Asian Journal of Medical Research Original Article

The management of diabetic foot disorders in six hospitals in jeddah, saudi arabia

Hasan Ali Alzahrani[1],Wail Abdulhafeez Tashkandi[1], Anas Hasan Alzahrani[1]

[1]King Abdulaziz University, Department of Surgery, Faculty of Medicine, Jeddah, Saudi Arabia

Abstract

Objective :the objective is study, the outcomes of Diabetic foot disorders in six public and private hospitals in Jeddah, Saudi Arabia,

Method: In this multicenter retrospective study, the outcomes of Diabetic foot disorders DFD management in six public and private hospitals in Jeddah, Saudi Arabia, were reviewed over 12 months in six hospitals in Jeddah, Saudi Arabia to identify the characteristics of patients admitted with DFD and problems in their care in less-developed countries.

Results: Medical records of 275 patients were reviewed; 229 were treated at public hospitals and 46 at private hospitals. The mean age of patients was 58.5 ± 11.6 years. Ulcer was the most common presentation (81.8% of patients). Ischemia was diagnosed in 52.7% of patients and was significantly correlated with the duration of DM. Among the studied patients 4.8% underwent revascularization procedures. Lower extremity amputation was performed in 48.8% of patients (69% were minor and 31% were major amputations). The 30-day mortality rate was 6.5%. Only 13.8% of patients were discharged with plans for rehabilitation. Lower extremity amputation was fairly common in patients hospitalized for DFD. Every effort should be made to avoid such procedures, particularly in less-developed countries with limited resources for rehabilitative care.

Conclusion: There is need for improving public educational programs, earlier referral, prompt revascularic1zation and improving rehabilitation and home/ambulatory care.

Key Words: Diabetes mellitus, Foot, Ulceration, Amputation, Ischemia

INTRODUCTION

Diabetes is a global epidemic of the 21st century. It was estimated that 366 million people worldwide have diabetes and 80% of them live in low- and middle-income countries.[1] By 2030, the global burden of diabetes is projected to reach 552 million people]1[, with a 69% increase in the number of adults with diabetes in developing countries and a 20% increase in developed countries.[2] Data accumulated over the last 30 years have confirmed that the epidemic of type 2 diabetes is mainly affecting Saudi Arabia SA and adjacent Gulf Council Countries GCC.[3] Indeed, SA is ranked with the 6th highest prevalence of diabetesworldwide, and is expected to hold this position for the next 20 years, with a prevalence rate of 20.0% among 20–79-year-old adults]1[. Other countries ranked in the Bahrain (19.9%) and the United Arab Emirates (19.2%)]1[. The prevalence of diabetes mellitus DM in SA variesamong studies,[3–5] principally because of differencesin research methodologies. Al-Nozha et al.]4[conducted a well-designed national survey and reported a prevalence rate of 23.7% in adult Saudis aged >30 years(26.2% in males versus 21.5% in females). Foot disorders are among the most feared chronic complications of DM. DFD comprise a group of disorders that often present with at least one of the following clinical manifestations: foot ulceration, infection, neuropathy, deformity, gangrene and ischemia. Some or all of these problems may develop in the same patient, often on both feet. If not treated in a timely and appropriate, amputation will become necessary.[6,7] In turn, amputation is often associated with significant morbidity and mortality,[7-9] in addition to immense social, psychological and financial consequences.[10–12]

DFD and related complications represent a significant medical and economic challenge to healthcare systems globally.[12] SA has its peculiar health system structure which is a mix of public and private sectors. The main player in the public sector is Ministry of Health hospitals followed by other governmental hospitals such as universities and military hospitals.[13] Any study must therefore cover both sectors. In addition, many differences between Arab patients and patients in other developed countries have already been highlighted including local cultural practices.[5,11]

Address for correspondence*

Hasan Ali Alzahrani

King Abdulaziz University, Department of Surgery, Faculty of Medicine, Jeddah, Saudi Arabia Email : haaz59@yahoo.com

Over the last two decades, a total of ten five studies on the management of DFD. Half of the studies were conducted in Jeddah, SA,[6,14–17] two studies from eastern province and another three from the capital Riyadh and.[7,18-21] All of the previously mentioned studies included patients from a single hospital in the public sector and contained a relatively small number of patients.

