

Diabetic Foot Treatment by Endocrinologists-our Experience**Merita Emimi Sadiku^{1,2}, Nadije Morina Kuqi, Adem Rama, Sanije Godanci, Aferdita Kukaj, Naser Miftari¹**

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Abstract: Diabetic foot complications are one of the most serious and expensive complications to treat. Lower limb amputations are always preceded by an ulcer. Strategies that include prevention, education of patients and staff, multidisciplinary treatment of diabetic ulcer, and close monitoring can reduce the level of amputation. At the Clinic of Endocrinology of UCCK, multidisciplinary approach of diabetic foot is evident last years, including (in addition to individual education, glycemic control and control of other complications of diabetes which were done earlier) and group education for diabetic foot as part of education diabetic, routine clinical examination for diabetic neuropathy, debridement and local treatment. There are regular professional consultation from vascular and orthopedic specialists, and also physiotherapists. Knowing the lack of podiatrist professionals, some trained endocrinologists do the debridement. In this paper our experience in the diagnostic and therapeutic approach of diabetic foot is presented by several clinical cases, some of which were part of the risk group for amputation.

As a recommendation we emphasize that every patient at least once a year should be examined for foot problems; high-risk patients should be examined more frequently - every 1 to 6 months, depending on the degree of risk; the absence of symptoms (such as pain) does not mean that they are healthy; screening should not necessarily be done by the doctor or podiatrist but also by other trained staff.

Key words: Diabetic foot, endocrinologist, debridement

1. Introduction

Diabetic foot and lower limb complications are one of the most severe and chronic complications of diabetes mellitus. According to International Diabetic Federation (IDF) these complications affect 40 to 60 million people with diabetes globally (IDF, 2020). Chronic ulcers and amputations can affect quality of life and increase the risk of early death.

Around 30% of physicians recognize the signs of diabetes-related peripheral neuropathy and missed diagnoses contribute greatly to the high rates of disease and mortality (IDF, 2020).

The number of foot complications are different between countries in the world and are depended from economic development. 5% of diabetics in developed countries have foot problems whereas 40% in developing countries. 85% of amputations start with ulcers. The percentage of amputations in the world has decreased approximately 49-85% of multidisciplinary prevention programs, diabetic foot education of patients and professional staff.

mities, poor blood supply and injury. All these changes in diabetic patients are based from high blood glucose. Neuropathy is a frequently encountered chronic complication of diabetes. In this way nerve damage can be quite significant and allow injuries to go unnoticed, leading to ulceration, serious infections and in some case amputations (IDF, 2020). Nerve damages can alter from automatic, motor and sensory functions

Diabetic foot is one of the most common, costly and severe complications of diabetes. Based on the IDF data amputation in people with diabetes is 10 to 20 times more common than in people without diabetes and it is estimated that every 30 seconds a lower limb or part of a lower limb is lost somewhere in the world as a consequence of diabetes (IDF, 2017). Appropriate educational program, health services and regular screening for chronic complications can lower the risk for diabetic foot.

2. Methodology and findings

Treatment of diabetic foot by endocrinologists in the Clinic of Endocrinology, University Clinical Center of Kosova, started in 2014, before this period the treatment of diabetic foot was mainly the field of vascular and orthopedics specialists, independently of diabetic ulcer grades classification. In order to have a clear diagnosis and treatment of our patients with diabetic ulcer we follow all the IWGDF recommendations as in following below described. In this research we have illustrated 5 cases from all diabetic patients treated in the Clinic of Endocrinology with different foot ulcers (Table 3 and Figure 5).

2.1 Approach to diabetic foot

In order to have a full information based on recommended of IWGDF we obtain a medical history about: previous ulcer or amputation, level of knowledge for foot care, life and social circumstances, neuropathy needle-like piercing or loss of sensation, vascular diseases: as claudicating, pain at rest, discoloration depending on the position of the legs, presence of deformations and appropriate shoes the patient wears.

Examination of the feet should distinguish the following problems: neuropathy, ischemia, deformation, non-ulcerative pathologies, ulcers or other skin injuries, infection and suitable shoes.

