

Plasma flow treatment of the diabetic foot.**Kheladze Z., Kistauri A., Jaiani S., Tsutskiridze B., Kheladze Zv., Devidze G.
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Combined use of plasma flow (Zv.Khelade at all. „New usage of Plasma flow” producer 2008.06.26 #4825) and the traditional methods gave the opportunity to achieve the high effectiveness of the treatment: -decreased dryness of the skin, paleness of the skin and cyanosis, and warming up of the extremity if the ischemic form takes place; -decreased pain in the damaged extremities, and total vanishing of the pain in 7 cases; -decreased swollenness in 11 patients, and total liquidation in 6 cases; it lowered demarcation zone in 15 patients; -in 12 cases the size of ulcers was decreased, and in 5 cases – they were completely treated; -recovered pulsation of the art. tibialis post. and art. dorsalis pedis in 17 patients. The use of given method in the patients with DM and DFS allows the stabilization of the level of glycemia and lowers the dose of hypoglycemic drugs, or lowers the level of sugar in the blood when using the previous doses of the hypoglycemic drugs. Combined treatment improves hemodynamics, increases the level of energy shift in the nervous tissue, widens the contracted blood vessels, gives anti-inflammatory effect and improves the subjective self-appraisal of the patient.

Key words: plasma flow therapy, diabetic foot.

Actuality

Currently all countries of the world the “pandemic” diabetes mellitus (DM) are signalized. According to WHO, in 2000th year, there were 160 million people with DM, and they are assuming that by the end of 2010 year there will be 230 million patients (9, 10).

The Diabetic Foot Syndrome (DFS) is the pathologic statement of the foot at the patients with DM and there are putrescent necrotic processes, pierces of ulcers and bone-joints on the foot, which is also caused by the changes of peripheral nerves, vessels, skin and soft tissues, bones and joints. DFS occurs in 8-10% of the patients with DM and 40-50% of them can be related to the risk group. At DM DFS occurs 10 times often in the patients with secondary diseases. In 47% of these patients the treatment starts later than necessary. The result from this is the amputation of the limb, rise of lethality frequency by 2 times and the further prices of treatment and rehabilitation which are 3 times higher. In the patients with DM, the frequency of non-trauma amputations is 10-15 times higher than in total population. The hospital lethality of the “high” amputations is 45-50%. And the percentage of the patients who stayed alive for more than 5 years does not exceed 50% (2, 4, 8).

Perfecting the tactics of diagnosing, hospitalization and treatment makes it possible to reduce the frequency of amputations by 43-85%. DFS occurs in the patients with DM type 1 mostly after 7-10 years from the evolving of the disease, in the patients with DM type 2 it may occur from the beginning of the disease and it may cause the ulcers of the different heaviness to develop in 85% of the cases. Generally, DFS occurs in 4-10% of the patients with DM and is the main reason of amputating the limbs in this contingent of patients.

The pathogenesis of DFS is multi-componential and is represented with neuropathy and perfusion changes with the expressed deviation to infections. There are three clinical forms of diabetic foot:

- neuropathic
- neuroischemic
- mixed

The neuropathic form of DFS is the most often and amounts to 60-70% of all cases. Pure ischemic form of DFS occurs in 3-7% of the cases. In the 15-20% of cases there are mixed forms and it is typical to detect symptoms of both forms. Last years, the researches and positive therapeutic results were achieved for DFS treatment thanks to the team-work including endocrinologist, general surgeon, joint surgeons, orthopedist and dermatologist. As a result the amount of "high" amputations decreased by 4 times in the Scandinavian countries after installing this method, and in the USA it decreased by 8 times (1, 3, 7).

Today, the tactic of controlling this kind of patients is related to the following aspects:

through compensation of DM and metabolic infraction;

anti-aggregate therapy;

treatment with nicotine acid;

anti-neuropathic arrangements;

categorical disavowal of smoking;

intensive rational anti-inflammation therapy, desintoxication, passive and active immunization, enzymatic therapy, immunomodulating therapy (2, 5, 6, 7).

Despite this, it is obvious that the treatment for DFS needs further optimization. In our opinion, it is very perspective to add methods of local coercion on the damaged area to the complex of treating arrangements, especially when putrescent necrotic complications occur. Related to this, after 2005 year we started using plasma irradiation with plasma flow (PF) on the pieced area of the limb in patients with DFS.

