

This study aimed to evaluate the effect of incorporating temgicoluril into standard treatment protocols for patients with Q-wave myocardial infarction on the activity of nitric oxide synthase isoforms, serum concentrations of nitrites and peroxynitrites, and serum cortisol levels.

The study evaluated 80 patients with acute myocardial infarction, stratified into groups based on the presence or absence of a Q wave, and further divided into subgroups according to the administration of temgicoluril at a dose of 500 mg three times daily for one month alongside guideline-based medical therapy and multidisciplinary cardiac rehabilitation. The control group comprised 20 healthy individuals. Serum activities of inducible (iNOS), endothelial (eNOS), and neuronal (nNOS) nitric oxide synthases were quantified spectrophotometrically by measuring the rate of L-citrulline accumulation. Serum levels of nitrites, peroxynitrites, and cortisol were likewise determined using spectrophotometric assays. Statistical analysis was performed using Microsoft Office Excel equipped with the Real Statistics 2019 add-in package (Charles Zaiontz; License CC BY 4.0).

The results demonstrated that standard therapy for Q-wave myocardial infarction is accompanied by a significant suppression of excessive nitric oxide production alongside a reduction in serum cortisol levels. Concurrently, the addition of temgicoluril to the treatment protocol preserves total NO production through a more moderate modulation of inducible isoform (iNOS) activity and maintains optimal adaptive serum cortisol concentrations.

Thus, the incorporation of temgicoluril into standard management protocols for patients with Q-wave myocardial infarction exerts a pathogenetically grounded modulating effect on the nitric oxide system and serum cortisol levels, offering new avenues to enhance myocardial cytoprotection and patient rehabilitation.

Key words: Q-wave myocardial infarction, nitric oxide (NO), NO-producing enzymes, cortisol, temgicoluril.

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COMPARATIVE ASSESSMENT OF CLINICAL AND LABORATORY PARAMETERS AND INDICATORS OF MACRO- AND MICROCIRCULATION IN ELDERLY PATIENTS WITH DIABETIC FOOT USING SINGLE PERIPHERAL NERVE BLOCK OF THE SCIATIC NERVE WITHOUT AND WITH TOPICAL APPLICATION OF NITROGLYCERIN

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The search for new methods of anesthesia and treatment that enhance the effectiveness of therapy for diabetic foot syndrome remains a priority area of modern medicine. The aim of the study was to compare the parameters of macro- and microcirculation, as well as clinical and laboratory parameters in elderly patients with diabetic foot syndrome with a single peripheral nerve block of the sciatic nerve followed by the use of a nitroglycerin patch and without it. The study included 40 elderly patients (60–75 years old) with Wagner stage II–III diabetic foot, as well as with combined forms (stages II–IV). There were 21 men (52.5%) and 19 women (47.5%) among them. The patients were divided into two groups of 20 people: in the first group, a single peripheral nerve block of the sciatic nerve was used without the subsequent use of a nitroglycerin patch, in the second – with its application. The studies were conducted at 3 stages before surgery, on the 10th and 15th days of the postoperative period. Clinical and laboratory parameters, as well as macro- and microcirculation parameters, were evaluated. The results of the studies showed

that in patients with diabetic foot syndrome, when using a single peripheral nerve block of the sciatic nerve in combination with a nitroglycerin patch, there was a more pronounced improvement in clinical and laboratory parameters, macro- and microcirculation parameters, as well as accelerated wound healing compared with the group without the use of this patch.

Key words: *diabetic foot syndrome, single peripheral nerve block of the sciatic nerve, nitroglycerin patch, macro- and microcirculation.*

Connection of the publication with planned research work.

The work is part of a dissertation for the degree of Doctor of Philosophy in medicine on the topic "The effect of prolonged conduction block of the sciatic nerve with local nitroglycerin application on wound healing in the postoperative period in elderly patients with diabetic foot syndrome".

Introduction.

Over the past 20 years, the number of people with diabetes has doubled worldwide, and a further global increase in the number of patients with this condition is projected over the next few decades [1, 2]. Diabetic foot (DF) is a common complication of diabetes, leading to a worsening of the disease course, increased mortality, and a higher number of amputations. Current literature indicates that impaired blood circulation significantly hinders the healing processes of diabetic foot ulcers [3].

