Epidemiology of Diabetic Foot Infections in an Eastern Caribbean Population: A Prospective Study

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Perm J 2013 Spring;17(2):37-40

http://dx.doi.org/10.7812/TPP/12-126

Abstract

Introduction: This study evaluates the epidemiology of diabetic foot infections in an Eastern Caribbean nation in order to direct public health preventive measures.

Methods: We prospectively identified all patients with diabetic foot infections who were admitted to tertiary care hospitals across Trinidad and Tobago from July 2011 to June 2012. A questionnaire was used to collect data on demographics, patient knowledge, avoidance of risk factors for chronic diseases (a proxy to unhealthy lifestyles), and glycosylated hemoglobin measurements on admission as an index of blood glucose control. The data were analyzed with statistical software.

Results: There were 446 patients with diabetic foot infections (mean age = 56.9 years, standard deviation = 12.4 years). Most patients had Type 2 diabetes (93.3%) and were of Indo-Trinidadian (49.1%) or Afro-Trinidadian (41.7%) descent. There were preexisting complications of diabetes in 82.9% of patients with Type 2 diabetes: foot infections requiring hospitalization (70.2%), ischemic heart disease (32.5%), renal impairment (13.7%), and retinopathy (22.1%).

Despite most patients claiming compliance with treatment, 75% had glycosylated hemoglobin levels above 7.1% at presentation, and 49.3% continued unhealthy lifestyles. Despite the high prevalence of diabetic complications at admission, and despite 70% having had previous hospitalization for treatment of foot infections, only 57.4% of patients reported ever being counseled or taught about foot care by medical personnel.

Conclusions: There is room for improvement in public health strategies to prevent diabetic foot complications in this setting. Such strategies should focus on patient education with emphasis on lifestyle modification and compliance with medical therapy.

Introduction

The prevalence of diabetes mellitus is increasing at an alarming rate across the Caribbean.[1-5] The presence of hyperglycemia, neuropathy, angiopathy, and immune paresis predispose these patients to infections of the lower limbs.

Foot infections are the number one cause of hospital admission to the surgical floors in Caribbean public hospitals[6,7] and of amputations,[8,9] which frequently result in mortality. This study evaluates the epidemiology of diabetic foot infections in an Eastern Caribbean nation. This information is needed to define the cohort at risk to direct public health preventive measures.

Methods

Ethical approval was obtained from the local institutional review board to collect data on all patients presenting with diabetic foot infections at tertiary care hospitals across Trinidad and Tobago. We evaluated this data over a 12-month period from July 2011 to June 2012.

All patients who presented to tertiary care hospitals across both islands were identified on admission from the hospital registers. All patients admitted with diabetic foot infections were considered potential participants for this study. We excluded patients who were unwilling to participate in the study or could not complete the questionnaire for whatever reason. An independent investigator interviewed all remaining patients during hospitalization and completed a questionnaire.

The questionnaire sought to collect epidemiologic data, including age, sex, self-reported race/ethnicity (black, white, East Indian, Chinese, and mixed race), duration of diagnosis, family history of diabetes, type of diabetes, and details of previous medical and surgical therapies. We also questioned patients about their subjective impression of knowledge relating to their diabetes and their participation in formal educational courses.

As a proxy to the patients' healthy lifestyle, we also sought information about avoidance of recognized risk factors for chronic diseases, including smoking, alcohol use, and illicit drug use. If the patients could not demonstrate sufficient restraint to avoid these risk factors and maintain healthy lifestyles, this could be indicative of poor compliance with foot health recommendations. To standardize reporting with regional bodies, we used the definitions from the CARICOM (Caribbean Community) Heads of State and Government summit.[10] Regular alcohol intake was considered present when there was at least one alcoholic drink

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per day on four or more days per week. Regular tobacco use was considered present when patients consumed at least one cigarette daily. Any reported use of an illegal drug was considered illicit drug use.

