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DEFEAT OF ANGIOSOMA IN PURULENT-NECROTIC PROCESSES OF FOOT IN PATIENTS WITH DIABETIC GANGRENE OF LOWER LIMBS

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Purpose: to study the relationship between the lesion of feeding angiosomal arteries and the localization of purulent necrotic process of the feet in patients with diabetic foot syndrome.

Material and research methods: the results of examination and treatment of 119 patients for 2017-2020 are analyzed with purulent-necrotic lesions of the feet against the background of diabetes mellitus received inpatient treatment at the department of purulent surgery of the Tashkent medical academy.

Results and their discussion: according to our studies, with the defeat of feeding arteries, the probability of occurrence of purulent-necrotic complications of diabetic foot syndrome is 95% (in 113 patients out of 119). In most cases, the destruction of plantar arteries (distal branches of the PTA) occurred (47%). In these patients, after restoration of blood flow to the affected angiosomal, good and satisfactory results were obtained. In the basin of the medial plantar artery purulent necrotic process was observed in 29 (90.6%) of 32 patients, lesion of the lateral plantar artery in all cases (100%) led to trophic changes on the foot.

Conclusions: with the defeat of angiosomal arteries, the development of purulent necrotic processes with diabetic gangrene of the lower extremities is noted in 95% of cases. At the same time, the greatest probability of purulent necrotic foci was noted in patients with angiosomal lesions in the PA basin (100%) and ATA (92.2%).

Key words: diabetic mellitus, angiosome, suppur-necrotic process.

ПОРАЖЕНИЕ АНГИОСОМ ПРИ ГНОЙНО-НЕКРОТИЧЕСКИХ ПРОЦЕССАХ СТОП У БОЛЬНЫХ ДИАБЕТИЧЕСКОЙ ГАНГРЕНОЙ НИЖНИХ КОНЕЧНОСТЕЙ

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Цель: изучить взаимосвязь между поражением питающих ангиосомных артерий и локализацией гнойно-некротического процесса стоп у больных с синдромом диабетической стопы.

Материал и методы исследования: проанализированы результаты обследования и лечения 119 больных за 2017-2020 годы с гнойно-некротическими поражениями стоп на фоне сахарного диабета, находившихся на стационарном лечении на кафедре гнойной хирургии Ташкентской медицинской академии.

Результаты и их обсуждение: по данным наших исследований, при поражении питающих артерий вероятность возникновения гнойно-некротических осложнений синдрома диабетической стопы составляет 95% (у 113 больных из 119). В большинстве случаев имела место деструкция подошвенных артерий (дистальных ветвей ПТА) (47%). У этих больных после восстановления кровотока в пораженной ангиосоме получены хорошие и удовлетворительные результаты. В бассейне медиальной подошвенной артерии гнойно-некротический процесс наблюдался у 29 (90,6%) из 32 больных, поражение латеральной подошвенной артерии во всех случаях (100%) приводило к трофическим изменениям на стопе.

Выводы: при поражении ангиосомальных артерий развитие гнойно-некротических процессов с диабетической гангрой нижних конечностей отмечается в 95% случаев. При этом наибольшая вероятность образования гнойно-некротических очагов отмечена у больных с ангиосомным поражением в бассейне ПА (100%) и АТА (92,2%).

Ключевые слова: сахарный диабет, ангиосома, гнойно-некротический процесс.

QANDLI DIABETIK GANGRENASI BO'LGAN BEMORLARDA OYOQLARNING YIRINGLI-NEKROTİK JARAYONLARIDA ANGIOSOMALAR ZARARLANISHI

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Maqsad: diabetik oyoq sindromi bo'lgan bemorlarda ta'minlovchi angiosoma arteriyalarining shikastlanishi va oyoqlarning yiringli-nekrotik jarayonining lokalizatsiyasi o'rtasidagi bog'liqlikni o'rganish.

