European Scholar Journal (ESJ)
Available Online at: https://www.scholarzest.com
Vol. 4 No.01, January 2023
ISSN: 2660-5562

A MODERN APPROACH TO THE COMPLEX TREATMENT OF DIABETIC FOOT ULCERS. (LITERATURE REVIEW)

U.Yu.Ergashev, A.T.M.Ominov, N.M.M. Alikov, D.R. Ya kubov, B.A.Abdusalomov.
Ashkent Medical Academy, toAphedre of General Surgery No2

Article history:

Received: 11th November 2022
Accepted: 11th December 2022
Published: 20th January 2023

Abstract:

Diabetic foot ulcer (DFU) is the most costly and devastating complication of diabetes mellitus, which affect 15% of diabetic patients during their lifetime. Based on National Institute for Health and Clinical Excellence strategies, early effective management of DFU can reduce the severity of complications such as preventable amputations and possible mortality, and also can improve overall quality of life. The management of DFU should be optimized by using a multidisciplinary team, due to a holistic approach to wound management is required. Based on studies, blood sugar control, wound debridement, advanced dressings and offloading modalities should always be a part of DFU management. Furthermore, surgery to heal chronic ulcer and prevent recurrence should be considered as an essential component of management in some cases. Also, hyperbaric oxygen therapy, electrical stimulation, negative pressure wound therapy, bio-engineered skin and growth factors could be used as adjunct therapies for rapid healing of DFU. So, it's suggested that with appropriate patient education encourages them to regular foot care in order to prevent DFU and its complications

Keywords: Diabetes mellitus; Wound management; Diabetic foot ulcer; Amputation; Foot care.

UNDER MANAGEMENT

Diabetes mellitus (DM) is one of the main problems of healthsystems and a global threat to public health, which has increased dramatically over the past 2 decades [1,2]. According to epidemiological studies, the number of patients with diabetes increased from about 30 million cases in 1985, 177 million in 2000. to 285 million in 2010, and according to experts, if the situation persists, by 2030 more than 360 million people will suffer from diabetes [3, 4].

Patients with diabetes have developed severe complications, one of which is diabetic foot ulcer (SFD). DYS is a frequent complication of diabetes, which tends to increase over the past decades [5-7]. Overall, researchers estimate that 15% of patients with diabetes will suffer from DYAS during their lifetime [8]. Although it is difficult to obtain accurate data on the prevalence of DYAS, the presence of this complication ranges from 4% to 27% [9-11].

The incidence of diabetes has shifted from developed countries in Europe and the United States to developing countries in the Middle East, Asia, Africa and the Caribbean [77].

To date, DYS is considered the leading incidence and the leading cause of hospitalization in patients with diabetes [1,5,12,13]. It is estimated that approximately 20% of hospitalizations among patients with diabetes are the result of DYAS [14]. Indeed, DYAS can lead to infection, gangrene, amputation and even death if the necessary care is not provided [14]. On the other hand, with the development of DYAS, the risk of ulcer progression increases, which could eventually lead to amputation. In general, the frequency of amputations of the lower extremities in patients with diabetes is 15 times higher than in patients without diabetes [8]. It is estimated that approximately 50-70% of all lower limb amputations occur due to dyas [8]. In addition, it is reported that every 30seconds worldwide, one leg is amputated due to dyas [9].

In addition, DNF is responsible for significant emotional and physical suffering, as well as decreased productivityand financial losses, which impair quality of life [15]. According to a number of authors, it costs approximately $17,500 ($1998) to heal a single ulcer. In cases where amputation of the lower extremities is required, medical care is even more expensive and amounts to 30,000–33,500 US dollars [16].

ETIALOGY OF DYS

Recent studies have identified multiple risk factors associated with the development of DYS [18-21]. These risk factors are as follows: sex (male), duration of diabetes mellitus more than 10 years, elderly age of patients, high body mass index and other concomitant diseases such as retinopathy, diabetic peripheral neovopathy, peripheral vascular disease, level of glycated hemoglobin (HbA1C), foot deformity, high plantar pressure, infections and improper foot care [1,12, 20-22] (Fig. 1)

Figure 1. Risk factors for diabetic foot ulcers. Ulcers can be distinguished by general or systemic signs from those localized on the foot and its pathology. (Data adapted from Frykberg et al [18]).

Although the literature identifies a numberof risk factors associated with diabetes that contribute to ulceration of the lower extremities and amputations, to date, most of the JAS have been caused by ischemic, neuropathic, or combined neuroischemic abnormalities [6,17] (Fig. 2). The number of ischemic x ulcers is likely to be only 10% of JAS and 90% are caused bynon-ischemic ulcers ropathy, alone or with ischemia. In recent years, the frequency of neuroischemic problems has increased, and neuroischemic ulcers are the most common ulcers currently seen in most diabetic foot clinics.

