AMJ Australasian Medical Journal [AMJ 2015;8(4):106–112]

Diabetic foot complications in a secondary foot hospital: A clinical audit

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CLINICAL AUDIT

Please cite this paper as: Ismail I, Dhanapathy A, Gandhi A, Kannan S. Diabetic foot complications in a secondary hospital. AMJ 2015;8(4): 106–112. http://doi.org/10.21767/AMJ.2015.2274

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ABSTRACT

Background
Previous studies conducted in Australian hospital settings suggest high variability in assessments, investigations, and management of diabetic foot infections and poor adherence to widely accessible evidence-based protocols and guidelines. Diabetic foot complications require a multidisciplinary approach and often involve both medical and surgical teams during inpatient care.

Aims
The aim of this clinical audit was to better understand the scope of diabetes-related foot complications, evaluate whether current assessment and management strategies are in line with best practice guidelines, and to formulate future models of care.

Methods
A retrospective review of patients was carried out between 12 July 2012 and 11 July 2013. Recorded assessments of inpatient care, including risk factors, surgery, length of stay, interdepartmental referrals, and antibiotic administration were reviewed.

Results
There were 24 admissions in 12 months (total patients n=19). Fifty-eight per cent of patients were admitted to the medical ward. More than one-quarter had evidence of osteomyelitis. While one patient required intensive care unit (ICU) management, there was no inpatient mortality. Two patients experienced significant delay to undergo initial surgical intervention presumably because of failed medical treatment. Clinical data was recorded poorly, especially regarding neuropathy, HbA1c, and clinical examination findings. Twelve per cent of patients did not undergo any follow-up. The average length of stay was 12 days. One-half of the cohort was not evaluated by the endocrinology department.

Conclusion
This audit highlights the need for improved care for patients with diabetic foot complications and better coordination among the multidisciplinary teams involved.

Key Words
Diabetes, ulceration, audit

Implications for Practice:

1. What is known about this subject?
Overall diabetes management and diabetic foot complications were managed poorly in an inpatient setting.

2. What new information is offered in this case study?
This clinical audit found the same concerns that rose in studies performed in larger tertiary centres regarding poor documentation and management of diabetic foot complications.

3. What are the implications for research, policy, or practice?
Implementation of local guidelines and better education are needed to reduce the burden of diabetic foot complications.

Background

The Australian Diabetes, Obesity, and Lifestyle Study (AusDiab) was the first national study of diabetes and was conducted between 1999 and 2000.[1] It revealed that about one million Australians were affected by diabetes and 60 per cent of adults were overweight or obese.[2] The two follow-up studies to AusDiab showed an alarming burden of diabetes, with approximately 275 individual Australians developing diabetes every day. The prevalence of diabetes is rapidly increasing in Australia, and it is expected to reach 2.0–2.9 million by 2025.[3] In 2005, more than 1,000 people with diabetes died as a direct result of lower limb ulcerations; this represented eight per cent of all diabetes-related deaths.[4]

Annually, there are about 10,000 hospital admissions for diabetes-related foot ulcers (DRFUs) in Australia, and lower limb amputation is a common outcome.[5] Patients with diabetes have a 12–25 per cent lifetime risk of developing a diabetic ulcer.[6,7] Moreover, the cost associated with diabetes differs according to the presence of associated complications. Total direct healthcare costs in association with macrovascular complications were only 1.8 times higher compared with those related to other causes, and 2.8 times higher in association with both micro- and macrovascular complications. These higher costs reflect more frequent use of medical services, including visits to the general practitioner, emergency hospital admission, and overnight hospital stays, compared with those who had diabetes without complications.[8]

The management of a diabetic foot ulcer requires a multidisciplinary approach, including revascularisation and surgical procedures, as well as treatment of infection, oedema, pain, metabolic disturbances, malnutrition, co-morbidities, meticulous wound care, and biomechanical offloading.[9] The prevalence of peripheral vascular disease was 13.9 per cent in known diabetics and 6.9 per cent in newly diagnosed diabetics. Of those with diabetes, 19.6 per cent were at risk of foot ulceration.[10] There is up to a 15-fold increase in the risk of lower limb amputation in people with diabetes. Between 1997 and 1998, 2,634 diabetes-related lower limb amputations were recorded in Australia.[11]

