

Clinical and Radiographic Findings That Lead to Intervention in Diabetic Patients With Foot Ulcers

A nationwide survey of primary care physicians

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OBJECTIVE — To determine which elements of clinical history, physical examination, and diagnostic tests are important to primary care physicians in their management of foot ulcers in diabetic patients.

RESEARCH DESIGN AND METHODS — We conducted a national mail survey of 600 primary care physicians to determine which patient characteristics and diagnostic test results were important in their decisions to seek radiographic studies, surgical referrals, and hospitalization for diabetic patients with foot ulcers.

RESULTS — The case characteristics most likely to influence physicians to order advanced diagnostic or therapeutic interventions are the presence of osteomyelitis on plain radiographs, the failure of the ulcer to improve with conservative therapy, and the presence of visible bone, crepitus, or necrosis within the ulcer ($P < 0.001$). Information from the initial clinical history was less likely to influence physicians to order advanced diagnostic or therapeutic interventions ($P < 0.001$) than was information from the physical examination.

CONCLUSIONS — We conclude that 1) the patient's history is relatively unimportant to primary care physicians in their management of diabetic foot ulcers; 2) the failure of conservative management is a major reason that primary care physicians order surgical referral, hospitalization, or radiographic testing for diabetic patients with foot ulcers; and 3) primary care physicians rely heavily on plain X ray of the foot, a test with poor sensitivity and specificity, in deciding whether to order further interventions for their diabetic patients with foot ulcers.

Among the major management decisions faced by primary care physicians when seeing a diabetic patient with a foot ulcer are use of plain radiography, advanced radiographic tests, surgical referral, and hospitalization. Despite the complexity and importance of these decisions, no one has ever described primary care physicians' management of foot ulcers in diabetic patients. We undertook a nationwide physician survey to describe the extent to which physicians rely on elements of the patient's history, physical

examination findings, and radiographic tests to determine their management strategies for diabetic patients with foot ulcers.

RESEARCH DESIGN AND METHODS

Survey methods

From February to June 1995, we surveyed primary care physicians who were identified from the American Medical As-

sociation (AMA) Masterfile. We collected physician demographic and practice information, including year of birth, year of graduation, specialty (family practice, internal medicine, general practice), board certification status, practice setting, number of diabetic patients, and number of diabetic patients with foot ulcers seen per year. We then asked physicians to rate several case characteristics based on whether the presence of the characteristic would positively or negatively influence their ordering of four advanced interventions for their diabetic patients with foot ulcers. The four interventions were plain X rays, advanced radiographic studies (e.g., bone scan, magnetic resonance imaging [MRI]), surgical referrals, and hospitalization. The patient characteristics to be rated were comprised of elements from the initial clinical history and physical examination, the failure of conservative therapy, and the results of diagnostic radiographic tests (plain radiographs or advanced diagnostic studies that were positive or negative for osteomyelitis underlying the ulcer). The questionnaire is available on request.

We followed up the initial mailed questionnaire with a second copy to nonresponders. We then contacted a 22% random sample of two-time nonresponders by telephone. After the telephone call, we classified physicians into four categories: responders, active refusers, passive refusers, and ineligible. We received 111 responses from eligible physicians; extrapolating from the telephone survey of nonresponders, we estimate that the final response rate among eligible physicians was 36.2% (111 out of 307).

Statistical analysis

We performed all two-by-two analyses by either simple χ^2 or, when appropriate, Fisher's exact test. In analyses for which the number of foot ulcers seen per year was the outcome variable, we used Wilcoxon's rank-sum test. We used ridit analysis

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Received for publication 3 November 1995 and accepted in revised form 7 March 1996.

AMA, American Medical Association; MRI, magnetic resonance imaging.

Table 1—Clinical characteristics affecting physicians' likelihood of ordering an intervention for their diabetic patients with foot ulcers

Case characteristic	Plain X rays	Advanced radiology	Surgical referral	Hospitalization
Visible bone in the ulcer	↑	↑	↑	↑
No change, 8 weeks conservative Rx	↑	↑	↑	↑
Necrosis	↑	↑	↑	↑
Crepitus	↑	0	↑	↑
No change, 4 weeks conservative Rx	↑	↑	0	0
Subjective fever/chills/diaphoresis	↑	0	0	↑
Wide or deep ulcer	0	0	↑	↑
Temperature >101°	0	0	0	↑
Erythema, induration, or purulence	0	0	0	↑
Absence of foot pulses	↓	0	↑	0
Elevated WBC	0	0	0	0
Elevated sedimentation rate	0	0	0	0
No change, 2 weeks conservative Rx	0	0	0	0
Pain	0	0	↓	0
Location of ulcer	0	0	0	↓
Foot edema	↓	0	↓	↓
History of claudication	↓	0	0	↓
Longer duration of diabetes	↓	↓	↓	↓
Prior history of ulcer	↓	↓	↓	↓
Smoking history	↓	↓	↓	↓
Advanced age	↓	↓	↓	↓
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Plain films show osteomyelitis	NA	0	↑	↑
Plain films show no osteomyelitis	NA	0	↓	↓
Advanced radiology shows osteomyelitis	NA	NA	↑	↑
Advanced radiology shows no osteomyelitis	NA	NA	↓	↓

