Outcome of Diabetic Foot Infections Treated Conservatively

A Retrospective Cohort Study With Long-term Follow-up

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Background: Diabetic foot lesion is associated with increased morbidity and high resource use. Although early amputation has been advocated in case of osteomyelitis, conservative treatment is a more attractive alternative.

Objective: To identify criteria predictive of failure of conservative treatment of diabetic foot ulcer at time of admission to the hospital.

Methods: We conducted a 5-year retrospective cohort study with prospective long-term follow-up of all diabetic patients admitted for a foot lesion at a large (1600-bed) teaching institution. Predetermined criteria were used for the diagnosis and classification of diabetic foot lesions (Wagner classification). Study variables included patient demographics and clinical parameters related to infection and diabetes. The average follow-up after hospital discharge was 2 years. Failure of conservative treatment was the main outcome measure. Independent predictor variables were selected by logistic regression analysis.

Results: A total of 120 diabetic patients were admitted for foot lesions; complications of contiguous osteomyelitis, deep tissue involvement, and/or gangrenous lesions occurred in 78 (74%) of the 105 patients for whom charts were available. Fourteen patients (13%) underwent immediate amputation. Conservative treatment was successful for 57 (63%) of the 91 remaining patients. Success was achieved in 21 (81%) of 26 patients presenting with skin ulcer, 35 (70%) of 50 patients with deep tissue infection or suspected osteomyelitis, and 1 (7%) of 15 patients with gangrene ($P<.001$, χ^2 for trend). Independent factors predictive of failure were the presence of fever (odds ratio [OR] = 1.1 per degrees Celcius; 95% confidence interval [CI], 1.0-1.2) and increased serum creatinine level (OR = 1.002 per micromoles per liter; 95% CI, 1.0020-1.0021) on admission, prior hospitalization for diabetic foot lesion (OR = 1.4; 95% CI, 1.2-1.6), and gangrenous lesion (OR = 1.8; 95% CI, 1.5-2.2). Other patient characteristics, demographics, duration of diabetes mellitus, neutrophil count, or the anatomical site of the lesion failed to predict outcome.

Conclusions: Conservative treatment, including prolonged, culture-guided parenteral and oral antibiotics, is successful without amputation in a large proportion of diabetic patients admitted for a foot skin ulcer or suspected osteomyelitis. Future studies comparing early amputation with novel therapeutic strategies for severe diabetic foot infection should take into account currently identified factors that predicted failure of conservative treatment on admission to the hospital.

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FOOT ULCERATION and supervening infection are a major cause of morbidity in diabetic patients. Diabetic foot lesions necessitate more hospital admissions than any other specific complication of diabetes.[1-3] Major amputation in the Western world remains frequent and is associated with high human and financial costs.[4] Patients with diabetic foot ulcers require more than 50 000 lower extremity amputations annually in the United States, corresponding to direct annual costs associated with these amputations that exceed $1 billion.[5]

Quality of life is poor for the patient with a chronic foot ulcer,[6] but it is still worse after an amputation.[7] The US Department of Health and the European Association of Diabetes have set as a goal a major reduction in amputation rates for the next decade.[8,9] Effective diagnostic, prognostic, and therapeutic strategies are needed to minimize human and financial costs. In an effort to delineate predictors of successful nonsurgical treatment of diabetic foot ulcer (an approach used at our institution), we conducted a 5-year retrospective cohort study of patients admitted for foot infections at the University Hospital of Geneva (UHG), Geneva, Switzerland, and followed up their outcome prospectively.

PATIENTS AND METHODS

All diabetic patients admitted to UHG for foot lesions between January 1986 and December 1990 were included. The UHG is a 1600-bed, tertiary care institution serving Geneva and the surrounding area (800 000 population). Most diabetic patients with foot lesions are followed up by the Podiatric Diabetics Outpatient Clinic or are admitted to a specific orthopedic ward. Computer hospital discharge diagnoses and discharge summaries were used for case detection (key words: *diabetes*, *foot lesion*, *osteomyelitis*). The study cohort was followed up prospectively at random intervals until July 1993: all patients were reviewed at the outpatient clinic or on another hospital ward while readmitted. Telephone interview was conducted as final follow-up information or when additional information was requested.

OBJECTIVE AND STUDY VARIABLES

The objective of the study was to identify easily available clinical and laboratory criteria predictive of failure of conservative treatment in patients admitted to the hospital with diabetic foot lesions.

