MODERN ASPECTS OF DIAGNOSIS AND TREATMENT OF DIABETIC FOOT SYNDROME

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ABSTRACT

To date, relevant questions remain 1) formulation of differentiated treatment of diabetic foot syndrome, taking into account the status of vascular diagnostic data, microcirculatory changes; 2) improve surgical methods for treatment.

Material and Methods: *In purulent surgery Department of the Central Hospital of the city of Samarkand surveyed 120 patients who were hospitalized. The patients were divided into three groups: the first group – 79 patients with diabetic foot syndrome and diabetic lower limb gangrene, which conducted x-ray-radioisotope-ultrasonography and advanced surgical treatment; the second group – 29 patients without diabetes who conducted x-ray-radioisotope research; the third group – 12 patients who held multispiralcomputed tomography arteries of the lower limbs.*

Results: *Ultrasonic, radioisotope and x-ray studies complement each other, allow predicting the course of pathological process and to select the right treatment tactics.*

Conclusions: *When choosing the tactics of treatment of patients with diabetic foot syndrome it is advisable to take into account the condition of the arterial blood flow, the presence of arteriolosclerosis of Menkeberg, the degree of microcirculatory disorders.*

KEYWORDS: *Diabetic Foot, Microcirculation, Technetium, Calcification.*

1. INTRODUCTION

According to the World Health Organization (WHO), the number of people in the world suffering from diabetes had increased from 108 million in 1980 to 422 million in the 2014 year.

In addition, in 2012 year 1.5 million deaths were directly caused by diabetes and a further 2.2 million deaths were due to the high content of glucose in the blood [1]. WHO is projected in year 2030 diabetes will occupy seventh place among causes of death [2]. Despite some advances in treatment, diabetes is recognized as one of the most important non-communicable diseases, the incidence of which has become a pandemic [3, 4, 5]. There has been an increase in geometric progression. According to the International Diabetes Federation to 2040 year projected growth in the number of people with diabetes to 642 million [6].

The General result of uncontrolled diabetes is hyperglycemia, or high blood sugar, which eventually leads to severe damage many body systems, especially the nerves and blood vessels [1]. The issue is the severity of surgical complications of diabetes. The urgency of the problem lies in the severity of the surgical complications of diabetes – diabetic foot syndrome (DFS) and diabetic gangrene of the lower limb (DGLL). Amputation of lower limbs in patients with diabetes are produced in 17-45 times more likely than people not suffering from this disease [7].

To improve the diagnosis, treatment and prevention of DFS in the world a number of targeted research, including screening for early detection of patients and the provision of timely preventive and curative care, the development of various methods of surgical treatment. In this regard, to date remain relevant issues related to the development of differentiated treatment, taking into account all possible diagnostic data and improvement of surgical methods for treatment of the DFS. At the heart of angiopathy, often, lies calcification of the middle shell of arteries and arterioles (arteriolosclerosis of Menkeberg, mediakalcinosis). According to I.I.Dedovs, sclerosis leg arteries is more than 10-15% of cases [8]. Calcification of the arteries on the background of its thickening and sclerosis — increases with age from 5% to 37% among the young in the elderly. In patients with diabetes calcification of arteries is detected, on average, 3 times more frequent than in persons without violating carbohydrate Exchange. Manifestations of calcification of the arteries not only clearly visible on x-ray pictures, but also at duplex receptacles lower limbs [9, 10]. In the long-term the current diabetes, especially when no satisfactory metabolic control and peripheral neuropathy often develops calcification of arteries legs [11].

Development of calcification of the arteries is primarily due to the formation of polyneuropathy and defeat the standalone link peripheral nervous system. In the face of autosimpatektomy there is a violation of the trophic myocytes vascular wall accompanied by the deposition of calcium. As a result, the artery becomes stiff tubing with a fixed diameter, which creates prerequisites for the development of "functional" ischemia extremities, i.e., ischemia arising amid conditions that require increasing the volumetric blood flow and primarily during physical exercise, as well as, possibly, other conditions (inflammation) [11, 12]. In addition, several studies have noted the existence of the so-called rigidity or increasing the density of the walls of the arteries of the lower extremities, resulting in limiting volumetric blood flow and formation of ischemia of the extremities even when shoulder ankle-brachial index (ABI) more than 0.9 [13]. One of the pathogenetic ways of development of such state believe glycation of proteins of the arterial wall. Accumulation of glycation end-products in the vessel wall leads to endothelial structure, possible thrombotic complications and is a substrate for occlusion of the affected vessel [12]. Despite the presence of calcification of the arteries in the treatment of diabetes, there is still insufficient knowledge about it at different stages of development of DFS. The analysis of published data indicates that calcification of the arteries, common in patients with DFS is not taken into account sufficiently when choosing the tactics of surgical treatment.