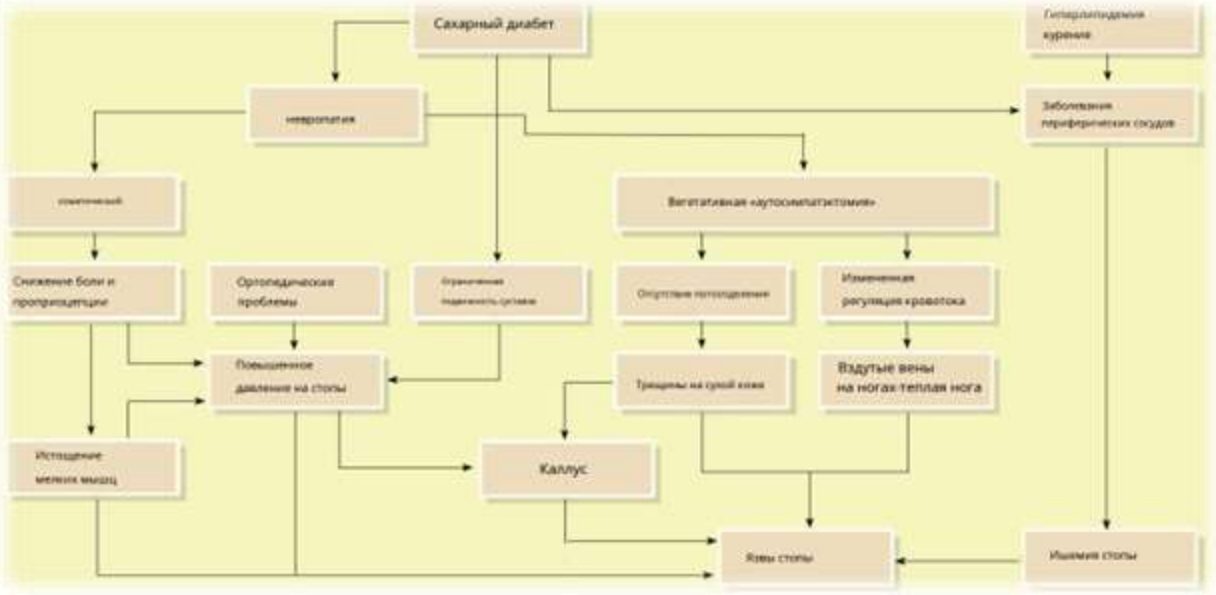

Figure 2. Etiology of diabetic foot ulcer. (Data adapted from Boulton et al [17]).

In general, the most frequent way of developing foot problems in patients with diabetes mellitus is peripheral sensorimotor and autonomicneuropathy, which leads to increased pressure on the feet, foot deformities and gait instability, which increases the risk of developing ulcers [24-26]. Asof today, numerous studies have shown that increased plantar pressure is associated with ulceration of the foot [27-29]. Data on the prevalence of neuropathy among individuals with diabetes range from 28 to 65%, depending on the duration of the disease and diagnostic methods [78]. In addition, it has been demonstrated that foot deformities and gait instability increase plantar pressure, which can lead to ulceration of the foot [24,30].

CARE AND CONTROL OF DYAS

Unfortunately, often patients deny their disease and cannot take responsibility for their disease, as well as take the necessary measures to prevent complications and solve many problems associated with the treatment of DYAS. However, numerous studies have shown that proper treatment of DYAS can significantly reduce, delay or prevent complications such as amputation, gangrene, death [6,31,32]. Since diabetes is a multi-organ systemic process, all comorbidities affecting wound healing should be monitored by an interdisciplinary team to achieve optimal treatment outcomes. DYAS [35-38]. In accordance with health care strategies, clinical treatment of dYAS should be carried out immediately by an interdisciplinary team consisting of a general practitioner, nurse, orthopedist, as well as consultations with other specialists, such as vascular surgeons, infectious disease specialists, dermatologists, endocrinologists,

nutritionists [39]. Today, numerous studies have shown that a multidisciplinary team can reduce the frequency amputations, reduce costs and improve the quality of life of patients with DYAS [39-41].

The American Diabetes Association has concluded that a preventive care team, defined as an interdisciplinary team, can reduce the risks associated with DYS and amputation by 50–85% [42]. DYAS to consistently reduce the severity of complications, improve overall quality and increase the life expectancy of patients [36]. In this article, we review the available evidence on the treatment of DYAS as follows: training, blood sugar control, wound debridement, dressings with modern medicines, including the need for self-examination, foot temperature control, proper daily foot hygiene, the use of comfortable and suitable shoes and blood sugar control[47].

Teaching

Up to 50% of cases of DNF have been shown to be preventable through effective training. In fact, educating patients on self-help for foot lesions is considered a cornerstone of preventing DYS [12,43-45].

Controlling blood sugar levels in patients with DYAS is essential in the self-help process. Blood glucose is the most important metabolic factor. In fact, inadequate blood sugar control is the main cause of DYAS [6,49,50]. The best indicator of glucose monitoring for a period of time is HbA1C. This test measures the average sugar concentration over a 90-day period in an erythrocytex peripheral The higher the level of HbA1C, the more glycosylation of hemoglobin in erythrocytes will occur. Studies have shown that blood glucose levels > 11.1 mmol / l (equivalent > 310 mg / ml or HbA1C level > 12) is associated with a decrease in neutrophil function, including leukocyte chemotaxis [50]. Indeed, a greater increase in blood glucose levels was associated with a higher potential for suppression of inflammatory reactions and a decrease in response host for infection [6]. Pomposelli et al [51] indicated that a single blood glucose level of > 220 mg/dLon the first postoperative day was a sensitive (87.5%) predictor of postoperative infection. In addition, the authors found that patients with blood glucose levels of > 220 mg/dL had 2.7 times higher infection rates than those with lower blood glucose levels (31.3% vs. 11.5%, respectively) [51]. In addition, indicates that an average 1% reduction in HbA1C was associated with a 25% reduction in microvascular complications, including non-occupational disease [47]. Studies have shown that poor glucose control accelerates the manifestation of peripheral artery disease (PAD). It has been shown that for every 1% increase in I HbA1C levels, the relative risk increased by 25-28% is the main cause of DYAS [52].

