

## **DIABETIC FOOT – PHENOMENON OR COMPLICATIONS OF DIABETES.**

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The medical literature and the daily practice already have the perception that certain symptoms occurring on the foot in patients that had Diabetes must be considered as an individual complex of symptoms, but not only as complications of different type associated with the development of the Diabetes. The Diabetic foot can be defined as a “phenomenon” of the Diabetes.

The topicality of the problem of this more and more frequently found, socially significant disease is justified by the famous Saint-Vincent declaration (from 1989).

In the report of the Committee on diabetes by the experts of the World Health Organization it had been sad that more than 25% of the people suffering of Diabetes had different complications on their feet. The necrotic and the suppurative complications on the feet in patients that had Diabetes is the reason for more than 83% of the high amputations of the lower limb and the high risk of death (10-15%).

In the world there are more than 200 millions of people that had diabetes, in Bulgaria they are more than 300 000 (around 4% of our population). While in Diabetes type I the main risk factor is the heredity, in Diabetes type II the knowing of the risks is essential for treatment, protection and prevention of this dangerous, socially significant disease. The main risk factor is the overweight, which can be seen in  $\frac{3}{4}$  of the diabetics. In man the waist size mustn't be over 94 cm (37 inch) and in women – 80 cm (31.5 inch). The second risk factor is the obesity, which is closely related to pathological changes in the lipid metabolism – hypercholesterolemia and dyslipidaemia. The third risk factor is the lack of movement, which combined with excessive intake of high-calorie food, leads also to overweight. Fourth is the arterial hypertension, which can be combined with Diabetes in 50% of the cases. Stress, different types of depressions, heredity are determined as risk factors.

The Diabetic polyneuropathy is a disease of the peripheral sensory, motor and autonomic nervous system. It is the most common specific complication of Diabetes – in more than 50% of all cases. Nerves in different parts of the body can be affected, but most often – those on the lower extremities. The most common form of the Diabetic polyneuropathy is the so called peripheral, distal, symmetric neuropathy.[1, 2] It starts gradually and the main symptoms are numbness, tingling, decreased sensitivity to touch, pain and temperature. Sometimes there is pain that patients describe as shooting, stabbing, burning. It appears mainly in the night and at rest, which is typical for that illness. In some cases it can be so strong that this can be the symptom for the patient to start searching for the first time help from a vascular surgeon. There is also muscular weakness, cramps on the lower extremities, difficulty of movement gait disturbances. Unlike the rich symptoms the objective examinations and the dopplersonographie (DSG) doesn't show any significant homodynamic disruptions on the arteries in the extremities. The vascular lesions are on the level of arterioles, precapillary and capillary were a specific for diabetes thickening on the basal membrane is found, however in most of the cases a full obliteration of the blood vessels can not be found.[1]

To form the syndrome of Neuropathic Diabetic foot a specific configuration of the foot must be developed (typical deformation with hyperkeratosis (corns) because of the development of the atypical plantar overloading). Fissures and cracks often appear near the corns also atypical deformations. Micro traumas, fungal infections between the toes and different minimal injuries while wearing uncomfortable shoes are often. All of those can be a gateway for trivial infections which in a combination with poorly treated diabetes can lead to phlegmon and gangrene of the feet. A typical ulcer is formed in the points of highest load surrounded by hyperkeratosis, which is almost always infected. In the World on every 30 seconds a high amputation is performed. Between

15 and 25% of the diabetics develop during their life an ulcer. The data shows that one of every ten diabetics had a Diabetic foot and nearly 2% had at least one amputation because of that. People who had Diabetes type II are with 21 times higher risk of having a non-traumatic amputation in comparison to the normal population of the country. The injury on the feet leads to increasing morbidity, restriction of quality of life and very high costs for treatment. These wounds carry the highest risk of amputations for diabetics. [15,18]

The infections of the Diabetic foot (IDF) usually start in wound and most often in neuropath ulceration. They are classified as mild (superficial and limited in size and depth), moderate (deep and extensive) and severe (accompanied by systemic symptoms and metabolic disorders) according to the new instructions of IDSA (Infectious Diseases Society of America) for diagnostics and treatment of IDF publicized in the Clinical Infectious Diseases magazine [4].

Most of the IDF are polymicrobial. The most common agents are aerobic Gram (+) positive cocci (GPC), especially staphylococci. The aerobic Gram (-) negative bacteria are pathogens that often accompany chronic infection or after antibiotic treatment. Obligate anaerobes are found as accompanying pathogens in ischemic or necrotic wounds.