The available data on the evaluation of assessment and management of diabetes-related foot complications in hospital settings in Australia are limited. In 2004, a study[12] identified high variability in patient care for diabetes-related foot complications, suggesting poor adherence to currently available evidence-based protocols. Our hospital is a secondary healthcare centre without a vascular surgery department and limited orthopaedic facilities. To the best of our knowledge, no previous study has evaluated diabetic foot complications in a similar setting in Australia.

Method

An electronic search was conducted using the International Classification of Diseases-10-AM codes to identify patients admitted with diabetes-related foot infections between 12 July 2012 and 11 July 2013. To overcome the under-reporting of diabetes foot-related infections we ran the search to include codes for any soft tissue infection including cellulitis, ulcer, osteomyelitis, and paronychia in addition to the "diabetic foot" ICD code. A total of 24 admissions were identified for final evaluation.

A detailed chart review was undertaken to assess a number of characteristics and outcomes, including demographics, type and duration of diabetes, type of diabetic foot complication and duration, primary reason for admission, readmission rates, investigations undertaken (radiology and swabs), interdepartmental referrals and follow-up, inpatient and outpatient diabetic treatment, and diabetes control. We also specifically evaluated surgical treatment, if required, including debridement and/or amputation, and duration of the surgical intervention to assess if there was any significant finding or outcome.

Definitions

Some definitions of the terminology used in relation to diabetic foot complications, during the collection of the data are as follows.

Diabetic foot: infection, ulceration, or destruction of deep tissues of the foot associated with neuropathy and/or peripheral arterial disease in the lower extremity that affects patients with diabetes.[13]

Infection: a pathologic state caused by invasion and multiplication of microorganisms in tissues accompanied by tissue destruction and/or a host inflammatory response.[14,15]

Superficial infection: an infection of the skin not extending to any structure below the dermis.[16]

Deep infection: an infection deeper than the skin, with evidence of abscess, septic arthritis, osteomyelitis, septic tenosynovitis, or necrotising fasciitis.[16]

Contamination: external introduction of non-resident bacteria into host tissue. The number and virulence of the organisms and the robustness of the host's immune system

determine the next steps.[13] It can also indicate contamination of a culture sample after it was obtained from the patient.

Colonisation: new bacteria introduced into an ulcer replicate and establish a physiologic state of coexistence without overt tissue damage or host response.[13]

Osteitis: infection of bone cortex, without the involvement of bone marrow.

Osteomyelitis: infection of bone, with involvement of bone marrow.

Acute osteomyelitis: osteomyelitis that is usually of recent onset and characterised by polymorphonuclear infiltrate but without necrosis.[17]

Chronic osteomyelitis: osteomyelitis that has usually been present for at least several weeks and is characterised by round cell infiltrates and necrosis.[17]

Results

A total of 19 patients, with 24 hospitalisations, were identified. More than half (58 per cent) were admitted to the general medicine department, while 42 per cent were admitted to an orthopaedics department. The majority (87.5 per cent) were men. None of the patients admitted were of Aboriginal or Torres Straight Island descent, but most of the data on patient ethnicity were not recorded. Patient characteristics are shown in Table 1.

One patient with sepsis secondary to lower limb cellulitis required intensive care unit (ICU) admission for vasopressor support and management. There was poor documentation of the duration of diabetes: the duration of diabetes was documented in the admission notes of only 61 per cent and 36 per cent of patients admitted to the medicine and orthopaedics departments, respectively. Based on the available information, the average duration of diabetes was estimated to be 14 years and 18 years in the medicine and orthopaedics departments, respectively.

