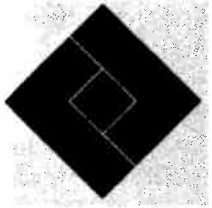




WOUND CARE



Impact of a Preventive Program on Amputation Rates in the Diabetic Population

Laura B. King

Diabetic neuropathy and the resulting wounds often result in economic and social hardships for those afflicted. Simple steps such as routine foot inspection, fitting of appropriate shoes and orthotics, combined with patient education about the importance of self-care, can decrease the incidence of wounds in the diabetic population. Consistent follow-up with prompt treatment of wounds and management of callous formation to prevent further injury can result in fewer lower extremity amputations in the diabetic population. This article describes implementation of preventive care that led to a diminished hospitalization rate for nontraumatic amputations in our diabetic population.

■ Introduction

Diabetes mellitus has been called the world's leading cause of nontraumatic lower extremity amputation (LEA).¹ It is estimated that one third of persons with diabetes are at risk for amputation.² In 2006, the Centers for Disease Control and Prevention (CDC) estimated that 20.8 million people are living with diabetes mellitus. The CDC and National Institutes for Health are working together to continue surveys of incidence. The Agency for Health Research and Quality (AHRQ) estimates that 650,000 new cases of diabetes occur each year.³ Given these statistics, the economic and social implications are apparent and significant.

Amputation is a costly procedure for both the patient and the healthcare system.⁴ Fiscal issues for the healthcare system include the cost of hospitalization and medical management associated with amputation. Since many of these patients suffer from multiple comorbidities,^{4,5} admission for amputation may cost well over the amount reimbursed by Medicare and private insurance payors. The average length of stay for LEA was 10.8 days in 2003,⁶ and the Veteran's Administration estimated that direct costs associated with managing a patient with an LEA during that fiscal year was approximately \$40,000 to \$75,000.⁷

Individual costs to the patient undergoing LEA include the expenses associated with hospitalization and

rehabilitation and lost income during the extensive post-surgical recovery period. In addition, loss of employment is a real danger because of the extended time off required to undergo the surgery and subsequent rehabilitation, as well as compromised functional abilities associated with the loss of the limb itself. The personal costs associated with amputation may outweigh even these financial considerations. Patients admitted for LEA are estimated to experience a 12% to 25% higher rate of depression as compared to the average hospital population.⁸ They also report less independent living after an amputation. Furthermore, a patient with diabetes mellitus who undergoes an amputation is 30% to 50% more likely to undergo a second amputation.⁹ Finally, studies indicate a 6% mortality rate for those undergoing amputation; this rate rises to 16% if the person also requires hemodialysis for end-stage renal disease.¹⁰

These data point to the urgent need for healthcare services designed to reduce the incidence of amputation in the diabetic population. The primary factor leading to preventable amputation among persons with diabetes mellitus is painless trauma associated with peripheral neuropathy. Fortunately, with proper care and education, the ulcerations that lead to amputation can frequently be prevented.

■ Etiology and Impact of Neuropathy

The human foot is an anatomically complex structure that has been called a biomechanical marvel. Containing 26 bones, 29 joints, 42 muscles, and multiple tendons and ligaments, there are many opportunities for dysfunction. Diabetic neuropathy results in significant structural changes and functional alterations that increase the risk of painless trauma, ulceration, and subsequent amputation. Muscles and ligaments are shortened causing the bones and joints to shift. These structural changes can then alter

■ Laura B. King, RN, BS, CWON, WOCN, Trinity Medical Center, Birmingham, Ala.

Corresponding author: Laura B. King, RN, BS, CWON, 3407 Waverly Dr, Birmingham, AL 35209 (LBking45@bellsouth.net).

the pressure distribution of the foot leading to callous and ultimately wound formation.

Prolonged hyperglycemia damages sensory, motor, and autonomic nerve function. Damage to the sensory fibers may initially cause painful paresthesias, but it ultimately results in progressive anesthesia with loss of protective sensation (LOPS). This LOPS results in increased risk of wounds due to injury from inappropriate footwear, thermal injuries, or stepping on objects. Damage to the motor nerve fibers results in anatomic deformities such as hammertoes, claw foot, and abnormally prominent metatarsal heads. These deformities also increase the risk of trauma when the person with diabetes dons footwear that does not adequately accommodate anatomic alterations. In addition, the accompanying sensory neuropathy renders the patient unaware that damage is occurring. LOPS typically results in deeper tissue injury than is likely to occur in the sensate foot. Damage to autonomic nerve fibers also predisposes patients to drying, cracking of the skin of the feet, and is postulated to contribute to the risk of Charcot foot deformity. In addition to these changes, diabetic retinopathy increases the risk of trauma when trimming the nails.

