



## THE EFFECTIVENESS OF SELECTIVE INTRA-ARTERIAL CATHETER THERAPY IN THE TREATMENT OF DIABETIC GANGRENE OF THE LOWER EXTREMITIES

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### Abstract

The problems of treatment of patients with occlusive-stenotic diseases of the peripheral arteries of the lower extremities against the background of diabetes mellitus (DM) occupy one of the main places among the problems that must be fulfilled in modern surgery. The number of people with diabetes is constantly increasing [1,3]. In recent years, reconstructive and X-ray endovascular operations on the peripheral arteries of the lower extremities have become widespread, which in many cases can significantly improve the quality of life of patients with gangrene of the lower extremities.

Despite the presence of newly developed methods in modern angiosurgery and x-ray endovascular methods of treating patients with gangrene due to diabetes, the frequency of limb amputation in this category of patients reaches 23% and does not tend to decrease [4]. From year to year, the number of upper limb amputations varies from 13.7 to 32.3 per 100,000 people in economically developed countries [10].

Diabetic gangrene of the lower extremities is a severe complication of diabetic foot syndrome. The severity of this complication is determined not only by the mental trauma caused by the loss of a leg and awareness of disability, but also by the real risk of the patient's death. Currently, the mortality rate after amputation of the lower limbs is 13-24% [2,6]. According to the literature, amputations performed below the knee joint are accompanied by repeated amputations in almost 40% of patients. 30-35% of operated patients have postoperative complications of the node after upper amputations [7,9].

Damage to the peripheral arterial bed in patients with diabetes is most closely associated with bilateral amputation [8]. Literature data showed that high amputations range from 48.9 to 60%, while according to cohort studies this figure is 24%[11].

The gold standard for the treatment of critical lower limb ischemia threatening limb loss (CLLI) today is surgical revascularization of the peripheral arteries (endovascular treatment), but this method can only be used in patients with good distal recipient vessels without severe concomitant pathology. The prospects of balloon angioplasty





are determined by the following factors: achieving adequate results at lower costs, low complication rates, the possibility of repeated re-interventions and low mortality. All this opens up great opportunities for the use of this method in the treatment of CIUP [8].

Despite the centuries-long history of amputation, a large number of scientific studies, the treatment of patients with gangrene of the lower extremity due to diabetes is an unresolved and extremely relevant not only in surgery, but also a social problem [9,10].

In this regard, the purpose of this study was to evaluate the effectiveness of selective intra-arterial catheter therapy (SICT) in the treatment of patients with gangrene of the lower extremities due to diabetes.

### **Material and research methods**

Our study analyzed the results of inpatient treatment of 63 patients for 2019-2021. with gangrene of the lower extremities against the background of DBS in the department of purulent surgery and surgical complications of diabetes mellitus at the multidisciplinary clinic of the Tashkent Medical Academy. All patients suffered from type 2 diabetes mellitus. In 73% of cases (46), patients received insulin to correct blood sugar.

The average duration of the disease was  $14.7 \pm 5.2$  years. The age of the patients ranged from 43 to 67 years (mean  $56.2 \pm 4.7$  years). Among the patients, there were 49 (77.8%) men and 14 (22.2%) women. The neuroischemic form of diabetic foot syndrome was diagnosed in 51 (81.0%) patients, the ischemic form - in 12 (19%).

The main instrumental method for assessing the state of macrocirculation was duplex scanning of the lower extremities, performed on an ultrasound duplex system Acuson-128 XP/10 (Acuson, USA) using a standard method with a linear sensor with a frequency of 7-15 MHz and multislice computed tomography of the arteries of the lower extremities (MSCT). After determining renal activity and normalizing renal tests (urea, creatinine), all patients underwent MSCT, which was used to determine the segment of localization of stenosis and occlusion of peripheral arteries, the degree of narrowing of the arteries, the extent of the lesion and the exact location of atherosclerotic plaques.

In 19 (30.1%) cases, after identifying the affected segment (occlusion and/or stenosis), patients underwent transluminal balloon angioplasty (TLBAP) of the arteries of the lower extremities. Revascularization of peripheral arteries was performed strictly according to the angiosomal principle. In all cases, patients underwent selective catheterization of peripheral arteries depending on the affected angiosome on the



foot. A distinctive feature of this technique is the installation of a catheter through the popliteal artery (PcA) and this technique creates several favorable conditions for the patient than the standard technique of catheterization through the common femoral artery. Firstly, patients can calmly have a sitting position, secondly, they can move in bed without bending the knee joint, and thirdly, using this technique, we did not observe intraoperative and postoperative complications such as hematoma, pain syndrome, etc. In this case, under angiographic control, the distal part of the catheter is installed in the artery responsible for the blood supply to the foot, which has a purulent-necrotic process (see Fig. 1.). This procedure lasted for 3-5 days and was highly effective compared to the traditional one. Since, we clinically noted a clear regression of the purulent-inflammatory process and signs of compensation for foot ischemia.



