Metabolic control and morbidity of Type 2 diabetic patients in a general practice network

M Bouma, JH Dekker[a], JThM van Eijk[a], FG Schellevis[a], DMW Kriegsman[a] and RJ Heine[b]

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Methods. Glycaemic control and the prevalence of modifiable cardiovascular risk factors, and micro- and macrovascular morbidity was examined in 637 Type 2 diabetic patients in general practice, of whom 405 consented to undergo a more extensive examination.

Results. In these 405 patients, HbA1c was ⩾7% in 56.6%, and hypertension and dyslipidaemia were found in 59.8% and 46.5% of the patients, respectively. The level of cardiovascular risk factors was acceptable, according to the European guidelines, in the following proportions of patients: BMI 45.0%; total cholesterol 69.1%; HDL-cholesterol 68.1%; triglycerides 67.8%; current blood pressure 89.8%; and smoking 21.0%. Retinopathy was present in 12.5% and micro-albuminuria in 27.0% of the patients. In all 637 patients, the prevalence of angina pectoris was 17.7%, of myocardial infarction 11.4% and of congestive heart failure 10.7%.

Conclusion. The care for Type 2 diabetic patients needs improvement and should focus on cardiovascular risk factors as much as on glycaemic control.

Keywords. Complications, diabetes, general practice, metabolic control.

Introduction

The improvement of diabetes care has become an important issue in Europe, which is also reflected in the Saint Vincent Declaration.[1] In recent years, several guidelines on the management of Type 2 diabetes have been published, the most authoritative of which, in Europe, is the report of the European Non-Insulin-Dependent Diabetes Mellitus Policy Group.[2] In The Netherlands, where the majority of Type 2 diabetic patients are managed in general practice, the Dutch College of General Practitioners has issued national practice guidelines for the diagnosis and management of Type 2 diabetic patients. These guidelines were published in 1989. The main objectives of the guidelines were in line with the directives of the 1988 European report.

However, even if guidelines are well received by most doctors, implementation in daily practice is not guaranteed: in order to effect changes in medical routines and practice organization, more is needed than mere theoretical approval.[3–5] In order to specify what efforts should be made to optimize diabetes care in general practice, 4 years after the publication of the national guidelines an attempt was made to assess the diabetes-related health status of Type 2 diabetic patients in a general practice network. Cardiovascular risk factors and morbidity were an important aspect of the study owing to the greatly enhanced risk of cardiovascular disease and mortality in Type 2 diabetic patients.[6–10]

Methods

Study design
The study was cross-sectional in design, and had been approved by the Medical Ethics Committee of the University Hospital of the Vrije Universiteit in Amsterdam.

Patients
The study was carried out in 1993 in 15 general practices in a semi-rural region in the east of The Netherlands and in Amsterdam and its surroundings, where 22 GPs

provided care for 51 748 registered patients. The participating GPs were recruited for a programme on the quality of care for patients with chronic diseases in general practice. They were already affiliated to the University for reasons of education of students. The GPs had no specific interest in diabetes before the start of the study and they had not been involved in a quality programme on diabetes before.

Before the initiation of the quality programme, the records of all patients were screened to identify Type 2 diabetic patients. The diagnosis of Type 2 diabetes was (re)checked by the GP, according to the 1985 WHO criteria.[11]

The study population consisted of 637 Type 2 diabetic patients treated by the GPs. Patients who were capable of completing a questionnaire in the Dutch language were asked to undergo a more extensive examination (EE). Four hundred and five patients met the inclusion criteria (110 refused to participate and 122 were unable to complete a questionnaire, a response rate of 79%). Data from a limited examination (LE) were available for patients who did not meet the requirements for inclusion.

Measurements

The GPs provided information on the duration of the diabetes, the diabetic treatment provided, the most recent glucose measurement and cardiovascular morbidity. Cardiovascular risk factors and symptoms, duration of diabetes, level of education and actual capillary blood glucose were checked during a routine diabetes consultation. The EE-group were physically examined by the GP, completed a questionnaire, were sent to a laboratory for blood and urine samples, and were referred to an ophthalmologist for funduscopy or to an optician for non-mydriatic fundus photography.