■ Preventive Care

It has been estimated that 40% of persons newly diagnosed with diabetes mellitus already have some degree of peripheral neuropathy and LOPS. About 15% will experience a foot ulcer, and 14% to 24% will ultimately require LEA.¹¹ Early identification of peripheral neuropathy is critical and must be accompanied by proper education, use of appropriate footwear, and early treatment of existing wounds. Both the American Diabetes Association (ADA) and the American Association of Wound Care emphasize *prevention* as the primary strategy for decreasing amputation rates in the diabetic population. The Lower Extremity Amputation Prevention program, originally developed for patients with peripheral neuropathy associated with Hanson's disease, has been adapted for the diabetic population. This program consists of 5 simple activities: (1) annual foot screening, (2) patient education, (3) daily self-inspection of the feet, (4) appropriate footwear selection, and (5) management of simple foot problems.⁹

Unfortunately, diabetes care services provided to many patients are fragmented and lack preventive education or referral for diabetic foot care. In addition, wound treatment may focus exclusively on the existing wound and fail to adequately address contributing factors such as unrelieved pressure or coexisting ischemia, which contribute to an increased risk for additional neuropathic wounds.⁹ Ultimately, this combination of inadequate preventive care increases the risk for potentially preventable amputation.

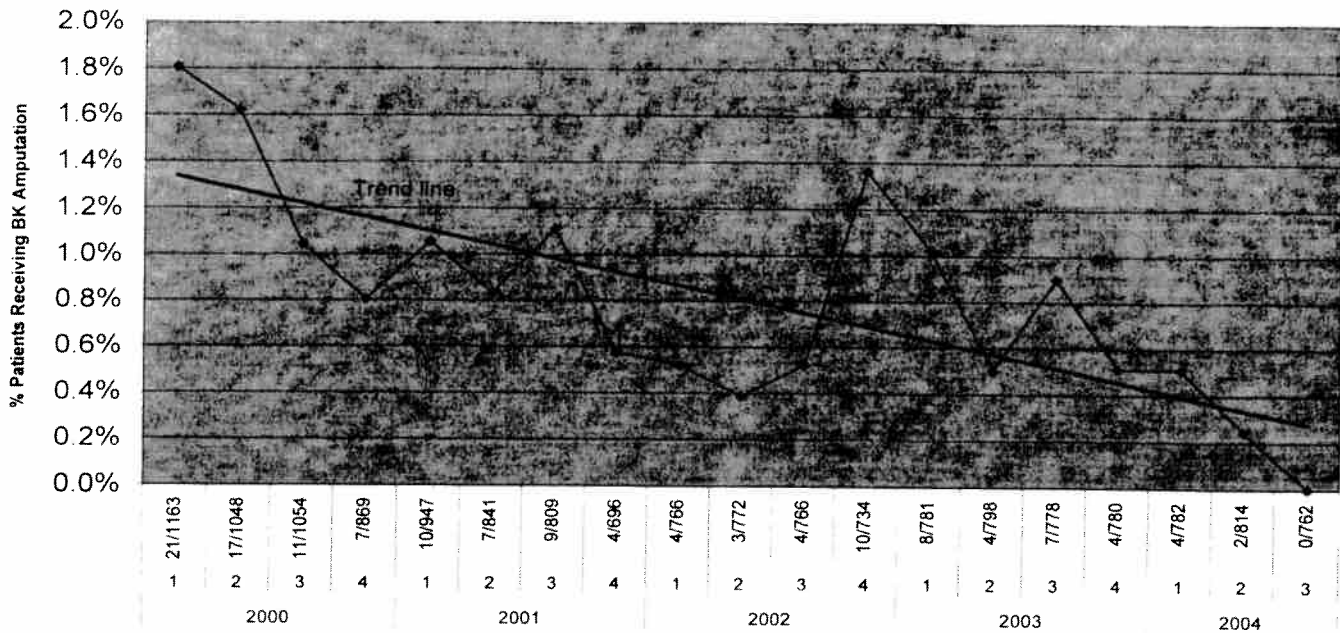
An investigation in our facility revealed that during fiscal year 1999–2000, the cost associated with LEA in persons with diabetes mellitus was \$2 million. Although

substantial, this figure underestimated the total cost of care associated with neuropathic wounds because it did not include the cost of wound care or cellulitis among patients that did not result in amputation. We therefore decided to establish a dedicated foot care clinic in an attempt to reduce the number and associated costs of LEA.

