Turkish Journal of Endocrinology and Metabolism, (1999) 3 : 123-127 **ORIGINAL ARTICLE**

A Retrospective Analysis of Hospitalized Diabetic Foot Patients in Akdeniz University School of Medicine, Division of Endocrinology

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The purpose of this study is to investigate the medical, epidemiological, and financial aspects of diabetic patients who were hospitalized because of diabetic foot problems in Akdeniz University School of Medicine, Division of Endocrinology during 1995-1998 (n=58; 21 females,37 males; 56 NIDDM, 2 IDDM; age 60.5±10 years; duration of diabetes 15.1±8.1 years). The time period between the appearance of foot lesions and hospitalisation was 30 (7-360) days. Twenty patients had Grade IV, 27 Grade III, 10 Grade II, 1 Grade I diabetic foot (according to Wagner's classification). In 35 patients, osteomyelitis was suggested by Tc 99m-MDP three phase bone scanning; 17 of these patients had a normal bone x-ray. One or more organisms were identified in aerobic wound culture of 32 patients. Clindamycin and fluoroquinolones were given empirically. The most frequently isolated agent was S.aureus. Angiography was performed in 18 patients in whom physical examination and/or Doppler ultrasound suggested arterial insufficiency and 11 had severe stenosis or occlusion. Above or below knee amputations were performed in 13 patients; 5 of these patients had severe arterial insufficiency established by angiography, 2 by Doppler ultrasound, 4 by physical examination. Forty five patients improved with medical and/or conservative surgical therapy. The median duration of hospitalization was 21(4-81) days, and median treatment cost per patient was 1292 (110-9420) US dollars. The median hospitalisation period and cost per person was 11 days, 710 $ for grade II; 22 days, 1215 $ for grade III and 28 days, 2190 $ for grade IV ulcers. All grade I and grade II, 24 of 27 grade III, and 10 of 20 grade IV ulcers were cured by conservative therapy. Major amputation was performed in 3 grade III and 10 grade IV ulcers.

KEY WORDS Diabetic foot, management, osteomyelitis, amputation, cost

Introduction

Diabetic foot develops in approximately 2.5% of diabetic patients and accounts for 20 % of all hospitalizations of diabetics (1,2). 50% of non-traumatic major lower extremity amputations are due to diabetic foot lesions (3) and lower extremity amputation rate is 15-40 times greater in diabetics when compared with non-diabetics (4,5). Approximately 50% of patients who have had a major amputation will require a second amputation in future Hypo or anesthesia due to sensorial neuropathy, alteration of pressure points on the sole of the foot due to motor neuropathy, and dryness of the skin due to autonomic neuropathy may be more important than macroangiopathy in the pathogenesis of diabetic foot ulcers (6-9).

These patients require long periods of hospitalization and the management costs sum up to hundreds of millions of dollars per year in the US (10,11) Education of diabetic patients with respect to proper foot care will result in a decrease in both diabetic foot problems and financial costs.

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The aim of this study is to investigate the medical, epidemiological and financial aspects of diabetic patients hospitalized because of diabetic foot problems.

Patients and Study Design

In this retrospective study, 58 diabetic patients who were hospitalized because of diabetic foot problems in Akdeniz University Hospital, Division of Endocrinology during 1995-1998 were analyzed (21 females, 37 males; 56 NIDDM and 2 IDDM; age 60.5±10.2 years; duration of diabetes 15.1±8.1 years; 29 on oral hypoglycemic agents and 29 on insulin treatment). Thirty seven (64%) were non-smokers, 13 (22 %) were active smokers and 8 (14 %) were ex-smokers. Twenty nine patients (50 %) had a history of previous foot lesions. None of these patients had been educated previously with respect to proper foot care.