The goal of the research was to rate the results of efficiency of the outside irradiation with PF of the damaged area of the limb in patients with DM; stating the possibility of improvement of the results of treating DM patients with DFS and angiopathy by PF.

Material and methods

We treated 97 patients with MD with DFS and angiopathy during 2005-2009 years. All patients had diabetic neuropathy, 60 patients had DFS and 37 had macroangiopathy of the low limb. The following program was used for examination of the patients with diabetic foot:

- General clinic analyses of the blood and urine;
- Specialists' inspection: endocrinologist, surgeon;
- Consultation of neuropathologist;
- Consultation of ophthalmologist (inspection of the eye bottom);
- Measuring the ankle-brachial index (doppler apparatus);
- Measuring the tension of transcutaneous oxygen;

- Ascertaining glycemic profile;
- Ascertaining of the blood lipids: cholesterol level, triglycerides.

On the patients with not existing pulse on the arteries of knee and with ulcer defects:

- Ultrasound dopplerography of arteries of the low limbs;
- Consultation of angiologist;
- Microbiologic research of the damaged area;
- Roentgenography;
- Consultation of orthopedist.

The 78 patients were treated with the routine schemes of treatment (group #1). The conservative treatment with the PF was used on the 19 patients (group #2). The argon based apparatus of plasma irradiation was used (Zv.Khelade at all. „New usage of Plasma flow producer 2008.06.26 #4825) . The basic of it is that it leads the flow of inert gas through electric arc. The gas basks till very high temperature (3000-4000⁰C) and transits into the whole new statement which is plasma. It comes out through the pointed top of the plasma manipulator-microplasmotrone with a narrow flow that creates a luminary fire torch of 15-25 mm length and temperature at the top is 1800-2000⁰C and higher. The temperature critically decreases as it moves slowly away from the top and after some mm it does not exceed 30-35⁰C (patent – P 2075 31.03.1998 y. “Materials of treatment of pathologic processes”). The method was based on 5 or 10 PF irradiation courses of the low limb zones from the middle third part of the knee and more distally, till the foot toes. The “plasma irradiation” regime was used, and irradiation was daily, and lasted 5-7 minutes. The temperature of the plasma ray on the surfaces of the skin tissue was safe and compiled 36-38⁰C, and the method did not need any preparation and did not depend on the condition of the patient. The whole course of treatment lasted for 25 days.

DFS therapy also included the base (necessary for all patients) and additional (only testified) arrangements.

The base treatments are:

Prophylactic of polyneuropathy: control of glucose, pressure, lipids;
Arthritic care of foot;
Lowering the pressure on the foot;
Endovascular treatment of the diabetic foot

The additional treatments are:

Antimicrobial therapy;
Treatment of pain syndrome;
Treatment of neuropathy;
Healing pressure reduction and immobilizing of foot;
Treatment of angiopathy;
Local treatment of ulcers and wounds

Table #1. Age and sex of patients in group #1.

Sex	Men		Women		Total	
	Amount	%	Amount	%	Amount	%
Age						
30-39	3	5.8	-	-	3	3.8
40-49	5	9.6	3	11.5	8	10.2
50-59	7	13.4	5	19.2	12	15.4
60-69	20	38.5	12	46.2	32	41.1
>70	17	32.7	6	23.1	23	29.5
Total	52	100	26	100	78	100

Table #2. Share of diseases in patients (group #1).

Diagnose	Number of patients	
	Amount	%
DFS	47	60.3
Angiopathy	31	39.7
Total	78	100

Table #3. Age and sex of patients in group #2.

Sex	Men		Women		Total	
	Amount	%	Amount	%	Amount	%
Age						
30-39	-	-	-	-	-	-
40-49	2	14.3	-	-	2	10.5
50-59	3	21.4	-	-	3	15.8
60-69	3	21.4	2	40.0	5	26.3
>70	6	42.9	3	21.0	9	47.4
Total	14	100	5	100	19	100

Table #4. Share of diseases in patients (group #2).

Diagnose	Number of patients	
	Amount	%
DFS	13	68.4
Angiopathy	6	31.6
Total	19	100

Table #5. Using plasma in treating the patients in group #2.