Surgicalintervention

Surgical wound treatment is the removal of necrotic and non-viable tissues, as well as foreign and infected materials from the wound, which is considered the first and most important surgical step leading to the closure of the wound and the reduction of the risk of limb amputation in patients with DYAS [53-56]. The use of CO_2 laser allows you to perform woundin yu and bloodless necrectomy, improve wound repair, and also reduces the microbial contaminationof a purulent wound. CO2 laser has photocoagulant properties and sterilizing effect on tissues [79].

Sanitation appears to reduce the number of bacteria and stimulate the production of local growth factors. This method also reduces pressure,cleanses the wound bed and facilitates wound drainage [32,57]. There are various types of debridement, including surgical, enzymatic, autolytic, mechanical and biological [58]. Among these methods, the greatest effectiveness of surgical sanatsiand and that it is more effective in healing DYA [54,59-62]. Surgical or acute debridement involves excision of dead and infected tissues followed by daily application of a cotton napkin moistened with an antiseptic solution [53]. The main purpose of this type of debridement is to turn a chronic ulcer into an acute one. Surgical treatment should be repeated as often as necessary if new necrotic tissue continues to form [63]. It has beenreported that regular (weekly) acute wound treatment is associated with faster healing of ulcers than less frequent treatment [59,64-66]. The method of sanitation depends on the characteristics, preferences and level of knowledge of the practitioner [54]. When surgical or acute debridement is not indicated, other types of debridement can be used. Despite the advantages of sanitation, adequate sanitation should always precede the use of local healing agents [54]. When surgical or acute debridement is not indicated, other types of debridement can be used. Despite the advantages of sanitation, adequate sanitation should always precede the use of local healing agents [54]. When surgical or acute debridement is not indicated. Despite the benefits of sanitation, adequate sanitation should always precede the use of local healing agents wounds, dressings, or wound closure procedures that can be costly.

Methodsof loadingand

The use of unloading techniques, commonly known as pressure modulation, is considered the most important component of the treatmentofnon-ropathic ulcers in patients with diabetes [81,82]. Recent studies have provided evidence that proper discharge promotes the healing of DYS [83-85]. Although many unloading techniques are currently used, only a few studies describe the frequency and rate of wound healing using some of the techniques often used in clinical practice. The choice of these methods is determined by the physical characteristics of the patient and his ability to comply with the treatment regimen, as well as the localization and severity of the ulcer [42]. The most effective method of unloading for the treatment of neuropathic DYAS is total contact dressing (TCP) [42,4 6,51]. The TCP has minimal padding and exactly repeats the shape of the foot with a heel for walking (Fig. 3). The dressing is designed to relieve pressure from the ulcer and distribute pressure over the entire surface of the foot, thus protecting the wound site.

Figure 3. Total contact bandage

A study by Mueller et al [51] found that TCP heals a higher percentage of plantar ulcers at a higher rate compared to standard treatment. Themost important breakthrough in the treatment of DYAS in recent decades has been the improved dressing [13]. Since this device does not require a qualified specialist, it can revolutionize the treatment of plantar ulcersin the future. It has been suggested that the SSP will radically change the treatment of non-ischemic, non-ischemic ulcers. It has been suggested that the SSP will radically change the treatment of non-ischemic, non-ischemic ulcers. It has been suggested that the SSP will radically change the treatment of non-ischemic ulcers. It has been suggested that the SSP will radically change the treatment of non-ischemic, non-ischemic ulcers. ropathic, diabetic plantar ulcers and may replace TCC as the gold standard for unloading plantar neuropathic ulcers [42]. Ideally, dressings should provide moisture balance, protease sequestration, stimulation of growth factors, antimicrobial activity, oxygen permeability and promote autolytic sanitation, which leads to the formation of granulation tissue and the process of reepithelialization. In addition, it should have a prolonged time of action, high efficacy and delayed release of the drug in the case of drug therapy [46, 53]. Consequently, no bandage meets all the requirements of a patient with diabetes and a foot ulcer. The choice of dressing is largely determined by the causes of dyas, the location of the wound, depth, the amount of scar or scab, exudate, the condition of the edges of the wound, the presence of infection and pain, the need for adhesion and adhesion of the dressing [13].

Figure 4. Instant total contact dressing for patients with diabetic foot ulcers.

Diabetic foot surgery plays an important role in the prevention and treatment of DYAS [52], and over the past 2 decades its number has been increasing [53, 55]. Although surgical interventions in patients with DYAS are associated with some risk, selective correction of persistent foot ulcers can improve results [53]]. Typically, DYAS healing surgeries include non-vascular foot surgery, vascular foot surgery, and in some cases, amputation. Vascular surgery of the foot is divided into planned, prophylactic, therapeutic and urgent, aimed at correcting deformities that increase plantar

pressure [52]. Recently, vascular foot surgeries have been developed, such as femoral artery bypass grafting to the pedal arteries and peripheral angioplasty to improve blood flow in the ischemic foot [60].

Modern therapy

Hyperbaric oxygen therapy - ganderbaric oxygenation (HBO) has shown promise in treating severe cases of non-healing DYAS resistant to other therapeutic methods [55-57]. HBOT involves intermittent pumping of 100% oxygen, usually in daily sessions [57]]. During each session, patients breathed pure oxygen at 1.4–3.0 abs. atmosphere for 3 periods of 30 minutes (90 min in total) with intercalation at 5-minute intervals in the hyperbaric chamber [34, 44].