A complete history was taken and physical examination was performed and the patients were followed by a team (Endocrinology, Infectious Disease, Plastic Surgery and Orthopedics Departments). Aerobic wound cultures were obtained from the base of the ulcer; anaerobic cultures couldn't be obtained. Leucocyte count and eritrocyte sedimentation rate were measured. Oral or parenteral clindamycin and fluoroquinolon were started empirically in 52 patients. In one patient with a life threatening infection imipenem was started. Ampicillin+ sulbactam was given to two patients,and oflaxocin was given to one patient. One patient was treated by wound dressing only. In patients with osteomyelitis the antibiotic therapy was continued for at least 6 weeks; in others it was continued for 3-4 weeks. Patients were evaluated with x-ray and Tc 99m-Methylene Diphosphate (Tc99m-MDP) three-phase bone scintigraphy for the presence of osteomyelitis.

Patients suspected of having arterial insufficiency by physical examination underwent lower extremity arterial Doppler ultrasonography (n=37) or angiography (n=18).

Daily wound management was performed. Debridement, minor conservative amputations or skin grafting were performed when necessary. Major amputations were performed in patients in whom infection could not be controlled by conservative treatment. Patients were discharged to continue their treatment at home when possible. The cost of medical treatment, hospitalization and surgical treatment was calculated in US $.

Statistic analysis:

All values are given as median (range) and mean ± standard deviation. Pearson correlation analysis was used for correlation of parameters. A p value < 0.05 was considered to be statistically significant.

Results

The time period between the appearance of foot lesions and hospitalization was 30 (7-360) days. Fifty seven patients (98%) had distal sensitive neuropathy established by physical examination. Eight patients (14%) had predominantly ischemic, whereas fifty patients (86%) had predominantly neuropathic ulcers. The precipitating factors were mechanical in 23 (40 %), thermal in six (10 %), and unknown in twenty one patients (36 %). In six patients of the last group, the wound developed following a diabetic bulla. Twenty patients (34 %) had grade IV, twenty seven (47 %) grade III, ten (17 %) grade II and one patient (2 %) had grade I diabetic foot according to Wagner's classification. One or more microorganisms were identified in aerobic wound cultures of 32 patients (55 %). The most commonly isolated microorganisms were S. aureus and P. aeuroginosa. Thirty six patients (62 %) had normal bone x-ray and twenty two patients (38 %) had periostae reaction and/or lytic bone lesions. In thirty five patients (60 %), osteomyelitis was suggested by Tc 99m-MDP three phase bone scanning; 17 of these patients had normal bone x-rays. Angiography was performed in 18 patients in whom physical examination and or Doppler ultrasound suggested arterial insufficiency. Severe stenosis or occlusion were found in 11 of these patients. Major amputation was performed on 13 patients (22 %); five of these patients had severe arterial insufficiency determined by angiography, two by Doppler ultrasound and four by physical examination. Minor amputation and skin

Table. Some features of the diabetic foot patients according to ulcer grade

Grade	I	II	III	IV
N	1	10	27	20
Admission period (day)*	7	15(3-90)	30(7-180)	21(7-360)
Hospitalization period (day)*	28	11(7-35)	22(8-60)	28(4-81)
Sensitive neuropathy (n)	1	9	27	20
Type of ulcer (neuropathic/ischemic)	1	10/-	26/1	13/7
Improvement by conservative treatment (%)	100	100	89	50
Major amputation	-	-	3	10
Cost (US dollars)*	1713**	710(400-2371)	1215(110-3905)	2190(638-9420)

* Values are given as median (min-max). ** The cost of the patient is high due to accompanying diseases.

grafting were performed on 7 and 12 patients, respectively. One patient with Grade IV diabetic foot died due to septisemia. Forty five patients (78%) were cured completely by medical and/or conservative surgical therapy. The duration of hospitalization was 21(4-81) days and the cost per patient was 1292(110-9420) US $. The characteristics of diabetic foot patients and the costs with respect to the grade of the ulcers are shown in the table (Table 1). The median hospitalization period and cost per patient was eleven days, 710 $ for Grade II; 22 days, 1215 $ for Grade III and 28 days, 2190 $ for Grade IV ulcers. All Grade I and Grade II, 24 of 27 Grade III and 10 of 20 Grade IV ulcers were cured by conservative therapy. Major amputation was performed in three Grade III and ten Grade IV ulcers.

