Diabetic Foot Prevention

A neglected opportunity in high-risk patients

Lawrence A. Lavery, DPM1
Nathan A. Hunt, DPM2
Javier Lafontaine, DPM1,3
Cory L. Baxter, DPM1
Agbor Ndip, MD4
Andrew J.M. Boulton, MD4

OBJECTIVE — To evaluate the frequency of foot prevention strategies among high-risk patients with diabetes.

RESEARCH DESIGN AND METHODS — Electronic medical records were used to identify 150 patients on dialysis and 150 patients with previous foot ulceration or amputation with 30 months follow-up to determine the frequency with which patients received education, podiatry care, and therapeutic shoes and insoles as prevention services.

RESULTS — Few patients had formal education (1.3%), therapeutic shoes/insoles (7%), or preventative podiatric care (30%). The ulcer incidence density was the same in both groups (210 per 1,000 person-years). In contrast, the amputation incidence density was higher in the dialysis group compared with the ulcer group (58.7 vs. 13.1 per 1,000 person-years, P < 0.001). Patients on dialysis were younger and more likely to be of non-Hispanic white descent (P = 0.006) than patients with a previous history of ulcer or amputation.

CONCLUSIONS — Prevention services are infrequently provided to high-risk patients.

From the 1Department of Surgery, Scott and White Hospital and Texas A&M Health Science Center College of Medicine, Temple, Texas; the 2Orthopaedic Center of the Rockies, Fort Collins, Colorado; the 3Podiatry Section, Central Texas Veterans Healthcare System, Temple, Texas; and the 4Department of Diabetes and Medicine, Manchester Royal Infirmary, Manchester, U.K.

Corresponding author: Nathan A. Hunt, nhunt@orthohealth.com

Received 17 February 2010 and accepted 19 April 2010. Published ahead of print at http://care.diabetesjournals.org on 27 April 2010. DOI: 10.2337/dc10-0310. © 2010 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. See http://creativecommons.org/licenses/by-nc-nd/3.0/ for details.

The costs of publication of this article were defrayed in part by the payment of page charges. This article must therefore be hereby marked “advertisement” in accordance with 18 U.S.C. Section 1734 solely to indicate this fact.

Pedorthic services were identified from notes in the EMRs and durable medical equipment codes (codes A5501, A5503–A5508, A5512, and A5513). Diabetes education was defined as a session with a certified diabetes educator (CPT codes S9445, S9460, and S9465). Our diabetes education program addressed “the diabetic foot” in the third of four education sessions. Podiatry care was assessed by review of the EMRs to identify the number of visits and determine whether the visit was for prevention, ulcer treatment, or other pathology. Foot assessment by any health care provider was also identified.

Peripheral vascular disease was defined as at least two nonpalpable foot pulses or abnormal ankle-brachial indexes (<0.9). Neuropathy was defined as at least one site insensitive to a 10-g Semmes-Weinstein monofilament, abnormal vibration perception (>25 volts), or abnormal light-touch sensation. Pearson χ² and Fisher exact tests were used to compare categorical data between study groups. Student t test was used to compare continuous data.

RESULTS — We studied 300 patients (dialysis group, n = 150; ulcer group, n = 150), and 92.3% had type 2 diabetes (Table 1). Compared with the ulcer group, dialysis patients were 10 years younger on average and less likely to be of Hispanic (P = 0.006) or African (P < 0.001) descent. The incidence of ulceration and amputation was high in both study groups. Incidence of ulceration was 210 per 1,000 person-years in both groups. However, amputation incidence was significantly higher in the dialysis group (58.7 vs. 13.1 per 1,000 person-years, P < 0.001).

Few patients received prevention services (Table 1). Two patients (1.3%) in the dialysis group had formal diabetes education, and neither attended the diabetic foot care session. No one in the ulcer group received formal education. A small proportion of patients received therapeutic shoes. During the first 12-month evaluation period, 21 patients (7%) received shoes and insoles. Only four patients (1.3%) received a second pair of therapeutic shoes and insoles during the sec-
second 12-month study period, and no one received a third pair of shoes in the final 6 months. There was no difference in the proportion of patients that received therapeutic shoes between the dialysis and ulcer groups (7.3 vs. 6.7%, P = 1.0).

During the 30-month evaluation period, 195 patients (65%) received care by a podiatrist. However, the majority of patients (70%) were seen after they developed a foot ulcer. Only 90 patients (30%) were seen for preventative care prior to ulceration. Significantly fewer patients in the ulcer group were seen by a podiatrist for preventative care (18%) compared with the dialysis group (42%, P < 0.001). Additionally, neuropathy (35%) and vascular assessments (62.4%) were infrequently performed.

**CONCLUSIONS** — This study focused on two high-risk groups for developing diabetic foot ulcers and amputations (1,9). As expected, the amputation incidence density was high in both groups (ulcer group 13.1 and dialysis group 5.8 per 1,000 person-years). The amputation incidence in the general population with diabetes ranges from 4.4 to 9.5 per 1,000 person-years (10).