Study variables included age, sex, diabetes-specific information (type, medication, duration, admission hemoglobin A_{1c} level), admission and follow-up serum creatinine levels, presence of peripheral vascular disease, participation in diabetic educational groups, podiatric consultation, signs of systemic infection (fever, leukocytosis, the presence of more than 10% immature neutrophils), and ulcer-related information (type and site of lesion, microbiological and radiological diagnostic procedures, type of therapy and evolution).

DEFINITIONS

Predetermined definitions for foot lesion were as follows: evidence of ulceration on clinical examination, inflammation with purulent discharge (or necrosis), and/or wound Gram stain and cultures showing the presence of leukocytes and pathogenic microorganisms (exclusion of skin flora). Samples were obtained for culture by deep-needle aspiration, bone biopsy, or curettage of the ulcer. The site of the lesion was noted: forefoot, midfoot, or hind foot.

Foot lesions were classified according to the Wagner classification,[10,11] which is a classification for diabetic, neuropathic, and dysvascular foot problems. Wagner classification grades are as follows: 0 indicates absent skin lesions, hyperkeratose below or above bony prominences; 1, skin and immediate subcutaneous tissue are ulcerated and the base may be gangrenous, infected, or clean; 2, lesions are deeper and may penetrate to tendon, bone, or joint capsule; 3, deep tissues are always involved, progression along tendon sheaths to midspace abscess is frequent, and osteomyelitis may be present but may not be evident on x-ray film during the first several weeks; 4, gangrene of some portion of the toes or forefoot is present; and 5, the entire foot is involved with gangrene or there is sufficient gangrene and infection that no local procedures are possible. The lesions were then categorized into 3 main clinical groups: (1) skin ulcer (Wagner 1 and 2); (2) deep tissue infection and suspected osteomyelitis (Wagner 3); and (3) gangrenous lesion (Wagner 4 and 5). Osteomyelitis was established in patients presenting with

RESULTS

STUDY POPULATION

Between 1986 and 1990, a total of 120 diabetic patients were admitted at UHG for foot lesions. Charts were available for 109 patients (91%); follow-up was not possible for 4 patients. Dropouts were random events, and amputation and hospital mortality rates were similar among patients enrolled in the study and those who were excluded. Thus, a total of 105 patients with diabetic foot lesions were studied, 52 women and 53 men. Age averaged 67 ± 12 years (age range, 27-91 years).

Ninety-eight patients (93%) had type 2 diabetes mellitus, while only 7 had type 1 diabetes mellitus. Diabetes had been present for an average of 13 ± 8.6 years (range, 1-40 years). A third of patients (35 of 105) attended diabetic educational groups, and 43 patients (41%) received podiatric advice. Fifty patients (48%) used insulin and 39 (37%) took oral hypoglycemic agents; 15 patients were diet controlled. Blood levels of hemoglobin A_{1c} (available for 66 patients) varied between 0.05 and 0.15 (mean = 0.09 ± 0.02; normal value, 0.03-0.06). Admission creatinine value averaged 111 ± 49 µmol/L (1.2-0.6 mg/dL) and ranged 53 to 387 µmol/L (0.6-4.4 mg/dL) (normal value <115 µmol/L [1.3 mg/dL]).

Most of the lesions involved the forefoot (91/105, 87%); the heel was the affected part in 11 patients (10%) and the midfoot in 7 (7%). The distribution of patients according to the classification proposed by Wagner was as follows: skin ulcer (27 patients, 26%), deep tissue infection and suspected osteomyelitis (58 patients, 55%), and gangrenous lesion (20 patients, 19%). Transcutaneous oxygen averaged 28 ± 16 mm Hg in the infected foot for 49 patients evaluated (range, 2-58 mm Hg; estimated threshold for ischemia, 20 mm Hg). Blood pressure at hallux averaged 64 ± 33 mm Hg (range, 1-145 mm Hg; estimated threshold for ischemia, ≤20 mm Hg).

Ten patients died during hospitalization. The causes of death were bacteremia (3 cases related to the foot infectious process), diabetic acidosis (2 cases), heart failure (4 cases), and pulmonary emboli (1 case). Follow-up after hospital discharge averaged 24 ± 13 months (range, 5-60 months). Nine additional deaths were recorded during the postdischarge follow-up period; none was related to diabetic foot lesion.