Tadqiqot materiali va usullari: Toshkent tibbiyot akademiyasi yiringli jarrohlik kafedrasiga yotqizilgan qandli diabet tufayli oyoqning yiringli-nekrotik shikastlanishi bilan kasallangan 2017-2020 yillar davomida 119 nafar bemorni tekshirish va davolash natijalari tahlil qilindi.

Natijalar va muhokamalar: Bizning tadqiqotlarimizga ko'ra, ta'minlovchi arteriyalar shikastlanganda diabetik oyoq sindromining yiringli-nekrotik asoratlari ehtimoli 95% ni tashkil qiladi (119 bemordan 113 tasida). Ko'pgina hollarda plantar arteriyalarining (PTA distal shoxlari) vayron bo'lishi (47%) sodir bo'ldi. Ushbu bemorlarda ta'sirlangan angiosomada qon oqimini tiklashdan so'ng yaxshi va qoniqarli natijalarga erishildi. Medial plantar arteriya havzasida 32 bemorning 29 tasida (90,6%) yiringli-nekrotik jarayon kuzatildi, barcha hollarda (100%) lateral plantar arteriyaning shikastlanishi oyoqda trofik o'zgarishlarga olib keldi.

Xulosa: angiosomal arteriyalar zararlanganda, 95% hollarda pastki ekstremitalarning diabetik gangrenasi bilan yiringli-nekrotik jarayonlarning rivojlanishi kuzatiladi. Shu bilan birga, yiringli-nekrotik o'choqlarning paydo bo'lishining eng yuqori ehtimoli PA (100%) va ATA (92,2%) havzasida angiosomal lezyonlari bo'lgan bemorlarda qayd etilgan.

Kalit so'zlar: qandli diabet, angiosoma, yiringli-nekrotik jarayon.

Relevance. The development of critical ischemia due to the defeat of the arteries of the lower leg and the foot against the background of diabetes mellitus (DM) is associated with a high risk of limb amputation. The consequences of amputations are not only in reducing the quality of life and social interaction, but also in a higher mortality rate compared to patients with preserved limbs. In recent years, the frequency of limb preservation has significantly increased in connection with the technical progress in performing revascularization (endovascular) surgeries in purulent necrotic lesions of the foot.

It is not possible to imagine the cases where the implementation of revascularization surgery, the percentage of amputations with gangrene of the lower extremities is more than 50% over a five-year follow-up period. In the group of patients with successfully performed revascularization, it ranges from 8.5 to 21.2%. To date, the main problem is to find a way to optimize blood flow in the ischemia zone during trophic foot processes. There are different points of view as to how this can be achieved. One of them is the restoration of blood flow to

the maximum possible number of arteries of the shin. Other authors argue that for positive dynamics, it is enough to restore blood flow in two main vessels: the anterior and posterior tibial arteries (ATA and PTA). According to some data, only the restoration of the permeability of the vessel feeding the lesion can lead to a positive result of revascularization.

To date, there is no single point of view regarding the choice of the volume and tactics of revascularization of the limb in critical ischemia against diabetes mellitus. One of the modern theories is the idea of restoration of arterial blood flow, based on the principle of angiosome, developed by Ian Taylor. The principle of angiosome was the division of the entire surface of the body into different parts (angiosomes).

Angiosome - this is part of the tissues, including the skin, subcutaneous tissue, fascia, muscles and bones, which get their food from a certain artery. In total, there are 40 angiosomes in the human body. The foot and the shin can be divided into 7 zones (angiosome), each of which has a blood supply from a certain source (table 1).

Table 1.

Separation of tibia and foot into regions depending on blood supply

No	The area of the lower limb	Source of blood supply
1.	Posterior surface of lower leg	PTA
2.	The front surface of the lower leg and the back of the foot	ATA and the artery of the rear of the foot
3.	Lateral ankle	Popliteal artery (PA)
4.	Lateral part of calcaneal region	Heel branches of PA
5.	The medial part of the calcaneal region	Heel branches of PTA
6.	Plantar surface of foot	Medial and lateral plantar arteries from PTA
7.	First toe	Artery of the rear of the foot and branches from the plantar arteries

Using this principle of the arterial architectonics of the foot structure, it can be assumed that endovascular surgical interventions depending on purulent necrotic lesions of the feet can lead to healing of the ulcerative defect and a decrease in the percentage of amputation in patients with critical ischemia.