Insufficient blood supply can lead to ischemia, which disrupts the delivery of essential nutrients and oxygen to the affected tissues, thereby impairing the cellular functions necessary for wound healing [4–6]. Moreover, the inflammatory response, which plays a crucial role in the healing process, can further complicate tissue regeneration [6].

Modern methods of treating diabetic foot ulcers include mandatory monitoring of glucose levels, diet therapy, conventional ulcer treatment, surgical debridement of chronic wounds, and revascularization [7]. However, these approaches do not always ensure ulcer healing, especially in cases of pronounced circulatory disorders.

Although single injections that block the sciatic or femoral nerve for the purpose of analgesia are widely used in clinical practice, their anatomical distance from the sympathetic chain results in a short-lived and unstable vasodilatory effect [8–10]. This limitation likely reduces the therapeutic potential of the method in terms of improving the healing of diabetic foot ulcers [11, 12].

In addition to revascularization, additional therapeutic strategies are needed to improve microcirculation and relieve pain [13].

It has been established that glyceryl trinitrate helps reduce pain syndrome in diabetic neuropathy [14]. Studies conducted both in normal conditions and in the presence of vascular pathology have demonstrated a pronounced and sustained vasodilatory effect of this substance at both the systemic and peripheral levels [15]. Nitroglycerin enhances blood supply to the toes, which makes it suitable for use in the prevention and treatment of wounds, and it can also be considered as an adjunct to standard therapy, especially in cases of chronic non-healing wounds [16, 17].

The use of nitroglycerin patches helps reduce pain, decrease the size of ulcerative defects, gangrene, and local ischemic foci in patients with the terminal stage of chronic ischemia of the lower extremities, especially in the absence of alternative treatment methods or when

there is a high risk of revascularization interventions [18, 19].

Therefore, the development of new treatment methods aimed at improving blood supply and accelerating the healing of diabetic ulcers using anesthesia techniques is a pressing task for modern medicine.

The aim of the study.

To compare clinical and laboratory parameters and macro- and microcirculation parameters in elderly patients with diabetic foot syndrome following a single peripheral nerve block of the sciatic nerve, both without and with the local application of nitroglycerin.

Objects and research methods.

The study was conducted in the diabetic foot department of the Center for Scientific Surgery named after Academician M. A. Topchubashev over a period of 4 months (October 2025 – January 2026). The study included 40 elderly patients (aged 60–75) with diabetic foot (DF) with Wagner stage II–III, as well as those with combined forms (stages II–IV).

The number of men was 21 (52.5%), and the number of women was 19 (47.5%). No statistically significant differences by gender were found between the groups ($\chi^2=0.200$; $p=0.655$).

The patients were divided into two groups:

20 patients who underwent SPNB without subsequent use of a nitroglycerin patch (NP).

20 patients who underwent SPNB, followed by the use of NP in the postoperative period (figs. 1, 2).

During the conduction anesthesia, an ultrasound device (Sonoscape S20), a neurostimulator (B. Braun, Stimuplex HNS-12), and a 0.5% bupivacaine solution (Marcaine) in a volume of 20 ml were used. The sciatic nerve block was performed on the affected limb in the popliteal region.

Sensory and motor blockade were assessed using the Bromage scale. In the postoperative period, a nitroglycerin patch (NP) (Deponit 10 mg/24 h) was applied to the dorsal surface of the foot in the projection of the dorsal artery. The patches were replaced daily for 15 days.

Laboratory parameters were determined using biochemical, immunological, and hematological analyzers. To assess microcirculation and tissue metabolism, a portable LAZMA-PF device was used, and to study macrocirculation, a portable Doppler device and a tonometer cuff were employed.

The area of study for laser Doppler flowmetry (LDF) and laser fluorescence spectroscopy (LFS) was the pulp surface of the great toe; in cases of iatrogenic absence or amputation, the plantar surface of the first metatarsal bone was selected. The studies were conducted in a state of rest, without functional tests, for 10 minutes after a preliminary 10-minute rest period for the subjects.

Indicators of macro- and microcirculation were analyzed: the ankle-brachial index (ABI), the mean perfusion value (M), nutritive blood flow (Mnutr), the oxidative



Figure 1 – Foot without nitroglycerin patch.

metabolism index (OMI), the nutritive component of perfusion, the amplitude of nicotinamide adenine dinucleotide fluorescence (Anadh), as well as the amplitudes of blood flow oscillations in the endothelial (Ae), neurogenic (An), myogenic (Am), respiratory (Ar), and cardiac (Ac) frequency ranges.