**Fig.1. Catheterization of the anterior tibial artery (ATA) and localization of the pathological focus on the foot.**

### **The results obtained and their discussion**

When analyzing the affected segments of the peripheral arterial bed, patients often have damage to two arteries of the leg - the anterior and posterior tibial (APTA and PTA). The appearance of a purulent-necrotic process in the basin of the PBA was observed in 23 (36.5) patients, and in these patients selective catheterization was carried out precisely by the PBA. The localization of the pathological focus in the heel region was noted in 22 (35%) cases, and therefore they underwent catheterization of the spinal cord. Due to total lesions of the foot or combined localization of the process, in 18 (28.5%) patients, catheterization was performed just above the bifurcation of the 3BA – tibio-peroneal segment (TPS) (Table 1).



Table 1. Damage to the arterial segment depending on the nosology

No	Segment Locat. purulent necrotic lesion of the foot	anterior tibial artery	posterior tibial artery	tibio- peroneal segment	Total	$\chi^2$	P
1	Gangrene of fingers	18 (78,2)	3 (13,0)	2 (8,7)	23 (36,5)	0,12	>0,05
2	Gangrene of the heel area	3 (12,5)	16 (66,7)	5 (20,8)	24 (38,1)	0,36	>0,05
3	Gangrene of the entire leg	2 (12,5)	3 (18,7)	11 (68,7)	16 (25,4)	0,07	>0,05
4	Overall	23 (36,5)	22 (35)	18 (28,5)	63	25,20	<0,001

We know theoretically that the STBA plays the main role in the nutrition of the foot, with the exception of cases when there is arterial circulation of the foot according to the type of variant anatomy. In this case, single-stem nutrition of the foot is often found due to one artery of the foot. Damage to the posterior tibial artery (PTAA) was observed in 22 (35%) patients, and this localization of the occlusive-stenotic process was characterized by a malignant course. In these patients, high limb amputations were most often performed (more than half of all amputations (71.4%)) (Table 2).

If we analyze all the amputations performed on the foot and high amputations (lower leg amputation), we can state that in 22 (35%) patients, 63 of them had to undergo some kind of amputation surgery to save part of the foot or limb. At the same time, it was revealed that in patients with gangrene of the fingers, in all cases we managed to preserve the musculoskeletal function of the limb, and when the purulent-necrotic process was localized in the heel area, only 2 (28.6%) patients managed to save the foot. Total damage to the foot led to limb loss in 42.8% of cases (Table 2).

Table 2. Characteristics of operations performed depending on the location of the pathological focus

No	Segment the location of the injury	Finger amputation	Foot amputation	High amputation	Total	$\chi^2$	P
1	Gangrene of fingers	7 (87,5)	1 (12,5)	0	8 (36,4)	0,23	>0,05
2	Gangrene of the heel area	1 (14,3)	1 (14,3)	5 (71,4)	7 (31,8)	0,31	>0,05
3	Gangrene of the entire leg	2 (28,6)	2 (28,6)	3 (42,8)	7 (31,8)	0,09	>0,05
4	Overall	10 (45,4)	4 (18,2)	8 (36,4)	22	17,4	<0,001



In cases of massive tissue damage or severe progressive ischemia of the lower limb, the level of high amputation was determined individually. At the same time, our strategy was to maximize the preservation of the knee joint and in our experiment, amputation at the level of the lower leg was performed in 7 (87.5%) patients out of 8. Patients who underwent high amputation in most cases were patients with gangrene of the heel region, amounting to 62,5%. By preserving the knee joint, we have several advantages than without it:

1. we make it easier for patients to move in bed.
2. high possibility of limb prosthetics.
3. we reduce the number of deaths in the postoperative period.
4. We improve the quality of life for patients with gangrene of the foot due to diabetes.

#### Обсуждение

A comparative analysis of the results of patients who received selective intra-arterial catheter therapy showed that these patients, most often of minor surgical operations on the foot, underwent staged necrectomy (30.6%), due to the appearance of a demarcation line in the affected area for a short period of time and a sharp decrease in purulent -inflammatory process. Despite the treatment procedures performed, high amputation of the lower limb was performed in 8 (12.7%) cases.

Thus, minimally invasive endovascular interventions are the most effective in the treatment of diabetic gangrene of the lower extremities. Carrying out selective intra-arterial catheter therapy taking into account the affected part of the foot by administering drugs after revascularization with improved blood circulation in patients with purulent-necrotic lesions on the foot against the background of critical ischemia increases the chances of preserving the musculoskeletal function of the lower extremities to 88.7%.

#### Conclusions:

1. In patients with diabetic gangrene of the lower extremities and in the presence of purulent-necrotic processes against the background of critical leg ischemia in 81.7% of cases, revascularization of the peripheral artery bed is a highly effective treatment method. , which allows you to save the lower limb.
2. Balloon angioplasty of the peripheral arterial bed with subsequent selective catheterization of the feeding artery for intra-arterial administration of drugs increases the chances of maintaining the supporting function of the limb to 88.7% and reduces mortality by 2.5%.





The combined use of endovascular methods of treatment allows the patient to get the best result, and to preserve the patient's significant potential and the highest quality.

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