



Araştırma/Research

The Treatment Approaches in Diabetic Foot and The Role of Wagner Classification in The Guidance of Treatment

Kamil Gökhan Açar¹, Tayfun Bilgiç²

1 Baku Medical Plaza, Azerbeycan

2 Acibadem Kadıköy Hastanesi, Genel Cerrahi Kliniği

Öz

Amaç: Diabetik ayak enfeksiyonları alt ekstremitte amputasyonlarının 2/3 ünden sorumludur. Diabetik ayak yaralarının toplumlara maliyetide çok yüksektir. Bizim bu çalışmadaki amacımız diyabetik hastalarda oluşan ayak problemlerinin derecelendirmesini yaparak uygulanacak en uygun tedavi şeklini seçmek ve buna bağlı olarak hastanın yaşam kalitesini, ruhsal durumunu bozan travmatik bir işlem olan amputasyon oranını azaltmaktır.

Yöntem: SB Göztepe Eğitim ve Araştırma Hastanesi Genel Cerrahi Kliniğine diabetik ayak nedeniyle yatmış 49 hasta çalışma kapsamına alınmıştır.

Bulgular: 49 hastadan 30'u (% 61.2) erkek 19'u (% 38.8) kadındı. Yaş ortalaması 61,4 (39-80) idi. Hastaların hepsinde tip 2 DM mevcut idi. Hastalar Wagner sınıflamasına göre değerlendirildiğinde 4 (%8,25) hasta grup 1, 19 (%38,7) hasta grup 2, 13 (%26,5) hasta grup 3, 9 (%18,3) hasta grup 4 ve 4 (%8,25) hasta grup 5 olarak tespit edildi. Wagner sınıflaması ve amputasyonlar ile yaş, cinsiyet, açlık kan şekeri, üre, kreatinin değerleri arasında anlamlı fark saptanmamıştır.

Sonuç: Diabetik ayak enfeksiyonları komplikasyonların oldukça ağır olması, amputasyon ve hatta mortalite ile sonuçlanması nedeniyle ekonomik ve sosyal kayıplara neden olan önemli bir sağlık problemidir. Bu yüzden diabetik ayak oluşumunun önlenmesi hem toplumsal hem de ekonomik açıdan önemlidir. Bunun için hastalığın risk faktörlerinin belirlenmesi ve buna göre risk altındaki hastaların belirlenip bilinçlendirilmesi gerekmektedir. Hekimlerin de bu risk faktörlerini bilerek daha dikkatli davranmaları sonucunda yeterli ve zamanında tedaviye başlanması ile amputasyon oranlarının düşürülmesi söz konusudur. Multidisipliner bir yaklaşımla diabetik ayak enfeksiyonlarının tedavisinin başarıyla yapılabilmesi ve ampütasyon oranlarının düşürülmesi mümkündür.

Anahtar Kelimeler: Diabetik ayak, Wagner sınıflaması, komplikasyon.

Yazışmadan Sorumlu Yazar

Tayfun Bilgiç

Acibadem Kadıköy Hastanesi, Genel Cerrahi
Kliniği

Tel : +90 532 655 7134

Email: tbilgic77@gmail.com

Doi:10.30569.adiyamansaglik.490165

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THE TREATMENT APPROACHES IN DIABETIC FOOT AND THE ROLE OF WAGNER CLASSIFICATION IN THE GUIDANCE OF TREATMENT

Abstract:

Aim: Diabetic foot infections are responsible for 2/3 of the lower extremity amputations. The cost of diabetic foot ulcers is a significant expense for society. The aim of the present study was to select the best treatment modality by performing the staging of the foot problems in diabetic patients, and decrease the rate of amputations which being a traumatic procedure decreases the quality of life, and affects mental health of the patient.

Methods: Forty-nine patients diagnosed with diabetic foot who presented to the General Surgery Clinic of Gztepe Education and Training Hospital under Turkish Ministry of Health were included in the study.

Results: Thirty patients (61.2%) out of 49 were male, and 19 (38.8%) were female. The mean age was 61.4 years (range, 39-80 years). All patients were diagnosed with type 2 diabetes mellitus. The evaluation in accordance with the Wagner classification showed that 4 (8.25%) patients were in Group 1, 19 (38,7%) were in Group 2, 13 patients (26.5%) were in Group 3, 9 (18.3%) were in Group 4, and 4 (8.5%) patients were in Group 5. No significant difference was detected between the groups, in terms of age, sex, fasting blood glucose, urea, creatinine levels.

Conclusion: Diabetic foot infections are significant health problems which creates serious economic and social burden owing to severe complications like amputation and even with mortality. Therefore, prevention of diabetic foot is important from social and economic perspective. The identification of the risk factors of the disease, and educating the patients who are under risk is required. Amputation rates may be decreased with the initiation of the adequate treatment in proper time with the attentive approach by physicians who are informed of the risk factors. The treatment of the diabetic foot infections may be accomplished, and the amputation rates may be decreased with a multidisciplinary approach.