Only 57% of the patients admitted with diabetic foot infections in this study reported ever being counseled or taught about foot care by health care workers.

The hospital charts of all patients were retrieved, and the glycosylated hemoglobin (HbA_{1c}) measurements on admission were recorded to give an index of compliance/blood glucose control over the preceding eight weeks.

The data were entered into a spreadsheet (Microsoft Excel, Microsoft, Redmond, WA) and analyzed with the Statistical Package for Social Sciences (SPSS) version 12.0 (IBM SPSS, Armonk, NY). Descriptive statistics were generated as appropriate. Chi-squared and Fisher exact tests were used to assess associations, and *t* tests were used to compare means between variables of interest.

Results

Over 12 months, there were 446 patients with diabetic foot infections admitted to the surgical floors at tertiary care hospitals in Trinidad and Tobago. Of this, 315 (70.63%) had prior hospital admissions for treatment of foot infections.

Patients presented at an average age of 56.9 years (standard deviation [SD] = 12.4 years, range = 24 to 93 years). Most patients were of Indo-Trinidadian (49.1%) and Afro-Trinidadian (41.7%) descent. It was much less common (9.19%) for Chinese and mixed-race patients to be admitted for treatment of diabetic foot infections.

There were more men than women (241 men vs 205 women). However, there was no statistical difference between the ages of men (mean age = 57.3 years; SD = 12.15 years) and women (mean age = 56.43 years; SD = 12.71 years).

Patients with Type 2 diabetes accounted for 416 (93.3%) of the admissions (230 men and 186 women), with a mean age of 57.89 years (SD = 11.98 years). These patients lived with diabetes for a mean duration of 15.3 years (SD = 9.39 years), and most patients (84.4%) had a first-degree relative with diabetes.

Of 416 patients with Type 2 diabetes and diabetic foot infections, 345 (82.9%) had at least 1 preexisting complication of their diabetes. There were 292 patients (70.2%) with previous hospital admissions because of foot infections and 201 patients (48.3%) with end-organ disease: ischemic heart disease (32.5%), renal impairment (13.7%), and retinopathy (22.1%).

Thirty patients with Type 1 diabetes were admitted with foot infections (11 men and 19 women). They presented to the hospital at a mean age of 20.17 years (SD = 10.49 years; range = 7 to 55 years). These patients lived with diabetes for a mean duration of 14.2 years (SD = 6.4 years; range = 7 to 55 years), and all these patients had a first-degree relative with diabetes. Twenty-five (83.3%) of these patients had preexisting complications of diabetes, including previous admission because of foot infections (n = 23), renal impairment (n = 6), and/or retinopathy (n = 6).

Overall, 220 (49.33%) of the patients admitted to regular use of tobacco (n = 129), alcohol (n = 148), and/or illicit drugs (n = 10). Despite the high prevalence of complications of diabetes at the time of admission, and despite 70% having had previous hospitalization because of foot infections, only 256 patients (57.4%) reported ever being counseled or taught about foot care by medical personnel. Many patients (28.7%) tried some form of home remedy before presenting to a medical practitioner for care.

Most patients with diabetic foot infections were taking oral medications (45.9%) compared with insulin (28.6%); 21.6% of patients used both medications and insulin, and 1% took no medications. Although most patients claimed to be compliant with their treatment, 334 (74.89%) patients had HbA_{1c} concentrations above 7.1% at the time of presentation.

The most common causes of diabetic foot infections were trauma, 226 (50.7%); footwear-related injuries, 189 (42.4%); lacerations, 10 (2.2%); and burns, 7 (1.6%). There were 178 patients (39.9%) with documented sensory neuropathy on monofilament testing.

At the time of hospital discharge, 61 patients (13.7%) had major amputations and 135 (30.3%) had minor amputations as a part of their treatment of the diabetic foot infections. In the remaining 250 patients (56.1%), an amputation was avoided in favor of treatment with débridement and antibiotic therapy only.

