

## **The analysis of efficiency of application of interval vacuum therapy on the device VACUMED® in patients with diabetic foot infections**

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**Relevance.** In illness patterns of residents in economically developed countries the diabetes mellitus (DM) is high on the list. Its prevalence rate is 1,5–6%. The lower body affects of various genesis occur in 30–80% of persons with broken carbohydrate exchange. In many cases these affects are complicated by development of chronic ulcer defects that at untimely diagnostics and inadequate treatment lead to amputation of the affected extremity. Each hour in the world there are 55 amputations of the lower extremities in patients with diabetes mellitus [1-3]. Despite considerable achievements in the field of studying of pathogenesis of diabetes mellitus and its complications, the number of amputations of feet at diabetes grows. The first risen ulcer defect on foot, as a rule, passes into the recurrent one. During 5 years ulcer defects recur in 70% of cases [4]. A lot of things are reached in the field of treatment of diabetic affects of feet: the multidisciplinary approaches to treatment are developed, the number of experts-podiatrists engaged in care of foot is increased, the modern antibiotics and means of local treatment, medical bandages are available, the system of adaptation training works because of this chronic disease [5].

Interval vacuum therapy was used first by experts of NASA in 60-s in the form of the device for supplying of negative pressure on lower body (low body negative pressure device) for preservation of perfusion of the lower extremity in astronauts during flight at influence of zero gravity [6, 7], and also for restoration of pressosensitive reflex and tonus of veins of the lower extremities after flights [8-10]. On the basis of NASA developments and together with the German Space Agency, the "land" version of the device, named Vacumed, for treatment of a number of diseases in which vascular disorders play the main pathogenetic role, was created. The operating principle of the device consists in creation of periodically supplied pulsing negative pressure in the range from -20 to -70 Mbar in the cylindrical camera in which the lower extremities of the patient are placed. The pump provides alternation of negative and atmospheric pressure with the set interval (duration of phases from 2 to 30 seconds). When supplying negative pressure (5–12 seconds, 2-7 times per minute) sucking-on operation of the device causes a dilatation of capillaries, filling of arteries and lymphatic vessels, strengthening of blood circulation and oxygenation of the lower extremities, especially at the microcirculatory level. In phase of atmospheric pressure lasting 4-9 seconds, 2 - 7 times per minute, there is a compression of veins and acceleration

of bloodstream. At increase in intervals of negative pressure the filling of arteries increases, at increase in time of normal pressure the venous and lymphatic return increases. Thus the effect of interval vacuum therapy is expressed in increase in peripheral perfusion, increase of lymph outflow, and respectively, acceleration of wound healing [7, 11-13].

**Objective of this research** was the assessment of efficiency of application of interval vacuum therapy on the device VACUMED® in patients with diabetic foot infections.

**Materials and methods.** The research included 82 patients (from them 37% –men, 63% – women) with diabetic foot infections. Average age of patients was 60,1±12,6 years.

After medical examination and verification of diagnosis according to diagnostic criteria of American Diabetes Association DAIINF Study Group, the vacuum therapy on the device VACUMED® was ordered as a part of complex treatment, in number of 10 sessions for 20 minutes with negative pressure of -30 - 40 mm Hg with intervals 2-4 days, 2-3 courses and more within a year.

Classification of diabetic foot infections is presented according to Wagner [14, 15]. During research the dynamics of such indicators as macrocirculation in the lower extremities according to Ultrasonic dopplerography (USDG), arterial pressure and intensity of a sharp pain syndrome in the lower extremities according to Numerical Rating Scale of pain (NRS), was estimated. Statistical processing was carried out in the program SPSS, version 20.0 for Windows (IBM Ireland Product Distribution Limited, Ireland).

### Results.

The main demographic and anamnestic characteristics of research participants are presented in Tables 1 and 2.

**Table 1. Main demographic characteristics of participants of research (n-82)**

Age	60.1±12,6
Gender	
Male	37%
Female	63%
Nationality	
Kazakh	80%
Russian	15%
Other	5%
Educational level	
Secondary	10%
Secondary technical	25%
Higher	65%

**Table 2. Main anamnestic data of participants of research (n-82)**

Diagnosis Type 2 diabetes mellitus, diabetic foot infections, neuropathic form	56%
Type 2 diabetes mellitus, diabetic foot infections, ischemic form	18%
Type 2 diabetes mellitus, diabetic foot infections, neuroischemic form	26%
Assessment of pain in the lower extremities	8.8±1.2
Smoking Yes	4%
No	96%
Duration of disease 1-5 years	4%
5-10 years	6%
More than 10 years	90%
Glycosylated hemoglobin (HbA1C)	7.5±0.5%

Against the carried-out therapy a restoration of microcirculation due to reduction of stenosis presence, increase in a bloodstream and increase of amplitude by 35% against initial 55-60% ( $p < 0,01$ ), and also restoration of the main type of bloodstream on peripheral arteries was noted (Figure – 1).