MICROBIOLOGY ASSESSMENT

All specimens were cultured for aerobic microorganisms, while anaerobic cultures were not performed routinely. Most specimens (90%) showed the presence of microorganisms by Gram stain; a total of 189 organisms were identified. They were 123 gram-positive bacteria (predominant microorganisms isolated: *Staphylococcus aureus* [n = 43], *Staphylococcus epidermidis* [n = 24], *En-*

clinical infection (Wagner stage 3) associated with radiological criteria on plain x-ray films (osteopenia, cortical lysis, periostitis, bone sequester, bone erosion, or presence of intra-articular bone fragment) and positive technetium bone scan results.[12] A systematic review of all available radiological and radionuclear charts was made by 2 blinded senior radiologists and 1 expert in radionuclear medicine.

Arterial circulation was evaluated by palpation of the peripheral pulses (105 patients) and from the recording (49 patients) of transcutaneous oxygen levels on the dorsum of the foot and blood pressure readings taken at the hallux of the affected extremity.[13,14]

TREATMENT AND OUTCOME

Treatment was defined as conservative if surgery was not carried out in the first 5 days following admission. Treatment consisted of daily wound dressing, debridement when indicated, bed rest, special casts, crutches or wheelchairs used to avoid putting pressure on the affected area when ambulating, and parenteral antibiotics. After obtaining culture specimens, empirical parenteral treatment was started; change in antimicrobial regimen was guided by culture results. Parenteral treatment (mean ± SD, 24 ± 18 days) was followed by prolonged (at least 6 weeks) oral therapy. The antibiotics most commonly used included semisynthetic penicillins (floxacillin or amoxicillin-clavulanic acid, n = 74 patients), second- and third-generation cephalosporins (n = 30), and fluoroquinolones (n = 24). Clindamycin hydrochloride, fluoroquinolones, and metronidazole were part of combination regimens.

Conservative treatment was considered a success if the lesion responsible for hospital admission had healed completely and there was no sign of relapse at the same site or at a site contiguous to the previous lesion during the 2-year follow-up period (minimum follow-up, 5 months). Conservative treatment was considered a failure if the patient subsequently required amputation or if the lesion had not completely healed or a lesion contiguous to the original one had developed during follow-up. Death during the hospital stay directly or indirectly attributable to the foot lesion was considered a failure of conservative treatment. Treatment was defined as surgical when limited or extensive bone amputation was required.

STATISTICAL ANALYSIS

The strength of the association between single prognostic variables and failure of conservative treatment was evaluated by calculating the odds ratios (ORs) and their corresponding 95% confidence intervals (CIs). Continuous variables were compared using the Mann-Whitney *U* test (with correction for ties when appropriate). For selected continuous variables, mean values were compared using 2 sample tests for independent samples after correction for equality of variance (F test). Differences in proportions were compared using either the χ^2 test or Fisher exact test. Yates correction was used when necessary. The χ^2 for trend test was carried out when appropriate. Stepwise logistic regression was used to estimate the independent effect of each selected variable on the outcome. Analyses were conducted on SPSS software (SPSS Inc, Chicago, Ill).

All tests of significance are 2-tailed. Mean values are given with 1 SD. *P* values less than .05 were considered significant.

terococcus faecalis [n = 23], group A streptococci [n = 17]) and 52 gram-negative bacteria (in this group, Enterobacteriaceae were predominant [n = 35]). Most infections were polymicrobial; a mean of 2.1 individual species per lesion was recovered.

CONSERVATIVE APPROACH

Fourteen patients (13%) required immediate amputation. Reasons for early amputation included poor social (n = 3) or medical (n = 4) condition, expected low compliance with conservative treatment (n = 3), advanced peripheral vascular disease (n = 2), and multiple amputations on the same site (n = 2).

Ninety-one patients received the conservative approach. Clinical and laboratory characteristics of patients in whom conservative treatment was successful (57/91, [63%]) and in whom it failed (34/91[39%]) are compared in the **Table**. Patients in the 2 groups were comparable with respect to age, sex, type of diabetes, attendance of diabetic educational courses or podiatric consultations, mean hemoglobin A_{1c} levels on admission, organisms isolated, antimicrobial regimen used, and duration of intravenous antibiotic therapy (Table). Follow-up was similar in the 2 groups of patients.

