ABSTRACT

Objective: The purpose of this investigation was to stratify the risk in a consecutive group of diabetic patients presenting, for the first time, in a diabetic foot clinic. Additional aims were to investigate the preventive measures in the local health system and to evaluate the level of patient’s awareness about diabetic foot-associated morbidity. Methods: Fifty consecutive adult diabetic patients referred to a Diabetic Foot Clinic of a Municipal Public Hospital comprised the sample for this observational study. The enrollment visit was considered as the first health-system intervention for potential foot morbidity. The average time elapsed since a diagnosis of diabetes among patients was five years. Results: At the time of presentation, 94% of sample was not using appropriate footwear. Pedal pulses (dorsalis pedis and/or posterior tibial arteries) were palpable in 76% of patients. Thirty subjects (60%) had signs of peripheral neuropathy. Twenty-one subjects (42%) had clinical deformity. There was a positive correlation between a history of foot ulcer, the presence of peripheral neuropathy, and the presence of foot deformity (p < 0.004 in each correlation). Conclusions: Informing and educating the patients and those interested in this subject and these problems is essential for favorable outcomes in this scenario.

Keywords: Diabetic foot/prevention & control; Health education; Foot ulcer/prevention & control; Shoes/adverse effects

INTRODUCTION

There are an estimated ten to twelve million adult diabetic patients in Brazil, and probably just as many as yet undiagnosed(1). Ninety percent are diagnosed as adults(2). One in four has evidence of peripheral neuropathy(3-4). The incidence of peripheral neuropathy increases after ten years of diagnosis, if control of blood glucose is sub-optimal(3,5-6). Pecoraro showed that peripheral neuropathy was a contributing factor in 61% of diabetes-associated lower extremity amputations; this author estimated that 86% of these could be avoided(4-14). A comprehensive foot-specific patient education, skin and nail care, and therapeutic footwear program has been shown to substantially decrease that risk(2,8-9,15-25). Government-initiated programs have been shown to decrease foot-associated morbidity and the rate of lower extremity amputation in countries with underserved patient populations(13-14,20-22,26-28). Therapeutic footwear appears to play an important role in potentially reducing the morbidity(6,11,13,18).
OBJECTIVE

The purpose of this observational study was to objectively evaluate the risk status and risk factors in a consecutive series of indigent public hospital adult diabetic patients receiving their first specific health system intervention for potential diabetic foot morbidity.

METHODS

Following approval by the local Committee of Research on Humans, this observational study was started after a concerted educational plan to promote awareness in primary care physicians about potential foot-associated morbidity in adult diabetic individuals. The cohort group consisted of 50 consecutive adult-onset diabetic individuals referred to a public hospital diabetic foot clinic. There were 21 males and 29 females. The mean age was 60.5 years (range 22 to 97 years). The average time elapsed from date of diagnosis of diabetes was 10.3 years (range 4 months to 30 years).

All subjects were asked whether medical instruction about the potential for and avoidance of foot morbidity had been provided. A history of previous foot-associated morbidity was recorded. A clinical examination evaluated the *dorsalis pedis* and posterior tibial pulses. The presence of deformity was recorded simply as present or absent. The presence of peripheral neuropathy was determined by applying 10 g of force with the Semmes-Weinstein 5.07 monofilament (Figure 1). A diagnosis of peripheral neuropathy was made when patients were unable to perceive pressure from the monofilament in a minimum of four of ten testing sites.

Risk grading is shown in Table 1. A subjective evaluation of footwear adequacy was based on risk status. Subject graded 0 required only soft leather shoes with a reasonable toe box. Risk grade 1 subjects required soft leather shoes, an adequate toe box, and cushioned soles or insoles. Risk grade 2 subjects required soft leather oxford lace shoes, an adequate toe box, and accommodative insoles. High risk (grade 3) subjects required all of these items and a custom-made accommodative insole.

Statistical analysis

Descriptive statistics were used to establish the relative frequencies of negative events. The Wilcoxon signed rank test was used to establish right and left feet differences. Spearman's linear correlation test was used to analyze the effects of age and duration of diabetes, and illustrated by dispersion diagrams. The Mann-Whitney test was used to assess the relation between qualitative (categorical) variables and sensitivity.

The SPSS for Windows version 11.0 software was used for processing.