Discussion

Diabetes mellitus is one of the leading causes of morbidity and mortality in the Caribbean.[1-10] The disease takes a heavy toll because most of the patients in whom complications develop are relatively young and still active in the workforce.

The nation of Trinidad and Tobago consists of 2 islands in the Eastern Caribbean with a total area of 5153 km^2 (1982 square miles) and an estimated population of 1,317,714 persons at the latest population census report.[11] The population is made up primarily of people of Indo-Trinidadian (40%), Afro-Trinidadian (37.5%), Chinese (0.5%), and mixed-race (18.5%) descent.[11] Diabetes affects 10.9% of the unselected adult population in Trinidad and Tobago[5] and is the second most common cause of mortality across the nation.[11]

Treatment of these patients with diabetes places a substantial burden on the national expenditure, accounting for 5.21% of the gross domestic product in Trinidad and Tobago or an estimated US $467 million.[12] Treatment of foot infections accounts for 29% of the expenditure,[6] as it is the most common complication of diabetes requiring hospital admission[1-3]; it accounts for 14% of all hospital admissions in Trinidad and Tobago.[6]

Recognizing that there was an epidemic of diabetes and other chronic noncommunicable diseases (NCDs) in the region, CARICOM health ministers convened at a summit on NCD in Trinidad on September 15, 2007. This resulted in the "Declaration of Port-of-Spain" that attempted to unite the countries in the region to the common goal of developing effective public policy to combat NCDs.[13] Following this declaration, CARICOM led the development of a strategic plan of action to prevent chronic NCDs in CARICOM countries.[10] It was intended to form a blueprint for resource mobilization at the regional level.

Trinidad and Tobago responded by introducing several public health initiatives to combat diabetes.[14,15] As it relates specifically to foot complications, the North West Regional Health Authority developed the Diabetic Foot Care Management Programme aimed at improving foot care in patients with diabetes.[7] In the initial phase, a team of podiatrists trained

a cadre of local health care workers. In the second phase, dedicated diabetic foot clinics were incorporated into existing health centers through which diabetes educators delivered educational lectures, performed risk factor screening, and administered foot care. The clinics were aligned with the vascular clinics at tertiary hospitals for continuity of care.[7] These secondary prevention programs have been greeted with great success. Singh and colleagues[7] identified and followed-up 361 patients from the diabetic clinics who were at high risk of foot infections. They reported a low (4%) rate of ulceration in high-risk patients. Additionally, when ulcers did develop, there was a 54% ulcer healing rate without operative intervention.[7]

Although it is clear that this secondary prevention strategy is beneficial to patients enrolled in the diabetic clinics, the results of this study suggest that there is room for improvement because the benefits were not available to the entire target population. Only 57% of the patients admitted with diabetic foot infections in this study reported ever being counseled or taught about foot care by health care workers. Much of this counseling came from previous foot complications that occurred in 70% of cases. Thus, almost none of these patients were enrolled in the dedicated clinics.

One strategy to increase the catchment may be to develop a mobile arm of the foot care team for dispatch to strategic areas. Hospital staff could communicate with the foot care team, requesting visits to patients admitted with foot infections. By ensuring contact with patients before discharge, a larger fraction of the population at risk for future events could benefit from the foot care team's interventions. Considering that 71% of the patients in this study population had already recovered from previous foot infections, this strategy would have allowed the preventive strategies to reach the majority of this group.

Additionally, the mobile foot care team could be dispatched to carry out home training because 84% of the patients with diabetic foot infections had at least one first-degree relative living with diabetes. This would increase the catchment population and allow development of the family unit to provide a support structure for these patients. Another strategic point to performing foot care training could be specialty care clinics because 83% of patients had another complication of their diabetes, with 48% of patients having end-organ damage for which they would be seen in other clinics.