**I. The following criteria can be referred to the presence of IDF:**

1. In patients with Diabetes who also had wounds on their feet must be suspected for infections. The diagnosis is made on the basis of the classic signs for local inflammation (erythema, edema, warming, pain) or on the base of suppuration. Secondary signs are: non pus secretion, pale granulation tissue, unclear boundaries of the wound, odor.
2. Factors that increase the risk for IDF: osteomyelitis (the negative result of the probe to bone test – PTB exclude the presence of osteomyelitis); traumatic wounds on the feet; the presence of peripheral vascular disease on the affected limb; previous low amputation of lower limb; loss of protective reflexes in the area; the presence of renal failure.
3. In their practice, physicians should use classifications as PEDIS \* and IDSA \*, to define the infection and to determine a mixed in type and severity pathology \*.

DFI Wound Score\*\* can provide additional qualitative indicators for research purposes. Other systems for classification of IDF have limited significance because they can only mark the presence or absence of inflammation.

The most frequently used scale for classification of the Diabetic foot is Wagner’s. Harkles’s modifies it pathogenically in two groups: “A” for lesions without chronic obstruction of the peripheral arteries in which the outcome is better. The “B” subgroup include lesions that had ischemic genesis and are with poorer outcomes.[5, 6]

Table 1. Wagner’s classification of Diabetic foot, modified by Harkles – H.

Stages	H	Lesions	Complications	Inflammation
Stage 0		Deformation hyperkeratosis		none
Stage I	A/B	Superficial lesions		none
Stage II	A/B	Deep lesions	Bone, tendon or joint capsule are affected	Moderately
Stage III	A/B	Deep lesions	Abscess or osteomyelitis	Greatly
Stage IV	A/B	Gangrene of the toes or the front part of the sole	Abscess or osteomyelitis	With/without
Stage V	A/B	Gangrene of the entire foot		

## **II. Evaluation of patients with IDF.**

1. Patients with IDF should be examined and analyzed in three main areas: general condition, condition of the Diabetic foot, grade and severity of the infection.
2. The diagnosis infection may be set in the presence of at least two symptoms (erythema, edema, warming, pain) or suppuration. The degree of the infection should be classified according to the spread, the depth and the presence of systemic symptoms \*.
3. It is recommended that the affected limb should be examined for arterial ischemia, venous insufficiency, the presence or absence of protective response and biomechanical problems.
4. Every wound that had necrosis should be put under excision, no matter of their size.

## **III. Consultation of patients with IDF.**

1. There should be a multilateral approach in the diagnosis and treatment of the IDF. The consultation with specialists should include: infectious diseases specialist, microbiologist and a surgeon or a vascular surgeon with experience in the treatment of the Diabetic foot.
2. If there is a limb ischemia a consultation with a vascular surgeon is necessary for possible revascularization.

## **IV. Criteria for hospitalization and hospital discharge.**

1. All patients with severe infections as well as patients with moderate infection with complications (for example peripheral vascular disease) should be hospitalized.
2. Hospital discharge should be performed after surgical treatment, after effective control of the blood sugar, prescribed antibiotic therapy, given instructions on how to change their bandages and recommendations for postoperative observation.

## **V. Microbiological tests.**

1. In the absence of clinical evidence for infection of the tissues or bone matter it is not recommended taking material for Microbiology.
2. If there is evidence for infection it is necessary to take material for microbiology test before starting the antibiotic treatment.
3. It is recommended that the material taken for microbiology test should be from the deep tissues, biopsy or curettage after the cleaning and the debridement of the tissues.

## **VI. Modification of the antibiotic therapy.**

1. In the absence of clinical data for infection of the wound it is not recommended an antibiotic therapy.
2. Antibiotic therapy should be prescribed if there are infected wounds and should be combined with surgical treatment.
3. Empirical choice of the antibiotic therapy should be based on the severity of the infection and on the suspected agent:
  - In mild and moderate infections in patients that haven't been treated with antibiotics till now it is recommended an antibiotic against Gram (+) positive agents
  - For the most severe forms of the infection it is recommended for the antibiotic treatment to start with a broad-spectrum antibiotics (Gram-positive, Gram-negative, anaerobic pathogens) till the results of the antibiogram
  - A therapy for *Pseudomonas aeruginosa* is not necessary except in patients with high risk of such an infection.
  - Antibiotic therapy against methicillin-resistant *Staphylococcus aureus* (MRSA) can be prescribed in patients with evidence of prior infection with MRSA; clinically severe infection.