The current study is the first multicenter study of patients from public and private sectors. The objective of this study was to review the current management of DFD over one year in six different hospitals in Jeddah and hence identify opportunities to improve DFD care in these hospitals. By doing so, it is hoped that he findings and recommendations can be generalized to other regions in Saudi Arabia, as well as other countries in the Middle East and North Africa MENA with a high prevalence of DM and similar healthcare systems, and cultural and social characteristics. One hopes that other countries with under-developed health systems could also benefit from the lessons learned in managing DFD in Jeddah, Saudi Arabia.

METHODS

A multicenter retrospective study was conducted over 12 months in Jeddah, starting on January 2008. There were 12 major hospitals (of more than 200 beds) and 20 minor hospitals in Jeddah [13]. All of Jeddah's major hospitals were approached. Six hospitals (50%) agreed to participate and provided information on all patients admitted with DFD. Two of the hospitals were part of the Ministry of Health, one was a university hospital and three were private hospitals. Military hospitals were not invited as they have specific referral patterns. Case records of patients diagnosed with DFD were identified using ICD-9codes. In addition, admission registries, wards registries and operation departments' records were reviewed manually. Overall, the medical records of 245 patients admitted to one of the six participating hospitals with the diagnosis of DFD were reviewed. Of these, 229 patients were admitted to public hospitals [King Fahd General Hospital (KFGH), n = 130; King Abdulaziz Hospital and Oncology Center (KAH&OC), n = 52; King Abdulaziz University Hospital (KAUH), n = 47]. These three public hospitals are the largest and busiest hospitals in the region, serving a population of approximately 3 million people [22]. KAUH is the only teaching hospital in Jeddah, and treats emergency and elective cases, with a capacity of 715 beds. KFGH is the largest public hospital in Jeddah and treats elective and emergency cases, with a capacity of 825 beds. KAH&OC also has a trauma and oncology center, and a capacity of 250 beds. Forty-seven patients were admitted to three private hospitals in Jeddah.

The study protocol and case-report form was approved by King Abdulaziz University Hospital Research Bio-Ethical Committee (Approval N. 293). Data were collected using a self-designed case report form, which recorded the patient's age, sex, nationality, duration of diabetes, and clinical presentations. Duration of hospital stay, frequency of admission, type of medical and/or surgical interventions and the patient's condition at discharge were also recorded. After reviewing the medical record, the researchers completed the form according to the definitions used for the purpose of this study.

The clinical presentations were defined as that recorded on admission at initial assessment of studied cases. Infection with or without ulceration was diagnosed clinically and was confirmed by microbiological tests. Infection included superficial (which is limited to skin), deep local (including abscess) and bone osteomyelitis. Cellulitis was defined as spreading of a subcutaneous bacterial infection associated with acute inflammation.

Ischemia was diagnosed if the patient had history of vascular insufficiency symptoms such as intermittent claudication, pain at rest or changes in foot color, and symptoms were associated with the absence of a pulse in one or both feet. Duplex ultrasound scan was used to confirm the clinical suspicion. Neuropathy was diagnosed if the patient had experienced the loss of superficial sensations and been confirmed by a cotton ball test and/or loss of deep sensations as tested by at least tuning fork test. Foot deformity was defined as swollen deformed neuropathic foot including acute Charcot foot. Major amputation was defined as above or below knee amputation. Minor amputation was defined as any amputation involving the ankle joint or distal to it.