2.2 How the diagnosis of neuropathy and ischemia can be done?

The feet are hot, veins are swollen, and feet dry from decreased sweating. Sensory foot examination at peripheral neuropathy can be detected by using the 10g (5.07 Semmes-Weinstein) 10 g monofilament (detects loss of protective sensation) and a tuning fork (128 Hz, detects loss of vibratory sensation) and cotton (Figure 1). By these examination are able to be classified the levels of

neuropathy at diabetic patients (Table 1, 2).



Figure 1. Feet examination with cotton and vibrating fork

Table 1. Classification of neuropathic ulcers according to NSS (Dycks Neuropathy Symptoms Score) and NIS Neuropathy Impairment Score

Grades	Evaluation of diabetic polyneuropathy
0	No polyneuropathy (clinically no signs and symptoms)
1	Asymptomatic polyneuropathy (no symptoms, but with distinguished clinical signs)
2	Asymptomatic polyneuropathy (distinguished symptoms + signs)
3	Severe polyneuropathy (distinguished symptoms + signs + neuropathic deformities + foot ulcer)

Table 2. Risk categorization system based on International Consensus on Diabetic Foot

Category	Risk profile	Visits at diabetologist/endocrinologist
0	No sensory neuropathy	Once a year
1	Sensory neuropathy	Once in a 6 months
2	Sensory neuropathy and signs of the periferic vascular disease and/or foot deformities	Once in a 3 months
3	Early ulcer	Once a month, once in a 3 months

Ischemia of diabetic foot can be diagnosed by clinical examination. Feet can be cold, examiner has to see for pulses, coloration, edema and atrophy. From the images examination the most important are Doppler ultrasonography, transcutaneous measurement of oxygen (TcPO₂) and duplex angiography. In the meantime, feet have to be examined for deformities.

2.3 How about non-ulcerative pathologies?

During the consultation the examiner should nspect the feet for calluses or hyperkeratosis, fungal infections (tinea pedis), bullous changes, nail deformities (onychogryphosis), returning the nails from the inside and inserting them into the nail flesh (onychocryptosis), nail thickening (onychosis)etc.(Figure 2).



Figure 2. Examination for non-ulcerative pathologies

2.4 What to keep in mind at diabetic ulcer?

Every foot ulcer should be inspected if it is a solitary or multiple ulcers, where is located, what is the magnitude or size of the ulcer also boundaries of the ulcer, depth in millimeters and infiltration of different tissues. It has to be analyzed if there is a granular tissue, purulent or clean base. The state of the bones, ligaments, tendons, leakage as serous, bloody or purulent and the skin which surrounds the ulcer, if there are signs of inflammatory changes like redness, edema (Figure 3). Mobility of foot and ankle is very important to be noticed. It has to be in mind also for clinical signs of infection, obtaining the swab after debridement for microscopy and culture and planning if it is a need for other images examinations like radiography, CT scan or MRI. 50-60% of severe infections and 10-20% of less severe ones are complicated by osteomyelitis.



Figure 3. Diabetic ulcer before the treatment

2.5 What are the principles of treatment?

First of all, for all diabetic ulcer is important removal of pressure on the foot-special shoes (cast contact-if needed, half shoes, shoe layers, shoes at the shoemaker). The aim of the treatment is to ensure perfusion, to treat the infection, control of diabetes and other medical problems, local wound care, education of the patient with diabetes and family members and identification of other causes. Debridement is removal of calluses with scalper by an experienced professional staff. Sometimes there is a need revascularization by bypass-graft angioplasty. In the meantime, it is necessary treatment of high blood pressure, fats, high glycemia and antiaggregant therapy.

2.6 Who can help?

A multidisciplinary team can help diabetic foot treatment: Diabetologist, general surgeon, vascular surgeon, orthopedics, podologist, plastic surgeon, rehabilitation specialist, physiotherapists, microbiologist, dermatologist, psychiatrist, nurse, diabetes educator, special shoe preparation technician and administrators.

