



The Influence of an Interdisciplinary Diabetic Foot Team on the Outcome of Patients with Diabetic Foot

İnterdisipliner Yaklaşımın Diyabetik Ayak Enfeksiyonu Olan Hastaların Akibeti Üzerine Etkisi

The Role of Interdisciplinary Diabetic Foot Team

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Özet

Amaç: Diyabetik ayak enfeksiyonlarının (DAE) yönetimi zordur ve bu hastalarda multidisipliner yaklaşımın amputasyon oranını düşürdüğü gösterilmiştir. Enfeksiyon hastalıkları kliniklerinde interdisipliner ekibin hasta yükü ve sonuçları üzerine etkisine dair sınırlı bilgiler mevcuttur. Bu çalışmada interdisipliner ekibin enfeksiyon hastalıkları kliniğine kabul edilen hastaların özellikleri, yatış süresi ve amputasyon üzerine etkisini araştırmayı amaçladık. **Gereç ve Yöntem:** Bu çalışmada Ocak 2005- Ekim 2014 arasında DAE tanısı ile Enfeksiyon Hastalıkları kliniğine yatırılan hastaların dosyaları geriye dönük olarak incelendi. İnterdisipliner ekibin oluşturulmasından önce (Ekim 2013) yatırılan hastalar grup-1, bu tarihten sonra yatırılanlar grup-2 olarak adlandırıldı. Grup-2'deki bütün hastaların tedavisi interdisipliner ekip tarafından yürütüldü. Gruplar hasta özellikleri, klinik ve laboratuvar bulgular, yatış süresi ve amputasyon açısından karşılaştırıldı. **Bulgular:** Grup-1'e 53, grup-2'ye 39 hasta dahil edildi. İnterdisipliner ekibin oluşturulmasından sonra hem daha fazla hasta (0,5 hasta/ay vs 3,25 hasta/ay) hem de daha ciddi hastalar (Wagner grade 4-5, %26,4 vs. %51,3; p=0,013) yatırılmıştır. Bununla birlikte yatış gün sayısında değişiklik gözlenmemiştir (23,4±11,0 gün vs. 21,0±14,5 gün; p=0,478). Cerrahi müdahale olmadan sırasıyla grup-1 ve grup-2'deki hastaların 13 (%24,5) ve 11 (%28,2)'inde yara iyileşmesi görüldü (p=0,691). Her iki grupta minör (grup-1 %30,2 vs grup-2 %30,8) ve major amputasyon (grup-1 %9,4 vs grup-2 %7,7) açısından istatistiksel fark bulunamadı (p=0,786). **Tartışma:** İnterdisipliner ekibin oluşturulmasından sonra daha ileri evre diyabetik ayak yarısı olan hastalar yatırılmış olmasına rağmen, hastane yatış süresi ve amputasyon oranında değişiklik gözlenmemiştir. İnterdisipliner ekibin diyabetik ayak enfeksiyonlarının yönetimindeki rolünü ortaya koyabilmek için daha çok vakanın dahil edildiği çok merkezli çalışmalara ihtiyaç vardır.

