DIFFERENTIAL APPROACH TO ENDOVASCULAR TREATMENT OF CRITICAL LOWER LIMB ISCHEMIA

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Abstract. *In the world of last decades of the 20th century and at the beginning of the 21st century, specialists in the treatment of patients with diabetes (DM) pay attention to the diabetic foot syndrome (DFS) with critical ischemia of the lower extremities and diabetes and its complications combine "pathological processes of the microcirculatory, peripheral nervous systems, bone and articular apparatus of the foot, which pose a direct threat or development of ulcerative necrotic processes and gangrene of the foot. According to some epidemiological studies, the incidence of "peripheral artery disease (PAD) in patients with diabetes is from 10 to 40%, and in the presence of foot ulcers reaches 50%". In Uzbekistan, CINC was diagnosed in more than one hundred thousand people. Vascular atherosclerosis is the cause of chronic lower limb ischemia (CLLI) in 80-90% of cases. Especially often this pathology is observed in people over 60 years of age.*

Keywords*: critical ischemia, diabetes mellitus, endovascular interventions.*

ДИФФЕРЕНЦИАЛЬНЫЙ ПОДХОД К ЭНДОВАСКУЛЯРНОМУ ЛЕЧЕНИЮ КРИТИЧЕСКОЙ ИШЕМИИ НИЖНИХ КОНЕЧНОСТЕЙ

Аннотация. *В мире последних десятилетий 20 века и в начале 21 века специалисты по лечению больных сахарным диабетом (СД) обращают внимание на синдром диабетической стопы (СДС) с критической ишемией нижних конечностей и сахарным диабетом и ее осложнения сочетают в себе «патологические процессы микроциркуляторной, периферической нервной систем, костно-суставного аппарата стопы, которые представляют непосредственную угрозу или развитие язвенно-некротических процессов и гангрены стопы. По данным некоторых эпидемиологических исследований, заболеваемость «периферической заболевания артерий (ЗПА) у больных сахарным диабетом составляет от 10 до 40 %, а при наличии язв стопы достигает 50 %. В Узбекистане КИНК диагностирован более чем у ста тысяч человек. Атеросклероз сосудов является причиной хронического нижнего ишемия конечностей (ИКЛИ) в 80-90% случаев Особенно часто эта патология наблюдается у лиц старше 60 лет.*

Ключевые слова: *критическая ишемия, сахарный диабет, эндоваскулярные вмешательства.*

INTRODUCTION

Topicality. Critical ischemia of the lower extremities, despite the progress made in diagnosis and treatment, is an actual problem of vascular surgery and occupies one of the leading places in the structure of morbidity, permanent disability and mortality [1,2].

According to the calculated data of our researchers, from 3 to 10% of the population suffers from occlusive diseases of the arteries of the lower extremities, increasing to 15–20% among patients older than 70 years [3]. In a third of patients with critical ischemia of the lower extremities, critical ischemia develops 6–8 years after the onset of the first signs of the disease [4,5]. According to JI.A. Bokeria (2014), chronic "critical ischemia" develops in 30-35% of

patients, while during the first year about 15-20% of patients die, 20% suffer a high amputation of the limb, and only 55-60% of the limb can be saved [6].

Diabetes mellitus (DM), due to its high prevalence and steady upward trend, is recognized as a non-infectious epidemic of the late XX - early XXI century, representing a serious medical and social problem, and entails high mortality, ranking third after cardiovascular and oncological diseases [7,8].

One of the characteristic manifestations of DM, both insulin-dependent and non-insulin-dependent, is diabetic angiopathy, which is of a generalized nature and plays a significant role in the genesis of the disease, its complications, and outcome [9]. In patients suffering from disorders of carbohydrate metabolism, a rapidly progressive form of arteriosclerotic changes is often found [8,9].

Endothelial dysfunction caused by chronic hyperglycemia is discussed as its cause. Although the relationship between DM and vascular pathology remains unclear, it is believed that the loss of endothelial regulatory capacity underlies this process [10].

The purpose of this study: to improve the results of treatment of patients with critical lower limb ischemia in diabetic foot syndrome through a differential treatment approach, taking into account endovascular interventions.

MATERIALS AND METHODS

The work is based on the data of examination and treatment of 47 patients with critical ischemia of the lower extremities with diabetic foot syndrome, who received inpatient treatment at the clinical base of the Bukhara State Medical Institute of the Bukhara Multidisciplinary Regional Medical Center for the period 2019 to 2022.