The final outcomes were limited to the study's period and classified according to the patient's condition at discharge from hospital into four categories: (1) healed, and undergoing rehabilitation or a plan for rehabilitation had been proposed at discharge; (2) healed, but no rehabilitation or any plan for rehabilitation; (3) unhealed, and no rehabilitation; (4) died during admission or within 30 days of admission.

Data entry and statistical analyses were conducted using SPSS software version 16.0 (IBM-SPSS Inc., Chicago, IL, USA). Quality control was applied during both coding and data entry. Data are presented descriptively as frequencies and percentages for qualitative variables, or means and standard deviations for quantitative variables. Continuous data were compared using Student's t-test for comparisons between two groups. When normal distribution of the data could not be assumed, the non-parametric Kruskal-Wallis or Mann-Whitney tests were used instead of Student's t-test. Qualitative variables were compared using $\div^2$ tests. If the expected value in one or more of the cells in 2×2 tables

was less than 5, Fisher's exact test was used instead. Pearson's correlation analysis was used to determine correlations among quantitative variables. Statistical significance was considered at values of $P < 0.05$.

RESULTS

A total of 275 patients were treated at the six participating hospitals, with 229 treated at public hospitals and 46 at private hospitals. The mean age of patients was 58.5 ± 11.6 years. Most of the patients who were admitted with DFD were males (76.4%) and almost two-thirds (64.4%) were Saudis. Other nationalities included Yemenis (11.6%) and Sudanese (6.2%), followed by Egyptians and Palestinians (3.3%). The remaining percentage was distributed on various nationalities.

The admission analyzed in this study was the first admission for 86.2% of patients. However, 13.8% of patients had been admitted more than once, with 11.6% having been admitted twice and 2.2% admitted three times during the one year study's period (Figure 1). The duration of admission ranged from 1 to 118 days (median, 9 days).

Ulcer was the main reason for admission in 81.8% of patients. The majority of patients (93.8%) had evidence of infection as defined above. On examination, almost half of the patients had evidence of peripheral arterial disease or peripheral ischemia (52.7%). Among the patients with other presentations, 17 (6.2%) presented with ischemic gangrene, and six (2.2%) had other types of infection (localized abscess and necrotizing fasciitis) (Table 1).

Table 1 - Clinical presentations and findings (n = 275)

Clinical presentations	n	%
Presentation		
Ulcer	225	81.8
Neuropathy manifestations	24	8.7
Cellulitis	236	85.8
Ischemic manifestations	131	47.6
Other	30	10.9
Clinical findings		
Evidence of infection	258	93.8
Evidence of ischemia	145	52.7
Evidence of neuropathy	70	25.5
Evidence of foot deformity	23	8.4

Conservative or medical treatment was the main intervention in 42.9% of patients. Almost three quarters (71.3%) needed anesthesia to enable surgical interventions, including wound debridement. General anesthesia was necessary in 21.1% of patients. Surgical interventions included amputations (48.8%), debridement (42 . 2%), vascular/endovascular procedures (4.8%) and plastic surgery (2.9%). Toe amputation was the most common type of amputation. The ratio of minor to major amputations was approximately 1:2, as major amputations (amputations above or below the knee) accounted for 31% of the all amputations, while amputations distal to the ankle joint accounted for 69% of all amputations. Only 4.8% of the patients underwent revascularization, the most common being open bypass (i.e., femoro-popliteal bypass) (Table 2).

The rates of ulcerations and ischemia were significantly greater among patients with a duration of

Table 2 - Medical and surgical interventions (n = 275)

Procedure	n	%
Conservative treatment	118	42.9
Anesthesia	196	71.3
Local	90	32.7
Regional	48	17.5
General	58	21.1
Debridement	116	42.2
Amputation	134	48.8
Toes	72	26.2
Trans-metatarsal	8	2.9
Below the knee	39	14.2
Above the knee	15	5.5
Vascular/endovascular interventions	13	4.8
Aorto-femoral bypass	2	0.7
Femoro-popliteal bypass	4	1.5
Iliac artery angioplasty	3	1.1
Superficial femoral angioplasty	1	0.4
Infra-genicular angioplasty	3	1.1
Plastic surgery (split-skin graft)	8	2.9