Our clinic was originally established with a staff of 5 physicians who served on a rotating basis. These included 2 infectious disease specialists and 3 internal medicine physicians. In addition, specialists in general surgery, vascular surgery, and orthopedic surgery were available for consultation as needed. The staff also included 2 certified WOC nurses, who provided continuity of care as well as clinical expertise. Clinic was held a half day each week. Patients were seen exclusively on a referral basis in order to ensure that all patients had a primary physician to manage their diabetes mellitus and related medical issues. The most common indications for referral were management of nonhealing wounds of the foot and lower leg and preventive care and education.

Patients were assessed and treated using the ADA recommendations for diabetic foot care^{12,13} along with evidence-based principles of moist wound healing. Each patient was assessed for LOPS with a Semmes-Weinstein 10-g monofilament. The patient's feet were inspected for deformities and calluses, and abnormal findings documented. Patients were placed in the appropriate risk category of the Wagner Scale^{5,9} based on self-reported history and physical assessment findings. Education and management for each patient were based on Wagner Scale risk classification and on guidelines provided by the Comprehensive Diabetes Lower Extremity Amputation Prevention program. New admissions were provided with nail and callous debridement as needed, and patients were referred to local podiatrists for appropriate footwear. Those with wounds were referred for off-loading devices as indicated. All patients were provided with education about routine care of their feet. Because research reveals that up to 93% of patients do not retain initially provided information about diabetes care,⁸ self care information was repeated at each visit.

All wounds were measured and photographed to provide an objective record of wound status and to document progress toward healing. Treatment of wounds was determined on a highly individualized basis. All neuropathic ulcers were treated with off-loading as needed. Known arterial ulcers were referred to vascular surgery for assessment and possible revascularization, and venous stasis ulcers were treated with compression therapy. Those wounds with exposed bone were assessed radiographically for osteomyelitis and referred to infectious disease services for intravenous antibiotic therapy as needed. If antimicrobial therapy failed to eradicate osteomyelitis, orthopedic surgery was consulted for surgical debridement of the bone. While preliminary Ankle Brachial Index tests were performed at the bedside in the clinic, it was recognized that the patient



- At-risk patient: patient with P/SDX of diabetes (ICD-9 250.xx), peripheral vascular disease (ICD-9 443.xx) or other circulatory disorders (ICD-9 459.8x or 459.9x).
- Below knee amputation: P/SPX of 84.10 through 84.15

FIGURE 1. The Montclair Baptist. Patients receiving initial care between January 1, 2003, and November 30, 2004. Prepared by Decision Support, pc12rg1.sas.prog2(ftclin).

with diabetes often has noncompressible veins, giving skewed results. Those wounds that did not respond to evidence-based wound healing methods were referred to vascular studies for venous and arterial Doppler studies. If these indicated arterial insufficiency, the patient was referred to vascular surgery for further evaluation and possible revascularization. Wounds with avascular tissue were treated with conservative sharp debridement as indicated, followed by topical therapy using moist wound healing principles. Specific dressing selection was based on the characteristics of the patient's wound and the home situation.

All patients were encouraged to return every 3 to 6 months for routine foot assessment and for nail or callous debridement. Those who were found to have foot wounds were seen every 1 to 2 weeks as indicated. Shoes and inserts were inspected at each visit, and patients were encouraged to replace them as needed.

■ Clinical Impact of Program

In our first 6 months of operation, 50% of our patients were referred for preventive care. By the end of 2004, our focus had shifted to that of more wound care with 20% presenting for preventive care. A total of 679 patient visits occurred during 2004. Slightly more than half (56%) were women, and patient ages ranged from 32 to 95 years. The vast majority (90%) were found to have evidence of LOPS. We used a 4-point risk assessment scale for patients with

diabetes to classify our patients where category 0 indicated no callous, wounds, and preservation of protective sensations; category 1 indicated no callous or wounds but LOPS was noted on monofilament testing; category 2 indicated a foot with callous, deformity, LOPS, but no wounds; and category 3 indicated callous, foot deformity, LOPS and a history of 1 or more wounds involving the foot or lower extremity. The majority of referral patients (65%) were rated as a category 3, indicating a currently or previously had had wounds on the lower extremity.

Following the first 2 years of operation, quality improvement monitoring revealed that admissions to our facility for LEA diminished from a peak of 1.8% in 2000, 1.1% in 2001, just below 1.4% in 2003, and 0.5% in 2004 (Figure 1). Further investigation revealed no apparent change in facility practices other than implementation of the diabetic foot clinic.

■ Conclusion

In order to address the growing population of persons at risk for neuropathic and lower extremity wounds, we established an outpatient foot care clinic focusing on preventive care and prompt management of existing lower extremity wounds. While the clinic did not produce revenue from direct charges, it generated indirect financial benefits from increased referrals to both inpatient and outpatient diagnostic services while diminishing hospital

admission rates for lower elective amputation of the lower extremities.