The patients underwent surgical treatment: taking into account the angiographic study with the use of endovascular. The surgical tactics of patients was determined taking into account the results of angiographic studies. Based on the obtained results of X-ray contrast angiographic examination, as well as the depth of the lesion of the purulent-necrotic process, the methods of minimally invasive endovascular interventions for each specific patient were determined.

When determining purulent-necrotic lesions of the examined patients, the classifications of Wagner (1979) were used (Table 1).

Wagner classification 1979

Degree	Definition	Description
0	Risk to the foot	No wound defect, but there is dry skin, dry calluses, deformities of the joints of the fingers and/or foot
1	Superficial ulcer	Complete destruction of the skin
2	Deep ulcer	Wound defect affecting the skin, subcutaneous fat, tendons, but without bone damage
3	Abscess	Wound defect involving the skin, subcutaneous fat, tendons and bone
4	Limited gangrene	Necrosis at the level of fingers or feet
5	Extensive gangrene	Foot necrosis with systemic signs of inflammation

Taking into account the peculiarities of the angiographic examination, localization and degree of damage to the vessels of the lower extremities, the following types of endovascular minimally invasive interventions were determined: balloon angioplasty (vascular delamination), stenting of stenotic vessels, reconalization of occlusive vessels.

At admission, the phenomena of general intoxication prevailed: fever or persistent subfebrile condition, pallor, low mobility, tachycardia against the background of a weak pulse, increased blood erythrocyte sedimentation rate, leukocytosis, and a shift of the formula to the left. In parallel with the general symptoms, local manifestations of the disease were expressed; hyperemia, swelling and infiltration of tissues in the affected area of the limb. In the process of treatment, these indicators of intoxication, inflammatory response to the focus of infection gradually returned to normal.

The examination used generally accepted clinical, laboratory and instrumental methods. When patients were admitted, great attention was paid to the collection of anamnesis. Information about the pain syndrome, the duration of the existence of intermittent claudication, the nature and localization of pain when walking, the distance without painful walking, pain at rest, their intensity, increased or decreased pain in a horizontal position and when lowering the leg from the bed were clarified. When examining the patient, the color of the skin and the presence of visible trophic disorders were visually assessed: thinning of the skin, tuberosity and porosity of the nail plates, the presence of trophic ulcers or necrosis. An objective examination included: palpation determination of the pulsation of the arteries of the lower extremities at typical points, auscultation of the aorta of the iliac and femoral arteries. Among all patients, there was a multilevel lesion of the arterial system of the limb with occlusive-stenotic lesions, including the femoral (general, superficial and deep), popliteal, leg arteries (anterior and posterior tibial, interosseous). Based on the clinical examination, further treatment tactics were determined, depending on vascularization.

RESULTS

When determining the tactics of surgical treatment of patients, endovascular X-ray contrast diagnostics of the vessels of the lower leg and foot was carried out. Taking into account the results of angiographic diagnostics, the method of choosing an endovascular minimally invasive surgical intervention was determined to eliminate the blood flow of the affected vessel. At the same time, we took into account the anatomy of the vessels of the lower leg and foot and their lumen at different levels of the foot. To differentiate the approach of endovascular surgical interventions, taking into account the size of the vessels, we divided the vessels of the foot into three levels.

I level - the upper level of the foot. To the level of the medial malleolus. Vessel lumen up to 2.5 mm. (Distal peroneal and posterior tibial arteries).

II level - the middle level of the foot. Vessel lumen up to 2.0 mm. (Dorsal, medial foot artery).

III level - the distal level of the foot. Vessel lumen up to 1.5 mm. (Arcuate, dorsal, metatarsal arteries).

When assessing the severity of a purulent necrotic process in this group of patients, the Wagner classification was also used.

Table 2

Distribution of patients according to the degree of damage according to Wagner

0	I	III	IV	V	Total
-		10 (21.3%)	16 (34 %)	21 (44.6%)	47

As can be seen from Table 2, most patients were with IV-V degree of limb damage (Wagner). Treatment of patients with purulent-necrotic lesions of the limb was provided with the participation of a group of specialists: a surgeon of the purulent department, a vascular surgeon and an angiographist, an endocrinologist, a therapist, an anesthesiologist-resuscitator.

