THE PLACE OF SENSORY NEUROPATHY IN THE PATHOGENESIS OF CRITICAL LIMB ISCHEMIA IN DIABETIC PATIENTS

Abstract. In the article peculiarities of sensory neuropathy in 47 diabetic patients with and without surgical complications of the lower extremities have been studied. The simple clinical screening technique for diabetic neuropathy which included four tests: tactile and pain sensation, vibration perception, presence and level of Achilles reflex was used. Manifestations of neuropathy included the most common symptoms such as numbness, prickling, aching, decreased thermal sensation and burning. Approximately 75 % of all study subjects had sensory neuropathy (47,1 % patients without surgical complications and 88,9 % patients with complications in the lower extremities). The pathogenesis of critical limb ischemia in general is complex and includes impaired glycemic control, microcirculation deterioration and neuropathy. The study established that sensory neuropathy is one of the main causative factors in critical limb ischemia and development of diabetic foot syndrome.

Key words: diabetes, sensory neuropathy, angiopathy, diabetic foot syndrome.

Materials and methods. In total 47 patients aged 43–82 years (mean age – 64,7±1,3 years, 66,0 % men and 34,0 % women) were involved in the study. The patients were subdivided in 2 groups – the first group with type 2 diabetes without DFS (19 patients) and the second one- with DFS (28 patients). Clinical and paraclinical investigations were conducted. Infrared thermometry of low limbs and sublingual biomicroscopy were performed by means of digital devices. We used simple clinical screening technique for diabetic neuropathy which included four tests: tactile and pain sensation, vibration perception, presence and level of Achilles reflex. The subjects were requested to remove their shoes and socks and to lie supine on a couch for at least 5 minutes before the measurements were made. The foot was kept warm during the measurement and the room temperature was about 22°C. Tactile and pain sensation were assessed by the monofilament smooth needle prickling just proximal to the nail bed of the toe. Vibration testing was conducted using a 128-Hz tuning fork applied to the bony prominence on the dorsum of the first toe. The patient reported perception of both the start and cessation of the vibration sensation con-
ducted twice on each toe, and the score (between 0 and 2) was defined as absent, shorter than 10 seconds and longer than 10 seconds. The score for each test was defined on three grades: 0 (absent), 1 (decreased) and 2 (normal). The total score of all tests was between 0 and 8. Four severity strata were defined, including no neuropathy (7-8), mild neuropathy (5-6), moderate neuropathy (3-4) and severe neuropathy (0-2) according to the total score. The patients were treated with either oral hypoglycemic agents or insulin. Data statistical analysis was conducted by using the software Statistica (version 5.11, StatSoft Inc.). The data were expressed as mean ± standard error for quantitative variables and as numbers and percentages for categorical variables. Statistical analysis was performed using the Student’s t-test for numerical variables. All p-values were two-tailed and p<0.05 was considered statistically significant.

Results of the research and their discussion.
Approximately 75 % of all experimental subjects had sensory neuropathy. The majority of such patients noted mild to moderate discomfort associated with the neuropathy. Manifestations of neuropathy included the most common presentation of diabetic neuropathy such symptoms as numbness, prickling, aching, burning and decreased of thermal sensation. Subjectively patients initially experience sensory decrease in the toes and feet. There could be weakness of the toe flexor and extensor muscles but significant weakness was not a common finding in early diabetic neuropathy. The pain could be provoked by activity but was often worst at night. Some patients reported deep aching pain, vasomotor changes (pallor alternating with rubor or cyanosis). The presence of cardiac autonomic neuropathy was in 3 cases with symptoms of resting tachycardia, palpitations and orthostatic hypotension. Muscle strength and reflexes in these cases were often normal. According to opinion of J.W. Russell just small fiber neuropathy is characterized by superficial burning pain in the feet caused by preferential involvement of the small unmyelinated nerve fibers that mediate pain, temperature sensation and autonomic functions [4]. Small fiber neuropathies may not have any abnormalities on nerve conduction studies and could be further evaluated only with skin biopsy.

In our patients we assessed clinical screening tests for diabetic neuropathy: tactile and pain sensation, vibration perception and level of Achilles reflex. We found out some asymmetry in test results – right legs had dipper changes of sensation (fig. 1). Small myelinated and unmyelinated fibers convey sensations of light touch, pain, and temperature, while large fibers are responsible for vibratory sensation and joint position sense. The lowest level of sensation was just in vibration perception which shows on large fibers problems.

