Diabetic Foot Prevention

A neglected opportunity in high-risk patients

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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.

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The prevalence of foot complications is 250% higher among dialysis-treated patients than among patients without chronic kidney disease (1–3). Similarly, patients with a past ulcer history have a 34-times-greater risk of developing another ulcer (4,5). Programs to prevent foot ulcers and amputations generally involve therapeutic shoes and insoles, regular foot care, and patient education (6–8). This study evaluated the frequency of prevention services among high-risk patients.

RESEARCH DESIGN AND METHODS

— We used claims data for diabetes (ICD-9 250.X), ulceration (ICD-9 707.10, 707.14, and 707.15), and dialysis (CPT 90935–90937) from the Scott and White Health Plan to identify 150 consecutive patients in each group with at least 30 months follow-up from the time of diagnosis. We enrolled subjects from 2000 to 2006. We verified these diagnoses by reviewing comprehensive electronic medical records (EMRs), including all patient care notes, imaging, labs, and prescriptions. Scott and White is an integrated, multispecialty physician group with ~550 physicians, 14 clinics, three dialysis centers, and a 535-bed hospital.

For the ulcer group, our evaluation began after the initial ulcer healed. For the dialysis group, our evaluation began with the initiation of dialysis. Subjects with HIV/AIDS, trauma from motor vehicle accidents, bilateral amputations, and patients with <30 months follow-up were excluded.

Three prevention therapies were evaluated: pedorthic care (professionally fitted therapeutic shoes and insoles), diabetes education, and podiatry services. 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 insensate to a 10-g Semmes-Weinstein monofilament, abnormal vibration perception (>25 volts), or abnormal light-touch sensation. Pearson χ^2 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-

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Table 1—*Patient demographics and results*

	Dialysis	Ulcer history	Total
n	150	150	300
Male (%)	61 (40.7)	62 (41.3)	123 (41.0)
Race*			
White	116 (77.3)	64 (42.7)	180 (60.0)
Black	20 (13.3)	54 (36.0)	74 (24.7)
Hispanic	11 (7.3)	28 (18.6)	39 (13.0)
Other	3 (2.0)	4 (2.7)	7 (2.3)
Age*	64.9 ± 0.98	74.25 ± 1.04	70.22 ± 0.58
Type 2 diabetes (%)	139 (92.6)	138 (92.0)	277 (92.3)
Amputation (%)*	22 (14.7)	5 (3.3)	27 (9)
Ulceration (%)	79 (52.7)	79 (52.7)	158 (52.6)
Neuropathy testing			
Semmes Weinstein monofilament	40 (26.7)	41 (27.3)	81 (27)
Vibration perception threshold	4 (2.7)	3 (2.0)	7 (2.3)
Other assessment	5 (3.3)	12 (8.0)	17 (5.7)
No neuropathy testing	101 (67.3)	94 (62.7)	195 (65)
Vascular assessment			
Pedal pulse evaluated	71 (47.3)	84 (56.0)	155 (51.7)
Ankle-brachial index evaluated	19 (12.7)	13 (8.7)	32 (10.7)
No assessment	60 (40.0)	53 (35.3)	113 (37.6)
Diabetes education			
Session 1 (*n*)	1 (0.6)	0	1 (0.3)
Session 2 (*n*)	1 (0.6)	0	1 (0.3)
Sessions 3–4	0	0	0
Podiatry			
Podiatry (anytime)*	74 (49.3)	121 (80.6)	195 (65)
Podiatry before an ulcer*	63 (42)	27 (18)	90 (30)
Total podiatry visits	296	362	658
Therapeutic shoes and insoles			
Received shoes or insoles	11 (7.3)	10 (6.6)	21 (7.0)
Received second shoes or insoles	1 (0.6)	3 (2.0)	4 (1.3)
Received third shoes or insoles	0	0	0

Data are *n* (%) or means ± SE. *$P < 0.001$.

ond 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 58.7 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.

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