2.7 Which are the other types of ulcer treatment?

Except debridement, treatment with silver ions that reduce infection, alginate-absorption of exudates, hydro gels and hydrofibrates, growth factors, bio-engineering leather, hyperbaric chambers with O₂ and treatment of fungal infections are very important for appropriate foot ulcer approach.

2.8 Classification of Diabetic Ulcer

Classification of diabetic ulcer is very important in order to decide about the level of the treatment and professionals from the multidisciplinary team who can deal with appropriate ulcer (Table 3).

Ulcer classification assess the severity of infection using the IWGDF/ISDA classification criteria (Monteiro-Soares, Russell, Boyko, Jeffcoate et al., 2020), and in patients with peripheral artery diseases (PAD) we recommend using the WIfI (wound/ischaemia/infection) system to stratify amputation risk and revascularization benefit (Hinchliffe, Forsythe, Apelqvist, Boyko et al., 2020). For communication among healthcare professionals we are based on recommendation of the SINBAD system, which can also be used for audit of outcome of populations (Monteiro-Soares, Russell, Boyko, Jeffcoate et al., 2020).

Table 3. Classification of Diabetic Ulcer

Grades	
0	No risk for ulcer
1	Superficial ulcer which includes the skin, but not the tissue below
2	Deep ulcer that penetrates down in ligaments and muscles, but not in bone and without abscess formation
3	Deep ulcer with cellulite or abscess, often with osteomyelitis
4	Localized gangrene
5	Expand gangrene which includes complete leg

2.8.1 Charcot arthropathy

Clinically Charcot can be diagnosed as unilateral located (Figure 4, b), painful and with oedema (Figure 4, c) and in radiography images there are destructions of the bones (“bone basket”)(Figure 4, a), fragmentation and remodeling. Treatment is orthopedics immobilization.



Figure 4. Charcot arthropathy: a) radiography images of destruction of bones, b) unilateral location c) oedema.

2.9 Management of diabetic ulcer by grades

2.9.1 Management of grade 1-2

When diabetic ulcer is classified as 1 or 2 the role in the treatment is of diabetologist and nurses as well. It is recommended at least once a week wide debridement with local wound care and pressure removal, hospitalization for bed regimen and appropriate antibiotic based on antibiogram (I.V). Also is crucial culture of ulcer with curettage

2.9.2 Management of grade 3

At grade 3 of diabetic ulcer there is a vascular peripheral diseases and bone involvement, deeper ulcers, high Erythrocyte sedimentation > 40 mm / hour. There is a need for culture of ulcer with curettage from the depth of the ulcer and bone biopsy, surgical debridement, antibiotic I.V. for longer period 10-12 weeks.

2.9.3 Management of grade 4-5

When we are facing with the grades 4 and 5 of diabetic ulcer urgent surgical treatment is recommended where amputation is often necessary.

3. Results

We have presented 5 different cases with diabetic ulcers in order to show all the above mentioned IWGDF recommendations implemented in practice. In Table 4 and Figure 5 are presented all the work done in clinical settings.

Table 4. Clinical and laboratory data of the patients with foot ulcers included in the study

Clinical and laboratory data	Cases				
	Case 1	Case 2	Case 3	Case 4	Case 5
Duration of diabetes mellitus	28 years	2 years	15 years	27 years	16 years
Therapy	Insulin and OHA-insulin	OHA	Insulin and OHA	Insulin and OHA	Insulin and OHA
Glycemia in the beginning of treatment	19.9 mmol/l	9.0 mmol/l	18.3 mmol/l	7.2 mmol/l	14.7 mmol/l
Glycemia in the end of treatment	7.0 mmol/l	6.8 mmol/l	5.5 mmol/l	7.0 mmol/l	6.2 mmol/l
Cholesterol	5.0 mmol/l	4.5 mmol/l	4.2 mmol/l	5.4 mmol/l	6.3 mmol/l
Triglycerides	2.4 mmol/l	1.2 mmol/l	2.3 mmol/l	3.2 mmol/l	1.6 mmol/l
BUN	6.5	9.0	29.2	10.9	10