Area of use	Number of patients	
	Amount	%
Fingers	13	68.4
Angiopathy	6	31.6
Total	19	100

Results

On the background of using plasma rays the amount of glucose was normalized in blood and lowered glucosuria. The lowered temperature in feet was decreased, the weakness in feet while walking, syndrome of transition joint, trophic changes, dryness of the skin of the shank and feet, cyanosis, the hair started growing, the blood pressure was normalized and pulsation on arteria tibialis posterior and arteria dorsalis pedis was recovered.

Table #7. Laboratorial changes in patients (group #2).

Glucose in Blood mmol/l		Glucose in gr/%		Albumen in urine gr/%		Arterial pressure	
before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment
8.5-11.5	6.0-8.0	under 0.5	-	0.03-0.09	-	120/90- 150/100	110/70- 120/80
11.5-15.5	8.5-9.5	0.5-1.2	under 0.3	0.1-0.7	marks	150/110- 180/130	120/80- 130/90
15.5 and higher	9.5-10.5	1.2 and higher	under 0.6	0.8 and higher	0.08-0.15	180/130 or higher	under 150/100

In group #2 of the patients with diabetic nephropathy in 9 cases albuminuria was changed into microalbuminuria and in 10 cases normalalbuminuria was found. All patients of this group with neuropathy have had a pain syndrome in distal parts of extremities. Paresthesia, feeling numbness and cold, weakness and heaviness in the lower extremities were also decreased. 7 patients have had tonic convulsions in the shank muscles. In 3 patients sinew and periosteal reflexes were recovered, Achilles and knee reflexes mainly. Sweat secretion, growth of hair and nails on feet was normalized and scaly skin was decreased.

After finishing the treatment with the use of PF in the patients with DFS we have achieved these results (table # 8 and 9)

Table #8. Results of treatment in patients (group #2).

Clinical symptoms	Totally cured (patients' number)	Lowered (patients' number)	Without changes (patients' number)
Pain	7	10	2
Oedema	6	11	2
Demarcation	4	11	4
Ulceration	5	12	2

Table #9. Results of treatment in patients (group #2).

Name of the artery	Fully recovered pulsation	Partially recovered pulsation	Without changes
a. tibialis post. et a. dorsalis pedis.	3	14	2

For more acceptances the following example was done: a 65 year-old patient, diagnose – Diabetes Mellitus II type, diabetic neuropathy, macro-micro angiopathy, functional failure of arterial bloodstream in lower extremities IV level (Fontain), trophical ulcer of the right lateral foot. The patient has diabetes mellitus for 15 years. He was on peroral therapy. 1 month ago, the patient was assigned to insulin-therapy in order to treat the progressing necrotic-ulcer process or the right foot, which was developing spontaneously. The standard treatments, done before coming to our clinic, ended unsuccessfully and the dynamics were negative (pic.1), and the patient might have needed the amputation of the 2/3 part of the leg. We have provided a therapy with the use of PFs, in the process of which the positive dynamics were seen (pic.2). The late result of this therapy was also positive (pic.3). Currently, the patient has practically rehabilitated and is under our supervision. He has recovered the function of the extremity.

Picture #1**Picture #2**

Picture #3**Picture #4****Conclusions.**

Thus, the combined use of PF and the traditional methods gave the opportunity to achieve the high effectiveness of the treatment:

- decreased dryness of the skin, paleness of the skin and cyanosis, and warming up of the extremity if the ischemic form takes place;
- decreased pain in the damaged extremities, and total vanishing of the pain in 7 cases;
- decreased swollenness in 11 patients, and total liquidation in 6 cases;
- lowered demarcation zone in 15 patients;
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The use of given method in the patients with DM and DFS allows the stabilization of the level of glycemia and lowers the dose of hypoglycemic drugs, or lowers the level of sugar in the blood when using the previous doses of the hypoglycemic drugs. Combined treatment improves hemodynamics, increases the level of energy shift in the nervous tissue, widens the contracted blood vessels, gives anti-inflammatory effect and improves the subjective self-appraisal of the patient.

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**დიაბეტური ტერფის მკურნალობა პლაზმური ნაკადით.
ზ.ხელაძე, ა.ქისტაური, ს.ჯაიანი, ბ.ცუცქირიძე, ზ.ხელაძე, გ.დევციძე.
კრიტიკული მედიცინის ინსტიტუტი. თბილისი. საქართველო.**

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