In our investigation dominated mild neuropathy, severe and moderate forms of neuropathy were in one third of cases (fig. 2).

It was typically a slow progressive sensory predominant neuropathy. Diabetic subjects with neuropathy were older and had longer duration of diabetes. The degree of neuropathy in our study correlated with age (r=0.44, p<0.05), duration of disease (r=0.45, p<0.05), level of diastolic blood pressure (r=-0.28, p<0.05) and local skin temperature (r=-0.35, p<0.05).

The comparison between groups show presence of neuropathies in 47.1 % patients of the first group and 88.9 % in patients with DFS (p<0.05). The total score of neuropathy severity in the first group was 5.5±0.57 (mild neuropathy) in comparison with 3.8±0.45 (moderate) in the second (p<0.05). The patients with DFS had higher level of blood glucose (11.3±0.82 and 9.9±0.78) (p<0.05) and systolic blood pressure – 138.6±3.02 mm Hg in comparison with 128.2±2.1 mm Hg (p<0.05). In patients with neuropathy in sublingual microcirculation pictures presence of capillaries with irregular morphology and avascular areas were more frequently seen.

It is important, that some patients with diabetic neuropathy are unaware of their sensory loss and could experience painless injuries and they are at

![Box & Whisker Plot](image-url)

Fig. 1. Results of clinical screening methodic for diabetic neuropathy
2. The simple clinical screening technique which included four tests: tactile and pain sensation, vibration perception, presence and level of Achilles reflex is effective to diagnose diabetic sensory neuropathy.

3. Diabetic patients with insensitive feet are especially prone to developing foot ulcerations. Early diagnostic of sensory neuropathy and sanitary education regarding proper foot care is especially important for such patients.

Prospects for further research. To establish an influence of other factors such as microcirculation changes in following clinical examination. The possible pathogenic role of elevated systemic arterial pressure could be also studied.

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MEСТО СЕНСОРНОЙ НЕЙРОПАТИИ В ПАТОГЕНЕЗЕ КРИТИЧЕСКОЙ ИШЕМИИ НИЖНИХ КОНЕЧНОСТЕЙ У БОЛЬНЫХ САХАРНЫМ ДИАБЕТОМ

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Резюме. В статье рассмотрены особенности сенсорной нейропатии у 47 пациентов с сахарным диабетом с наличием хирургических осложнений со стороны нижних конечностей и без них. Использована простая клиническая скрининговая методика для выявления диабетической нейропатии, которая включала четыре теста: определение тактильной и болевой чувствительности, восприятие вибрации, наличие и уровень Ахиллова рефлекса. Проявление нейропатии включали наиболее распространенные симптомы: онемение, покалывание, ноющие боли, снижение тепловой чувствительности, ощущение жжения. Около 75 % всех обследованных имели сенсорную нейропатию (47,1 % пациентов без хирургических осложнений и 88,9 % пациентов с осложнениями со стороны нижних конечностей). Патогенез критической ишемии нижних конечностей в целом является сложным и включает нарушения гемоциркуляции, ухудшение микроциркуляции крови и нейропатию. В исследовании установлено, что сенсорная нейропатия является одним из главных причинных факторов в развитии критической ишемии нижних конечностей и синдрома диабетической стопы.

Ключевые слова: сахарный диабет, сенсорная нейропатия, ангиопатия, синдром диабетической стопы.
Резюме. У статті розглянуто особливості сенсорної нейропатії у 47 пацієнтів із цукровим діабетом з наявністю хірургічних ускладнень з боку нижніх кінцівок та без них. Використана проста клінічна скринінгова методика для виявлення діабетичної нейропатії, яка включала чотири тести: визначення тактильної і більової чутливості, сприйняття вібрації, навіяність і рівень Achіллового рефлексу. Прояви невропатії включали найбільш поширений симптом: оніміння, поколювання, нючі болі, зниження теплової чутливості, відсутність печіння. Близько 75 % всіх обстежених мали сенсорну нейропатію (47,1 % пацієнтів без хірургічних ускладнень і 88,9 % пацієнтів з ускладненнями з боку нижніх кінцівок). Патогенез критичної ішемії нижніх кінцівок, у цілому, є складним і включає порушення глікемічного контролю, погіршення мікроциркуляції крові та нейропатію. У дослідженні встановлено, що сенсорна нейропатія – один із головних причинних факторів у розвитку критичної ішемії нижніх кінцівок та синдрому діабетичної стопи.

Ключові слова: цукровий діабет, сенсорна нейропатія, ангіопатія, синдром діабетичної стопи.

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