Prevention services were infrequently provided to patients in both risk groups. In our study, only 7% of patients received therapeutic shoes, 1.3% received professional education, and 30% received preventative care by a podiatrist. Other reports suggest a poor referral pattern for therapeutic shoes as well. In a study by Sugarman et al. (11) only 2.9% of subjects with diabetes that met the criteria for “high risk” received therapeutic footwear. Although the high rate of amputation may be due to our study patients’ inherent risk for foot complications, it is possible that poorly utilized prevention services played a role. We expect that appropriate prevention services could have significantly reduced the high rate of amputation.

We believe the results of this study can be generalized to high risk patients in other health care settings. Perhaps, prevention services would be provided less frequently in community practices that are not integrated and that do not have electronic medical records because it is more difficult to communicate and coordinate care.

Specialized diabetic foot programs have been reported to reduce the incidence of amputations by 50% (6–8). Uccioli et al. (12) demonstrated ~50% reduction in foot ulceration when therapeutic shoes were prescribed for patients with an ulcer history compared with patients that selected their own shoes, and others have demonstrated that patients receiving regular foot care have fewer recurrent ulcers (13).

Prevention services for the diabetic foot are simple to establish and can be made easily accessible through organized multidisciplinary care. This data provide further evidence that preventative foot care is not regularly provided, even among patients with the highest risk for lower-limb complications. It also highlights an opportunity to improve prevention services for the diabetic foot with simple protocols for evaluation and referral.

**References**

1. Ndip A, Lavery LA, Lafontaine J, Rutter MK, Vardhan A, Vileikyte L, Boulton AJ. High levels of foot ulceration and amputation risk in a multiracial cohort of diabetic patients on dialysis therapy. Diabetes Care 2010;33:878–880

2. Dossa CD, Shepard AD, Amos AM,
Diabetic foot and high-risk patients

Kupin WL, Reddy DJ, Elliott JP, Wilczewski JM, Ernst CB. Results of lower extremity amputations in patients with end-stage renal disease. J Vasc Surg 1994;20:14–19
3. Eggers PW, Gohdes D, Pugh J. Nontraumatic lower extremity amputations in the Medicare end-stage renal disease population. Kidney Int 1999;56:1524–1533
4. Peters EJ, Lavery LA, International Working Group on the Diabetic Foot. Effectiveness of the diabetic foot risk classification system of the International Working Group on the Diabetic Foot. Diabetes Care 2001;24:1442–1447
5. Lavery LA, Peters EJ, Williams JR, Murdoch DP, Hudson A, Lavery DC, International Working Group on the Diabetic Foot. Reevaluating the way we classify the diabetic foot: restructuring the diabetic foot risk classification system of the International Working Group on the Diabetic Foot. Diabetes Care 2008;31:154–156
6. Foster AV, Snowden S, Greffell A, Watkins PJ, Edmonds ME. Reduction of gangrene and amputations in diabetic renal transplant patients: the role of a special foot clinic. Diabet Med 1995;12:632–635
7. Rith-Najarian S, Branchaud C, Beaulieu O, Gohdes D, Simonson G, Mazze R. Reducing lower-extremity amputations due to diabetes. Simplification of the staged diabetes management approach in a primary care setting. J Fam Pract 1998;47:127–132
8. Lavery LA, Wunderlich RP, Tredwell JL. Disease management for the diabetic foot: effectiveness of a diabetic foot prevention program to reduce amputations and hospitalizations. Diabetes Res Clin Pract 2005;70:31–37
9. Game FL, Chipchase SY, Hubbard R, Burden RP, Jeffcoate WJ. Temporal association between the incidence of foot ulceration and the start of dialysis in diabetic mellitus. Nephrol Dial Transplant 2006;21:3207–3210
10. Lavery LA, Ashry HR, van Houtum W, Pugh JA, Harkless LB, Basu S. Variation in the incidence and proportion of diabetes-related amputations in minorities. Diabetes Care 1996;19:48–52
11. Sugarman JR, Reiber GE, Baumgardner G, Prela CM, Lowery J. Use of the therapeutic footwear benefit among diabetic Medicare beneficiaries in three states, 1995. Diabetes Care 1998;21:777–781
12. Uccioli L, Faglia E, Monticone G, Favales F, Durola L, Aldeghi A, Quarantiello A, Calia P, Menseinger G. Manufactured shoes in the prevention of diabetic foot ulcers. Diabetes Care 1995;18:1376–1378
13. Plank J, Haas W, Rakovac I, Gorzer E, Sommer R, Siebenhofer A, Pieber TR. Evaluation of the impact of chiropodist care in the secondary prevention of foot ulcerations in diabetic subjects. Diabetes Care 2003;26:1691–1695