Available online at www.sciencedirect.com
SCIENCE DIRECT®
ELSEVIER
Diabetes Research and Clinical Practice 70 (2005) 71–80
DIABETES RESEARCH AND CLINICAL PRACTICE
www.elsevier.com/locate/diabres

Hypertension in type 2 diabetes mellitus in Isfahan, Iran: Incidence and risk factors

Mohsen Janghorbani *, Masoud Amini

Isfahan Endocrinology and Metabolism Research Centre, Isfahan University of Medical Sciences and Health Services, Department of Epidemiology and Biostatistics, School of Public Health, Isfahan, Iran

Received 12 August 2004; received in revised form 30 November 2004; accepted 28 February 2005
Available online 9 April 2005

Abstract

Background: Evidence on the long-term incidence of and risk factors of hypertension in diabetic patients is scarce and mainly derived from studies in developed countries. Evidence from developing countries is required for planning a well-co-ordinated approach to this public health problem in these countries.
Objective: The objectives of present study were to estimate the incidence of and risk factors for the development of hypertension in people with type 2 diabetes mellitus using routinely collected data from a clinical information system at Isfahan Endocrinology and Metabolism Research Centre, Iran.
Method: During the mean (standard deviation (S.D.)) follow-up period of 2.9 (2.5) (range 1–11) years, 3202 diabetic patients (1315 male and 1887 female) from Isfahan Endocrinology and Metabolism Research Centre out patient clinics, Iran have been examined. The mean (S.D.) age of participants was 48.3 (10.6) years with a mean (S.D.) duration of diabetes of 6.5 (6.7) years at initial registration. Blood pressure was measured by standardised protocols, and hypertension was defined as at least in two consecutive measurements within 2 months a systolic and/or diastolic blood pressure of $\geq$130 and/or $\geq$80 mmHg and/or taking anti-hypertensive medication.
Results: Among the 3202 patients free of hypertension at initial registration who attended the clinic at least twice in the period 1992–2004, the incidence of hypertension was 20.8 (20.6 male and 20.9 female)) per 100 person-years based on 9403 person-years of follow-up. The age-adjusted incidence rate of hypertension was 22% lower among insulin-treated than non-insulin-treated type 2 diabetes mellitus clinic attenders and it was greater with older age. Using a Cox's Proportional Hazards Model, male gender, and treatment regimen were significant independent predictors of hypertension. Smoking, duration of diabetes, age at diagnosis of diabetes, fasting blood glucose, glycosylated haemoglobin, BMI, proteinuria and creatinine, had no significant independent association with hypertension when other covariates were considered.

* Corresponding author. Tel.: +98 311 2334893; fax: +98 311 6682509.
E-mail address: janghorbani@yahoo.com (M. Janghorbani).

0168-8227/$ – see front matter
doi:10.1016/j.diabres.2005.02.017

Conclusion: These findings will help the identification of those patients at particular risk of hypertension and strongly support the case for vigorous control of blood pressure on type 2 diabetic patients.

Keywords: Hypertension; Blood pressure; Complications; Epidemiology; Diabetes mellitus; Risk factors; Incidence; Iran

1. Introduction

Patients with type 2 diabetes are at higher risk for many long-term complications, including early mortality and cardiovascular disease. The relationship between diabetes complications and hypertension is well established and consistent and has been examined in many different populations in developed nations [1–13]. Hypertension is associated with increased risk of nephropathy [1–3], retinopathy [4–6], and cardiovascular disease mortality and morbidity in diabetic patients [7–9]. Epidemiological studies of the impact of hypertension in type 2 diabetes in developing countries are scarce. Accurate information regarding the incidence of hypertension and associated risk factors in people with diabetes is important in the prevention or delaying of its development and of the cardiovascular impairment caused by this complication in these countries.

Diabetes mellitus and hypertension are often associated with each other, and both are risk factors for cardiovascular disease. Hypertension and type 2 diabetes mellitus are common causes of morbidity and mortality and are serious problems in Iran but to our knowledge, there have been no longitudinal studies describing the incidence or risk factors of hypertension in diabetic patients.

The objective of this report was to estimate the incidence of and risk factors of hypertension in diabetic patients using routinely collected data from a clinical information system for diabetes at Isfahan Endocrinology and Metabolism Research Centre, Iran.

2. Patients and methods

2.1. Data collection

Details of the recruitment and examination procedures of the Isfahan Endocrinology and Metabolism Research Centre out patient clinics have been published previously [14,15]. In brief, clinical data are collected for all consecutive patients at the first attendance and at review consultations (usually annually) using standard encounter forms. These include an examination of ocular fundus, lens, limbs, blood pressure and construction of a problem list by the clinician, measurement of fasting blood glucose, glycosylated haemoglobin (HbA_1), urine protein, triglyceride, cholesterol and serum creatinine, and reporting of smoking as part of a completed questionnaire on demography, family history, and smoking by the patient. A registry clerk enters data from these forms into the computer after the clinic.

Blood pressure was measured by standardised protocols, and hypertension was defined at least in two consecutive measurements within 2 months, based on the criteria of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) [16]. According to this protocol, systolic and/or diastolic blood pressure $\geq$130 and $\geq$80 mmHg and/or the current use of anti-hypertensive medication in diabetes diagnosed as hypertension. However, according to the blood pressure classification of JNC7, systolic 120–139 and/or diastolic blood pressure 80–89 was classified as prehypertension in non-diabetic and systolic and/or diastolic blood pressure $\geq$130/80 mmHg as hypertension in diabetic individuals. The JNC7 recommendations are consistent with guidelines from the American Diabetes Association recommendations [17] which has also recommended that blood pressure in diabetic patients be controlled to level of 130/80 mmHg or lower.

Many patients have hypertension at diagnosis or develop it shortly afterwards. Since many patients were referred some years after diagnosis we have no means of knowing the relationship between the onset of diabetes and the development of hypertension among those with this complication at the time of referral. Also, the onset of type 2 diabetes may precede diagnosis by some years. This study was therefore