Use of public media is another way of increasing knowledge in the population at risk. This study has identified Indo- and Afro-Trinidadian persons with Type 2 diabetes of more than 15 years' duration in the sixth decade of life as a high-risk cohort to allow targeted public health interventions. This is in keeping with previous reports documenting an association with diabetic complications and Indo- or Afro-Trinidadian ethnicity, lower socioeconomic status, and the use of public health care facilities.[2,6]

Using the regular ingestion of alcohol, tobacco, and/or recreational drugs as a proxy for unhealthy lifestyles, we found that 52% of the patients admitted with diabetic foot infections continued to lead unhealthy lifestyles. Continuation of these high-risk practices is a well-recognized factor increasing the risk of diabetic complications.[16-22] This has important public health implications because these patients would likely not be sufficiently disciplined to be compliant with medical therapy either. Comprehensive education must include information on healthy lifestyles as well.

Although most patients admitted with diabetic foot infections claimed compliance with their diabetic medications, 75% of patients had HbA_{1c} concentrations above 7% at presentation, suggesting that they still had poor long-term glucose control.[23,24] This underscores the need for improved primary prevention strategies, targeting both patients with diabetes and primary care physicians.

Primary care physicians must be reminded to routinely use proven primary prevention strategies at every point of contact with patients who have diabetes.[24-32] These strategies include the removal of shoes for physician-directed foot examinations,[24,25] optimization of blood glucose control,[23-25] monofilament testing for sensory neuropathy,[24,25] prescription of appropriate footwear[26-32] (or orthotist referral), and counseling about healthy lifestyles.[17-22]

Because most of the Caribbean patients with diabetes routinely wear "flip-flops," use of the "slipping slipper" sign in public education campaigns can assist patients and their relatives to identify the foot risks at home without needing medical assistance for diagnosis.[25] This message has resonated in several countries with similar practices, such as India, Southwest Africa, and Asia, where the wearing of flip-flops is common.[26-32] Similar to the experience in these countries, the anecdotal experience is that many persons with diabetes still continue to wear flip-flops in keeping with local customs.[27-29]

Conclusion

There is room for improvement in this setting in public health strategies to prevent diabetic foot complications. Introduction of a mobile arm of the diabetic foot care team may be one method to improve prevention. Clinicians should focus on patient education while the patient is still in the hospital or enrolled in other specialty clinics. Focus should also be placed on lifestyle modification and compliance with medical therapy. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

Acknowledgment

Kathleen Louden, ELS, of Louden Health Communications provided editorial assistance.

References

1. Boyne MS. Diabetes in the Caribbean: trouble in paradise. Insulin 2009 Apr;4(2):94-105. DOI: http://dx.doi.org/10.1016/S1557-0843(09)80018-3
2. Gulliford MC, Mahabir D. Social inequalities in morbidity from diabetes mellitus in public primary care clinics in Trinidad and Tobago. Soc Sci Med 1998 Jan;46(1):137-44. DOI: http://dx.doi.org/10.1016/S0277-9536(97)00155-X
3. Ferguson TS, Tulloch-Reid MK, Wilks RJ. The epidemiology of diabetes mellitus in Jamaica and the Caribbean: a historical review. West Indian Med J 2010 Jun;59(3):259-64.
4. Hennis A, Wu SY, Nemesure B, Li X, Leske MC; Barbados Eye Study Group. Diabetes in a Caribbean population: epidemiological profile and implications. Int J Epidemiol 2002 Feb;31(1):234-9. DOI: http://dx.doi.org/10.1093/ije/31.1.234
5. Barceló A, Rajpathak S. Incidence and prevalence of diabetes mellitus in the Americas. Rev Panam Salud Publica 2001 Nov;10(5):300-8. DOI: http://dx.doi.org/10.1590/S1020-49892001001100002