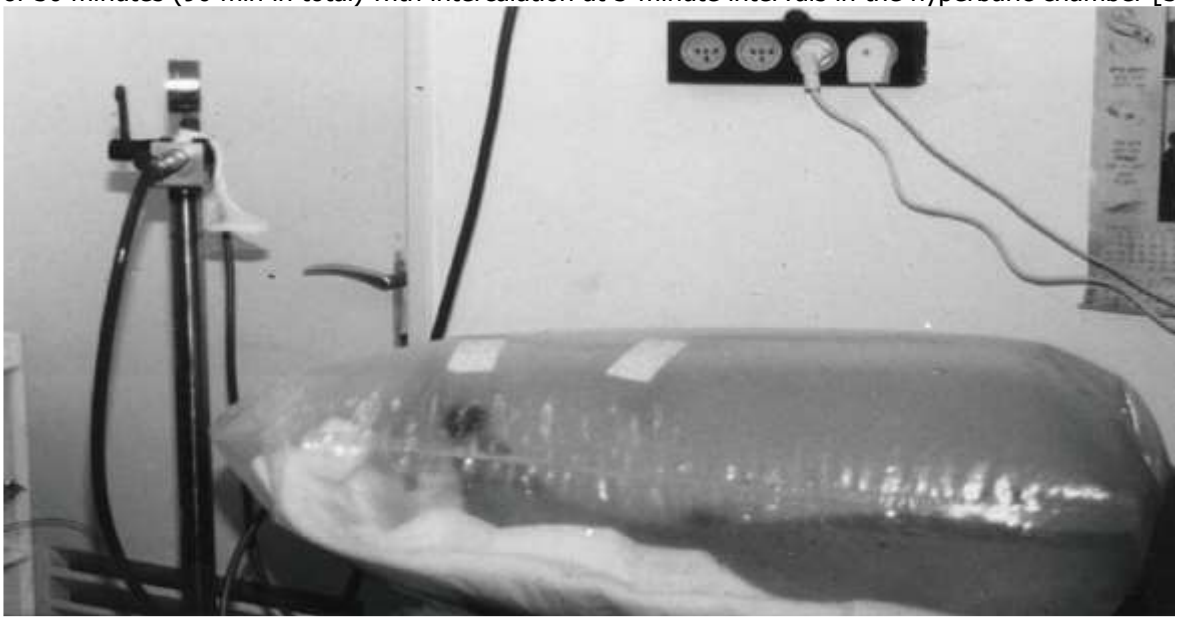

Figure 5. Polyethylene hyperbaric chamber. Oxygen in a concentration of 100% was pumped into the bag through the usual valve of the car's wheel. The open end of the bag was fixed with an elastic bandage to the leg above the knee. Oxygen was passed through the bandage, and the pressure in the chamber was maintained at 20-30 mm Hg. art. (1.02–1.03 atm) above atmospheric pressure. (Data adapted from Landau [57]).

To date, numerous studies have reported positive effects of HBOT [56]. The exact mechanism of HBOT remains poorly understood. Some studies have reported that HBOT reduces wound tissue hypoxia, increases perfusion, reduces swelling, reduces inflammatory cytokine levels, and promotes fibroblast proliferation, collagen production, and angiogenesis [5 7]. In addition, HBOT has been demonstrated to stimulate the mobilization of vasculogenic stem cells from the bone marrow and recruit them into a skin wound [54]. Despite reports of an increase in the frequency of healing and a decrease in the number of amputations with the use of HBOT, the adjuvant use of this method in DNS remains a controversial issue.

Electrical stimulation

Electrical stimulation (ES) has been described in the recent literature as an ideal complementary therapy for the healing of DYS. Currently, there is a significant amount of work confirming the effectiveness of ES for the healing of nuclear power plants [63-66]. ES does not replace antibiotic therapy. In a randomized, double-blind, placebo-controlled, 12-week study conducted by Peters et al [63] on 40 patients with DYAS, significant differences were found in the number of healed ulcers (65% in the treatment group versus 35% in the control group). Based on a literature review, it is assumed that ES may havea smaller common deficiencies that have been associated with improper wound healing in DYAS, such as poor blood flow, infection, and insufficient cellular response [63,67]. This therapy is a safe, inexpensive, and simple intervention to improve wound healing in patients with DYAS [67,68].

Bioengineered skin

Bioengineering leather (ВИК) has been used in recent decades as a new therapeutic treatment for DYAS [71]. This method replaces the degraded and destructive environment of the extracellular matrix with the introduction of a new matrix of the main substance with cellular components to begin a new healing trajectory. [72]. Three types of B products are currently available for nuclear nuclear powerИК, одобренных в США, включая Derma graft (Advanced Bio Healing Inc., Ла-Хойя, Калифорния), Apligraf (Organogenesis Inc., Кантон, Массачусетс) и, совсем недавно, Oasis (Cook Biotech, West Lafayette, IN) [74,75]; numerous studies have shown their effectiveness in the healing of DYS. Despite the advantages of ВИК, they cannot be used in isolation to treat DYAS. Peripheral ischemia, which is one of the pathological characteristics of DYAS, is a critical factor affecting transplantation ВИIn addition, this method requires infection control [7]1,75]. Thus, the above points may lead to high long-term costs and raise serious concerns about the use of this treatment [76].

Inthe lead

Foot ulcers in patients with diabetes occur and often lead to amputation of the lower extremities if an operative, rational interdisciplinary approach to therapy is not adopted.

The main components of treatment that can ensure successful and rapid healing of DYAS include training, blood sugar control, wound debridement, extended dressing, unloading, surgery, and advanced treatments that are used in clinical practice. These approaches should be used whenever possible to reduce the high incidence and risk of serious complications resulting from foot ulcers.