Data studies of the microcirculatory bed are not entirely unambiguous. On the one hand, numerous morphological studies have shown changes in basal membranes and other components of the vascular wall in patients with diabetes. Great attention has been given to a possible pathogenetic role of morphological changes of microcirculatory bed in the development of diabetic complications, particularly destructive lesions stop. Despite the apparent obviousness of such a link and numerous data on the morphological changes and correlation functions of capillaries, the value of microangiopathy as an independent factor in the development of tissue necrosis stop not proven [14].

Thus, the current diagnostic methods need to be refilled with new data on microcirculatory changes in patients with diabetic foot syndrome. Therefore, one of the important items in the solution of the above problems is improvement of methods of diagnosis and treatment of diabetic foot, which justified the conduct of this study.

2. Material and Methods

In purulent surgery department of the Central Hospital of the city of Samarkand surveyed 120 patients who were hospitalized. The patients were divided into three groups: the first group – 79 patients with DFS and diabetic gangrene of the lower limb (DGLL), which carried out an x-ray-radioisotope-ultrasonography and improved surgical treatment; the second group – 29 patients without diabetes who conducted x-ray-radioisotope study; the third group – 12 patients who held multislice computed tomography (MCT) arteries of the lower limbs.

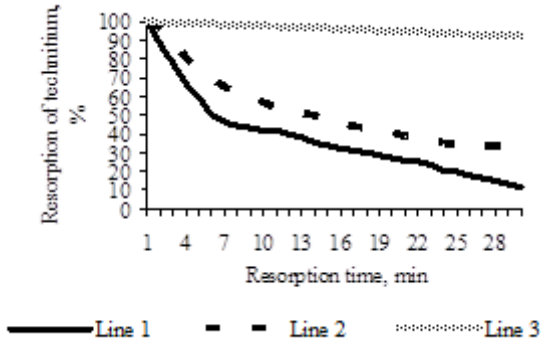
The status of microcirculation defined proposed us radioisotope method of research using technetium ^{99m}Tc. Drug activity in the volume of 70-90 MBk 0,3-0,5 ml saline injected subcutaneously in the toe of the foot intervals symmetrically on both sides. Degree of microcirculatory changes determined by the speed of resorption of technetium using a gamma camera fitted with electronic-computing device. All the patients conducted dynamic fixing technetium resorption within 30 minutes, as well as the determined time of resorption 50% technetium ($T_{1/2}$, or half of resorption).

Foot x-ray was done using the apparatus of "RUM-20M" (traditional radiography) and ECONET EVA-HF 525 (digital radiography) on standard technique in frontal and lateral projections. While determined not only bone changes, but also identified stage of calcification of the arteries. 5 stages of calcification were distinguished in view of x-ray changes: 1 stage – seal the walls of the vessel caused by calcium salts inlay beginning linear shadow small intensity; 2 stage – circular shadow in the first metatarsal span (display on the radiograph of the foot in front projection cross-section deep plantar artery); 3 stage – partial calcification of the walls of the receptacle; 4 stage – calcification of the walls of the vessel in the form of "jets of smoke"; 5 stage – wall calcification full-blown vessel in the form of "curved cord" with a cord lesion and small branches.

Clinical evaluation methods macroangiopathies served as a sound definition of pulsation of the femoral, popliteal, posterior tibial artery and dorsal artery of the foot using the device "Minidop". In addition, conducted with doppler ultrasound measurement of segmental blood pressure in lower extremities using machine «Minidop» and the determination of magnitude of ABI. Duplex scanning was performed using the apparatus of "PHILIPS".

Treatment was carried out taking into account the severity of clinical manifestations of DFS. Organ-saving operations on the foot, in particular, amputation of fingers, performed with high

excision flexor and extensor tendons concerned, sparing minimal excision, metatarsal heads resection muscles bones on improved methodology (resection of the first and fifth metatarsal not less than ½ in the slanting direction; isolated resection of second, third, and fourth metatarsal bones in the transverse direction is no less 2/3; when the amputation of multiple fingers – combined multiple metatarsal bone resection is stepped in the slanting direction). We abdicated by exarticulationin the joint of Lisfrancs and Shopars with transmetatarsal resection instead holding the foot on Sharp. In the case of DGLL were "big" ("high") amputation (legs and thighs). Tibia level amputation was performed in the upper third with extirpation of soleus muscle.