Skin ulcer (Wagner stages 1 and 2) affected 26 patients treated conservatively; deep tissue infection and suspected osteomyelitis (Wagner stage 3) affected 50 patients; and gangrene (Wagner stages 4 and 5) affected 15. Skin ulcer was successfully treated in 21 patients (81%) (Table) and deep tissue infection and osteomyelitis in 35 patients (70%). Gangrene was largely associated with failure of conservative treatment (93% failure). The site of lesion was not predictive of outcome of conservative treatment.

Previous hospital admission for foot ulcer was associated with higher failure rates of conservative treatment. Vascular compromise was more severe in the failure group (Table), with an absence of peripheral pulse in 22 patients (65%), compared with 26 patients (46%) in the success group, (*P* = .08); significantly (*P* = .01) reduced transcutaneous oxygen level; and significantly (*P* = .049) lower blood pressures at hallux. Although a similar proportion of patients in the 2 groups developed new lesions on the other foot during follow-up, patients in the failure group were at higher risk (OR = 5.5; 95% CI, 1.2-29.0) for a new noncontiguous lesion on the same foot compared with the success group (Table; *P* = .02).

Signs of systemic infection were more frequent in the failure group (Table). In particular, although only 3 (5%) of 57 patients in the success group presented with a body temperature greater than 38.5°C, 8 (24%) of 34 of those in the failure group did (*P* = .02). The failure group had a higher mean serum creatinine level (127.4 ± 72.3 mmol/L [1.4 ± 0.8 mg/dL] compared with 101.4 ± 29.3 µmol/L [1.1 ± 0.3 mg/dL], *P* = .01) on admission; a significantly higher pro-

Characteristics Associated With Failure of Conservative Treatment of Diabetic Foot Lesions (N = 91 Patients)*

Characteristics	Success (n = 57)	Failure (n = 34)	P
Male/female	27/30	18/18	. . .
Age, y			
Average ± SD	67 ± 13	69 ± 12	. . .
Median	70	70	
Diabetes mellitus			
Type 2, No. (%)	51 (89)	33 (97)	. . .
Type 1, No.	6	1	
Mean (±SD) evolution, y	14 ± 9	15 ± 8	. . .
Median	12	17	
Range	1-40	3-33	. . .
Treatment, No. (%)			
Insulin	29 (51)	16 (47)	.68‡
Oral antidiabetic agents	21 (37)	13 (38)	
Diet only	7 (12)	5 (15)	
Podology consultation, No. (%)	23 (40)	15 (44)	
Hemoglobin A_{1c}*†			
Average ± SD	0.09 ± 0.02	0.08 ± 0.02	. . .
Range	0.05 - 0.15	0.05 - 0.13	. . .
Duration of hospital stay, d			
Average ± SD	40 ± 28	51 ± 36	. . .
Median	35	43	. . .
Creatinine level, µmol/L† (mg/dL)			
<115 (1.3) (Normal value)	44	22	.03‡
115-149 (1.3-1.6)	11	5	
≥150 (1.7)	2	7	
Signs of infection, No. (%)			
Temperature >38.5°‡	3 (5)	8 (24)	.02
Leukocyte count (<4000 or >10 000)‡	16 (28)	15 (44)	
Left shift (>5%)‡	2 (4)	3 (9)	
Distribution of foot lesions, No. (%)			
Wagner 1	11 (19)	4 (12)	<.001‡
Wagner 2	10 (18)	1 (3)	
Wagner 3	35 (61)	15 (44)	
Wagner 4	1 (2)	12 (35)	
Wagner 5	0	2 (6)	
Clinical diagnosis, No. (%)			
Plantar ulcer	21 (37)	5 (15)	<.001
Osteomyelitis and deep tissue infection	35 (61)	15 (44)	
Gangrene	1 (2)	14 (41)	
Localization, No. (%)			
Forefoot	52 (91)	26 (76)	.11
Midfoot	3 (5.2)	2 (5.9)	≈1.00
Heel	5 (8.7)	6 (18)	.35
Gram stain	46 (81)	32 (94)	. . .
Bacteria, No. (No. per smear)	98 (2.1)	61 (1.9)	. . .
Gram-positive organisms, No. (%)	72 (73)	42 (69)	. . .
Gram-negative organisms, No. (%)	26 (27)	19 (31)	. . .
Vascular disease			
Absence of peripheral pulses	26 (46)	22 (65)	.08
Transcutaneous oxygen, mm Hg§			
Average ± SD	33 ± 15	21 ± 13	.01
Median	36	18	
Range	2-52	3-51	
Blood pressure at hallux, mm Hg‖			
Average ± SD	74 ± 31	52 ± 33	.049
Median	70	53	
Range	25-145	1-130	
Duration of intravenous antimicrobial therapy, d			
Average ± SD	23 ± 15	26 ± 22	. . .
Median	21	24	. . .
Duration of follow-up after discharge, mo			
Average ± SD	26 ± 16	24 ± 14	. . .
Median	24	24	. . .
Range	5-60	5-51	. . .
New noncontiguous lesion on same foot, No. (%)	3 (5)	8 (24)	.02
New lesion on the other foot, No. (%)	12 (21)	10 (29)	.12