The severity of the pain syndrome was assessed using a visual analog scale (VAS), as well as laboratory parameters, including inflammatory markers: interleukin-6 (IL-6), leukocyte count, C-reactive protein (CRP), fibrinogen, lactate, and fasting blood glucose. A visual assessment of the wound parameters (length, width, depth, cm) was carried out, as well as an assessment of the presence of granulation tissue and other signs of healing.

The study was conducted before the surgery, as well as on the 10th and 15th days of the postoperative period. Since the size of the wound defect in DF changes after surgery, when comparing wound sizes, the time immediately following the surgery was taken as the beginning of the healing period.

The statistical analysis was carried out using Statistics 16.0 software, the SPSS statistical package for Windows (StatSoft Inc., USA). Quantitative indicators were presented in the form of the arithmetic mean (M) and the standard deviation (+m). The quantitative indicators were compared using the Mann–Whitney criterion (U). The differences between the compared values were recognized as statistically significant at a significance level of $p < 0.050$.

This study was conducted in accordance with the requirements of Good Clinical Practice (ICH E2(R6) GCP) and the Declaration of Helsinki of the World Health Organization. All patients provided informed voluntary consent prior to any procedures.

Research results and their discussion.

When comparing clinical and laboratory parameters in patients with diabetic foot using SPNB without and with the use of a nitroglycerin patch (NP) at 3 stages before surgery, on the 10th and 15th days of the postoper-



Figure 2 – Foot with nitroglycerin patch.

ative period, the average values and standard deviations of the parameters were evaluated. The level of interleukin-6 (IL-6) in both groups was analyzed only before surgery and on the 10th day of the postoperative period (**table 1**).

As can be seen from **table 1**, the level of interleukin-6 (IL-6) in patients with diabetic foot (DF) who received SPNB without using a nitroglycerin patch (NP) decreased 1.1-fold on the 10th day after surgery compared to the pre-operative level ($p < 0.05$). In patients using the NP, the IL-6 level decreased by an average of 3.5-fold compared to the baseline value ($p < 0.01$). When comparing the IL-6 levels between the groups without and with the use of the NP before surgery, no statistically significant differences were found ($U=188.0$; $p=0.745$). On the 10th day after surgery, statistically significant differences between the groups were revealed ($U=118.5$; $p=0.028$).

The level of C-reactive protein (CRP) in patients who did not use the NP decreased on average by a factor of 2.6 and 2.2 on the 10th and 15th days after surgery, respectively. The differences between the values before surgery and on the 10th and 15th days were statistically significant ($p < 0.01$).

In the group using the nitroglycerin patch, the CRP level decreased by an average of 2.6 times by the 10th day and by 3.1 times by the 15th day after surgery. The differences were also statistically significant ($p < 0.001$).

In the intergroup comparison of CRP levels, no statistically significant differences were found either before surgery or on the 10th and 15th days ($p > 0.05$).

Leukocytosis was not detected in patients who did not use the NP, either before surgery or in the postoperative period. At the same time, a statistically significant decrease in the level of leukocytes was observed on the 10th day ($p < 0.001$) and on the 15th day ($p < 0.05$) compared to the preoperative values.

In the group using the nitroglycerin patch, the leukocyte level before surgery was elevated and averaged $11.64 \pm 6.96 \times 10^9/L$. On the 10th and 15th days, a decrease in the indicator was observed, by a factor of 1.5

Table 1 – Clinical and laboratory parameters in patients with diabetes mellitus when using a single peripheral nerve block followed by treatment without and using a nitroglycerin patch