3. Results and Discussion

3.1. Study of the First Group

3.1.1. History

The study of the history of the first group of patients has shown that recourse to the hospital through 30 or more days after the onset of purulent-necrotic changes observed at 30 (37.97%) patients. Treatment of patients during the first week after the disease made up 25.32%, which is not sufficient in relation to diabetes. Among all patients of this group period from the moment of occurrence of symptoms of DFS before hospitalization averaged 24.33 ± 2.63 days. In four cases (5.06%) a core group of diabetes was identified for the first time, while patients have noted the presence of subjective symptoms. 40 (50.63%) patients visited an endocrinologist irregularly, diet is not adhered to, control the level of glycemia with their hand held in a timely manner. Mostly these were rural dwellers. Duration of diabetes before entering the hospital averaged 9.62 ± 0.62 years. 52 patients suffered from diabetes throughout 5-15 years, which stood at 65.82%. At 44 (55.7%) patients with diabetic history amounted to 10 years or more.

3.1.2. Ultrasonography

Ultrasound examination of patients showed that the ABI when receiving at 38 (48.1%) averaged 1.1 ± 0.14 that has been associated with the presence of these patients the calcification of arteries; at 31 (39.24%) patient rate of ABI was 0.67 ± 0.12; critical ischemia was observed at 10 (12.66%) patients, ABI amounted to 0.51 ± 0.13.

3.1.3. Radioisotope Study

Radioisotope survey was administered to all 79 patients in the first group. Comparative analysis of the results of treatment with the radioisotope study patients helped allocate 2 subgroups of patients with completely different quantitative and graphical indicators: 1) Patients with diabetic angio-neuropathy, DFS developed, which was conducted by conservative treatment and organ-saving operations on the foot. During pathological process was relatively favorably and ended without major amputations (72 patients – 91.14%). 2) Patients with DGLL, which was a great deal of amputation (7 patients – 9.6%).

In patients with the first subgroup (uncomplicated DGLL) resorption of technetium occur relatively slowly, gradually. Resorption time 50% technetium averaged 15.4 ± 0.44 min (T1/2 = 11-30 min). A graphical image of resorption of the drug has crescent shaped, or gradually decreasing form (Figure 1, line 2).

Study of microcirculation in the second subgroup of patients, with DGLL, revealed that the resorption of technetium from this category of patients proved to be extremely slow. During the observation in any case 50% technetium resorption was observed (T1/2 > 30 min – P < 0.0001). Therefore, graphic image was nearly horizontal placement. This graphic type got the name "horizon necrosis" (Figure 1, line 3). Treatment in this group of patients ended holding big amputation (legs and thighs), that was associated with the phrase "over the horizon – amputation".

Thus, this study has allowed us to draw the following conclusions: a radioisotope study method using technetium ^{99m}Tc according to the degree of resorption of fabric depot allows you to obtain reliable quantitative information on the status of the microcirculation in patients with DFS. Data 50% resorption technetium ^{99m}Tc are an additional criterion for accurately predict future illness and select tactics of treatment of patients with DFS.

Figure 1. Dynamics of technetium resorption in patients with diabetes and without diabetes

3.1.3. X-ray Study

Analyzed the results of X-ray examinations of 79 patients. Calcification of the arteries was more than half of the cases – 49 (62.03%) we found that clearly allocates 4 clinically important subgroups of patients (Figure 2): 1) patients who have not revealed calcification of arteries and saved trunk blood arteries foot – 20 (25.32%) – favourable disease course; 2) patients who have not revealed calcification of the arteries, but trunk blood arteries determined not – 10 (12.66%) – a varied course of disease; 3) patients who have revealed calcification of the arteries 1-4 stage – 42 (53.16%) – favourable for disease (Figure 3); 4) patients who have identified arteriolosklerosis 5 stage – 7 (8.86%) cases – critical for disease (Figure 4). And arteriolosklerosis two main arteries of the foot dorsalis pedis, a. a. tibialis posterior to their branches – aa. plantares, a. metatarsea dorsalis prima, a. plantaris profundus, aa. digitalessimultaneously.

