Contents available at ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

International Diabetes Federation

Temporal trends in initial and recurrent lower extremity amputations in people with and without diabetes in Western Australia from 2000 to 2010

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ARTICLE INFO

Article history:
Received 4 August 2014
Received in revised form
26 September 2014
Accepted 6 February 2015
Available online 21 February 2015

Keywords:
Amputation
Diabetes
Trends
Cardiovascular disease
Epidemiology

ABSTRACT

Aims: To examine temporal trends in lower extremity amputations in people with type 1 diabetes, type 2 diabetes and cardiovascular disease (CVD) without diabetes in Western Australia (WA) from 2000 to 2010.

Methods: We used linked health data to identify all non-traumatic lower extremity amputations in adults aged ≥20years with diabetes and/or CVD from 2000 to 2010 in WA. Annual age- and sex-standardised rates of total, initial and recurrent amputations, stratified by major and minor status, were calculated for type 1 and type 2 diabetes, and CVD without diabetes, from the at-risk population for each group. Age- and sex-adjusted trends were estimated from Poisson regression models.

Results: 5891 lower extremity amputations were identified. Peripheral vascular disease (71%), hypertension (70%) and chronic kidney disease (60%) were highly prevalent. Average annual rates of total amputations were 724, 564 and 66 per 100,000 person-years in type 1, type 2 diabetes and CVD without diabetes respectively. Rates of initial amputations fell significantly by 2.4%/year (95% CI −3.5, −1.4) in type 2 diabetes, with similar declines for type 1 diabetes and CVD without diabetes (interaction $p = 0.96$), driven by large falls in major amputations. There was limited improvement in recurrence rates overall, with recurrent minor amputations increasing significantly in type 2 diabetes (+3.5%/year, 95% CI +1.3%, +5.7%).

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http://dx.doi.org/10.1016/j.diabres.2015.02.008

Conclusion: Lower extremity amputation rates have declined at a population level in people with diabetes and CVD without diabetes, suggesting improvements in prevention and management for this high-risk patient group, however limited declines in recurrent amputations requires further investigation.

1. Introduction

Complications of diabetes such as peripheral neuropathy and peripheral vascular disease and their sequelae of foot ulceration, sepsis and lower extremity amputation, are compounded by an ageing population and increasing prevalence of diabetes [1]. In Australia, diabetes-related lower extremity amputations pose a substantial personal and public health cost and contribute disproportionately to diabetes-related inpatient costs [2,3].

Although rates of foot ulceration and subsequent wound healing are the best indicators of disease severity and quality of foot care, rates of amputations are easier to measure [4,5]. Population level trends in initial and recurrent procedures, stratified by diabetes type and by major and minor amputation status, are scarce and have not been reported in Australia. Studies internationally show considerable variation in the incidence of amputations, attributed to methodological factors, healthcare systems, and choices of treatment [5]. Despite these variations, most reports indicate that the incidence of major amputations has fallen over the last two decades [6–9].

Assessing trends in amputations in people with and without diabetes is complex and results need to be interpreted carefully. The average incidence and its trend over time may be influenced by type and definition of diabetes, the level of amputation and whether an amputation is an initial (true incident) or recurrent (subsequent) one. It is also crucial that the denominator used for the calculation of amputation rates in people with diabetes is the population at risk, not the whole population [4,5].

The aim of this study was to examine trends in lower extremity amputations in Western Australia (WA) using comprehensive state-wide linked data. Trends in initial and recurrent major and minor amputations were compared in patients with type 1 diabetes, type 2 diabetes and cardiovascular disease (CVD) without diabetes between 2000 and 2010.

2. Materials and methods

Data for this study were obtained from the Western Australian Data Linkage System (WADLS), which systematically links administrative health data whilst conserving patient privacy [10]. All hospitalisations and death records for an individual are linked by computerised probabilistic matching with manual clerical checking, which has >99% accuracy. The linked dataset included all public and private hospital morbidity and mortality records for all patients admitted with diabetes, CVD or renal disease in WA between 1985 and 2010, and all non-cardiovascular disease records for these patients. Approval for this study was obtained from the Human Research Ethics Committees of The University of Western Australia and the WA Department of Health.

Patients in the linked dataset who underwent any lower extremity amputation in WA between 2000 and 2010 were identified using the Australian Classification of Health Interventions. Patients aged <20 years at the time of amputation were excluded from the study (n = 38), as were lower extremity amputations for trauma and cancer. A minor amputation was defined as any amputation distal to the ankle joint (44338-00, 44358-00, 44364-00, 44364-01, 90557-00) and a major amputation as through or proximal to the ankle joint (44361-00, 44361-01, 44367-00, 44367-01, 44367-02). Multiple minor amputations performed during the same admission were counted as a single minor amputation, and a major and minor amputation recorded on the same admission designated as a major amputation only.

Amputations were identified as initial if the patient had a 15-year amputation-free history, and all other amputations classified as recurrent. Because the International Classification of Procedures in Medicine and International Classification of Diseases (ICD) version 9 was used in WA prior to July 1999, additional ICD codes were used to determine minor or major amputation status during the look-back period (minor: 5-845, 5-846, 84.11, 84.12; major: 5-847, 5-848, 84.13–84.17).

Diabetes was identified for each patient from any diagnosis field using 15 years of hospitalisation history prior to amputation (type 1, ICD-9 250.x1, 250.x3/ICD-10 E10; type 2 250.x2, 250.x4/E11). For individuals with inconsistent coding for diabetes type at different hospitalisations, type was assigned based on the most frequent code. Patients were classified as having CVD without diabetes if they had prior hospitalisations for CVD (ICD-9 398-459; ICD-10 I00-I99) but no diabetes coded during the 15-year period prior to their amputation. Identification of comorbidities was based on hospitalisation history and included coronary heart disease (ICD-10 I20-I25); peripheral vascular disease (I70-I79); chronic kidney disease (CKD, based on the Australian Institute of Health and Welfare definition) [11]; hypertension (I10-I15); cerebrovascular disease (I60-I69, G45); heart failure (I50); and atrial fibrillation (I48).

2.1. Statistical analysis

Descriptive statistical analysis was performed separately for the three groups (type 1 diabetes, type 2 diabetes and CVD without diabetes) and presented as mean (±SD) for continuous variables and as frequencies (%) for categorical variables.