibial nerves according to ENMG, more expressed among patients of the 2d group (tab. 1).

CONCLUSION

Computer pallestesiometry and ENM allow to estimate objectively degree of affection of nerve fibrils and their character among patients with PDP. There is time connection between expressiveness of changes and duration of disease and pathological changes are more expressed in peripheral nerves of the lower extremities. Stabilometrics elicits the fact of postural damages and their character, estimates involving degree of proprioceptive evaluator reflecting affection of thick myelinated fibres of the lower extremities in PDP. The received results of neurophysiological researches were co-ordinated with increase of neurologic semiology while carrying out polymodal research of sensitivity. Thus, the offered algorithm of PDP diagnostics can be more widely used for PDP objectification and assessments of its severity degree.

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Table I. Results of stimulation ENMG

	1st group (n=27)	2nd group (n=23)	p-value
Median nerves, motor fibers			
Motor nerve action potential			
Normal	18 (66.7%)	18 (78.3%)	< 0.001*
Some to half	8 (29.6%)	5 (21.7%)	
More than half	1 (3.7%)	-	
Motor nerve conduction velocity on the segment "wrist-elbow"			
Normal	20 (74.1%)	11 (47.8%)	0.09
Some to half	7 (25.9%)	12 (52.2%)	
More than half	-	-	
Motor nerve conduction velocity on the segment "elbow- the lower third of the shoulder"			
Normal	21 (77.8%)	12 (52.2%)	< 0.001*
Some to half	5 (18.5%)	11 (47.8%)	
More than half	1 (3.7%)	-	
Median nerves, sensory fibers			
Sensory nerve action potential			
Normal	21 (77.8%)	16 (69.6%)	< 0.001*
Some to half	-	-	
More than half	6 (22.2%)	7 (30.4%)	
Sensory nerve conduction velocity on the wrist			
Normal	15 (55.6%)	4 (17.4%)	0.13
Some to half	7 (25.9%)	14 (60.9%)	
More than half	5 (18.5%)	5 (21.7%)	
Peroneal nerves, motor fibers			
Motor nerve action potential			
Normal	11 (40.7%)	-	0.07
Some to half	8 (29.6%)	7 (30.4%)	
More than half	8 (29.6%)	16 (69.6%)	
Motor nerve conduction velocity on the segment "tarsus-head of the fibula"			
Normal	25 (92.6%)	11 (47.8%)	< 0.001*
Some to half	2 (7.4%)	10 (43.5%)	
More than half	-	2 (8.7%)	
Motor nerve conduction velocity on the segment "head of the fibula-the lower third of the thing"			
Normal	22 (81.5%)	10 (43.5%)	< 0.001*
Some to half	4 (14.8%)	11 (47.8%)	
More than half	1 (3.7%)	2 (8.7%)	
Peroneal nerves, sensory fibers			
Motor nerve action potential			
Normal	10 (37%)	5 (21.7%)	0.005*
Some to half	-	-	
More than half	17 (63.%)	18 (78.3%)	
Motor nerve conduction velocity on the rear foot			
Normal	9 (33.3%)	5 (21.7%)	0.002*
Some to half	-	-	
More than half	18 (66.7%)	18 (78.3%)	

Table I. Cont.

Tibial nerves, motor fibers			
Motor nerve action potential			
Normal	10 (37%)	5 (21.7%)	< 0.001*
Some to half	-	-	
More than half	17 (63.%)	18 (78.3%)	
Motor nerve conduction velocity on the segment "tarsus-popliteus"			
Normal	14 (51.9%)	4 (17.4%)	< 0.001*
Some to half	13 (48.1%)	17 (73.9%)	
More than half	-	2 (8.7%)	
Tibial nerves, sensory fibers			
Motor nerve action potential			
Normal	19 (70.4%)	7 (30.4%)	0.78
Some to half	-	-	
More than half	8 (29.6%)	16 (69.6%)	
Motor nerve conduction velocity on the lateral malleolus			
Normal	21 (77.8%)	9 (39.1%)	0.16
Some to half	-	-	
More than half	6 (22.2%)	14 (60.9%)	

* - significant differences

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