Clinical and laboratory parameters (units of measurement)	Preoperatively	Postoperative day 10	Postoperative day 15	Reliability of differences
IL-6 (pg/ml)				
Without use of NP	41.62±36.28	36.72±31.16		$p_{\text{preoper}/10s} < 0.050$
With NP	67.69±89.55	19.12±22.35		$p_{\text{preoper}/10s} < 0.010$
Reliability of differences	$p > 0.050$	$p < 0.050$		
CRP (mg/dl)				
Without use of NP	72.72±30.27	28.09±27.06	33.31±46.93	$p_{\text{preoper}/10s} < 0.001$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} < 0.010$
With NP	100.29±70.06	38.23±42.93	32.07±39.74	$p_{\text{preoper}/10s} < 0.001$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} < 0.001$
Reliability of differences	$p > 0.050$	$p > 0.050$	$p > 0.050$	
White blood cells *109/l				
Without use of NP	8.15±4.14	5.30±1.69	5.72±2.36	$p_{\text{preoper}/10s} < 0.001$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} > 0.050$
With NP	11.65±7.15	7.96±5.39	9.61±5.68	$p_{\text{preoper}/10s} < 0.050$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} > 0.050$
Reliability of differences	$p > 0.050$	$p > 0.050$	$p < 0.050$	
Fibrinogen (mg/dl)				
Without use of NP	414.50±156.5	367.90±122.80	402.05±108.36	$p_{\text{preoper}/10s} > 0.050$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} > 0.050$
With NP	385.05±92.41	329.90±101.70	371.45±93.09	$p_{\text{preoper}/10s} < 0.050$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} > 0.050$
Reliability of differences	$p > 0.050$	$p > 0.050$	$p > 0.050$	
Glucose (mg/dl)				
Without NP	206.21±44.40	187.26±29.21	203.89±31.54	$p_{\text{preoper}/10s} > 0.050$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} > 0.050$
With NP	135.15±49.58	172.30±75.30	146.05±53.80	$p_{\text{preoper}/10s} > 0.050$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} > 0.050$
Reliability of differences	$p < 0.050$	$p > 0.050$	$p < 0.050$	
Lactate (mmol/L)				
Without NP	1.07±0.48	1.51±0.87	1.48±0.58	$p_{\text{preoper}/10s} > 0.050$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} < 0.050$
With NP	1.39±0.97	1.30±0.69	1.38±0.91	$p_{\text{preoper}/10s} > 0.050$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} > 0.050$
Reliability of differences	$p > 0.050$	$p > 0.050$	$p > 0.050$	
Lower limb temperature (C°)				
Without NP	31.61±2.51	29.39±1.66	30.49±1.77	$p_{\text{preoper}/10s} < 0.050$ $p_{10s/15s} < 0.050$ $p_{\text{preoper}/15s} > 0.050$
With NP	29.59±3.25	30.27±2.09	30.92±2.20	$p_{\text{preoper}/10s} > 0.050$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} > 0.050$
Reliability of differences	$p > 0.050$	$p > 0.050$	$p > 0.050$	
The degree of pain on a VAS				
Without NP	4.10±0.62	2.50±1.02	2.50±1.15	$p_{\text{preoper}/10s} < 0.001$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} < 0.001$
With NP	4.50±0.74	1.45±1.16	0.90±1.17	$p_{\text{preoper}/10s} < 0.001$ $p_{10s/15s} > 0.050$ $p_{\text{preoper}/15s} < 0.001$
Reliability of differences	$p > 0.050$	$p < 0.050$	$p < 0.001$	

Notes: differences were considered statistically significant at $p < 0.001$; $p < 0.01$; $p < 0.05$; at $p > 0.05$, they were considered statistically insignificant.

Table 2 – Assessment of wound size in patients with diabetic foot in groups without and with the use of nitroglycerin patch (average values)

Indicators	Immediately postoperatively	Postoperative day 10	Postoperative day 15	Reliability
Wound length (cm)				
Without use of NP	5.4±2.6	5.0±2.8	5.2±2.7	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	8.0±2.8	7.2±2.7	6.8±2.6	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
Reliability	p<0.050	p<0.050	p<0.050	
Width (cm)				
Without use of NP	3.2±2.1	2.9±2.1	3.0±2.8	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	1.2±1.8	1.1±1.5	0.9±1.3	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
Reliability	p<0.010	p<0.010	p<0.001	
Depth (cm)				
Without use of NP	0.9±0.1	0.9±0.1	0.9±0.1	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	0.4±0.5	0.4±0.5	0.4±0.5	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
Reliability	p<0.001	p<0.001	p<0.001	

Notes: differences were considered statistically significant at p<0.001; p<0.01; p<0.05; at p>0.05, they were considered statistically insignificant.

and 1.2, respectively. Statistically significant differences were found between the preoperative level and the value on the 10th day (p<0.05), whereas by the 15th day the differences were not significant (p>0.05). In the intergroup comparison of leukocyte levels, no differences were observed before surgery and on the 10th day (p>0.05); however, statistically significant differences were found on the 15th day (p<0.05).