The general condition of the patients in most cases upon admission was moderate to severe: they all complained of constant pain at rest, trophic ulcers, gangrene of the fingers or feet, numbness, general weakness, malaise, thirst, fever up to 390C and above. All patients had pronounced signs of general intoxication of the body: high hyperthermia, increased heart rate (tachycardia) up to 110 beats per minute and above, dryness of the tongue and skin (signs of hypovolemia), and constipation was noted in most patients. There was a violation of the sensitivity of the affected limb: in 29 (61.7%) patients with affected areas of the foot, a neuropathic form of the diabetic foot syndrome was noted, a complete lack of sensitivity and local hypothermia of the limb, hyperemia and swelling of the skin tissue around the ulcerative necrotic defect of the skin.

When evaluating purulent-necrotic lesions of the extremity in patients, the following lesions were found: lesions of the I finger 10 (21.2%), I-II fingers 5 (10.6%), soles 6 (12.7%), feet 17 (36.1%), feet and lower legs 9 (19.1%).

The main diagnostic method for assessing the state of the vessels was X-ray contrast angiographic studies. Angiographic studies were performed after appropriate preparation under local anesthesia in the angiography room.

All these patients, also regardless of the type of diabetes mellitus (DM), were transferred to short-acting insulin according to the principle of "intensive insulin therapy". Intensive insulin therapy included frequent (more than 3 times a day), subcutaneous or intravenous administration of small doses (8-10 units) of short-acting insulin with careful control of glycemic levels during the day, taking into account the recommendation of an endocrinologist. In severe cases, combined administration of insulin (intravenously and subcutaneously) was carried out. Pathogenetic therapy was based on preparations of the alpha-lipoic acid group.

In the absence of contraindications, all patients were prescribed intravenously, drip heparin up to 15-20 thousand units. per day or other anticoagulants (Clexane 0.6, 0.8, Enoxiparin 0.6, 0.8, Fraxiparin 0.6, 0.8. s / c)

The use of vasodilators, symptomatic treatment and antibiotic therapy were similar to those in the control group.

The complex of conservative measures included, as in the control group, the treatment of concomitant diseases and the correction of violations of the rheological properties of the blood.

All surgical operations were performed in an urgently delayed order, after appropriate preoperative preparation.

The study of the microflora of purulent necrotic wounds of patients revealed the following points: as can be seen from table 3, 56 strains of aerobic microflora were detected in 47 examined patients in the comparison group. Most cases were sown Staph.aureus (46.4%),

Proteus spp. (25.0%). The percentage of occurrence of Streptococcus and E. coli microflora was 19.6% and 8.9%, respectively.

Table 3

Species composition of the aerobic microbial association from the wound of the comparison group, patients n=47

Aerobes	Number of strains	In %
S. aureus	26	46,4
Proteus spp.	14	25,0
Streptococcus spp.	11	19,6
E. coli	5	8,9
Total	56	100

The study of the level of sugar in the blood showed that by the time of admission to the clinic, on average, it was 12.7±2.1 mmol/l. Against the background of complex conservative and surgical treatment, the elimination of a purulent-necrotic focus, carried out in the postoperative period, contributed to a decrease in the level of sugar in the blood of patients to the upper limit of normal by 6-7 days of treatment.

The study of the functional state of the vessels was carried out using duplex angioscanning, determination of regional MCC and MDS. Vascular examination a. Poplitea, a.tibialis posterior on the day of admission showed that MSS, MDS were significantly below the norm - 30.5±1.2 and 2.2±0.16, respectively.

The study of the distal parts of the arteries of the lower leg is carried out in the position of the patient lying on his back with slightly bent at the knees and slightly apart legs. To visualize the STBA, the sensor is placed along the lower third of the lower leg and somewhat posterior to the medial malleolus. The PBBA is located along the lower third of the lower leg along the anterior surface in the projection of the continuation on the lower leg of an imaginary line drawn between the 1st and 2nd toes of the dorsum of the foot.

In everyday practice, the study of MBA is not carried out. Its examination and measurement of blood flow parameters become relevant if the patient has chronic ischemia of the lower extremities or stenosing lesions of the tibial arteries. The MBA is visualized along the medial surface in the middle third of the leg.

The main points of research in the study of the arteries of the lower leg:

• PBBA - pierces the interosseous membrane in the upper third of the leg, descends and in the lower third of the leg comes out on the front surface, continuing into the artery of the rear of the foot;

• ZBBA - a direct continuation of the PA on the lower leg, goes down, giving in the upper third of the lower leg to the MBA, and in the lower third of the branch involved in the blood supply to the heel region; the common plantar artery is a continuation of the STBA on the foot.

If a patient has ultrasound signs of ischemia of the lower extremities, the ankle-brachial index (ABI) is measured.