**Ellipses indicate data not computed. For hemoglobin A_{1c}, 62 patients were evaluated: 45 of 57 in the success group and 17 of 34 in the failure group. Normal values for hemoglobin A_{1c} are 0.03 to 0.06.*

†Admission values.

‡χ^2 Test for trend.

§For transcutaneous oxygen, 40 patients were evaluated. Threshold for ischemia was 20 mm Hg.

‖For blood pressure at hallux, 41 patients were evaluated. Threshold for ischemia was 30 mm Hg or less.

portion of patients in the failure group presented with a creatinine level equal or greater than 150 mmol/L (1.7 mg/dL) (21% vs 5%, respectively; Table). These patients were at significantly higher risk for failure of conservative treatment (OR = 7.0; 95% CI, 2.2-22.0).

To determine the importance of the different variables for the outcome of conservative treatment, we performed a logistic regression analysis using the most significant prognostic variables assessed on admission to the hospital. These were age, duration of diabetes, temperature, level of serum creatinine, absence of peripheral pulses (posterior tibial and pedal), a history of hospital admission for diabetic foot lesion, and Wagner classification. Four factors independently predicted failure of conservative treatment: the presence of fever (OR = 1.14 per degrees Celcius; 95% CI, 1.04-1.24), increased creatinine level (OR = 1.002 per micromoles per liter; 95% CI, 1.0020-1.0021), prior hospitalization for diabetic foot lesion (OR = 1.36; 95% CI, 1.15-1.62), and lesion graded Wagner 4 or 5 (OR = 1.81; 95% CI, 1.48-2.22). (For logistic regression analysis, the residual [goodness-of-fit] χ^2 value of the model was 2.51 with 4 *df* and the equation constant parameter was equivalent to –4.854 [SE, 1.684]).

PATIENTS WITH ARTHRITIS AND SUSPECTED OSTEOMYELITIS

Further analysis was conducted for the 50 patients with deep tissue infection or suspected osteomyelitis (Wagner stage 3). Thirty-five patients (70%) successfully responded to conservative treatment, while in 15 (30%) the treatment failed. Age, sex, type and duration of diabetes, diabetes educational courses or podiatric counseling, the species of microorganisms isolated, and the duration or type of intravenous antimicrobial therapy did not differ significantly between the 2 groups. Failure was associated with higher serum creatinine level ($P = .14$) and body temperature above 38.5°C ($P = .09$) on admission as well as lower transcutaneous oxygen levels ($P = .10$). A third of patients (5/15) who failed to respond to conservative treatment developed

a new noncontiguous lesion on the same foot compared with only 9% in the success group ($P = .003$).

COMMENT

A significant number of amputations in diabetic individuals can be prevented by patient education and increased awareness on the part of diabetes care teams of effective strategies in ulcer management.[9,15] Not all diabetic foot ulcers, however, are amenable to successful conservative outpatient treatment; a number of patients require hospitalization with a view to intravenous antibiotic therapy, debridement, and/or amputation. We defined patient characteristics present at hospital admission that predicted failure of a nonsurgical approach. Success was defined not only as local healing, but also as nonlocal recurrence after prolonged follow-up. Four independent predictors of failure were identified: fever, increased serum creatinine levels, a history of hospitalization for diabetic foot ulcer, and a gangrenous lesion.