Anahtar Kelimeler

Diyabetik Ayak; Enfeksiyon; Amputasyon; İnterdisipliner Ekip

Abstract

Aim: Management of diabetic foot infection (DFI) is challenging; a multidisciplinary approach has been shown to reduce amputation rates. There is limited information on the effect of having an interdisciplinary diabetic foot team (IDT) on patient load and outcomes at infectious disease departments. We aim to investigate the effect of the IDT approach on patient characteristics, the length of hospitalization, and amputation rates in patients hospitalized for DFI at the department of infectious disease. **Material and Method:** We retrospectively reviewed the files of patients who were hospitalized in the infectious disease department for DFI between January 2005 and October 2014. Patients hospitalized before the establishment of IDT (October 8, 2013) formed Group-1 and those hospitalized after the establishment of IDT formed Group-2. The members of IDT evaluated and treated all of the patients in Group-2. The groups were compared for patient characteristics, clinical findings, length of hospitalization, laboratory results, and outcome. **Results:** There were 53 patients in Group-1 and 39 patients in Group-2. The patient hospitalization rate increased after IDT (0.5 patients per month vs. 3.25 patients per month). Patients hospitalized after IDT had more advanced stage (Wagner grade 4-5) wounds (26.4% vs. 51.3%; p=0.013). However, the length of hospitalization did not change after IDT (23.4±11.0 vs. 21.0±14.5; p=0.478). Foot ulcers healed without surgical intervention in 13 (24.5%) and 11 (28.2%) patients in Group-1 and Group-2, respectively (p=0.691). Minor and major amputation rates were 30.2% and 9.4% in Group-1 and 30.8% and 7.7% in Group-2 (p=0.786). **Discussion:** Despite the fact that patients admitted after the establishment of IDT had more severe wounds, neither the length of hospitalization nor the amputation rate increased. Further studies are needed to evaluate the effectiveness of IDT in the management of DFI.

Keywords

Diabetic Foot; Infection; Amputation; Interdisciplinary Team

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Introduction

Diabetic foot ulcers (DFU) and infections (DFI) are among the serious complications of diabetes mellitus [1]. It is estimated that almost one-quarter of all diabetics develop DFU at least one time in their life [2]. DFU is the first stone on the path that ends up with lower extremity amputation [3]. More striking is that 50-60% of patients die within 5 years after lower extremity amputation [4,5]. DFUs often get infected, which impairs wound healing and increases the length of hospitalization and the risk of amputation [6-8]. Successful treatment of DFU/DFI will break the chain of events (ulceration, amputation, mortality) and will reduce amputation rates and hence mortality in diabetic patients.

Considering that multiple factors contribute to DFU/DFI, including neuropathy, ischemia, nephropathy, hyperglycemia, and abnormal foot biomechanics, the management plan should address all of these factors [9]. A team comprising members from several surgical and medical departments was established in our hospital to manage patients with diabetic wounds. This team regularly meets to evaluate patients with diabetic wounds. Rosenfield defines three systems of problem solving: multidisciplinary, interdisciplinary, and transdisciplinary approaches [10]. Today, these approaches are widely used by social and health scientists. In Rosenfield's definition of the multidisciplinary approach, team members evaluate patients only from their perspectives and consultations are done independently. In contrast, the interdisciplinary approach implies the evaluation of the patient concurrently by different disciplines. Our team's working principle was in accordance with Rosenfield's definition of the interdisciplinary approach. Therefore, we will use the term "interdisciplinary team" instead of "multidisciplinary team" [10]. Management of DFI is challenging; an interdisciplinary approach has been shown to reduce amputation rates [11]. An infectious disease specialist is a member of the interdisciplinary diabetic foot team (IDT) of our hospital. There is limited information on the effect of IDT on patient load and outcomes at infectious disease departments. In this study, we investigated the effect of the IDT approach on patient characteristics, length of hospitalization, and amputation rates in patients hospitalized for DFI at the department of infectious disease.

Material and Method

We retrospectively reviewed our department's records to identify the patients who were hospitalized for DFI between January 2005 and October 2014. The patients were assigned to two groups. Patients hospitalized before the establishment of IDT (October 8, 2013) constitute Group-1 (G1) and those hospitalized after IDT constitute Group-2 (G2). All patients in G2 were evaluated and treated by the IDT. We compared G1 and G2 with regard to patient characteristics, laboratory results, clinical findings, the length of hospitalization, and treatment outcomes. The IDT in our hospital includes specialists from the following departments: infectious disease and clinical microbiology, orthopedics, plastic and reconstructive surgery, endocrinology and metabolism disorders, cardiovascular surgery, and underwater and hyperbaric medicine.

A standardized form was used to record each patient's medical information. Digital images of wounds were taken weekly

to monitor treatment response. We defined major amputation as amputations above the ankle joint and minor amputation as those through or distal to the ankle joint. The study protocol was approved by the Institutional Review Board of Gulhane Military Medical Academy, Ankara, Turkey.