Measurement of ABI is a reliable and effective method for quantifying the blood supply to an extremity. Its positive predictive value is 90%, negative predictive value is 99%, and overall accuracy is 98%. The index is calculated by the formula:

ABI = tibial artery systolic blood pressure/systolic blood pressure brachial artery.

Systolic pressure is determined using a tonometer with a pneumatic cuff and a linear ultrasonic sensor installed at the location point of the PLA and ZBBA. In case of occlusion of the latter or the impossibility of its clear location due to the lesion, PBBA or MBA are used.

The measurement is carried out symmetrically on both arms and legs. The sensor is alternately installed at the points of location of the indicated arteries and pressure is applied to the cuff until the Doppler signal disappears in the vessel. At the moment of slow decompression of the cuff, the first stroke of the restored blood flow corresponds to the value of systolic blood pressure in the vessel.

Normally, a difference of up to 12-15 mm Hg is acceptable. If the pressure indicators on the hands differ more significantly, then a stenosing lesion of the subclavian or axillary arteries on the side with lower blood pressure values should be suspected. In this case, to calculate the ABI, the blood pressure indicator from the arm where the obtained value is greater is used.

Ankle pressure is normal at 10-15 mm Hg. higher than at the shoulder, and the value of the normal ABI systolic pressure is more than 1.0. Decrease in ABI less than 0.9 is considered as a pathology. The index correlates with the stage of the lesion and the clinical picture of lower limb ischemia:

Results of X-ray angiographic interventions.

An x-ray contrast angiographic study revealed vascular lesions under the knee artery and level I of the foot vessels in 55.3% of patients (the distal part of the peroneal and posterior tibial arteries). In 11 (23.4%) patients, stenosis and occlusion were noted at the second level of the vessels of the foot (the dorsal, medial subcutaneous artery of the foot). Ten (21.2%) patients had vascular lesions in the form of stenosis and occlusion up to level III of the foot vessels.

Of the 26 patients with lesions of the first level of the foot, 12 (46.1%) underwent stenting of the vessels of the distal part of the peroneal and posterior tibial arteries. The indication of stenting of these vessels was: the occurrence of residual vascular stenosis up to 45-50% and the ineffectiveness of transluminal balloon angioplasty.

Of the 26 patients with level I lesions of the foot vessels, 14 (53.9%) patients due to chronic ischemia of the lower extremities caused by occlusive-stenotic lesions of the arteries of the foot vessels underwent balloon angioplasty followed by reversal of the affected vessels. To carry out the manipulation, balloon angioplasty was performed. Subsequently, stenting of the affected areas was carried out according to the above method.

DISCUSSION

As noted above, out of 47 patients, 11 (23.4%) patients had stenosis or occlusion of the second level of the vessels of the foot (dorsal, medial subcutaneous artery of the foot). Of these, 4 (36.3%) underwent stenting of the affected vessels. In 7 (63.7%) patients, recanalization of vessels with balloon angioplasty was carried out as indicated. To do this, after establishing the level and degree of vascular damage, vascular recanalization was performed.

In 10 patients with damage to the third level of the vessels of the foot (arcuate, dorsal, metatarsal arteries). Four (40%) patients underwent reconalization with balloon angioplasty. In 6 (60%) patients, due to a severe form of chronic ischemia of the lower extremities, caused by

occlusive-stenotic lesions of the arteries of the 3rd level of vessels, they limited themselves to reconalization of the affected vessels.

The use of angioendovascular diagnostics and a differential approach of endovascular surgery with division into 3 levels depending on the size of the vessels of the foot changed for the better the indicators after surgical complications and the results of studies.

CONCLUSIONS

All of the above allows us to recommend a mandatory wide use in clinical practice of the method of surgical treatment using angiographic examination, taking into account the 3rd level of the size of the foot vessels, to carry out endovascular intervention using minimally invasive methods of recanalization, balloon angioplasty and stenting of distal vessels. At the same time, stenting and balloon angioplasty should be used for damage to the first level of foot vessels up to 2.5 mm in size, which often coincides in projection with the distal part of the peroneal and posterior tibial arteries. In case of damage to the II level of foot vessels with sizes up to 2.0 mm (dorsal, medial subcutaneous artery of the foot), it is more effective to use stenting with angioplasty with reconalization. In case of occlusion of the III level of foot vessels with sizes up to 1.5 mm (arcuate, dorsal, metatarsal arteries), the use of reconalization and balloon angioplasty is more optimal.

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