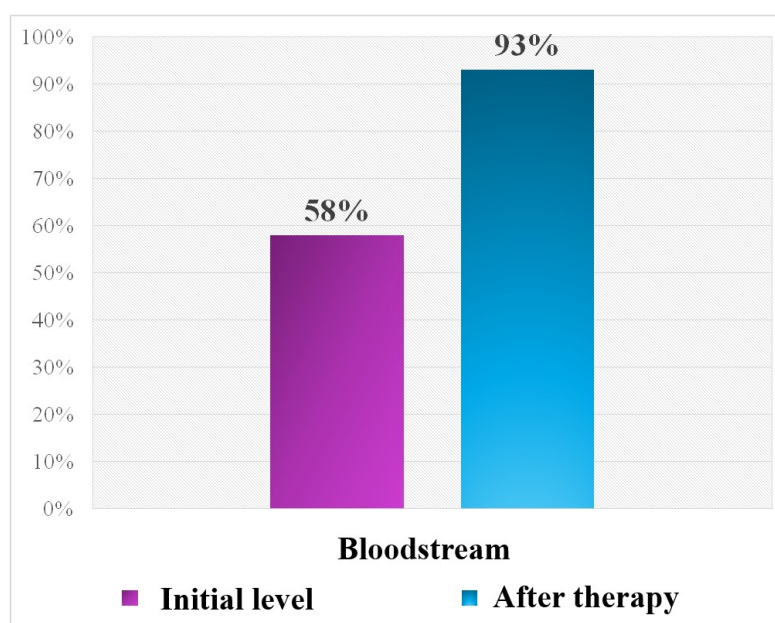


Figure 1 – Reduction of stenosis presence

Decrease in intensity of sharp pain syndrome in the lower extremities was an important component in the assessment of efficiency of procedures. Before treatment and after carried-out therapy the assessment according to Numerical Rating Scale of pain which showed significant decrease in pain more than by 3

points in the first days of treatment and essential decrease in pain more than by 5 points on the 10th day of therapy (Figure – 2) was carried out.

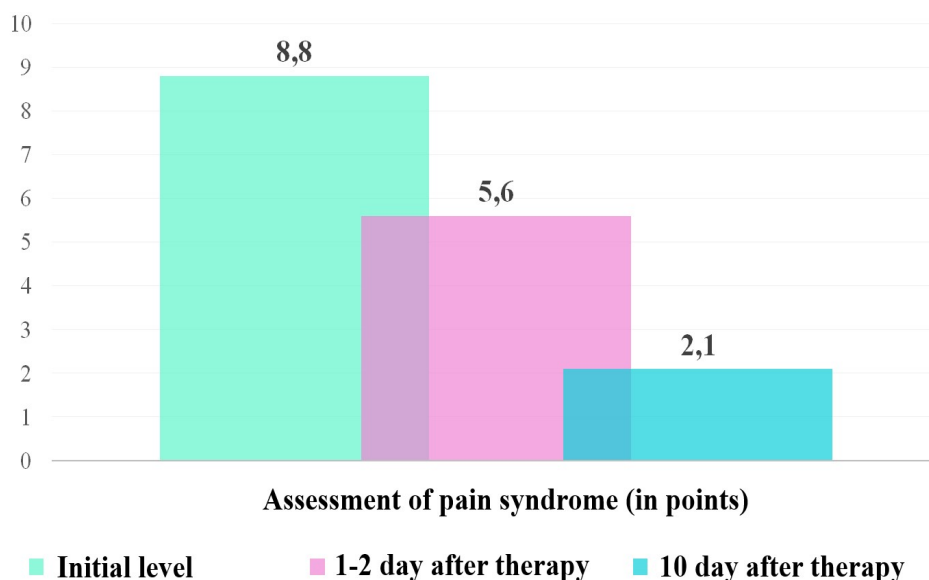


Figure 2 – Assessment of pain according to Numerical Rating Scale (NRS)

In addition, reduction of such symptoms as hypostasis and feeling of weight in the lower extremities was noted.

The positive effect was noted in normalization of indicators of systolic and diastolic arterial pressure till  $120 \pm 10$  mm Hg and  $85 \pm 5$  mm Hg against initial indicators of systolic  $150 \pm 12$  mm Hg and diastolic  $90 \pm 5$  mm Hg ( $p < 0,05$ ) types of arterial pressure (Figure – 3).

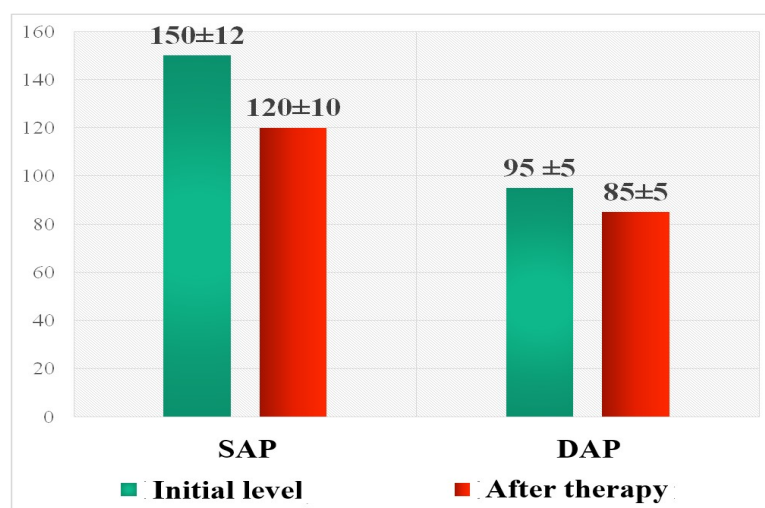


Figure 3 – Indicators of systolic and diastolic AP (mm Hg)

Against the carried-out treatment in the most part of patients with significant ulcer defects the epithelialization of defects, in the anamnesis resistant to other types of complex therapy, was observed (Figure – 4).

Figure 4 – Dynamics of epithelialization of ulcer defects in patients with diabetic foot infections against application of vacuum therapy on the device VACUMED®

**Conclusion.** Results of research allow speaking about efficiency of application of interval vacuum therapy on the device VACUMED® in patients with diabetic foot infections. Introduction of this method to the protocol of therapy of diabetic foot infections will promote decrease in the number of such consequences as amputations of the affected extremity.

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