4. Antibiotic therapy is chosen on the base of the microbiology results and antibiogram, and according to the clinical response of the patient.
5. In moderate and severe forms of IDF it is recommended parenteral administration of antibiotics. If patients had an improvement oral therapy can be started. Oral form of antibiotic therapy can be administered in mild and some moderate forms of infections; for some mild superficial infections a topical form of the antibiotic can be administered.
6. The antibiotic treatment should continue till the infection is eradicated, but not till full recovery of the wound. In soft tissue infections an initial antibiotic treatment for 1-2 weeks is recommended in the mild cases and for 2-3 weeks for the moderate and severe infections.

#### **VII. Review facility**

1. All patients diagnosed with IDF must have an X-ray on their foot for establishing bone deformities or debris (destructions) and also for the presence of gas-gangrene.
2. The MRI is a method of choice if it is needed a more precise imaging, especially in the presence of an abscess or osteomyelitis.

#### **VIII. Therapy for osteomyelitis in patients with IDF.**

1. Osteomyelitis should be assessed as a potential complication of IDF in the presence of a deep infected wound on the foot, especially when it is located on a convex bone. It occurs at 20% of light and moderate infections, and in 60% of the severe infections. The slow healing of the wound after 6 weeks of proper care and adequate blood supply of the limb also need to assess for the presence of osteomyelitis.
2. If there is a deep wound the probe-to-bone (PTB) test is recommended, which when properly conduct (negative predictive value 0.98) can exclude the presence of osteomyelitis. [2]
3. For proper diagnosis of osteomyelitis in patients with IDF a MRI of the bones is recommended. The X-rays of the foot are with a low sensitivity and specificity for the diagnosis (or rejection) of osteomyelitis. To improve the accuracy several X-rays can be performed.
4. Method for diagnosing the disease is the results from the micro biological and the histological tests of the bone. Bone biopsy is taken when debridement of the bone is not performed because of unclear diagnosis, insufficient information on microbiological testing and failure of empirical antibiotic therapy.
5. Specialists must make a choice between an initial conservative or surgical therapy for IDF in certain groups of patients. The available data doesn't show significant difference between the two methods for treatment of the infection. Surgical intervention can be from minimal (debridement) to maximal (resection or amputation). [13,14]
6. When curative resection is made a short course antibiotic therapy (2-5 days) is recommended. When the infection is persistence or the there is a presence of necrotic areas of the bone, a prolonged antibiotic treatment ( $\geq$  4 weeks) is necessary. When treated conservatively or in the presence of residual necrotic bone tissue following a surgical intervention, the antibiotic therapy should be continuous ( $\geq$  3 months).
7. For the treatment of IDF an additional therapy with hyperbaric chamber, administration of growth factors, topical negative pressure is not necessary.

#### **IX. Indications for surgical interventions.**

1. In moderate and severe forms of IDF, a consultation with a surgeon is necessary.
2. Emergency surgical intervention is necessary in the presence of gas in the deep tissues, abscess or necrotizing fasciitis. In big wounds with necrotic tissue, bone involvement or involvement of the joint a surgical treatment is also necessary (but not so urgent).

3. A consultation with a vascular surgeon is necessary when there is ischemia and especially when there is a critical ischemia of the limb.

#### **X. Wound care and bandages.**

1. The wound care in patients with IDF are consisted of :
  - Performance of debridement primarily surgically.
  - Redistribution of the pressure and relieve of the surface that absorbs a significant part of the burden (especially in plantar wounds).
  - Performing of bandages that allow drying of the wound and monitoring of the secretion; the choice of the bandage must be based on the size, depth and nature of the wound.
2. Application of topical antibiotics for treating a non-infected wound is not recommended. [9,17]
3. Bioengineered skin equivalents, growth factors, granulocyte colony-stimulating factor, local negative pressures (vacuum methods) aren't recommended in order to improve the outcome of infection except in certain patients with IDF and slow-healing wounds.

#### **XI. Treatment of ischemic diabetic foot.**

In established ischemic diabetic foot revascularizations can be performed whit the aim to overcome the ischemic component of the disease. They include TEA, femoro-popliteal and femoral-distal bypasses. Modern methods are the hybrids operations: balloon dilatation with or without grafts on the distal segments of the arteries on the shank. [2,3,14,17]

In conclusion it is necessary to be noted, that the complications in patients with Diabetic foot may be avoid with strict adherence to a few rules for prophylaxis: everyday hygiene of the feet, disinfection with a colloidal silver solution 20 mg / L, drying the spaces between the toes, in the presence of dry skin uses an appropriate cream, use appropriate shoes.[3] In cases of severe deformity of the foot it is necessary to be used special individually made orthopedic shoes .[5,6,7,8,9,12]

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