Statistical Analysis

We used the IBM SPSS for Mac version 20.0 for statistical analyzes. Categorical variables were presented as percentages and continuous variables as mean \pm standard deviation (SD) or median (quartiles). We used the Kolmogorov-Smirnov test to evaluate whether the distribution of continuous variables was normal. For parameters that showed normal distribution, we used the Student's t-test and for parameters that did not show normal distribution we used the Mann-Whitney U test. We used the Chi-square test to analyze categorical variables. A p-value less than 0.05 was accepted as statistically significant.

Results

During the study period, a total of 92 patients were hospitalized for DFI. Of these, 53 patients were hospitalized before the establishment of IDT (Group-1) and 39 patients were hospitalized after IDT (Group-2). The study period before IDT was 105 months and that after IDT was 12 months. We observed that the rate of hospitalization dramatically increased after the establishment of IDT in our hospital (0.5 patients per month vs. 3.25 patients per month).

Clinical characteristics and pretreatment laboratory results of the patients in Group-1 and Group-2 are presented in Table 1. Groups were similar in terms of age, sex, and pretreatment laboratory markers including hemoglobin, hemoglobin A1c, white blood cell count, erythrocyte sedimentation rate, C-reactive protein, albumin, urea, and creatinine. Diabetic age was significantly higher in Group 2 (15.4 \pm 8.7 vs. 21.7 \pm 9.8; p=0.003).

Wound characteristics and outcomes of the patients in Group 1 and Group 2 are presented in Table 2. Patients hospitalized after IDT had more advanced stage (Wagner grade 4-5) wounds (26.4% vs. 51.3%; p=0.013). However, the mean length of hospitalization was similar between the groups (23.4 \pm 11.0 vs. 21.0 \pm 14.4; p=0.478). Foot ulcers healed without surgical intervention in 13 (24.5%) and 11 (28.2%) patients in Group-1 and Group-2, respectively (p=0.691). Minor and major amputation

Table 1. Clinical characteristics and pretreatment laboratory results patients with diabetic foot infection

	G1 (n=53)	G2 (n=39)	p
Age, year	63.2 \pm 9.5	63.6 \pm 10.0	0.863
Sex, M/F	39/14	28/11	0.849
Diabetic age, year	15.4 \pm 8.7	21.7 \pm 9.7	0.003
HbA1c, %	8.8 \pm 1.6	8.4 \pm 1.9	0.439
Glycaemia, mg/dl	216.4 \pm 114.2	164.1 \pm 91.5	0.079
Hemoglobin, g/dl	11.1 \pm 1.8	10.5 \pm 2.1	0.224
WBC, x10 ³	10.6 \pm 4.3	10.4 \pm 4.9	0.863
ESR, mm/h	85.8 \pm 28.8	84.0 \pm 28.8	0.780
CRP	93.7 \pm 95.7	90.2 \pm 73.5	0.811
Urea, mg/dl	50.2 \pm 20.2	54.9 \pm 26.3	0.336
Creatinin, mg/dl	1.3 \pm 0.6	1.6 \pm 1.3	0.106
Albumin, g/dl	3.24 \pm 0.5	3.17 \pm 0.6	0.518

rates were 30.2% and 9.4% in Group 1 and 30.8% and 7.7% in Group-2 ($p=0.786$). Two patients in each group died ($p=0.752$).

Table 2. Wound characteristics and outcome in patients with diabetic foot infection

	G1 (n=53) n (%)	G2 (n=39) n (%)	p
Wound duration, mean±SD, day/s	157.1±335.6	55.8±51.8	0.863
Wound Grade			
Wagner 2-3	39 (73.6)	19 (48.7)	0.013
Wagner 4-5	14 (26.4)	20 (51.3)	
Length of stay, mean±SD, day/s	23.4±11.0	21.0±14.5	0.478
Wound healing	13 (24.5)	11 (28.2)	0.691
Amputation			
Minor	16 (30.2)	12 (30.8)	0.786
Major	5 (9.4)	3 (7.7)	
Exitus	2 (3.8)	2 (5.1)	0.752