Most patients with infected diabetic foot ulcers do not present with fever, and fever may well be absent even in patients with osteomyelitis, deep abscesses, or extensive soft tissue infection.[1,16,17] Also infrequent, fever is an ominous sign and probably indicates more widespread disease; when present on admission, it predicts poor response to conservative treatment in our series.

Renal insufficiency has long been thought to be a contributing factor in the nonhealing of diabetic foot ulceration.[18] The results of the present study confirm this view. In contrast, Griffiths and Wieman[19] found that renal function had no bearing on the severity of lesions or on their eventual outcome. Differences may be related to differing degrees of renal dysfunction. Renal insufficiency may be a surrogate for the extent of neuropathic or microvascular damage. Vascular insufficiency leads to poor healing of diabetic foot ulcer[20] in both adjusted[21] and unadjusted analysis.[13,22,23] Low skin oxygen tension in addition to the diminished peripheral pulses constitute easy clinical parameters to follow up in diabetic patients with foot lesions.[24]

Other reports emphasize the importance of previous amputation or foot lesions in diabetic patients as risk factor for amputation of the contralateral leg.[2,10,25] The present study extends these reports in that a history of hospitalization for diabetic infection independently predicts failure of conservative treatment.

Improved foot care and diabetic education can reduce the rate of diabetes-related amputations by 50% to 75%.[24,26-28] In a large population-based study,[28] the decrease only appeared when the multidisciplinary approach had been in operation for 5 years, by which time most patients undergoing amputation had been involved in the program before amputation. We observed no significant difference regarding outcome of conservative treatment between groups of patients receiving diabetic education and those not exposed to that advice; however, our study was not designed to question the impact of diabetic education on foot lesions.

Predictably, most patients with Wagner stages 1 and 2 were cured, whereas in those with gangrene conservative treatment failed. Osteomyelitis (Wagner stage 3), said to be present in up to one third of diabetic foot infections that required hospitalization,[29] has classically been treated by aggressive surgical resection, but this attitude is still the object of evaluation.[30] Bamberger et al[31] were the first to challenge this approach. These authors described a series of 51 diabetic patients with foot osteomyelitis in whom 27 (53%) showed clinical resolution without amputation at the time of follow-up (mean, 19 months). Those patients responded to conservative treatment only (involving a course of at least 4 weeks of intravenous antibiotics or a combination of intravenous and oral administration for at least 10 weeks). Peterson et al[32] described the successful outcome of 27 (56%) of 48 diabetic patients with pedal osteomyelitis for whom conservative treatment only was implemented (follow-up, 12 months).

Despite important technical advances,[21,33-35] the diagnosis of osteomyelitis in diabetic patients remains difficult.[21,36] Investigations suggest that magnetic resonance imaging may not be of primary importance in the management of the diabetic foot ulcer.[21,37,38] Conservative treatment was successful in 35 (70%) of 50 patients with deep lesion or suspected osteomyelitis in the present study. Although clinical and radiographic results were highly suggestive of osteomyelitis in our series, the diagnosis was definitively proven using bone biopsy in a few patients only. We elected to study our patient population with wide and easy-to-use clinical ranking criteria (Wagner classification) available at the bedside, which may be repeated in further research. The recently described probe-to-bone test is a reliable, inexpensive, and easy-to-perform approach to diagnose pedal osteomyelitis in diabetic patients.[16] We suggest that probing for bone combined with the evaluation of predictors for poor outcome of conservative treatment discussed herein be tested prospectively in the initial assessment of patients with diabetic foot lesions.

There are many clinical approaches to the diabetic foot ulcer, but, to our knowledge, there is no evidence at this time for a single best management strategy. In patients not experiencing systemic toxic effects, prolonged, culture-guided antibiotic therapy is the least expensive approach.[38] Simple clinical and laboratory parameters available on admission identified in the present study help to predict which patients are at higher risk for failure of conservative treatment. Overall, the independent factors predictive of failure of therapy in patients with diabetic foot infection were presence of fever and abnormal serum creatinine level on admission, gangrenous lesion, and prior hospital admission for diabetic foot lesion. Importantly, we studied only the subset of patients hospitalized for their foot disease, and our findings need further evaluation in ambulatory patients in whom the defined predictors have not been examined. Our observation also needs to be validated prospectively on an independent cohort of diabetic patients with foot lesions; it would help physicians decide whether to choose a conservative approach in the treatment of such a condition and it would provide a comparison with results obtained with early amputation or novel therapeutic strategies.

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