Overall, the examination of peripheral pulse and sensation was performed and documented poorly as shown in Table 2. The National Health and Medical Research Council (NHMRC) Guidelines suggest risk stratification of all patients with diabetes; patients with previous history of DRFU are at high risk of future complications, including amputation. The majority of patients had one or two risk factors as shown in Table 3.

Table 1: Patient characteristics

	Medicine	Orthopaedics
Number of inpatient hospitalisations	13	11
Males	12	9
Females	1	2
Age		
Average Youngest Oldest	59 44 73	63 48 74
Aboriginals	0	0
Required intensive care	1	0
Type of diabetes mellitus		
1	2	0
2	11	11
Total length of days	179	114
Average length of stay (days)	14	11
Duration of diabetes		
Number of patients with duration of diabetes known (documented)	8 (61%)	4 (36%)
Number of patients with unknown duration of diabetes	5	7
Average duration of diabetes (years)	14	18

Table 2: Clinical exam findings

Clinical exam	Medicine	Orthopaedics
Monofilament test	0	0
Peripheral pulses documented	2	4
Description of wound using classification system	0	3

Table 3: Risk factors for diabetic foot ulceration

Risk factors	Medicine count	Orthopaedics count
Chronic kidney disease	5	Nil
Hypertension	6	7
Peripheral vascular disease	5	2
Smoking	0	2
Neuropathy	5	3

Appropriately, all patients with abscesses that required surgical drainage were admitted to the orthopaedics department. The majority of DRFUs were treated by a general physician as the primary doctor. Three patients with episodes of osteomyelitis were admitted to the general

medicine department, while four were admitted to the orthopaedics departments as shown in Table 4.

Table 4: Types of diabetic foot complications

Type of infection	Medicine	Orthopaedics
Cellulitis	1	0
Abscess	0	2
Ulcer	9	4
Osteomyelitis	3	4
Septic arthritis	0	1
Inpatient mortality	0	0
Total	13	11

There were fewer HbA1c requests for the admissions to the orthopaedics department compared to those requested for the admissions to the general medicine department. The average HbA1c was estimated to be 10 per cent in both groups. Despite this, less than half of the patients with diabetic foot ulcer underwent evaluation by the endocrine department as shown in Table 5. Notably, there were few documented endocrinology outpatient follow-ups in both groups.

Table 5: Interdepartmental referrals

Interdepartmental referral	Medicine	Orthopaedics
Endocrine	6 (46%)	4 (36%)
Infectious disease	8 (61%)	6 (55%)

A total of six minor amputations were performed during the study period, and the majority of these patients were admitted into the orthopaedics department. The length of time to surgical intervention was eight days. Two patients required transfer to a tertiary care hospital for vascular surgical intervention. There were a significant number of readmissions among the patients admitted to the orthopaedics department, mainly because of failed initial surgical intervention. One patient admitted to the medicine department required multiple surgical interventions. In Table 6, we show the treatment received on an inpatient basis. A detailed list of the investigations performed is shown in Table 7.

Table 6: Management of diabetic foot complications

Initial antibiotic	Medicine	Orthopaedics
Intravenous (IV) cephazolin	1	1
IV piperacillin/tazobactam	4	7
IV flucloxacillin	3	2
Oral antibiotics	1	1
Vancomycin	1	0
Deep wound swabs/tissue specimen taken	0	3
Surgical management (types of intervention)		
Minor amputation	1	5
Major amputation	0	0
Incision and drainage	2	2
Debridement	2	2
Total surgery	6	9
Complications		
Delay in surgery identified during same admission	1	1
Longest time for intervention	8 days	8 days
Multiple return to operation theatre on same admission	1	Nil
Inter-hospital transfer	2	Nil
Readmissions	1	4

Table 7: Investigations ordered during inpatient stay

Imaging	Medicine	Orthopaedics
X-ray	7 (53%)	8 (73%)
Computed tomography (CT) lower limb	1(7%)	Nil
Magnetic resonance imaging (MRI)	2 (15%)	1 (9%)
Ultrasound	1(7%)	1(9%)
Pathology		
Haemoglobin A1C (HbA1c) on an inpatient basis	85%	36%
Average HbA1c, including private lab data	10%	10%
Average estimated glomerular filtration rate (eGFR)	64	80
Albumin:Creatine ratio available	6	1