Discussion

Management of DFI involves wound care, antimicrobial therapy, offloading, vascular evaluation and treatment, and metabolic control. Interdisciplinary cooperation may increase the accuracy of scientific judgments. The blending of the knowledge of different disciplines may bring out more effective solutions to the problems faced in the management of complex diseases [10]. Responsibility for the patients is shared among the members of the IDT. This allows a faster and more planned approach to the patients' care. Litzelman et al. [12] investigated the role of the multidisciplinary approach in the management of diabetic patients in general practice. They found a significantly lower incidence of serious foot lesions in patients treated with the multidisciplinary approach.

We found that the number of patients hospitalized for DFI markedly increased after the establishment of IDT in our hospital. Similarly, Hedetoft et al. [13] found that the number of patients admitted to their outpatient diabetic foot clinic increased fourfold in the 6 years following the establishment of a multidisciplinary team. Furthermore, we also found that patients hospitalized after IDT had more severe foot lesions. Evidence-based management of diabetic foot problems requires several treatments (metabolic control, infection control, wound care, surgical debridement, amputation, etc.) which fall under the expertise of different medical specialties. Without a dedicated IDT, it is very hard to organize all related specialists for the care of the patient with DFI. Our results confirm that IDT increased the confidence of infection disease specialists that they will get the necessary help from the members of IDF from other departments in the management of DFI patients. For instance, wound care would be provided by the department of plastic surgery, an endocrinologist would assist for glycaemia regulation, and the patient would be transferred to the department of orthopedics if an amputation was indicated.

The goal of the IDT should be not only healing the wound but also maintaining a functional ulcer-free lower extremity. Because patients with DFI often have multiple comorbidities, collaboration among specialists in the treatment of these patients is necessary. The interdisciplinary approach allows the patient to be evaluated by several specialists in a short time and a

coordinated treatment plan can be instituted. The efficiency of the IDT can be increased by implementing an evidence-based guideline that is tailored to the hospital's capabilities and patient population.

The IDT approach is becoming the gold standard in the management of patients with DFI [11]. The leader of this team should be a podiatrist (specialist in foot care) and the other members should be from the departments related to diabetic foot problems. All members of the IDT should have the appropriate skills and knowledge in the treatment of specific features of the diabetic foot. They should also work in cooperation with the other members of the team [14].

We did not find a statistically significant difference between the two groups in terms of length of hospitalization. Hospitalization duration was approximately 3 weeks in both groups. The reasons for prolonged hospitalization are parenteral antibiotic therapy for bone infection, surgical interventions, wound care, and hyperbaric oxygen therapy.

Lower extremity amputation is a devastating complication of diabetes mellitus [15]. Amputation rates, although varying among countries, are significantly high despite developments in the health care system [11,14,15]. Since amputation rates are high, subtle improvements in the care of diabetic patients will cause significant reductions in amputation rates. Recent studies showed reduced amputation rates in diabetic patients. Moxey et al. [16] found that the lower extremity amputation rate has declined more markedly in patients with diabetes as compared to non-diabetics. They suggested that this decline might be due to an increased number of specialized diabetic foot disciplines. Although we did not find a change in amputation rates following the establishment of IDT, considering that patients managed by IDT had more severe lesions compared to those managed during the pre-IDT era, obtaining a similar amputation rate may be regarded as a success.

This study has some limitations. First, the data were gathered retrospectively; therefore, our results depend on the availability and accuracy of medical records. Second, the study duration before and after IDT was markedly different (105 months vs. 12 months). Third, there was no control group. We think that IDT contributed to the favorable outcome; however, our results should be confirmed in a prospective, controlled, long-term outcome study.

In conclusion, establishment of the IDT increased the hospitalization rate of patients with DFI in our clinic. Despite the fact that these patients had more severe wounds than the pre-IDT patients, neither the length of hospitalization nor the amputation rate increased. Further studies are needed to evaluate both the effect of IDT on the infectious disease departments and the effectiveness of IDT in the management of DFI.

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Competing interests

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