The fibrinogen concentration in patients who did not use the NP before surgery was elevated (414.5±156.5 mg/dL). In the postoperative period, a slight decrease in the value was observed, but no statistically significant differences were found (p>0.05).

In the group using the NP, a statistically significant decrease in fibrinogen levels was observed only on the 10th day compared to the preoperative level (p<0.05). At the other time points, the differences were statistically insignificant (p>0.05). No statistically significant differences were found in the intergroup comparison of fibrinogen levels (p>0.05).

Analysis of glucose levels showed that patients who did not use the NP initially exhibited hyperglycemia (206.2±44.4 mg/dL). On the 10th day, a slight decrease in the value was observed, but by the 15th day, the glucose level returned to the initial values. No statistically significant differences were found at any time point (p>0.05).

In the group using the NP, elevated glucose levels were also observed. On the 10th day, the level increased by 1.3 times, and on the 15th day – by 1.08 times. No statistically significant differences between the time points were found (p>0.05). In the intergroup comparison, the glucose level was statistically significantly different before surgery and on day 15 (p<0.05), whereas there were no differences on day 10 (p>0.05).

The lactate level in all patients was within the reference range. In the group that did not receive the NP, statistically significant differences were identified only between the preoperative level and the value on the 15th day (p<0.05). In the group using the NP, no differences were observed at any time points (p>0.05). No statistically significant differences were found in the lactate levels when comparing the groups (p>0.05).

The skin temperature of the lower limb in patients who did not use the NP before surgery was within the normal range. On the 10th and 15th days, a decrease in the indicator was observed. The differences between the preoperative level and the postoperative values were statistically significant (p<0.05), but there were no differences between the 10th and 15th days (p>0.05).

In the group using the nitroglycerin patch, the temperature was initially lower. In the postoperative period, an increase in temperature was observed, but no statistically significant differences were found (p>0.05). No statistically significant differences in temperature were found when comparing the groups (p>0.05).

comparing the groups (p>0.05).

The intensity of the pain syndrome, as assessed using the visual analog scale (VAS), in both groups before surgery corresponded to moderate pain. In the group that did not receive the NP, there was a 1.6-fold reduction in pain by the 10th and 15th days. The differences between the pre-operative level and the postoperative values were statistically significant (p<0.001).

In the group using the nitroglycerin patch, the reduction in pain was more pronounced: 3.1-fold by day 10 and 5-fold by day 15 (p < 0.001).

In the intergroup comparison, no differences were observed before surgery (p>0.05); however, statistically significant differences were detected on the 10th and 15th days (p<0.05 and p<0.001, respectively).

When analyzing the size of the wounds, it was found that in the group without the use of the NP, their reduction amounted to an average of 1.07 times by the 10th day and 1.04 times by the 15th day. In the group using the NP, the reduction in wound size was more pronounced – by 1.1 and 1.2 times, respectively (**table 2**).

Based on the indicators of wound length, width, and depth in the group that did not receive the NP, no statistically significant differences were found between the values before surgery and on the 10th and 15th days after surgery (p>0.05). Similarly, in the group using the nitroglycerin patch, there were no statistically significant differences in the length, width, and depth of the wound between the specified time points (p>0.05).

In the intergroup comparison, it was found that the wound length (p<0.05), width (p<0.01), and depth (p<0.001) differed significantly between the groups both immediately after surgery and on the 10th and 15th days of the postoperative period.

Table 3 – Indicators of macro- and microcirculation in patients with diabetes mellitus when using a single peripheral nerve block without and using a nitroglycerin patch (average values)