Discussion

High-risk foot clinics are very successful both in healing ulcers and in reducing amputations in patients who have DRFUs.[18] These multidisciplinary clinics count on the service of specialists in vascular surgery, orthopaedic surgery, endocrinology, infectious diseases, orthotics, and podiatry. Further, it has been reported that late referral is associated

with larger ulcers and poorer prognosis.[19] It is well documented that best-practice management of complex DRFUs requires a coordinated, expert, interdisciplinary approach in both inpatient and outpatient settings.[19,20] Our audit suggests the interdepartmental referral rates were generally poor.

According to the Australian National Health and Medical Research Council Guidelines, the University of Texas wound classification is the most useful of all diabetic foot ulcer classification system.[21,22] The treating physician should be encouraged to learn and use this classification so that it is easier to document the patient's ongoing progress and communicate with our orthopaedic surgeons and members of the multidisciplinary team.

Superficial sampling with a cotton-tipped swab is the most frequently employed method for the microbiological evaluation of a wound. Swabs are nearly universally available and obtaining a swab culture is easy. Unfortunately, this method has several limitations. First, swabs frequently collect contamination (i.e., non-pathogenic) microbial species, especially when they are collected without adequate prior wound cleansing. Second, they are suboptimal for the growth of obligate anaerobes and fastidious organisms. Finally, the protocols used in many microbiology laboratories can lead to unhelpful reports from swab specimens, such as "mixed cutaneous flora," or "no *Staphylococcus aureus* isolated." Thus, most authorities advocate that specimens for culture should be obtained directly from tissue. This can be accomplished by curettage of the base of a debrided ulcer, aspiration of any purulent secretions, or procuring a tissue biopsy.[13,23] In patients with DRFUs, it has been reported that results of cultures of specimens obtained using the superficial swab method did not correlate well with those obtained from deep tissue.[24] Unfortunately, specimens obtained in this audit were mainly obtained by superficial swabs. In the future, it is recommended to obtain a tissue specimen when possible to facilitate appropriate treatment. In this audit, patients admitted under the care of the orthopaedics department had a higher chance of getting a tissue or deep wound swab.

Toe amputation is a significant predictor of future limb loss. Thus, it is essential that these patients are closely followed up at an outpatient clinic by a multidisciplinary team of specialists as recommended by NHMRC Guidelines published on diabetes-related foot infections.

A recently published study suggests that a structured healthcare system for subjects with DRFUs results in a reduction of major amputation rates.[25,26] If local resources do not allow the establishment of a formal foot clinic, a policy of frequent referral and collaboration among members of the group may provide optimum management of patients with these difficult complications. A limitation of this current audit is the small number of patients.

Conclusion

This clinical audit confirms that there is much room for improvement, including the development and implementation of local guidelines for the management of this complication. Moreover, the admission of a patient with diabetic foot complications is an opportunity to assess his/her risk factors and diabetic control. Increased referral for the evaluation of diabetic patients on an inpatient and outpatient basis and better documentation of risk factors and clinical examination findings are necessary measures to improve the standards of care for this population. Ensuring that we are using the available local resources in the best manner and using appropriate referral when needed will contribute to the reduction of further ongoing complications.

Appropriate management and documentation of diabetes control and other risk factors along with frequent collaboration with other multidisciplinary teams should be an integral part of delivering optimal care for these patients. A high-risk foot service is currently being established in the hospital as part of an initiative involving all health services.

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ACKNOWLEDGEMENTS

We would like to acknowledge the colleagues who gave encouragement to perform this audit.

PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

FUNDING

The study was self-funded.

ETHICS COMMITTEE APPROVAL

Formal ethics approval was not required as per the Queensland Office of Health and Medical Research manual as no new information was collected, personal details remained confidential, and the treatment regimen was not changed. Local hospital quality assurance approval was obtained.