LITERATURA

1. Shahbazian H, Yazdanpanah L, Latifi SM. Risk assessment of patients with diabetes for foot ulcers according to risk classification consensus of International Working Group on Diabetic Foot (IWGDF). *Pak J Med Sci* 2013; 29: 730-734 [PMID:24353617 DOI: 10.12669/pjms.293.3473]
2. Ramachandran A, Snehalatha C, Shetty AS, Nanditha A.Trends in prevalence of diabetes in Asian countries. *World J Diabetes* 2012; **3**: 110-117 [PMID: 22737281 DOI: 10.4239/wjd. v3.i6.110]
3. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010; **87**: 4-14 [PMID: 19896746 DOI: 10.1016/j.diabres.2009.10.007]
4. Whiting DR, Guariguata L, Weil C, Shaw J. IDF diabetes atlas: global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Res Clin Pract* 2011; 94: 311-321 [PMID:22079683 DOI: 10.1016/j.diabres.2011.10.029]
5. Aalaa M, Malazy OT, Sanjari M, Peimani M, Mohajeri-Tehrani M. Nurses' role in diabetic foot prevention and care; a review. *J Diabetes Metab Disord* 2012; 11: 24 [PMID:23497582 DOI: 10.1186/2251-6581-11-24]
6. Alavi A, Sibbald RG, Mayer D, Goodman L, Botros M, Armstrong DG, Woo K, Boeni T, Ayello EA, Kirsner RS. Diabetic foot ulcers: Part II. Management. *J Am Acad Dermatol* 2014; 70: 21.e1-2124; quiz 21.e1-2124 [PMID: 24355276 DOI: 10.1016/j.jaad.2013.07.048]
7. Cavanagh PR, Lipsky BA, Bradbury AW, Botek G.Treatment for diabetic foot ulcers. *Lancet* 2005; 366: 1725-1735 [PMID: 16291067 DOI: 10.1016/S0140-6736(05)67699-4]
8. Leone S, Pascale R, Vitale M, Esposito S. [Epidemiology of diabetic foot]. *Infez Med* 2012; 20 Suppl 1: 8-13 [PMID:22982692]
9. Richard JL, Schuldiner S. [Epidemiology of diabetic foot problems]. *Rev Med Interne* 2008; 29 Suppl 2: S222-S230 [PMID: 18822247 DOI: 10.1016/S0248-8663(08)73949-3]
10. Nather A, Bee CS, Huak CY, Chew JL, Lin CB, Neo S, Sim EY. Epidemiology of diabetic foot problems and predictive factors for limb loss. *J Diabetes Complications* 2008; **22**: 77-82 [PMID: 18280436 DOI: 10.1016/j.jdiacomp.2007.04.004]
11. Bakri FG, Allan AH, Khader YS, Younes NA, Ajlouni KM. Prevalence of Diabetic Foot Ulcer and its Associated Risk Factors among Diabetic Patients in Jordan. *J Med J* 2012; **46**:118-125
12. Iraj B, Khorvash F, Ebneshahidi A, Askari G. Prevention of diabetic foot ulcer. *Int J Prev Med* 2013; 4: 373-376 [PMID:23626896]
13. Fard AS, Esmaelzadeh M, Larijani B. Assessment and treatment of diabetic foot ulcer. *Int J Clin Pract* 2007; 61: 1931-1938 [PMID:17935551 DOI: 10.1111/j.1742-1241.2007.01534.x]
14. Snyder RJ, Hanft JR. Diabetic foot ulcers--effects on QOL, costs, and mortality and the role of standard wound care and advanced-care therapies. *Ostomy Wound Manage* 2009; 55: 28-38 [PMID: 19934461]
15. Vileikyte L. Diabetic foot ulcers: a quality of life issue. *Diabetes Metab Res Rev* 2001; 17: 246-249 [PMID: 11544609 DOI: 10.1002/dmrr.216]
16. Ragnarson Tennvall G, Apelqvist J. Health-economic consequences of diabetic foot lesions. *Clin Infect Dis* 2004; 39 Suppl 2: S132-S139 [PMID: 15306992 DOI: 10.1086/383275]
17. Boulton AJ, Vileikyte L, Ragnarson-Tennvall G, Apelqvist J. The global burden of diabetic foot disease. *Lancet* 2005; 366: 1719-1724 [PMID: 16291066 DOI: 10.1016/j.mpmed.2010.08.011]
18. Frykberg RG, Zgonis T, Armstrong DG, Driver VR, Giurini JM, Kravitz SR, Landsman AS, Lavery LA, Moore JC,Schuberth JM, Wukich DK, Andersen C, Vanore JV. Diabetic foot disorders. A clinical practice guideline (2006 revision).*J Foot Ankle Surg* 2006; 45: S1-66 [PMID: 17280936 DOI:10.1016/S1067-2516(07)60001-5]
19. Bortoletto MS, de Andrade SM, Matsuo T, Haddad Mdo C, González AD, Silva AM. Risk factors for foot ulcers--a cross sectional survey from a primary care setting in Brazil. *Prim Care Diabetes* 2014; 8: 71-76 [PMID: 23639609 DOI: 10.1016/j.pcd.2013.04.003]
20. Waaijman R, de Haart M, Arts ML, Wever D, Verlouw AJ, Nollet F, Bus SA. Risk factors for plantar foot ulcer recurrence in neuropathic diabetic patients. *Diabetes Care* 2014; 37:1697-1705 [PMID: 24705610 DOI: 10.2337/dc13-2470]
21. Monteiro-Soares M, Boyko EJ, Ribeiro J, Ribeiro I, Dinis-Ribeiro M. Predictive factors for diabetic foot ulceration: a systematic review. *Diabetes Metab Res Rev* 2012; 28: 574-600[PMID: 22730196 DOI: 10.1002/dmrr.2319]
22. McEwen LN, Ylitalo KR, Herman WH, Wrobel JS. Prevalence and risk factors for diabetes-related foot complications in Translating Research Into Action for Diabetes (TRIAD). *J Diabetes Complications* 2013; 27: 588-592 [PMID:24035357 DOI: 10.1016/j.jdiacomp.2013.08.003]
23. Prompers L, Huijberts M, Apelqvist J, Jude E, Piaggesi A, Bakker K, Edmonds M, Holstein P, Jirkovska A, Mauricio D, Ragnarson Tennvall G, Reike H, Spraul M, Uccioli L, Urbancic V, Van Acker K, van Baal J, van Merode F, Schaper N. High prevalence of ischaemia, infection and serious comorbidity in patients with diabetic foot disease in Europe. Baseline results from the Eurodiale study. *Diabetologia* 2007;50: 18-25 [PMID: 17093942 DOI:

10.1007/s00125-006-0491-1] 24 Formosa C, Gatt A, Chockalingam N. Diabetic foot complications in Malta: prevalence of risk factors. *Foot* (Edinb) 2012;22: 294-297 [PMID: 22981100 DOI: 10.1016/j.foot.2012.08.008]
24. Formosa C, Gatt A, Chockalingam N. Diabetic foot complications in Malta: prevalence of risk factors. *Foot* (Edinb) 2012;22: 294-297 [PMID: 22981100 DOI: 10.1016/j.foot.2012.08.008]
25. Malgrange D. [Physiopathology of the diabetic foot]. *Rev Med Interne* 2008; 29 Suppl 2: S231-S237 [PMID: 18822248DOI: 10.1016/S0248-8663(08)73950-X]
26. Sawacha Z, Gabriella G, Cristoferi G, Guiotto A, Avogaro A, Cobelli C. Diabetic gait and posture abnormalities: a biomechanical investigation through three dimensional gait analysis. *Clin Biomech* (Bristol, Avon) 2009; 24: 722-728 [PMID:19699564 DOI: 10.1016/j.clinbiomech.2009.07.007]
27. Ledoux WR, Shofer JB, Cowley MS, Ahroni JH, Cohen V, Boyko EJ. Diabetic foot ulcer incidence in relation to plantar pressure magnitude and measurement location. *J Diabetes Complications* 2013; 27: 621-626 [PMID: 24012295 DOI:10.1016/j.jdiacomp.2013.07.004]
28. Amemiya A, Noguchi H, Oe M, Ohashi Y, Ueki K,Kadowaki T, Mori T, Sanada H. Elevated plantar pressure in diabetic patients and its relationship with their gait features. *Gait Posture* 2014; 40: 408-414 [PMID: 24974127 DOI: 10.1016/j.gaitpost.2014.05.063]
29. Fernando ME, Crowther RG, Pappas E, Lazzarini PA, Cunningham M, Sangla KS, Buttner P, Golledge J. Plantar pressure in diabetic peripheral neuropathy patients with active foot ulceration, previous ulceration and no history of ulceration: a meta-analysis of observational studies. *PLoS One* 2014; 9: e99050 [PMID: 24915443 DOI: 10.1371/journal.pone.0099050]
30. Bacarin TA, Sacco IC, Hennig EM. Plantar pressure distribution patterns during gait in diabetic neuropathy patients with a history of foot ulcers. *Clinics* (Sao Paulo) 2009;64: 113-120 [PMID: 19219316 DOI: 10.1590/S1807-593220-09000200008]
31. Schaper NC, Apelqvist J, Bakker K. The international consensus and practical guidelines on the management and prevention of the diabetic foot. *Curr Diab Rep* 2003; 3: 475-479[PMID: 14611743 DOI: 10.1007/s11892-003-0010-4]
32. DiPreta JA. Outpatient assessment and management of the diabetic foot. *Med Clin North Am* 2014; 98: 353-373 [PMID:24559880 DOI: 10.1016/j.mcna.2013.10.010]
33. Markowitz JS, Gutterman EM, Magee G, Margolis DJ. Risk of amputation in patients with diabetic foot ulcers: a claimsbased study. *Wound Repair Regen* 2006; 14: 11-17 [PMID:16476067 DOI: 10.1111/j.1524-475X.2005.00083.x]
34. Patout CA, Birke JA, Horswell R, Williams D, Cerise FP. Effectiveness of a comprehensive diabetes lower-extremity amputation prevention program in a predominantly lowincome African-American population. *Diabetes Care* 2000; 23:1339-1342 [PMID: 10977029 DOI: 10.2337/diacare.23.9.1339]
35. Driver VR, Madsen J, Goodman RA. Reducing amputation rates in patients with diabetes at a military medical center: the limb preservation service model. *Diabetes Care* 2005; 28:248-253 [PMID: 15677774 DOI: 10.2337/diacare.28.2.248]
36. Frykberg RG. Diabetic foot ulcers: pathogenesis and management. *Am Fam Physician* 2002; 66: 1655-1662 [PMID: 12449264]
37. Sumpio BE, Aruny J, Blume PA. The multidisciplinary approach to limb salvage. *Acta Chir Belg* 2004; 104: 647-653[PMID: 15663269]
38. Wraight PR, Lawrence SM, Campbell DA, Colman PG. Creation of a multidisciplinary, evidence based, clinical guideline for the assessment, investigation and management of acute diabetes related foot complications. *Diabet Med* 2005; 22:127-136 [PMID: 15660728 DOI: 10.1111/j.1464-5491.2004.01363.
39. Malekian Ragheb S, Naderi Beni M. Management of a diabetic foot ulcer by specialist nurses in Iran. *Wounds International* 2013; 4: 20-23
40. Aydin K, Isildak M, Karakaya J, Gürlek A. Change in amputation predictors in diabetic foot disease: effect of multidisciplinary approach. *Endocrine* 2010; 38: 87-92 [PMID:20960107 DOI: 10.1007/s12020-010-9355-z]
41. Lepäntalo M, Apelqvist J, Setacci C, Ricco JB, de Donato G, Becker F, Robert-Ebadi H, Cao P, Eckstein HH, De Rango P, Diehm N, Schmidli J, Teraa M, Moll FL, Dick F, Davies AH. Chapter V: Diabetic foot. *Eur J Vasc Endovasc Surg* 2011; 42 Suppl 2: S60-S74 [PMID: 22172474 DOI: 10.1016/S1078-5884(11)60012-9]
42. Seaman S. The role of the nurse specialist in the care of patients with diabetic foot ulcers. *Foot Ankle Int* 2005; 26:19-26 [PMID: 15680114]
43. Mensing C, Boucher J, Cypress M, Weinger K, Mulcahy K, Barta P, Hosey G, Kopher W, Lasichak A, Lamb B, Mangan M, Norman J, Tanja J, Yauk L, Wisdom K, Adams C.National standards for diabetes self-management education. *Diabetes Care* 2005; 28 Suppl 1: S72-S79 [PMID: 15618119 DOI: 10.2337/diacare.28.suppl_1.S72]
44. Malone JM, Snyder M, Anderson G, Bernhard VM, Holloway GA, Bunt TJ. Prevention of amputation by diabetic education. *Am J Surg* 1989; 158: 520-523; discussion 523-524[PMID: 2589581]
45. Annersten Gershater M, E Pilhammar E, Apelqvist J, Alm-Roijer C. Patient education for the prevention of diabetic foot ulcers: Interim analysis of a randomised controlled trial due to morbidity and mortality of participants. *EDN* 2011; 8:102-107 [DOI: 10.1002/edn.189]
46. Dorresteijn JA, Kriegsman DM, Assendelft WJ, Valk GD. Patient education for preventing diabetic foot ulceration. *Cochrane Database Syst Rev* 2012; 10: CD001488 [PMID:23076893 DOI: 10.1002/14651858.CD001488]