Indicators (perfusion units, p.u.)	Preoperatively	Postoperative day 10	Postoperative day 15	Reliability
Ankle Index (ABI)				
Without use of NP	0.65±0.20	0.70±0.23	0.69±0.26	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	0.61±0.16	0.78±0.21	0.85±0.21	preoper/10s p<0.050 10s/15s p>0.050 preoper/15s p<0.001
Reliability of differences	p>0.050	p>0.050	p<0.050	
Microcirculation (M)				
Without use of NP	9.27±8.00	8.05±4.83	6.96±3.99	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	5.55±1.75	9.47±4.68	10.40±4.39	preoper/10s p<0.050 10s/15s p>0.050 preoper/15s p<0.010
Reliability of differences	p>0.050	p>0.050	P<0.050	
Nutritional blood flow (M _{nutr})				
Without use of NP	4.27±5.23	3.44±3.11	2.4±2.35	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	1.98±1.09	2.72±1.56	4.05±2.60	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p<0.050
Reliability of differences	p>0.050	p>0.050	P<0.050	
Oxidative metabolism (OMI)				
Without use of NP	0.73±1.06	0.58±0.50	0.73±0.80	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	0.51±0.33	1.81±2.19	1.70±2.01	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p<0.050
Reliability of differences	p>0.050	p>0.050	p>0.050	
Nicotinamide dinucleotide amplitude (Anadh)				
Without use of NP	2.76±2.27	5.84±9.27	5.13±4.55	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	3.44±4.30	2.25±3.57	1.94±1.60	preoper/10s p<0.050 10s/15s p>0.050 preoper/15s p>0.050
Reliability of differences	p>0.050	p<0.010	p<0.050	
The amplitude of endothelial oscillations (Ae)				
Without use of NP	0.29±0.52	0.36±0.69	0.34±0.55	preoper/10s p>0.050 10s/15s p>0.050
With NP	0.51±0.73	0.48±0.54	0.82±0.86	preoper/10s p>0.050 10s/15s p>0.050
Reliability of differences	p>0.050	p>0.050	p<0.050	
The amplitude of neurogenic oscillations (An)				
Without use of NP	0.37±0.61	0.34±0.52	0.58±1.59	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	0.50±0.64	0.48±0.39	0.93±0.81	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
Reliability of differences	p>0.050	p>0.050	p<0.010	
The amplitude of myogenic oscillations (Am)				
Without use of NP	0.28±0.41	0.39±0.66	0.21±0.15	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	0.32±0.48	0.48±0.55	0.76±0.69	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p<0.050
Reliability of differences	p>0.050	p>0.050	p<0.050	

The amplitude of respiratory oscillations (Ar)				
Without use of NP	0.26±0.32	0.33±0.52	0.30±0.40	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	0.40±0.48	0.36±0.39	0.63±0.77	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
Reliability of differences	p>0.050	p>0.050	p<0.050	
The amplitude of cardiac oscillations (Ac)				
Without use of NP	0.37±0.34	0.50±0.52	0.50±0.47	preoper/10s p>0.050 10s/15s p>0.050 preoper/15s p>0.050
With NP	0.51±0.42	0.88±0.85	1.02±0.80	preoper/10s p>0.050 10s/15s p>0.050 15s p<0.050
Reliability of differences	p>0.050	p>0.050	p<0.050	

When analyzing macrocirculation (linear blood flow) parameters, it was found that in patients with DF, when using SPNB without the use of NP, the ankle-brachial index (ABI) before surgery averaged 0.65 ± 0.20 units, which corresponded to moderate ischemia of the lower limb. On the 10th and 15th days after surgery, no significant changes were observed in the ABI in this group; there were no statistically significant differences between the values before surgery and on the 10th and 15th days ($p > 0.05$).

In the group that received the NP, the ABI increased on average by a factor of 1.3 by the 10th day and by a factor of 1.4 by the 15th day after surgery, approaching the threshold values of the norm (**table 2**). The differences between the pre-operative level and the values on the 10th and 15th days were statistically significant ($p < 0.001$).

In the intergroup comparison of the ABI, there were no statistically significant differences before surgery and on the 10th day ($U=223.0$; $p=0.534$ and $U=142.0$; $p=0.115$, respectively); however, statistically significant differences were observed on the 15th day ($U=124.0$; $p=0.040$) (**table 3**).

As can be seen from **table 3**, the microcirculation indicator (M) in patients with diabetic foot, when using a single peripheral nerve block without the use of a nitroglycerin patch prior to surgery, averaged 9.27 ± 8.0 p.u., which corresponded to reduced perfusion. No statistically significant differences were found between the values before surgery and on the 10th and 15th days of the postoperative period ($p > 0.05$). In patients who used the nitroglycerin patch, the initial M value was lower and averaged 5.55 ± 1.75 units. On the 10th day after surgery, the value increased by 1.7-fold ($p < 0.05$), and on the 15th day – by 1.9-fold, approaching normal values. When comparing the indicators before surgery and on the 15th day, statistically significant differences were identified ($p < 0.01$). In the intergroup comparison of the M indicator, statistically significant differences were absent before surgery and on the 10th day, but they were identified on the 15th day after surgery ($p < 0.05$).