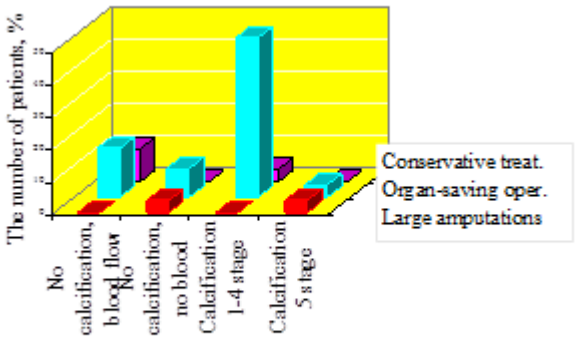


Figure 2. Comparison of x-ray examination and treatment

Results of treatment of patients in the first group. Of all the operations in the first group of 66 was at the level of the foot, which was 91.67%; 7 large amputations, which amounted to 9.6%. Large numbers of amputations performed on level 2 of the tibia, which amounted to 2.78% and 5 thigh – level amputation – 6.82%. One of the main reasons for large amputations were: delays in treatment of patients in the hospital, poor control of glycemia and unawareness foot care (burn hot tub, heating appliance, incorrect nail grooming), despite the fact that they aware that they have diabetes.

Figure 3. Calcification of the arteries of 3 stages, gangrene 4 fingers

The average length of stay of a patient in bed was 17.15 ± 1.46. Analysis of patients with foot operations showed that: 34 (47.22%) is necrectomy; 28 (38.89%) – amputation of one or more fingers; 1 (1.39%) resection of metatarsophalangeal joint; 3 (4.17%) – transmetatarsal resection of the foot by Sharp. Death came at 1 patient (1.27%), which is associated with the severity of the condition on admission, with late circulation, concomitant diseases.

The purpose of our analysis of the treatment of patients in the first group, was the definition of repeated surgery, study its causes. Repeated operations were conducted, only in 5 patients that amounted to 6.33% of patients the primary group, and 6.94% (5 reoperations) of all conducted transactions. Causes of these repetitive operations were undervaluing changes in the vascular bed and refusal of the patient from the proposed us big amputation. Efficacy of surgical treatment of patients in the first group, showed the correctness of the proposed us methods of improvement of traditional surgical treatment.

Thus, ultrasound, radiology and x-ray studies complement each other, allow predicting the course of pathological process and to select the right treatment tactics. In addition, the radiologic study showed that microcirculatory were available in all of the surveyed cases of DFS and DGLL, meaning they could be the cause as angiopathy, and neuropathy.

3.2. Results of a Survey of Patients in the Second Group (without Diabetes)

All Of the 29 patients accounted for 15 patients with pyo-inflammatory diseases of the lower extremities without diabetes and without vascular pathologies of the lower limbs in order to determine the status of microcirculation in lower limbs in relatively healthy persons (1 subgroup). The age of these patients ranged from 35 to 65 years. In the first subgroup were patients with infected wounds, ulcerous, phlegmonous-abscessing, osteomielitic changes in the lower limbs.

Patients throughout the treatment period was satisfactory. All of these patients was conducted using radiologic study technetium ^{99m}Tc, as in the first group. It has been established that in relatively healthy persons resorption of technetium tissue depot is fast, resorption time 50%

technetium averaged 5.8 ± 0.29 min (T1/2 < 10 min): a graphical picture of resorption of the drug had, as a rule, in the form of a hockey stick (Figure 1, line 1). Resorption time 50% technetium authentically significantly (P < 0.0001) differed from the testimony of the patients with DFS and DGLL. Thus, the comparison of the results of research on healthy patients with the results from the first group of patients found that the method of radioisotope definition of microcirculation by the degree of resorption 50% technetium from fabric depot allows you to obtain reliable quantitative information on the status of microcirculation. This information can be used in choosing the tactics of treatment of patients with DFS.

The remaining 14 patients in the second group comprised patients without diabetes, but with other vascular pathology (obliterative atherosclerosis – 12 patients and lower extremity occlusive disease – 2 patients) to determine whether they have a calcification of the arteries (2 subgroup). The age of patients ranged from 39 to 82 years. All of these 14 patients performed x-ray foot in frontal and lateral projections. In any case, the second group of calcification of the arteries was not detected.

Thus, the comparison of the results of radiographic studies of patients with vascular pathology of the arteries of the lower limbs, but without diabetes in the second group with the results from the first group of patients found that radiographic method definition of calcification of the arteries is valid. Foot x-ray data may also be used in choosing the tactics of treatment of patients with DFS.