Creatinine	85.5	115	213	159.5	93.7
Complete blood count	normal	normal	Mild leukocytosis	normal	normal
Erythrocyte sedimentation	normal	54mm	80mm	120mm	15mm
Urine	normal	normal	Mase of leukocytes	Mase of leukocytes	normal
Neuropathy	S, M, A	S, A	S, M, A	S,M,A	S,M,A
Angiopathy	with atherosclerotic narrows	normal	with atherosclerotic narrows	with atherosclerotic narrows	no atherosclerotic narrows
CV, nephropathy and retinopathy complications	CV, retinopathy, no nephropathy	no CV, no nephropathy, retinopathy	CV, retinopathy, nephropathy	CV (3x coronary stenting), retinopathy, nephropathy	No CV, no nephropathy, retinopathy
Wound / ulcer strip - for culture or microscopy	staphylococcus aureus	staphylococcus aureus	staphylococcus coagulants	staphylococcus coagulants	0
Diabetic ulcer	Grade 2	Grade 2-3, ulcer post bullous formation	Grade 2	Grade 2	Grade 1
Amputations			Second finger, left leg		Second finger right leg
Ulcer treatment	Ulcer debridement treatment, preparations of silver ions, AB, toilet.	Ulcer debridement treatment, preparations of silver ions, AB I.V., toilet.	Ulcer debridement treatment, preparations of silver ions, AB I.V., toilet.	Ulcer debridement treatment, preparations of silver ions, toilet, AB I.V. Hyaluronic acid	Ulcer debridement treatment, preparations of silver ions, toilet, AB I.V.

Legend:OHA-oralhypoglicemic agents, S-sensorics, M-motoric, A-autonom, CV-cardiovascular





Figure 5. Stages of treatment of our diabetic patients with diabetic foot a) Case 1 b)Case 2 c) Case 3 d)Case 4 e)Case 5

4. Discussion

Foot ulceration as one of the major chronic complications of diabetes mellitus is associated with high levels of morbidity and mortality (Lazzarini, Pacella, Armstrong, & Netten, 2018), as well as significant financial costs for family (Jupiter, Thorud, Buckley & Shibuya, 2016) and country as well Kerr, 2014). Incidence rate of diabetic foot ulceration vary from 19-34%, with a yearly incidence rate of 2% (Monteiro-Soares, Russell, Boyko, Jeffcoate et al., 2020). After successful healing the recurrence rates of diabetic foot ulcers (DFU) is high, 40% within a year and 65% within 3 years (Armstrong, 2017). Key risk factors for diabetic foot include loss of protective sensation, peripheral artery disease and foot deformity. Patients with a history of foot ulceration and any level of lower extremity amputation have increased risk for ulceration (Monteiro-Soares,Russell, Boyko, Jeffcoate, et al., 2012; Crawford, Cezard, Chappell, Murray et al., 2015).

Thereby, diabetic foot infections (DFIs) are associated with substantial morbidities, requiring frequent healthcare provider visits, daily wound care, antimicrobial therapy, surgical procedures, with associated high health care costs (Raspovic, & Wukich, 2014). DFIs remain the most frequent diabetic complication requiring, frequently, hospitalization and the most common precipitating event leading to lower extremity amputation (Lavery, Armstrong, Murdoch, Peters

et al., 2007; Ndosi, Wright-Hughes, Brown, Backhouse, et al., 2018; Tan, Shih, Concha-Moore, Diri et al., 2019).

Managing DFIs is very important because it requires careful attention to properly diagnosing the condition, obtaining appropriate specimens for culture, considerately selecting antimicrobial therapy, quickly determining when surgical interventions are required and providing any needed additional wound and overall patient care (Rayman, Vas, Dhatariya, Driver et al., 2020) based on International Working Group on the Diabetic Foot (IWGDF).

5. Conclusions

For a better control and evaluation of diabetic complications each patient even without any foot problems at least once a year should be examined for feet problems. High-risk patients should be examined with frequently - every 1 to 6 months, depending on the risk grade. Lack of symptoms (like pain) does not mean they are healthy (but with neuropathy). The screening is not necessarily done by a doctor or podiatrist but also by other trained health personnel.

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