47. American Diabetes Association. Standards of medical care in diabetes--2006. *Diabetes Care* 2006; 29 Suppl 1: S4-42 [PMID:16373931]
48. Faglia E, Favales F, Morabito A. New ulceration, new major amputation, and survival rates in diabetic subjects hospitalized for foot ulceration from 1990 to 1993: a 6.5-year follow-up. *Diabetes Care* 2001; 24: 78-83 [PMID: 11194246 DOI: 10.2337/diacare.24.1.78]
49. Bowering CK. Diabetic foot ulcers. Pathophysiology, assessment, and therapy. *Can Fam Physician* 2001; 47:1007-1016 [PMID: 11398715]
50. McMurry JF. Wound healing with diabetes mellitus. Better glucose control for better wound healing in diabetes. *Surg Clin North Am* 1984; 64: 769-778 [PMID: 6433493]
51. Mueller MJ, Diamond JE, Sinacore DR, Delitto A, Blair VP, Drury DA, Rose SJ. Total contact casting in treatment of diabetic plantar ulcers. Controlled clinical trial. *Diabetes Care* 1989; 12: 384-388 [PMID: 2659299]
52. Capobianco CM, Stapleton JJ, Zgonis T. Soft tissue reconstruction pyramid in the diabetic foot. *Foot Ankle Spec* 2010; 3: 241-248 [PMID: 20610846 DOI: 10.1177/1938640010375113]
53. Blume PA, Paragas LK, Sumpio BE, Attinger CE. Singlestage surgical treatment of noninfected diabetic foot ulcers. *Plast Reconstr Surg* 2002; 109: 601 609 [PMID: 11818842]
54. Armstrong DG, Lavery LA, Stern S, Harkless LB. Is prophylactic diabetic foot surgery dangerous? *J Foot Ankle Surg* 1996; 35: 585-589 [PMID: 8986899]
55. Hinchliffe RJ, Valk GD, Apelqvist J, Armstrong DG, Bakker K, Game FL, Hartemann-Heurtier A, Löndahl M, Price PE, van Houtum WH, Jeffcoate WJ. A systematic review of the effectiveness of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes Metab Res Rev* 2008; 24 Suppl 1: S119-S144 [PMID: 18442185 DOI: 10.1002/dmrr.825]
56. Armstrong DG, Frykberg RG. Classifying diabetic foot surgery: toward a rational definition. *Diabet Med* 2003; 20:329-331 [PMID: 12675649 DOI: 10.1046/j.1464-5491.2003.00933.x]
57. Landau Z. Topical hyperbaric oxygen and low energy laser for the treatment of diabetic foot ulcers. *Arch Orthop Trauma Surg* 1998; 117: 156-158 [PMID: 9521521]
58. Jain AC. A New Classification (Grading System) of Debridement in Diabetic Lower Limbs-an Improvization and Standardization in Practice of Diabetic Lower Limb Salvage around the World. *Medicine Science* 2014; 3: 991-1001 [DOI: 10.5455/medscience.2013.02.8093]
59. Steed DL, Donohoe D, Webster MW, Lindsley L. Effect of extensive debridement and treatment on the healing of diabetic foot ulcers. Diabetic Ulcer Study Group. *J Am Coll Surg* 1996; 183: 61-64 [PMID: 8673309]
60. Piaggesi A, Schipani E, Campi F, Romanelli M, Baccetti F, Arvia C, Navalesi R. Conservative surgical approach versus non-surgical management for diabetic neuropathic foot ulcers: a randomized trial. *Diabet Med* 1998; 15: 412-417[PMID: 9609364]
61. Saap LJ, Falanga V. Debridement performance index and its correlation with complete closure of diabetic foot ulcers. *Wound Repair Regen* 2002; 10: 354-359 [PMID: 12453138 DOI:10.1046/j.1524-475X.2002.10603.x]
62. Cardinal M, Eisenbud DE, Armstrong DG, Zelen C, Driver V, Attinger C, Phillips T, Harding K. Serial surgical debridement: a retrospective study on clinical outcomes in chronic lower extremity wounds. *Wound Repair Regen* 2009; 17: 306-311 [PMID: 19660037 DOI: 10.1111/j.1524-475X.2009.00485.x]
63. Peters EJ, Lavery LA, Armstrong DG, Fleischli JG. Electric stimulation as an adjunct to heal diabetic foot ulcers: a randomized clinical trial. *Arch Phys Med Rehabil* 2001; 82:721-725 [PMID: 11387573 DOI: 10.1053/apmr.2001.23780]
64. Petrofsky JS, Lawson D, Berk L, Suh H. Enhanced healing of diabetic foot ulcers using local heat and electrical stimulation for 30 min three times per week. *J Diabetes* 2010; 2: 41-46[PMID: 20923474 DOI: 10.1111/j.1753 0407.2009.00058.x]
65. Lundeberg TC, Eriksson SV, Malm M. Electrical nerve stimulation improves healing of diabetic ulcers. *Ann Plast Surg* 1992; 29: 328-331 [PMID: 1466529]
66. Baker LL, Chambers R, DeMuth SK, Villar F. Effects of electrical stimulation on wound healing in patients with diabetic ulcers. *Diabetes Care* 1997; 20: 405-412 [PMID:9051395 DOI: 10.2337/diacare.20.3.405]
67. Thakral G, Lafontaine J, Najafi B, Talal TK, Kim P, Lavery LA. Electrical stimulation to accelerate wound healing. *Diabet Foot Ankle* 2013; 4 [PMID: 24049559 DOI: 10.3402/dfa.v4i0.22081]
68. Barnes R, Shahin Y, Gohil R, Chetter I. Electrical stimulation vs. standard care for chronic ulcer healing: a systematic review and meta-analysis of randomised controlled trials. *Eur J Clin Invest* 2014; 44: 429-440 [PMID: 24456185 DOI: 10.1016/j.ejvs.2008.06.010]
69. Vikatmaa P, Juutilainen V, Kuukasjärvi P, Malmivaara A. Negative pressure wound therapy: a systematic review on effectiveness and safety. *Eur J Vasc Endovasc Surg* 2008; 36:438-448 [PMID: 18675559]
70. Armstrong DG, Lavery LA. Negative pressure wound herapy after partial diabetic foot amputation: a multicentre, randomised controlled trial. *Lancet* 2005; 366: 1704-1710[PMID: 16291063 DOI: 10.1016/S0140 6736(05)67695-7]
71. Kim PJ, Heilala M, Steinberg JS, Weinraub GM. Bioengineered alternative tissues and hyperbaric oxygen in lower extremity wound healing. *Clin Podiatr Med Surg* 2007; 24:529-46, x [PMID: 17613390]