The nutritive blood flow index (Mnutr) in patients who did not use the nitroglycerin patch before surgery was elevated and averaged 4.27 ± 5.22 p.u. On the 10th and 15th days after surgery, it decreased by 1.2 and 1.7 times, respectively. No statistically significant differences were found between the initial values and the indicators on the 10th and 15th days ($p > 0.05$).

In the group using the nitroglycerin patch, the Mnutr value before surgery was within the normal range. On the 10th and 15th days after surgery, an increase of 1.4 and 2.0 times, respectively, was observed, which indicates an improvement in capillary blood flow. Statistically significant differences were found between the indicators before surgery and on the 15th day ($p < 0.05$). In the intergroup comparison of the Mnutr indicator, there were no statistically significant differences before surgery and on the 10th day, but they were detected on the 15th day ($p < 0.05$).

Analysis of the oxidative metabolism index (OMI) showed that in the group without the NP, its values before surgery were within the normal range; on the 10th day, they decreased by 1.3 times, and by the 15th day, they returned to normal values. No statistically significant differences were found ($p > 0.05$).

In the group using the nitroglycerin patch, the OMI was reduced before surgery. On the 10th and 15th days, an increase in the indicator was observed, by 1.5 and 3.3 times, respectively. Statistically significant differences were found between the values before surgery and on the 15th day ($p < 0.05$).

There were no intergroup differences in the OMI at any of the observation periods ($p > 0.05$).

The fluorescence amplitude of NADH (Anadh) changed in accordance with the dynamics of oxidative metabolism. In the group without the use of a nitroglycerin patch, the value remained within the normal range before surgery and increased on the 10th and 15th days, but without statistically significant differences ($p > 0.05$).

In the group using the nitroglycerin patch, the Anadh was within the normal range before surgery, but it decreased in the postoperative period, which reflects an improvement in tissue metabolism. Statistically significant differences were identified between the values before surgery and on the 10th day ($p < 0.05$). In the intergroup comparison, there were no differences before surgery, but they were statistically significant on the 10th and 15th days ($p < 0.05$).

Similar trends were observed for the amplitudes of endothelial (Ae), neurogenic (An), myogenic (Am), respiratory (Ar), and cardiac (Ac) oscillations: in the group that received the nitroglycerin patch, a more pronounced increase in the indicators was observed by the 15th day after surgery, with statistically significant intergroup differences ($p < 0.05$), whereas no significant changes were detected in the group that did not receive the patch.

Conclusions.

The use of the nitroglycerin patch in combination with a single peripheral nerve block of the sciatic nerve helps improve microcirculation, enhance tissue blood flow, and normalize metabolic processes in patients with diabetic foot.

Prospects for further research.

The use of a single peripheral nerve block in combination with the application of the nitroglycerin patch im-

proves macro- and microcirculation parameters; therefore, in subsequent studies, we plan to conduct a more in-depth examination of the effectiveness in reducing the intensity of pain, diminishing the severity of the inflammatory process, and reducing the size of ulcerative defects, gangrene, and local ischemic foci in patients with diabetic foot.

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ПОРІВНЯЛЬНА ОЦІНКА КЛІНІКО-ЛАБОРАТОРНИХ ПАРАМЕТРІВ ТА ПОКАЗНИКІВ МАКРО- І МІКРОЦИРКУЛЯЦІЇ У ЛЮДЕЙ ПОХИЛОГО ВІКУ З ДІАБЕТИЧНОЮ СТОПОЮ ПРИ ВИКОРИСТАННІ ОДНОРАЗОВОЇ ПРОВІДНИКОВОЇ АНЕСТЕЗІЇ СІДНИЧНОГО НЕРВА БЕЗ ТА З МІСЦЕВИМ ЗАСТОСУВАННЯМ НІТРОГЛІЦЕРИНУ

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Резюме. З огляду на поширеність хронічних, незагоєних ран у пацієнтів із цукровим діабетом, застосування ефективних методів лікування для них є особливо актуальним. Тому пошук нових методів анестезії та лікування, що сприяють підвищенню ефективності терапії синдрому діабетичної стопи, залишається пріоритетним напрямом сучасної медицини.