Table 3 – Clinical manifestations and interventions stratified according to the duration of diabetes mellitus (n=275)

Clinical manifestations and interventions	Duration of diabetes mellitus						p.
	< 5 years		5–10 years		> 10 years		
	n	%	n	%	n	%	
Presentation							
Ulcer	25	78.1%	24	64.9%	176	85.4%	0.010
Cellulitis	28	87.5%	30	81.1%	178	86.4%	0.665
Ischemia	9	28.1%	16	43.2%	106	51.5%	0.014
Clinical finding							
Infection	30	93.8%	34	91.9%	194	94.6%	0.803
Ischemia	10	31.3%	17	45.9%	118	57.6%	0.015
Neuropathy	3	9.4%	11	29.7%	56	27.3%	0.079
Foot deformity	2	6.3%	7	18.9%	14	6.8%	NA
Interventions							
Conservative	15	46.9%	15	40.5%	88	42.7%	0.864
Debridement	23	71.9%	15	40.5%	116	56.3%	0.032
Anesthesia	20	62.5%	26	70.3%	150	72.8%	0.079
Amputation	9	28.1%	17	45.9%	108	52.4%	0.035

DM > 10 years compared with those a shorter duration of DM ($P < 0.05$). However, based on clinical examination, only the rate of ischemia was significantly higher in the former group of patients (57.6%) (Table 3). Regarding medical and surgical interventions, debridement was more frequently performed in patients with a duration of DM of up to 5 years (71.9%). By comparison, amputations were more frequently performed in patients with a duration of DM > 10 years (52.4%; $P < 0.05$; Table 3).

In terms of outcomes at discharge, almost two-thirds of the patients (64.2%) were discharged alive with healed wounds but with no plans for rehabilitation. Overall, 16 (6.5%) patients died, including 12 (4.9%) patients who died during hospitalization and four (1.6%) died within 30 days after discharge. The main causes of death included septic shock (n = 6) and cardio-pulmonary disorders (n = 5) (Figure 2).

DISCUSSION

Several reports of DFD and limb amputations in patients with DM in Saudi Arabia have been published in the last 20 years.[6,7,14–21] All of these publications included relatively small numbers of patients from individual public governmental hospitals. In Saudi Arabia, there are four main healthcare providers. The largest is the Ministry of Health which is providing approximately 60% of the services, followed by university, military and private hospitals.[13] The current study reviewed the records of 275 patients admitted to six hospitals across three different sectors (Ministry of Health, university and private hospitals). The inclusion of a relatively broad selection of hospitals was intended to strengthen the findings of the current study.

Jeddah is the second largest city in Saudi Arabia, with a total population of approximately 3.5 million people.[22] The International Diabetes Federation reported that the comparative prevalence rate of DM in Saudi Arabia was 16.8%.[1] Considering the at-risk population (2.7 million people aged > 20 years), there are at least

348,000 patients with DM in Jeddah, and approximately one-third of these are non-Saudis.[22]

The annual incidence of ulcers among people with DM ranges from 2.5% to 10.7% in resource-rich countries.[23,24] The annual incidence of ulcers was 3.1% in people with DM in Jeddah as reported in a single study [23]. This means that approximately 10,788 patients with DM are likely to develop diabetic foot ulcers each year in Jeddah. The six hospitals included in this study provide approximately 40% of all health services in Jeddah. Therefore, approximately 687 patients will be admitted each year to hospitals in Jeddah (i.e. 6.4% of all patients admitted with foot problems) and the remainder will be treated at healthcare centers or at home. However, these are speculative assumption and the exact magnitude of the problem is still unknown. The patients admitted are probably the sickest patients who present themselves to emergency departments for acute infection. This late presentation undoubtedly artificially increases the rates of amputation and other outcomes [18]. In a survey done in Jeddah on the use of topical treatments to treat foot problems in patients with DM, Bakhotmah and Alzahrani reported that 21.7% of the patients preferred using complementary and alternative medicine (CAM) products alone, while 31.2% used both conventional and CAM treatments.[25] Defining the role of CAM products in the management of DFD may help to convince patients to seek medical advice earlier. Improving access to primary healthcare (PHC) services, promoting the adoption of clinical practice guidelines by general practitioners and improving collaborations between the PHC services and hospitals may improve early detection and encourage referrals to specialized care providers in countries with relatively few podiatrists.[5,20]