6. Gulliford MC, Ariyanayagam-Baksh SM, Bickram L, Picou D, Mahabir D. Counting the cost of diabetic hospital admissions from a multi-ethnic population in Trinidad. Diabet Med 1995 Dec;12(12):1077-85. DOI: http://dx.doi.org/10.1111/j.1464-5491.1995.tb00424.x
7. Singh H, Rahaman MA, Ramcharitar Maharaj A, Armour B; County St George Central; North West Regional Health Authority. Diabetic foot care management programme in County St. George Central, Trinidad and Tobago [monograph on the Internet]. Washington, DC: Pan American Health Organization; 2007 Nov [cited 2013 Jan 30]. Available from: http://paho.org/english/ad/dpc/nc/trt-abstracts-2007-cmn-mtg.htm.
8. Solomon S, Affan AM, Gopie P, et al. Taking the next step in 2005, the year of the diabetic foot. Prim Care Diabetes 2008 Dec;2(4):175-80. DOI: http://dx.doi.org/10.1016/j.pcd.2008.08.004
9. Walrond ER. The Caribbean experience with the diabetic foot management of the diabetic foot. West Indian Med J 2001 Mar 1-4;50 Suppl 1:24-6.
10. Strategic plan of action for the prevention and control of non-communicable diseases for countries of the Caribbean community 2011-2015 [monograph on the Internet]. Georgetown, Guyana: Caribbean Community Secretariat, Pan American Health Organization/World Health Organization; 2011 Jan [cited 2013 Jan 30]. Available from: http://healthycaribbean.org/publications/strategic-plan-of-action.html.
11. Mid year population statistics 2000-2010 [monograph on the Internet]. Port of Spain, Trinidad and Tobago: Central Statistical Office, Ministry of Planning and Development, Government of the Republic of Trinidad and Tobago; [cited 2013 Jan 10]. Available from: http://cso.gov.tt/statistics/statistics/-in-statistics/statistics/population-statistics.
12. Abdulkadri AO, Cunningham-Myrie C, Forrester T. Economic burden of diabetes and hypertension in CARICOM states. Soc Econ Stud 2009 Sep/Dec;58(3/4):175-97.
13. Declaration of Port-of-Spain: uniting to stop the epidemic of chronic NCDs [monograph on the Internet]. Georgetown, Guyana: Caribbean Community Secretariat; 2007 [cited 2012 Nov 1]. Available from: http://caricom.org/jsp/communications/meetings_statements/declaration_port_of_spain_chronic_ncds.jsp.
14. Foot care for diabetics now available [monograph on the Internet]. Port of Spain, Trinidad and Tobago: Trinidad & Tobago Guardian Online; 2012 Apr 7 [cited 2013 Jan 30]. Available from: http://guardian.co.tt/news/2012-04-07/foot-care-diabetics-now-available.
15. Ministry of Health services [Web page on the Internet]. Port of Spain, Trinidad and Tobago: Government of the Republic of Trinidad and Tobago, Ministry of Health, Services; c2013 [cited 2013 Jan 30]. Available from: www.health.gov.tt/sitepages/default.aspx?id=4.
16. Samuels TA, Hospedales CJ. From Port-of-Spain summit to United Nations High Level Meeting CARICOM and the global non-communicable disease agenda. West Indian Med J 2011 Jul;60(4):387-91.
17. Rywik SL, Piotrowski W, Rywik TM, Broda G, Szcześniewska D. Is the decrease of cardiovascular mortality in Poland associated with the reduction of global cardiovascular risk related to changes in life style? Kardiol Pol 2003 May;58(5):344-55.