Метою дослідження було порівняння параметрів макро- та мікроциркуляції, а також клініко-лабораторних показників у літніх пацієнтів із синдромом діабетичної стопи при застосуванні одноразової провідникової анестезії сідничного нерва з подальшим використанням нітрогліцеринового пластиру та без нього.

До дослідження включено 40 пацієнтів похилого віку (60–75 років) із діабетичною стопою II–III стадії за Вагнером, а також із поєднаними формами (II–IV стадії). Серед них було 21 чоловік (52,5 %) і 19 жінок (47,5 %). Пацієнтів було розділено на дві групи по 20 осіб: у першій групі застосовувалася одноразова провідникова анестезія сідничного нерва без подальшого використання нітрогліцеринового пластиру, у другій – із його застосуванням. Критеріями включення були наявність цукрового діабету 2-го типу, ускладненого діабетичною стопою II–IV стадії за Вагнером. Критеріями виключення були виражені серцево-судинні порушення, септичний стан, значні когнітивні порушення, що унеможлилювали контакт із пацієнтом. Дослідження проводили-

ся на 3-х етапах: до операції, на 10-ту та 15-ту добу післяопераційного періоду. Оцінювалися клініко-лабораторні показники, а також параметри макро- та мікроциркуляції.

Проведені дослідження показали, що у пацієнтів із синдромом діабетичної стопи при застосуванні одноразової провідникової анестезії сідничного нерва у поєднанні з нітрогліцериновим пластиром спостерігалось більш виражене поліпшення клініко-лабораторних показників, параметрів макро- та мікроциркуляції порівняно з групою без застосування цього пластиру.

Застосування нітрогліцеринового пластиру в поєднанні з одноразовою провідниковою анестезією сідничного нерва сприяє прискоренню загоєння ран у літніх хворих із синдромом діабетичної стопи.

Ключові слова: синдром діабетичної стопи, одноразова провідникова анестезія сідничного нерва, нітрогліцериновий пластр, макро- та мікроциркуляція.

COMPARATIVE ASSESSMENT OF CLINICAL AND LABORATORY PARAMETERS AND INDICATORS OF MACRO- AND MICROCIRCULATION IN ELDERLY PATIENTS WITH DIABETIC FOOT USING SINGLE PERIPHERAL NERVE BLOCK OF THE SCIATIC NERVE WITHOUT AND WITH TOPICAL APPLICATION OF NITROGLYCERIN

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Abstract. Due to the prevalence of chronic, non-healing wounds in patients with diabetes mellitus, the use of effective treatment methods is especially important for them. Therefore, the search for new methods of anesthesia and treatment that enhance the effectiveness of therapy for diabetic foot syndrome remains a priority area of modern medicine.

The aim of the study was to compare the parameters of macro- and microcirculation, as well as clinical and laboratory parameters in elderly patients with diabetic foot syndrome with a single conduction anesthesia of the sciatic nerve followed by the use of a nitroglycerin patch and without it.

The study included 40 elderly patients (60-75 years old) with Wagner stage II–III diabetic foot, as well as with combined forms (stages II–IV). There were 21 men (52.5%) and 19 women (47.5%) among them. The patients were divided into two groups of 20 people: in the first group, a single conduction anesthesia of the sciatic nerve was used without the subsequent use of a nitroglycerin patch, in the second – with its application. The inclusion criteria were the presence of type 2 diabetes mellitus complicated by Wagner stage II–IV diabetic foot. The exclusion criteria were severe cardiovascular disorders, septic condition, significant cognitive impairment, excluding contact with the patient. The studies were conducted at 3 stages before surgery, on the 10th and 15th days of the postoperative period. Clinical and laboratory parameters, as well as macro- and microcirculation parameters, were evaluated.

Studies have shown that in patients with diabetic foot syndrome, when using a single conduction anesthesia of the sciatic nerve in combination with a nitroglycerin patch, there was a more pronounced improvement in clinical and laboratory parameters, macro- and microcirculation parameters compared with the group without the use of this patch.

The use of a nitroglycerin patch in combination with a single conduction anesthesia of the sciatic nerve helps to accelerate wound healing in elderly patients with diabetic foot syndrome.

Key words: diabetic foot syndrome, single conduction anesthesia of the sciatic nerve, nitroglycerin patch, macro- and microcirculation.

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The authors declare no conflict of interest.

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