However, there is little information in the literature on the dependence of purulent necrotic foci on the lesion of the feeding angiosomal arteries of the foot.

According to the angiosomal principle of the structure in accordance with the localization of ischemic injury of the lower extremities, it is possible to determine the tactics of restoring the arterial blood flow of the affected basin to the most operative intervention, which increases the effectiveness of revascularization.

In this regard, the purpose of our study is to study the relationship between the lesion of feeding angiosomal arteries and the localization of purulent necrotic process of the feet in patients with diabetic foot syndrome.

Material and methods of investigation

The results of examination and treatment of 119 patients for 2017-2020 are analyzed with purulent-necrotic lesions of the feet against the background of diabetes mellitus received inpatient treatment at the Republican Center for Purulent Surgery and Surgical Complications of Diabetes Mellitus at the 2nd Clinic of the Tashkent Medical Academy.

The average duration of diabetes mellitus in patients was 9.8 ± 3.5 years. The age of patients ranged from 51 to 77 years (an average of 62.5 ± 5.7 years). Among the patients, there

were 83 (69.7%) men and 36 (30.3%) women. All patients had purulent necrotic wounds in the area of the foot of various localization and depth. 96 (80.6%) of these patients within 3 months repeatedly received inpatient treatment at the place of residence.

In the examination complex, the main method for evaluating the state of the circulation was ultrasound duplex scanning of the lower extremities performed on an ultrasound duplex system Acuson-128 XP / 10 ("Acuson", USA) by a linear sensor with a frequency of 7-15 MHz. A qualitative assessment of the peripheral arterial blood flow was based on the determination of the presence and type of blood flow in the arteries of the lower leg and foot, while the blood flow was assessed as a major altered, unchanged and collateral trunk. The presence and level of stenosis, occlusion of arteries, degree of occlusive-stenotic lesions of arteries was established. With the help of dopplerography, the ankle-brachial index (ABI) was determined, but its reliability was not sufficient to assess the degree of ischemia in diabetes mellitus due to the prevalence of calcification of peripheral arteries.

Multispiral computer tomography (MSCT) of the lower limb arteries was used for the final evaluation of arterial blood flow and the definition of treatment tactics by a diagnostic method. Depending on the lesion and localization of the occlusal-stenotic segments, the patients underwent transluminal balloon angioplasty (TLBA) of the arteries of the lower limbs. Statistical processing was performed using the variance analysis (Statistica 6.0). Data for $p < 0.05$ were considered reliable.

RESULTS

The analysis of the results obtained made it possible to reveal the role of feeding angiosomal arteries in the event of purulent necrotic lesions on the foot in patients with diabetes mellitus. Immediate results of examination of patients with purulent-necrotic processes of feet with lesions of angiosomal arteries are presented in table 2.

According to our studies, with the defeat of feeding arteries, the probability of occurrence of purulent-necrotic complications of diabetic foot syndrome (DFS) is 95% (in 113 patients out of 119). In most cases, the destruction of plantar arteries (distal branches of the PTA) occurred (47%). In these patients, after restoration of blood flow to the affected angiosomal, good and satisfactory results were ob-

tained. In the basin of the medial plantar artery purulent necrotic process was observed in 29 (90.6%) of 32 patients, lesion of the lateral plantar artery in all cases (100%) led to trophic changes on the foot.

As a result of the analysis, it was revealed that the least number of patients with purulent necrotic changes in the lesion of feeding arteries was observed in patients with trophic processes in the region of the first toe of the foot (84.6%). This is due to the anatomical structure of the architectonics of the arterial network, since this area is the zone of anastomosing the ATA (the rear artery of the foot) and the PTA (perforating branches from the plantar arch). With circulatory failure in this area, ischemia is compensated for by another arterial pool.