Discussion

In our patients the time period between the appearance of foot lesions and hospitalization was very long 30 (7-360 days) and 81% had Grade III or IV ulcers. This implies that these patients had not been educated previously with respect to proper foot care. In fifty seven patients (98%) bedside neurological examination revealed distal sensitive neuropathy which is the most important pathogenetic factor in diabetic foot ulcers. Therefore, special emphasis with respect to proper foot care should be given to these higher risk patients who can be identified by bed-side physical examination.

Diabetic foot ulcers usually have mixed bacterial flora. In our patients the most frequently isolated microorganism was S. Aureus which was in concordance with the literature (12,13,14,15,16). Clindamycin + fluoroquinolon were started as first-line antibiotics in 52 patients. Forty two of these patients (80%) were cured without a major amputation which shows the success of this combination.

There are some difficulties in the diagnosis of osteomyelitis. Although Magnetic Resonance Imaging and In-111 leukocyte scintigraphy have high sensitivity and specificity, their high cost and unavailability in some centers limit their common usage (17). Bone x-rays may show periosteal reaction and osteolytic lesions in advanced osteomyelitis and are not very sensitive (18,19). Three phase bone scintigraphy with Tc99m- MDP which is highly sensitive but not very specific (50%) in the diagnosis of osteomyelitis (20) was performed in our study. In sixteen patients who had periosteal reaction and osteolytic lesions with bone x-ray, bone scintigraphy showed an increase in activity indicative of osteomyelitis. However, bone x-rays were normal in seventeen patients who had positive bone scintigrams for osteomyelitis.

A major amputation (below or above knee) was performed in 13 patients (22 %). Five of these patients had angiographically proven arterial insufficiency and 4 had severe macroangiopathy determined by physical examination. Five of these patients had predominantly ischemic type ulcers. Only two of the amputated patients had normal

arterial examination and Doppler findings. These findings imply the critical role of arterial insufficiency in the prognosis of diabetic foot ulcers (16,21,22). In these 13 amputated patients, the time period between the appearance of foot lesions and hospitalization was 30 (10-360) days, which was higher than the whole group.

Forty five patients (78 %) were completely cured with medical and/or conservative surgical therapy without requiring any major amputation. This result shows the importance of proper wound care and appropriate antibiotic combinations in preserving the lower extremities of diabetic foot patients. Management of these patients by a 'multidisciplinary team' composed of an Endocrinologist, Orthopedist, Plastic Surgeon and a Specialist in Infectious Diseases will improve the prognosis (23).

The hospitalization period of our patients was shorter [21(4-81) days] than that given in the literature (15,16,24). This is because of high turnover rates of the patients due to the limited number of hospital beds. The cost per patient is also considerably lower than that of patients in Europe or US. (5.516 VS 20.000 $ for a patient who had undergone a major amputation) (25,26). The reason for this is lower costs for accommodation, medical and surgical procedures in our country. Our study shows that the cost, hospitalization period and amputation rates increase with high Grade ulcers (Grade III and IV). This emphasizes the importance of early and proper management of minimal diabetic foot lesions which may be established with the education of medical staff dealing with diabetic patients (27,28). A study conducted in the US showed that only 12 % of doctors examined the feet of diabetic patients, which underlines the importance of education of medical staff in this respect and the need for Podiatrists in the 'diabetic team'.

The predictive value of eritrocyte sedimentation rate (ESR) and leucocyte count in the diagnosis of osteomyelitis is controversial (29,30). We, also, didn't find a correlation between leucocyte count or ESR and presence of osteomyelitis by three phase bone scintigraphy with Tc99m- MDP.

In conclusion, our study shows that if diabetic foot problems are not managed early and properly, they may result in a major amputation and loss of an extremity. However, the main strategy should be to educate the patient and the medical staff about proper foot care in an attempt to prevent the development of diabetic foot problems. In this way, amputation rates and the huge financial costs of these patients could be decreased.

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