Data represent responses to the question "Which of the following characteristics, if present, would change the likelihood that you would order [an intervention] for a diabetic patient with a foot or leg ulcer?" ↑, more likely than median to stimulate the intervention ($P < 0.001$); ↓, less likely than median to stimulate the intervention ($P < 0.001$). Rx, treatment; WBC, white blood cell count.

for Likert scale variables; a detailed description of this nonparametric analysis method can be found in Fleiss (1). Because there were 25 individual case characteristics that could affect each decision, we adjusted the α level for multiple comparisons ($\alpha = 0.05/25 = 0.002$). We performed all analyses using the SAS statistical analysis package (SAS Institute, Cary, NC).

RESULTS — A total of 77% of the respondents were in private practice; the remainder were divided approximately evenly among health maintenance organization, government, and university practices. The respondents' median age was 44 years (range 25–79); their median number of years since graduating medical school was 17 (range 3–51). The median number of diabetic patients with foot ulcers seen per year by eligible respondents

was 5 (range 1–200). Internists saw a median of 10 diabetic patients per year for foot ulcers; other respondents saw a median of 5 diabetic patients per year for foot ulcers ($P = 0.005$ by Wilcoxon's rank-sum test).

The relative influence of patient characteristics on physicians' ordering of interventions for their diabetic patients with foot ulcers is shown in Table 1. Physicians reported that the patient characteristics most likely to influence them to order interventions are 1) visible bone, necrosis, or crepitus in the ulcer or the presence of a large ulcer; 2) failure of the ulcer to improve after 4 or more weeks of conservative therapy; 3) report of fever, chills, or diaphoresis ($P < 0.001$). Overall, findings in the physical examination had a greater influence on physicians' likelihood of ordering interventions ($P <$

0.001) than did elements in the patients' history. Two laboratory findings, elevated white blood cell count and elevated erythrocyte sedimentation rate, were rated as being of intermediate importance for all interventions. The results of X rays did not affect the decision to order advanced radiographic studies, but the results of all radiographic studies were an important influence on the decision to order surgical referral and hospitalization.

CONCLUSIONS — Our survey suggests that there are three strong influences that drive decisions concerning diagnostic and therapeutic interventions by primary care physicians for their diabetic patients with foot ulcers: the presence of a few key physical examination findings, radiographic test results indicative of osteomyelitis, and the failure of conservative therapy. Recent reviews outline the wide variety of evidence-based elements of diagnosis and treatment (2,3). However, because of the large number of reasonable therapies and the heterogeneity of ulcer presentation, it is difficult to define a standard diagnostic or therapeutic approach to these ulcers. A recent decision analysis recommended a 12-week trial of outpatient oral antibiotics for all ulcers (4). However, the analysis presumed an initial inpatient surgical debridement, leaving open the issue of when it is appropriate to seek surgical consultation or to hospitalize a patient with a diabetic foot ulcer.

The presence of a positive X ray was the single most important factor influencing surgical consultation and hospitalization. This is consistent with the belief that plain radiographs are highly specific for osteomyelitis. However, most studies have shown that the specificity of plain X ray for the diagnosis of osteomyelitis in the diabetic foot is only 0.5–0.7 (4,5). Despite the fact that both MRI (4,5) and visible bone in the ulcer (6,7) have been shown to have a higher sensitivity and specificity for the diagnosis of osteomyelitis than plain X rays, respondents were as likely to be influenced to order hospitalization or surgical referral by a positive plain X ray as they were by a positive advanced radiographic study or the presence of visible bone in the ulcer. Similarly, there was no difference between a negative plain X ray and a negative advanced study in their influence on physicians' willingness to order hospitalization

or surgical referral. This suggests that primary care physicians are placing too much weight on plain X ray results, particularly in making such important treatment decisions as hospitalization and surgical referral.

Acknowledgments— We would like to thank Maria Horner for her assistance with the survey.

Dr. Oddone is supported by the Veterans Affairs Health Services Research and Development Career Development and the Robert Wood Johnson Generalist Physician Faculty Scholars Programs.

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