Glycaemic control

Glycaemic control was defined as a percentage of (standardized) HbA1c or, if this was not available (in the LE-group), the most recently recorded fasting blood glucose (FBG). HbA1c was categorized as: good, acceptable or poor (HbA1c $<7.0\%$; $\geqslant 7.0\%$ and $\leqslant 8.5\%$; and $>8.5\%$, respectively). Fasting glucose values were converted, if necessary, to correspond with whole blood assessment.[12] Categories of fasting blood glucose were <6.7; $\geqslant 6.7$ and $\leqslant 8.0$; and >8.0 mmol l^{-1}.[2]

Cardiovascular risk factors

The biomedical parameters Body Mass Index (BMI), blood pressure, cholesterol, HDL-cholesterol and triglyceride data were categorized as good, acceptable or poor.[2] Hypertension was considered to be present if the patient was being treated with antihypertensive drugs and/or if the actual blood pressure was $>160/95$ mm Hg. Dyslipidaemia was defined as an HDL-cholesterol of <0.9 mmol l^{-1} for men and <1.2 mmol l^{-1} for women,

and/or if the fasting triglycerides were >2.2 mmol l^{-1}, respectively.[2]

Lifestyle parameters were as follows. Smoking was defined as current smoking, based on data from the questionnaire or the medical records. Physical activity was operationalized as the sum of hours per week spent on light or heavy household activities, walking, cycling or other sports, as stated by the patient in the questionnaire.

Diabetes-specific complications

Retinopathy. Diabetic retinopathy (DRP) was defined as any stage of DRP.

Nephropathy. The albumin/creatinine ratio was used as an indicator of albuminuria and a ratio exceeding 2.5 for men and 3.5 for women was the accepted cut-off point for microalbuminuria.[13]

Cardiovascular morbidity

The GP provided information on cardiovascular morbidity, including angina pectoris, myocardial infarction, heart failure, cerebrovascular accidents, transient ischaemic attacks and intermittent claudication/peripheral artery disease.

Laboratory methods

HbA1c was measured according to HPLC, affinity chromatographic, electrophoretic or immunochemical methods, and glucose by means of enzymatic procedures (hexokinase, glucose oxidase or glucose dehydrogenase). The HbA1c values were standardized to adjust for differences between laboratories (assumed reference value of a non-diabetic population $\leqslant 6.0\%$).

Statistical analysis

For continuous variables, the results are presented as means and standard deviations or medians, with the 25th and 75th percentiles. Differences between sub-groups of patients were tested by means of unpaired chi-square tests, t-tests or Mann–Whitney tests. The association between patient characteristics and cardiovascular morbidity was subjected to multiple logistic regression analyses. All analyses were performed on SPSS-PC statistical software.

Results

Patient characteristics

See Table 1. Glycaemic control, according to FBG category, was good in 27.9% of all patients. In the EE-group, the HbA1c was good in 43.4% of the patients. The mean level of HbA1c was 7.6%.

No statistically significant differences were found with regard to sex, age, duration of diabetes or mode of treatment between the total LE-group and the

TABLE 1 *Characteristics of all Type 2 diabetic patients treated by their GP and of the Type 2 diabetic patients who underwent the extensive examination (EE)*

	Total study group, % (n = 637)	EE patients, % (n = 405)
Age (years)	68.1 [12.6][a]	68.2 [10.8][a]
Sex (% men)	43.0	44.2
Duration of diabetes (yrs)	4.8 (1.8; 9.0)[b]	4.3 (1.7; 8.8)[b]
Mode of treatment (%)		
Diet	29.9	31.6
1 OHA[c]	54.5	54.1
2 OHA	12.6	11.9
Insulin (+ OHA)	3.0	2.5
HbA1c (%)	N.A.	7.6 [2.0][a]
HbA1c categories (%)		
<7.0%	N.A.	43.4
⩾7.0% and ⩽8.5%		28.8
>8.5%		27.8
FBG mmol l$^{-1 d}$	8.4 [2.8][a]	8.2 [2.5][a]
FBG categories (%)		
<6.7 mmol l^{-1}	27.9	29.5
⩾6.7 and ⩽8.0 mmol l^{-1}	26.7	29.5
>8.0 mmol l^{-1}	45.3	40.9
Level of education (%)		
Primary school/basic vocational level	66.8	60.7
Secondary school	25.6	31.0
University/higher vocational level	7.6	8.3

[a] Results as mean [SD].
[b] Results as median (25th, 75th percentile).
[c] OHA: oral hypoglycaemic agents.
[d] FBG: fasting blood glucose.
N.A.: not available.