Key Words: Diabetic foot, Wagner classification, complications.

Introduction:

Diabetic foot is detected in 5-10% of all the patients diagnosed with diabetes mellitus. Foot problems are the most frequent cause of admissions to hospital, the most frequent cause of hospitalization, and constitute the longest hospital stay.

Diabetes mellitus is a major reason of amputation even in developed countries, and constitutes the reason of more than 50% of non-traumatic amputations. Foot infections are the most significant reason of morbidity, and mortality. Diabetic foot infections are responsible from the 2/3 of the lower extremity amputations.

The cost of diabetic foot ulcers is significantly high for the society. The annual cost of diabetic foot treatment in USA was calculated as approximately 200-500 million dollars. Approximately more than 50.000 amputations were performed in the USA, and the cost of the amputations was reported as 1 billion dollars (1-3).

Main reasons for high cost of diabetic foot are longer hospital stay and high morbidity and mortality. Therefore, the early diagnosis, and timely treatment of diabetic foot is very important for patients and society.

There is no accurate data on Turkish rates of amputation as there is a lack of knowledge about the stratification of the amputation levels, patient care, and rehabilitation. It was remarkable to detect that amputation was performed in higher than demarcation levels than the required for shortening the hospital stay period of the patients.

The aim of the present study was to select the best treatment modality by performing accurate staging of foot pathologies in diabetic patients and decrease the rate of amputations decreasing quality of life and affecting psychological status of patients.

Material and Method:

Forty-nine patients diagnosed with diabetic foot who presented to the General Surgery clinic of Göztepe Education and Training Hospital under Turkish Ministry of Health were included in the study. The patients who presented to outpatient clinics and the patients with diabetic foot who were hospitalized to other clinics were excluded from the study.

The demographic features such as age, sex of the patients were recorded, and type of diabetes, blood glucose, urea, creatinine levels, staging in accordance with the Wagner classification, localization of the lesion, culture antibiogram study, antibiotic treatment and duration, state and level of peripheral pulse, performed surgical procedures, complications, period of hospital stay,

and mortality rates were evaluated. These parameters were assessed in accordance with Wagner classification.

The ethical committee approval for his study was acquired from institutional Committee for Ethics.

Statistical Method:

The Statistical Package for the Social Sciences (SPSS) for Windows 10.0 program (IBM, SPSS Inc, Chicago, Illinois) was used in the statistical analysis in the evaluation of the obtained data. The Chi-square test was used in the comparison of the qualitative data in addition to the descriptive statistical methods (frequency). The results were evaluated in 95% confidence interval, and the significance value was regarded as $p < 0.05$.

Results:

Thirty patients (61.2%) out of 49 were men, and 19 (38.8%) were mean. The mean age was 61.4 years (range 39-80 years). All patients were diagnosed with type 2 diabetes mellitus. The evaluation in accordance with Wagner's classification showed that 4 (8.25%) patients were in Group 1, 19 (38,7%) were in Group 2, 13 patients (26.5%) were in Group 3, 9 (18.3%) were in Group 4, and 4 (8.5%) patients were in Group 5. No significant difference was detected between spoken groups in terms of amputation rate, age, sex, fasting blood glucose, urea, creatinine levels.

Most distal lesions were found to be infected and suppurred. The distribution of the lesions in accordance with the localization is shown in Table 1. The distribution of patients in whom absence of lower extremity peripheral pulses was detected in physical examination is shown in Table 2. Obstructed peripheral pulses were more frequently observed in distally localized lesion.

Table 1. The localizations of the lesions.

LESION	NUMBER	%
Fingers	23	46.9
Metatarsal bones	9	18.3
Middle foot	8	16.3
Foot	6	12.2
Leg	3	6.3

Table 2. The level of peripheral pulse detection.

The level of peripheral pulse	Number	%
Dorsalis pedis artery	15	42.8
Tibial posterior artery	15	42.8
Popliteal artery	4	11.6
Femoral artery	1	2.6

As a routine practice at the moment of admission to the hospital before initiation of antibiotic treatment, culture antibiogram was acquired from the wound site for each patient. Investigation showed that meticillin resistant *Staphylococcus aureus* (MRSA) was detected in 11 patients (22.4%), meticillin sensitive *Staphylococcus aureus* (MSSA) in 9 patients (18.4%), *Escherichia Coli* (E.Coli) in 7 patients (14.2%), *Proteus* in 5 patients (10.2%), Group D streptococcus in 3 patients (6.1%), *Pseudomonas aeruginosa* in 3 patients (6.1%), and *Klebsiella* species in 2 patients (4.2%), however, no bacterial growth at all was detected in 9 patients (18.4%). There was a statistically significant high association between the distribution of some microorganisms in accordance with the stages ($p < 0.01$). The growth of *Staphylococcus aureus* increased in the culture as the stage increased (Table 3).