Similar to earlier studies,[15,16,24] most of the patients in this study were males (76.4%). They are relatively older than that previously reported, as the mean age of patients in this study was 58.5 ± 11.6 years. The distribution of patient nationality was similar to that of the total population, as one-third of the patients (64.4%) were non-Saudis [23]. In view of these findings, educational and prevention programs should especially target elderly males with a duration of DM of approximately 5 years. Among non-Saudis, Yemenis (11.6%) and Sudanese (6.2%) should be also considered a high-risk group that warrants particular attention.

Compared with the studies published 20 years ago [14,21], the duration of hospitalization for DFD has improved significantly, decreasing from 47 days in the earlier studies to 9 days in the current study. This positive trend may improve further with the intended improvements in home and ambulatory care. Nevertheless, patients admitted to public hospitals stayed in hospital longer than did patients admitted to private hospitals. Further research should be done to identify the reasons for the longer duration of hospitalization in public hospitals.

The majority of patients (93.8%) had evidence of infection, consistent with the late presentation. Most admissions (81.8%) were because of ulcers. An interesting finding in this study is the high prevalence of peripheral arterial disease and/or peripheral ischemia (52.7%), which was much higher than the rate reported 20 years ago (38.6%). It seems that most of these patients did not undergo full vascular assessment, particularly those patients with a duration of DM of > 10 years. The importance of vascular assessment and the subsequent role of vascular surgeons were already stressed in 1991 [26]. However, efforts are still needed to improve multidisciplinary communication and collaboration. This is an important aspect for improvement to better salvage the lower limbs.[27]

Conservative or medical treatment was the main medical approach in 42.9% of the patients. This was expected considering the high rate of infection and associated cellulitis in these patients. Surgical interventions included amputations (48.8%), debridement (42.2%), vascular/endovascular procedures (4.8%) and plastic surgery (2.9%). The rate of amputation (48.8%) was higher than that reported in other countries, where the reported rate ranges from 5.2% to 39.4%.[9,27] However, most amputations were minor, predominantly of toes. The ratio of major to minor amputation was approximately 1:2, as major amputations below or above knee accounted for 31% of all amputations compared with 69% for amputations performed distal to the ankle joint. It is likely that the rate of amputation, including the ratio of major to minor amputations, will improve if the clinicians can be persuaded to revascularize ischemic limbs; in this study, only 4.8% of the patients underwent revascularization. Recently, Faglia et al. [28] adopted an aggressive approach for the treatment of DFD and reported that 96% of the patients with critical limb ischemia were successfully treated by revascularization. At 30 days, they had performed a total of 19 (5.3%) above-the-ankle amputations, including 8/12 non-revascularized limbs (66.7%). By comparison, amputations were necessary in just 8/308 (2.6%) limbs treated with percutaneous transluminal angioplasty and in 3/40 (7.5%) limbs treated with an open bypass graft [28]. In the current study, the most common vascular procedure was open bypass (femoro-popliteal bypass). Therefore, interventions aimed at increasing the use of revascularization should be a priority to salvage more limbs. These interventions will complement and not replace the established medical and surgical treatments.