18. Ergin A, Muntner P, Sherwin R, He J. Secular trends in cardiovascular disease mortality, incidence, and case fatality rates in adults in the United States. Am J Med 2004 Aug 15;117(4):219-27. DOI: http://dx.doi.org/10.1016/j.amjmed.2004.03.017
19. Sytkowski PA, Kannel WB, D'Agostino RB. Changes in risk factors and the decline in mortality from cardiovascular disease. The Framingham Heart Study. N Engl J Med 1990 Jun 7;322(23):1635-41. DOI: http://dx.doi.org/10.1056/NEJM199006073222304
20. Bata IR, Gregor RD, Eastwood BJ, Wolf HK. Trends in the incidence of acute myocardial infarction between 1984 and 1993—The Halifax County MONICA Project. Can J Cardiol 2000 May;16(5):589-95.
21. Thavorncharoensap M, Teerawattananon Y, Yothasamut J, Lertpitakpong C, Chaikledkaew U. The economic impact of alcohol consumption: a systematic review. Subst Abuse Treat Prev Policy 2009 Nov 25;4:20. DOI: http://dx.doi.org/10.1186/1747-597X-4-20
22. Rehm J, Monteiro M. Alcohol consumption and burden of disease in the Americas: implications for alcohol policy. Rev Panam Salud Publica 2005Oct-Nov;18(4-5):241-8. DOI: http://dx.doi.org/10.1590/S1020-49892005000900003
23. Markuson M, Hanson D, Anderson J, et al. The relationship between hemoglobin A(1c) values and healing time for lower extremity ulcers in individuals with diabetes. Adv Skin Wound Care 2009 Aug;22(8):365-72. DOI: http://dx.doi.org/10.1097/01.ASW.0000358639.45784.cd
24. Janghorbani M, Amini M. Patterns and predictors of long-term glycemic control in patients with type 2 diabetes. ISRN Endocrinol 2012;2012:526824. DOI: http://dx.doi.org/10.5402/2012/526824
25. Teelucksingh S, Ramdass MJ, Charran A, Mungalsingh C, Seemungal T, Naraynsingh V. The slipping slipper sign: a marker of severe peripheral diabetic neuropathy and foot sepsis. Postgrad Med J 2009 Jun;85(1004);288-91. DOI: http://dx.doi.org/10.1136/pgmj.2008.075234
26. Dorresteijn JA, Kreigsman DM, Assendelft WJ, Valk GD. Patient education for preventing diabetic foot ulceration. Cochrane Database Syst Rev 2012 Oct 17;10:CD001488. DOI: http://dx.doi.org/10.1002/14651858.CD001488.pub4
27. Chandalia HB, Singh D, Kapoor V, Chandalia SH, Lamba PS. Footwear and foot care knowledge as risk factors for foot problems in Indian diabetics. Int J Diabetes Dev Ctries 2008 Oct;28(4):109-13. DOI: http://dx.doi.org/10.4103/0973-3930.45269
28. Jayasinghe SA, Atukorala I, Gunethilleke B, Siriwardena V, Herath SC, De Abrew K. Is walking barefoot a risk factor for diabetic foot disease in developing countries? Rural Remote Health 2007 Apr-Jun;7(2):692.
29. Viswanathan V. The diabetic foot: perspectives from Chennai, South India. Int J Low Extrem Wounds 2007 Mar;6(1):34-6. DOI: http://dx.doi.org/10.1177/1534734606297987
30. Tyrrell W. Orthotic intervention in patients with diabetic foot ulceration. J Wound Care 1999 Nov;8(10):530-2.
31. Cavanagh PR, Boulton AJ, Sheehan P, Ulbrecht JS, Caputo GM, Armstrong DG. Therapeutic footwear in patients with diabetes. JAMA 2002 Sep 11;288(10):1231-3. DOI: http://dx.doi.org/10.1001/jama.288.10.1231
32. Reiber GE, Smith DG, Wallace CM, et al. Footwear used by individuals with diabetes and a history of foot ulcer. J Rehabil Res Dev 2 002 Sep-Oct;39(5):615-22.

Captain and Victim

Man may be the captain of his fate, but he is also the victim of his blood sugar.

— Wilfrid G Oakley, 1905-1998, English physician pioneer in clinical care of diabetes