Table 3. The relation between culture results and Wagner stage. χ^2 : Chi square test ** $p < 0.01$ significant.

Microorganism	Stage 1+2	Stage 3	stage 4+5	χ^2 ; p
MRSA		5 (% 38.5)	6 (% 46.2)	χ^2 :36.485; p :0.001**
MSSA	2 (% 8.7)	5 (% 38.5)	2 (% 15.4)	
E. Coli	5 (% 21.7)	1 (% 7.7)	1 (% 7.7)	
Proteus	4 (% 17.4)		1 (% 7.7)	
Group streptococcus D	2 (% 8.7)	1 (% 7.7)		
Pseudomonas A.			3 (% 23.0)	
Klebsiella	2 (% 8.7)			
No microorganism	8 (% 34.8)	1 (% 7.6)		

Antibiotic treatment was initiated empirically. Ampicillin+ sulbactam 1 gr 3x1/day was administered to 33 patients (67.3%), and Ciprofloxacin 200 mg+ Clindamycin 600 mg 2x1/day was administered to 16 patients (32.7%). Longest administration period was 15 days while shortest was 2 days. Secondary antibiotic treatment was initiated for 25 patients (51%) as an adjustment for culture antibiogram result. There was no statistically significant association between Wagner stages and adjustments in antibiotic treatment ($p=0.102$).

The performed surgical procedures are demonstrated in Table 4. Necrotic material debridement and drainage incisions were performed in 7 patients as additional procedure to the surgical treatment. Syme, Chopart and Lisfrac procedures and metatarsal amputation were performed in total of 4 patients while metatarsophalangeal amputation was performed in 22 patients for lesions of toe and metatarsal localisation.

For total of 8 patients with central foot lesions Syme procedure was performed in 1, Chopart procedure in 1, amputation below the knee was performed in 2 and debridement was performed in 4 patients.

For diabetic ulcers of foot and leg in total of 12 patients amputation above knee was performed in 9 patients, below knee amputation in 2 and bilateral amputation was performed in 1 patient. A statistically significant high association was detected between Wagner groups in terms of surgical procedures ($p<0.01$). The amputation rate increased as the group increased (Table 5).

The evaluation of the postoperative follow-ups of the patients who underwent amputation revealed that 1 patient died, and complications were detected in 9 patients. The reason for mortality was sepsis in the patient who underwent bilateral amputation above knee. The detected complications were infection, and need for reamputation. Reamputation was indicated for 1 patient out of 9 who developed infection. Reamputation was performed due to other reasons in 1 patient, and total amputation rate was detected as 4.8%.

The mean hospital stay was 9.1 days with longest and shortest of 24 and 2 days respectively.

Table 4. Surgical procedures. Amp. – stands for amputation.

Procedure	Number	%
Debridement+drainage	7	14.2
Met.-phalangeal amp.	22	44.8
Transmetatarsal amp.	1	2.2
Lisfrac amp.	1	2.2
Chopart amp.	2	4
Syme amp.	2	4
Transtibial amp.	4	8.1
Above knee amp.	9	18.3
Bilateral above knee amp.	1	2.2
Total	49	100

Table 5. Relation between Wagner stages and procedures. Amp. – stands for amputation.

Procedure	Stage 1+2	Stage 3	Stage 4+5	χ^2 ; p
Debridement+drainage	7 (% 30.4)			χ^2 :41.685; p:0.001**
Met.-phalangeal amp.	11 (% 47.8)	9 (% 69.2)	2 (% 15.4)	
Transmetatarsal amp.		1 (% 7.7)		
Lisfrac amp.		1 (% 7.7)		
Chopart amp.	1 (% 4.3)	1 (% 7.7)		
Syme amp.	1 (% 4.3)	1 (% 7.7)		
Transtibial amp.			4 (% 30.8)	
Above knee amp.	3 (% 13.0)		6 (% 46.2)	
Bilateral above knee amp.			1 (% 7.7)	

χ^2 : Chi square test ** p<0.01 significant.

Discussion:

The most significant outcome of peripheral effects of diabetes is decrease in the blood supply to the foot which causes a delay in recovery, predisposition to infection, ulcers, and wounds which may result in amputation. Patients do not notice developing complications in most cases until late periods. The combination of ischemia, neuropathy, and sepsis causes osteomyelitis and gangrene which further results in amputation (4-8). The treatment is delayed particularly in the underdeveloped and developing countries owing to sociocultural and economical problems. Amputation rates are also showed to increase with the delay in treatment. Some studies showed that amputation rates increased in accordance with Wagner stage. Dinççağ et al. detected that

6% of the patients were classified in Group 0-1, 32% were classified in Group 2, 51% were classified in Group 3, and 11% were classified in Group 4 in total of 800 patients diagnosed with diabetic foot (9). In our study we detected that distribution of patients among Wagner groups was slightly different with 8.25%, 38.7%, 26.5%, 18.3% and 8.25% for groups from 1 throughout 5 respectively. Wagner 3, and higher stage was detected in 36 patients (69.1%) out of 52 in the study by Bostanoğlu et al. having statistically significant association between amputation and Wagner stage (10).