The mortality rate was quite low in this study, as

only 16 (6.5%) patients died during hospitalization or within 30 days of discharge. Most of the deaths were caused by septic shock or other comorbidities in elderly patients. Much higher mortality rates were reported by Hambleton et al. in Barbados.[29] In the current study, two-thirds of the patients were discharged home with healed wounds and/or were considered treated but with no plan for rehabilitation. Only 13.8% were discharged with healed wounds and with a plan for rehabilitation. This rate is low and almost unchanged since the rate reported 20 years ago.[6] Improvements in rehabilitation and home services will likely reduce the rates of amputation, hospital costs and the patient's quality of life.[10,11]

This study has all the limitations of a retrospective multicenter hospital-based study including the accuracy of data collection of many variables and its interpretation based on sometimes limited information in medical records. However, we believe that it highlights the main problems in caring for diabetic foot problems in less-developed countries with similar health systems structure and cultural backgrounds.

CONCLUSIONS

DFD are fairly common in Saudi Arabia and are associated with high rates of amputation. To reduce the amputation rates, t is important to implement public health education programs and screening programs targeting elderly males who have had DM for > 10 years. It is also important for clinicians to adopt multidisciplinary approaches for patient referrals and foster collaborations between PHC providers and tertiary care centers. Vascular assessment should also be routinely conducted in patients with DFD. At the secondary and tertiary healthcare levels, there is a need for aggressive diagnostic and interventional vascular approaches to treat peripheral arterial disease in patients with DFD. Rehabilitation, home care and ambulatory care services should also receive improvements to meet the increasing demand on these services. Additional well-designed prospective and larger studies are needed to better understand the magnitude of the problem and possible solutions.

ACKNOWLEDGMENTS

The authors thank for funding this study. We would like to thank the consultants and hospital officials who gave permission for data collection. Finally, we wish to thank Dr Adel Ibrahim for his kind assistance with statistical analysis of the results.

FUNDING

The study is funded by the Mohammad Hussein Al-Amoudi Chair for Diabetic Foot Research, King Abdulaziz University.

REFERENCES

1. International Diabetes Federation: IDF Diabetes Atlas, Fifth Edition. [http://www.idf.org/diabetesatlas/5e/the-global-burden]
2. Shaw JE, Sicree RA, Zimmet PZ: Global estimates of the prevalence of diabetes for 2010 and 2030. Diabetes Res Clin Pract 2010, 87:4-14.
3. Elhadad TA, Al-Amoudi AA, Alzahrani AS: Epidemiology, clinical and complications profile of diabetes in Saudi Arabia: a review. Ann Saudi Med 2007, 27:241-250.
4. Al-Nozha MM, Al-Matouq MA, Al-Mazrou YY, Al-Harthi SS, Arafah MR, Khalil MZ, Khan NB, Al-Khadra A, Al-Marzouki K, Nouh MS, Abdullah M, Attas O, Al-Shahid MS, Al-Mobeireek A: Diabetes mellitus in Saudi Arabia. Saudi Med J 2004, 25:1603-1610.
5. Al-Wahbi AM. The diabetic foot in Arab world. Saudi Med J 2006, 27:147-153.
6. Al Zahrani HA, Ghandourah NM, Merdad HT: Limb Amputations in Western Saudi Arabia. Asian J Surg 1992, 15:119-122.
7. Al-Tawfiq JA, Johndrow JA: Presentation and outcome of diabetic foot ulcers in Saudi Arabian patients. Adv Skin Wound Care 2009, 22:119-121.
8. Robbins JM, Strauss G, Aron D, Long J, Kuba J, Kaplan Y: Mortality rates and diabetic foot ulcers: is it time to communicate mortality risk to patients with diabetic foot ulceration? J Am Podiatr Med Assoc 2008, 98:489-493.
9. Tentoulouris N, Al-Sabbagh S, Walker MG, Boulton AJM, Jude EB: Mortality in Diabetic and non-diabetic patients after amputations performed from 1990 to 1995. Diabetes Care 2007, 27:1598-1604.
10. Boutoille D, Feraille A, Maulaz D, Krempf M: Quality of life with diabetes-associated foot complications: comparison between lower limb amputations and chronic foot ulceration. Foot Ankle Int 2008, 29:1074-1078.
11. Alzahrani HA, Sehlo MJ: The impact of religious connectedness on health-related quality of life in patients with diabetic foot ulcers. J Relig Health 2011, Aug 24. [Epub ahead of print]
12. Kalish J, Hamdan A: Management of diabetic foot problems. J Vasc Surg 2010, 51:476-486.
13. Saudi Ministry of Health: [http://www.moh.gov.sa/en/Pages/Default.aspx]