RESULTS

Descriptive data

Six of the 50 subjects (12%) had a now healed previous foot ulcer. Four subjects (8%) had been given some form of foot-specific care education. According to the recommended standards of the American Orthopaedic Foot & Ankle Society, only three of the subjects used appropriate footwear (two of the three were risk grade 0). Pedal pulses (*dorsalis pedis* and/or posterior tibial) were palpable in 38 subjects (76%). Thirty subjects (60%) had evidence of peripheral neuropathy. Twenty-one subjects (42%) had clinical deformity. There were 14 forefoot deformities. Nine had lesser toe deformities, four had hallux valgus, and one had a splayed foot. Four subjects had *pes cavus* with prominent metatarsal heads, and three subjects had Charcot’s midfoot deformity. Risk stratification is shown in Table 2.

Figure 2 shows an example of inappropriate footwear.

![Figure 1. These ten sites were tested for the presence of peripheral neuropathy, that is, loss of protective sensations. Ten grams of pressure was applied using the Semmes-Weinstein 5.07 monofilament. Patients were considered insensitive when there was no perception of pressure in a minimum of four of ten sites.](image1)

![Table 1. Grading of risk status for developing a foot ulcer](image2)

<table>
<thead>
<tr>
<th>Grade</th>
<th>History of DFU</th>
<th>Appearance</th>
<th>Pedal pulses</th>
<th>Sensation</th>
<th>Deformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No</td>
<td>Normal</td>
<td>Palpable</td>
<td>+</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>No</td>
<td>Normal</td>
<td>Palpable</td>
<td>-</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td>Normal</td>
<td>Diminished or absent</td>
<td>-</td>
<td>±</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>±</td>
<td>Absent</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

DFU = diabetic foot ulcer

![Figure 2. This figure shows an example of inappropriate footwear.](image3)
There was no statistical difference in right and left foot sensitivity (p = 0.414). Only one patient among risk grade 1 or higher subjects used appropriate footwear. There was a positive – albeit not statistically significant – trend between increasing age and the presence of peripheral neuropathy (R = -0.179; p < 0.215). There was a positive correlation between the time elapsed since a diagnosis of diabetes and the presence of peripheral neuropathy (R = 0.035; p < 0.808). There was a positive correlation between a history of foot ulcer and the presence of peripheral neuropathy and foot deformity (p < 0.004 for each correlation). There was no correlation between foot-specific patient education and the presence of patient education (p < 0.853).

**DISCUSSION**

It is well accepted that diabetic foot ulcers have a strong negative effect on health-related quality of life. A significant share of healthcare resources is used on these patients; lower extremities are often amputated, walking is impaired, independence is compromised, and death may ensue in some cases. Experts have classified foot ulcers in two categories: ischemic ulcers caused by peripheral vascular disease, and neuropathic ulcers initiated by local trauma in the presence of peripheral neuropathy. Notwithstanding technological advances in the treatment of symptomatic peripheral vascular disease, there are no current interventions to be used before patients develop non-healing wounds or present ischemic pain. On the other hand, a combination of foot-specific patient education, skin and nail care, and therapeutic footwear, has been shown to successfully decrease the development of diabetic foot ulcers and the initiation of this pathologic process\(^{32-33}\).

In spite of such information, few diabetic patients appear to be adequately educated on the potential morbidity of diabetic foot ulcers or possible preventive measures to avoid foot-specific morbidity\(^{15,18,26}\). The present data supports the growing consensus that coordinated programs combining preventive foot-specific patient education, skin and nail care and therapeutic footwear may decrease significantly the diabetic foot disease epidemic.

This cohort of patients receiving healthcare in a public healthcare setting had poor level of preventive interventions at the time of entry into a government-sponsored program; few had foot-specific patient education. Only one of 50 at risk subjects used appropriate footwear, an apparently simple intervention. As shown in previous studies, patients which develop foot morbidity may easily be identified by investigating the presence of peripheral neuropathy and obvious deformity.

**CONCLUSIONS**

This study provides solid additional evidence that diabetic patients at risk for developing foot ulcers and foot infection may be easily identified by simple and inexpensive screening methods. Once identified, low-technology interventions offer the opportunity of avoiding the negative effects on health-related quality of life, decreasing resource-consuming patient morbidities, and ultimately decreasing the risk of lower limb amputations and early mortality in a patient population with many associated risk factors.

**REFERENCES**