The investigation of localizations of the lesions in patients who underwent amputation showed that lesions were in the level of toes approximately in half of the patients and lesions were infected and suppured. The main indication of amputation in these patients was untreatable infections. Selection of the amputation level to be performed in patients must be arranged as to provide a functional foot suitable for supporting weight of the body while standing and walking (11, 12). Physical examination, angiography, transcutaneous oxygen monitorization, thermography, and lower extremity segmental blood pressure measurements are used in determining a safe and the most distal amputation level (13). The rate of failure was reported as 20% in the amputation below knee when the amputation levels were determined with only physical examination (13, 14). In our study group in determining amputation levels in patients physical examination results were mainly used. The lower level where the maximum debridement can be performed was selected as the amputation levels because infection was the main problem. The functional condition, circulation, age, and activity of the patient were also considered in selection of the level. Amputation below knee was performed for 2 patients who had lesions in the central foot region, amputation above knee was performed for 9 patients out of 12 who had lesions on the leg, amputation below knee for 2 patients, and bilateral amputation above knee for 1 patient were performed for the patients who had lesions in central foot region. Hiil et al. performed debridement in 60.6% of patients, metatarsal amputation in 35%, and amputation below and above knee were performed in 14% in their study (15). Bostanoğlu et al. performed debridement in 42.3%, toe, and metatarsal head amputation in 36.5%, and amputations below and above knee in 32.6% of the patients in their study (10).

The conducted studies showed that approximately half of the amputations could have been prevented (16). The patient education on foot care was detected to be inadequate in the prevention of the development of ulcer, and amputation (17). Peripheral neuropathy was detected in first levels with 82% among the reasons for amputation, the rate of amputation was

demonstrated to significantly decrease with the detection of sensory loss and by taking required prophylactic measures (18). However, it was found that the prevalence of amputation increased with the increase of the depth and the stage of ulcer, and the possibility of amputation increased 11 folds in the ulcers reaching to the bone and increased up to 90 folds in patients with accompanying infection, and ischemia. In addition, studies showed that Wagner stage, history of stroke, history of previous major amputations, low transcutaneous oxygen pressure, white blood count and estimated glomerular filtration rate (eGFR) were the independent risk factors (16, 19, 20, 21).

Antibiotic treatment has a significant role in the treatment of diabetic foot infections. Performing surgical treatment with the initiation of empirical antibiotic treatment against probable pathogen decreased morbidity and mortality (17). Antibiotic to be selected against the most frequently detected pathogen microorganism must be given in a dose to reach high concentration in tissue. The administered antibiotic must be switched in accordance with antibiogram. Present study showed that the most frequently grown microorganism was the *Staphylococcus aureus*. Higher amputation rates in presence of staphylococcal infections compared to others were found statistically significant. However, the culture results must be known for prescription of efficient treatment. Antibiotic treatment was modified in our study in 25 patients (51%) due to culture antibiograms which were found sensitive to a different antibiotic. Antibiotics used in our patients were mainly wide spectrum single form antibiotics. West et al. suggested that initiation of empirical treatment with a parenteral wide spectrum single antibiotic was the most appropriate approach in high risk infections rather than a combination of antibiotics (22).

Mortality rates in present study were significantly low with nearly 2% likely to be related to distribution of our patients between stages with most of them spread among first three stages. Other studies by Gutman M et al. and Bostanoğlu et al reported mortality rates as 23.7% and 13.5% respectively. (10-23). In both studies Wagner stage 4 and 5 were more dominant in contrast to our study.

Akalin et al. detected that treatment costs increased 3 folds in patients who developed complications in their study investigating 959 diabetic patients. In addition, the cost of the hospitalized patients was 6.5 folds higher than the costs of the patients who were followed up and treated in outpatient clinics (24).

Diabetic foot infections are significant health problems which resulted in economic and social

burden because of severe complications resulting in amputation and even with mortality. Therefore, prevention of the occurrence of diabetic foot is important from social and economic perspective. Identification of the risk factors of the disease and educating patients who are under risk is required. Amputation rates can be decreased with early initiation of adequate treatment with standardized approach by physicians considering all possible risk factors. Treatment of diabetic foot infections may be accomplished and amputation rates may be decreased with a true multidisciplinary approach.

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