14. Al Zahrani HA, Saban SA, Merdad HT: Management of diabetic foot ulcer. Asian J Surg 1991, 14:24-27.

15. Badri MM, Tashkandi WA, Nawawi A, Alzahrani HA: Extremities amputations over five years 2005-2009 in King Abdulaziz University Hospital, Jeddah, Saudi Arabia. JKAU Med Sci 2011, 18:13-25.

16. Tashkandi WA, Badri MM, Badawood SM, Ghandoura NA, Alzahrani HA: Lower limb amputation among diabetics in three major hospitals in Jeddah, Saudi Arabia. JKAU Med Sci 2011, 18:23-35.

7 Qari FA, Akbar D: Diabetic foot: presentation and treatment. Saudi Med J 2000, 21:443-446.

18. Elsharawy MA: Outcome of midfoot amputations in diabetic gangrene. Ann Vasc Surg 2011, 25:778-782.

19. Abolfotouh MA, Alfaifi SA, Al-Gannas AS: Risk factors of diabetic foot in central Saudi Arabia. Saudi Med J 2011, 32:708-713.

20. Al-Wahbi AM: Impact of a diabetic foot care education program on lower limb amputation rate. Vasc Health Risk Manag 2010, 21:923-934.

21. Sulimani RA, Famuyiwa OO, Mekki MO: Pattern of diabetic foot lesions in Saudi Arabia: experience from King Khalid University Hospital, Riyadh. Ann Saudi Med 1991, 11:47-50.

22. Saudi Central Department of Statistics and Information: [http://http://www.cdsi.gov.sa/english/]

23. Alzahrani HA, Hitos K, Fletcher JP: The Diabetic Foot. Sydney: Hemi Australian Pty Ltd; 2011.

24. Hunt DL: Diabetes: foot ulcers and amputations. Clin Evid (Online) 2011, 2011:pii 0602.

25. Bakhotmah BA, Alzahrani HA: Self-reported use of complementary and alternative medicine (CAM) products in topical treatment of diabetic foot disorders by diabetic patients in Jeddah, Western Saudi Arabia. BMC Res Notes 2010, 3:254.

26. Al-Zahrani H: Role of vascular surgery in the management of diabetic foot problems. Ann Saudi Med 1991, 11:719-720.

27. Johannesson A, Larsson GU, Ramstrand N, Turkiewicz A, Wirehn AB, Atroshi I: Incidence of lower limb amputation in the diabetic and non-diabetic general population: a 10-year population based cohort study of initial unilateral and contralateral amputations and reamputations. Diabetes Care 2009, 32:275-280.

28. Faglia E, Clerici G, Losa S, Tavano D, Caminiti M, Miramonti M, Somalvico F, Airoldi F: Limb revascularization feasibility in diabetic patients with critical limb ischemia: results from a cohort of 344 consecutive unselected diabetic patients evaluated in 2009. Diabetes Res Clin Pract 2011 [Epub ahead of print].

29. Hambleton IR, Jonnalagadda R, Davies CR, Fraser HS, Chaturvedi N, Hennis AJ: All-cause mortality after diabetes related amputation in Barbados: a prospective case control study. Diabetes Care 2009, 32:306-307.