72. Teng YJ, Li YP, Wang JW, Yang KH, Zhang YC, Wang YJ, Tian JH, Ma B, Wang JM, Yan X. Bioengineered skin in diabetic foot ulcers. *Diabetes Obes Metab* 2010; 12: 307-315[PMID: 20380651 DOI: 10.1111/j.1463-1326.2009.01164.x]
73. Bello YM, Falabella AF, Eaglstein WH. Tissue-engineered skin. Current status in wound healing. *Am J Clin Dermatol* 2001; 2: 305-313 [PMID: 11721649]
74. Richmond NA, Vivas AC, Kirsner RS. Topical and biologic therapies for diabetic foot ulcers. *Med Clin North Am* 2013; 97:883-898 [PMID: 23992899 DOI: 10.1016/j.mcna.2013.03.014]
75. Futrega K, King M, Lott WB, Doran MR. Treating the whole not the hole: necessary coupling of technologies for diabetic foot ulcer treatment. *Trends Mol Med* 2014; 20: 137-142 [PMID:24485902 DOI: 10.1016/j.molmed.2013.12.004]
76. Dinh TL, Veves A. The efficacy of Apligraf in the treatment of diabetic foot ulcers. *Plast Reconstr Surg* 2006; 117:152S-157S; discussion 158S-159S [PMID: 16799383]
77. Alimov A.V., Khaydarova F.A., Berdykulova D.M., Alimova N.U., Sadikova A.S., Yuldasheva F.Z. Cdiabetes acharide in the republic Ezbekistan: prevalence, morbidity according to statistical reports for the last 10 years // Bulletin of the Tashkent Medical Academy 2019-8-12s
78. Karimov X. Y., Ergashev U. Y., Yakubov D. R. Complex treatment in severe forms of acute paraproctitis //Web of Scientist: International Scientific Research Journal. – 2022. – T. 3. – №. 9. – C. 199-203.
79. Ergashev U.Yu. , Mominov A.T., Malikov N.M., Yakubov D. Improvementof the integrity of the foot in patients with diabetes mellitus. *JOURNAL OF NEW CENTURY INNOVATIONS* Volume–7 17_Issue-1_November_2022
80. A. A. ATaliev, A. A. Mfreaks, H. A. Xtin, X. And. ERnazarov, N. A. MAlikov, F. A. Bobosharipov. Thebest results of the complex treatment of fournier gangrene with the use of CO_2 laser and photodynamic therapy. Problems of Biology and Medicine, 2017, No1 (93).