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Impact of a Preventive Program on Amputation Rates in the Diabetic Population

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CE TEST

General Purpose Statement: To provide registered professional nurses with an understanding of the circumstances surrounding nontraumatic lower extremity amputations in diabetic patients and how to implement a preventive care program that can lead to a diminished hospitalization rate for amputations in these patients.

Learning Objectives: After reading these articles and taking this test, the nurse will be able to:

- Describe the consequences of and risk factors for lower extremity amputations in diabetic patients as well as prevention strategies.
 - Identify the treatment of diabetic foot wounds at the foot clinic described in this article.
- What is one of the fiscal impacts of amputation on the healthcare system?**
 - Admission for amputation may cost well over the insurance reimbursement.
 - Home healthcare services are taxed unnecessarily by the needs of new amputees at home.
 - Hospitals gain increased revenue from surgical services.
 - Beds filled by amputation patients can require that emergency departments go on diversion.
 - Patients who are admitted for lower extremity amputations are estimated to experience a 12% to 15% higher rate of what complication compared to the average hospital population?**
 - anemia
 - depression
 - infection
 - pain
 - What is the primary factor leading to preventable amputation among persons with diabetes mellitus?**
 - avascular necrosis
 - idiopathic bone fractures
 - methicillin-resistant *Staphylococcus aureus* infections
 - painless trauma associated with peripheral neuropathy
 - When prolonged hyperglycemia results in damage to sensory fibers and ultimately to loss of protective sensation (LOPS), patients increase their risk of wounds from**
 - insect stings.
 - macrolide overuse.
 - thermal injuries.
 - Plasmodium* infections.
 - What should patient education include for a diabetic patient who has peripheral neuropathy?**
 - importance of using appropriate footwear
 - need for sandals or open-toed shoes
 - importance of lamb's wool placed under foot arch
 - need for dark-colored socks only
 - According to the American Diabetes Association and the American Association of Wound Care, the primary strategy for decreasing amputation rates in the diabetic population is**
 - early identification of neuropathy.
 - prevention of injury.
 - early treatment of infections.
 - proper treatment of wounds.
 - What is one of the simple activities included in the Lower Extremity Amputation Prevention program?**
 - compression wraps around feet at night
 - daily self-inspection of the feet
 - daily soaks with magnesium salts and warm water
 - prophylactic cephalosporin use
 - When treating a diabetic patient for a foot wound, what contributing factor should the nurse consider?**
 - coexisting ischemia
 - patient noncompliance with diet
 - social support system
 - use of throw rugs in the home
 - In the foot care clinic described by the author, patients were seen exclusively on a referral basis to**
 - ensure that all patients had a primary physician.
 - be able to provide high-quality care in a limited space.
 - ensure third party payer reimbursement.
 - restrict visits to a manageable number.
 - Because research reveals that up to 93% of patients do not retain information about diabetes care that is provided initially, the nurses in the diabetic foot clinic**
 - posted signs that reiterated the teaching points.
 - referred the patients to their primary physicians for further teaching.
 - repeated self-care information at each visit.
 - provided preprinted instruction sheets.

11. How were patients with known arterial ulcers treated at the foot clinic?
- compression therapy
 - orthopedic consult for surgical debridement
 - referred to vascular surgery
 - topical therapy using moist wound healing principles
12. For patients at the foot clinic, what was the appropriate treatment for venous stasis ulcers?
- antimicrobial therapy
 - compression therapy
 - revascularization
 - conservative sharp debridement
13. What additional tests were performed for patients whose wounds did not respond to evidence-based wound healing methods?
- computerized axial tomography scan
 - vascular Doppler studies
 - hyperbaric oxygen therapy
 - magnetic resonance imaging scan
14. What was the appropriate treatment for wounds with avascular tissue?
- antimicrobial therapy
 - compression therapy
 - revascularization
 - conservative sharp debridement

15. Patients without foot wounds were encouraged to return to the clinic for routine foot assessment and for nail or callus debridement every
- month.
 - 1 to 2 months.
 - 2 to 4 months.
 - 3 to 6 months.
16. Of 679 patients who visited the foot clinic in 2004, what percentage was found to have evidence of LOPS?
- 45%
 - 57%
 - 79%
 - 90%
17. Using the 4-point risk assessment scale that was used in the foot clinic for patients with diabetes, in what category would nurses place a patient who had a foot with callus, deformity, LOPS, but no wounds?
- Category 0
 - Category 1
 - Category 2
 - Category 3
18. The majority of referral patients (65%) were rated as a category 3, indicating that they
- currently or previously had wounds on the lower extremity.
 - had no callus or wounds, but LOPS was noted.
 - had callus, deformity, LOPS, but no wounds.
 - had no callus, wounds, and preservation of protective sensations.

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JWOCN 0908

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