3.3. Results of Examination and Treatment of Patients in the Third Group

The third group consisted of 12 patients with DFS, which was held on MCT of arteries of the lower limbs. As arteriography care for diabetic patients in terms of adverse effects due to the contrast in patients with diabetic nephropathy, in this group of patients were identified, which shows the arteries in tomography due to the presence of arterial occlusion of lower extremities arteries. The age of patients ranged from 49 to 79 years, an average of 63 ± 2.77. In this group were patients with infected wounds, ulcerous, phlegmonous-abscessing, gangrenous changes in the lower limbs.

Among the third group of patients from the time period signs of DFS before hospitalization averaged 21.4 ± 7.78 days. Duration of diabetes before entering the hospital averaged 14.17 ± 2.3 years. The value of ABI upon receipt from 3 (25%) patients averaged 1.2 ± 0.12, which was associated with the presence of these patients the calcification of arteries; at 5 (41.67%) patients ABI was 0.62 ± 0.09; critical ischemia was observed at 4 (33.33%) patients, ABI amounted to 0.41 ± 0.1.

All the patients of the third group held MCT and identified the main arteries occlusion of lower extremities due to atherosclerotic changes. The degree of occlusion in patients with varied, mainly it was the popliteus and tibial artery. MCT arteries showed that this survey gives a good idea about the changes occurring in the lumen of the vessel (Figure 5).

Of all the operations in the group, all operations were carried out at the level of the foot. Among them: 2 (10.53%) necrectomy; 6 (31.58%) – amputation of one or more fingers; 1 (5.26%) – transmetatarsal resection of the foot by Sharp. 8 (67%) sick of 12 patients with the third group held endovascular treatment: 6 patients – balloon angioplasty, 1 patient is prolonged intra-arterial catheter therapy, 1 patient – balloon angioplasty and intra-arterial catheter therapy. The average length of stay of a patient in bed was 6.5 ± 0.39 days. There were no deaths.

Thus, examination of patients in a third group showed, that all patients with DFS must hold duplex scanning (dopplerography) and x-rays of the lower limbs, and only when the ultrasonic detection occlusion of lower limb arteries advisable conduction MCT, which complements the picture about the functional status of the arteries of the lower limbs and allows you to define further tactics treatment of patients with occlusion of the arteries in DFS.

In these cases, it is recommended that you perform the balloon angioplasty and stenting arteries of lower extremities with further conducting organ-saving operations, which will preserve the supporting function of the lower limb (Figure 5).

4. Conclusion

When choosing the tactics of treatment of patients with DFS it is advisable to take into account the following:

- Data trunk blood arteries of the foot (absence or presence of at least one of the two arteries – a. dorsalis pedis, a. posterior tibialis) obtained by duplex scanning (dopplerography).

- X-ray data stop with taking into account the stage of the calcification of arteries main arteries of foot – a. dorsalis pedis, posterior tibialis a. with their branches – aa. plantares, a. metatarsea dorsalis prima, r. plantaris profundus, aa. digitales. In the presence of calcification of the arteries 1

- -4 stageone should think about carrying out organ-saving operations on the foot. When identifying the radiography total calcification of arteries 5 stage and the presence of arterial blood flow, one should think about maintaining the supporting function by performing a transmetatarsal resection of the foot by Sharp. Identifying the same total calcification of the arteries in the absence of arterial blood flow may be indication for holding large amputation at the level of the thigh and drumstick. According to ultrasonography vessels taking into account the main blood flow of the foot and radiography taking into account the stage of calcification of the arteries, it is possible to predict the further course of the disease with DFS and DGLL, but the absence of calcification of the arteries does not exclude the severe course of the diabetic foot syndrome (DFS), which can result in a large amputation.

Figure 5. Multislice computed tomography of the arteries. Occlusion of the right posterior tibial artery, uneven contraction of the right front tibial and both small tibial arteries. Stage of balloon angioplasty and stenting.

- Radioisotope studies (resorption is there 50% technetium for 30 min). In terms of the practical application of radioisotope study was most

effective in cases where the radiography calcification of arteries and the absence of arterial blood flow of the arteries of the foot.

- Results of MCT of arteries in case of detection in print duplex occlusion of lower extremities arteries. Treatment in these cases should be directed to the preservation of the support functions of the lower limb by holding a balloon angioplasty, stenting arteries of the lower extremity and only in the subsequent carrying out organ-saving operations on the foot.

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