Table 2.

The incidence of angiosomal arterial involvement as a function of the lesion of the purulent necrotic process of the foot (n = 119), abs%

№	Angiosoma	Segmental feeding artery	Lesion of feeding artery (angiosomal)	GNPS, (%)
1.	Rear of foot	a.dorsalis pedis	17 (14,3)	17 (100)
2.	Heel area (lateral surface)	r.calcanus a.fibularis	9 (7,5)	9 (100)
3.	Heel area (medial surface)	r.calcanus a.tibialis posterior	21 (17,6)	20 (95,2)
4.	Plantar area (lateral side)	a.plantaris lateralis	24 (20,1)	24 (100)
5.	Plantar area (medial side)	a.plantaris medialis	32 (26,9)	29 (90,6)
6.	Outer ankle	a.fibularis (r.perforans)	3 (2,5)	3 (100)
7.	I finger	a.dorsalis pedis, a.a.plantares (lat et med)	13 (10,9)	11 (84,6)
	Total:		119 (100)	113 (95)

In 20 patients (95.2%) of 21 s with occlusal-stenotic lesions of the feeding calcaneal branch of PTA in the angiosomal region, a purulent necrotic lesion was observed along the medial surface of the calcaneal region of the foot. Only in one patient there were no violations of trophism in this zone. This is due to the compensation of arterial blood flow due to the heel branch from the PA.

The common moment in these three-foot angiosomes (the first finger, the inner surface of the sole and the inner surface of the calcaneal region) is a good development of the connecting arteries ("click vessels") between adja-

cent angiosomal structures, thereby compensating the blood supply of the tissues.

In the remaining four-foot angiosomes (rear of the foot, lateral calcaneal and plantar areas, external ankle region), in all cases (63 patients) the defeat of the feeding arteries led to purulent necrotic processes.

It should be noted that in the purulent-necrotic processes in the external surface of the foot and ankle in all cases (100%), the lesion of the peroneal artery was detected, since the collateral network of these zones is closely connected with the PA and in most cases, when ATA and PTA are affected, the blood circula-

tion is compensated due to the lateral branches of this artery. In the case of occlusal-stenotic lesions of the PA in the area of the external surface of the foot, sub-compensated foot ischemia is noted in all cases.

DISCUSSION

Thus, the analysis of the dependence of purulent-necrotic lesions on the feeding arteries showed that on the foot the lesion of the angiosomal of the PTA pool less often leads to necrotic processes (90%). When lesions of angiosomal arteries are in the basin of the distal segment of the PA, purulent-necrotic lesions are observed in all 12 (100%) cases. The defeat of ATA in our studies in 92.2% of cases led to the development of purulent-necrotic process in the angiosomal structures of the foot.

The analysis of the obtained results of patients with purulent necrotic processes depending on the lesion of angiosomal arteries showed that the appearance of trophic processes on the foot is most often observed with occlusive-stenotic changes in angiosomes associated with PA (100%) and ATA (92.2%).

Analysis of the onset of purulent-necrotic changes in the foot in patients with impaired blood flow in the PTA made it possible to establish a high compensatory role of the plantar branches on the foot. Combined lesion of PTA with PA leads to decompensation of arterial blood flow in angiosomes associated with these arteries.

CONCLUSIONS:

1. With the defeat of angiosomal arteries, the development of purulent necrotic processes with diabetic gangrene of the lower extremities is noted in 95% of cases. At the same time, the greatest probability of purulent necrotic foci was noted in patients with angiosomal lesions in the PA basin (100%) and ATA (92.2%).

2. In 5% of cases with lesions of feeding arteries in patients with diabetes mellitus, pu-

rule necrotic changes were not detected, which indicates compensation of the circulation of the corresponding zones at the expense of neighboring angiosomal arteries through the connecting arteries.

3. Further development of the study of the types of circulation of the foot and the degree of compensation of arterial blood flow with the identification of critical angiosomes in our opinion will lead to an improvement in the results of treatment with diabetic gangrene of the lower extremities.

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