TABLE 2 *Cardiovascular risk factors of the Type 2 diabetic patients who underwent the extensive examination*

Risk factor	Total (n = 405)
Hypertension[c] (%)	59.8
Systolic blood pressure, mm Hg	154.8 [22.8][a]
Diastolic blood pressure, mm Hg	85.9 [10.6][a]
Categories of blood pressure[d]	
good	31.8
acceptable	58.0
poor	10.2
Categories of BMI[d] (%)	
good	26.1
acceptable	18.9
poor	55.0
Total cholesterol mmol l$^{-1 d}$ (%)	
good	21.4
acceptable	47.6
poor	30.9
Triglycerides mmol l$^{-1 d}$ (%)	
good	45.8
acceptable	22.0
poor	32.2
HDL-cholesterol mmol l$^{-1 d}$ (%)	
good	27.3
acceptable	40.8
poor	31.9
Dyslipidaemia[e] (%)	46.5
Physical activity (hours per week)	14.0 (7.0; 24.0)[b]
Current smokers (%)	
total	21.0
male	29.8
female	14.2

[a] Results as mean [SD].
[b] Results as median (25th, 75th percentile).
[c] Hypertension: blood pressure >160/95 mm Hg and/or blood pressure-lowering medication.
[d] All target values according to the European guidelines. Blood pressure: good <140/90; acceptable ⩾140/90 and ⩽160/95; poor >160/95. BMI: good in men <25 and in women <24; acceptable in men ⩾25 and ⩽27 and in women ⩾24 and ⩽26; poor in men >27 and in women >26. Cholesterol: good <5.2; acceptable ⩽6.5; poor >6.5 mmol l^{-1}. Triglycerides: good <1.7; acceptable ⩽2.2; poor >2.2 mmol l^{-1}. HDL-cholesterol: good in men >1.1 and in women >1.4; acceptable ⩾0.9 and ⩾1.2; poor <0.9 and <1.2 mmol l^{-1}, respectively.
[e] Dyslipidaemia: triglycerides >2.2 and/or HDL-cholesterol <0.9 for men and <1.2 for women.

EE-group, but the LE-group had a lower level of glycaemic control than the EE-group (mean FBG: 8.9 versus 8.2 mmol l^{-1}; mean difference 0.76, 95% CI 0.02–1.28). In the total group, 9.2% of the patients were poorly controlled and were already receiving maximal oral therapy.

Cardiovascular risk factors
See Table 2. Hypertension and dyslipidaemia were common. Twenty-nine per cent of the men and 14% of the women were smokers. In the majority of the patients the BMI was too high. The median number of hours of physical activity per week was 14.

TABLE 3 *Prevalence of cardiovascular morbidity of the Type 2 diabetic patients, treated by their GP, aged >40 years, as assessed by the GP (n = 598; missing n = 31; data of eight patients aged ≤40 years not shown)*

Morbidity	%
Angina pectoris	17.7
Myocardial infarction	11.4
Congestive heart failure	10.7
Any cardiac disease	25.3
Cerebrovascular accident	3.7
Transient ischaemic attack	5.9
Peripheral artery disease	8.4

Diabetes-specific complications

Data on the albumin/creatinine ratio were adequate in 267 patients. (Micro)albuminuria was present in 27% of these patients.

Ophthalmological data were available for 345 patients, of whom 269 underwent funduscopy and 76 underwent retinal photography. Diabetic retinopathy was found in 12.5% of these patients, more frequently during funduscopy (13.8%) than during retinal photography (7.9%). This difference was not statistically significant.

Cardiovascular morbidity

See Table 3. The prevalence of cardiac diseases was high: angina pectoris 17.7%, myocardial infarction 11.4% and congestive heart failure 10.7%. Twenty-five per cent of the patients had at least one cardiac disease. Myocardial infarction, transient ischaemic attack and peripheral artery disease were more frequent in men than in women, even after adjustment for age, duration of diabetes, level of education, glycaemic level, BMI and mode of treatment.

Discussion

This study shows that the target values for glycaemic control described in the European guidelines are not achieved in many GP-treated Type 2 diabetic patients. Although the practices participating in our study could not be considered as a random sample, it is reasonable to assume that in other (Dutch) practices glycaemic control will not be better, as the GPs in our study were motivated to participate in a quality-improvement programme for diabetes care. Studies in other countries have shown the same picture.[14,15] Recently, the UK Prospective Diabetes Study (UKPDS) showed the benefits of lowering plasma-glucose to the near-normal range, during a follow-up period of 10 years, in Type 2 diabetic patients.[16,17] Our study stresses, again, the need for improvement of diabetes care.

As to the microvascular complications, in our study 27% of the patients had an increased albumin/creatinine ratio, a figure which is comparable to the percentage of patients with (micro)albuminuria in the Wisconsin study.[18] In the latter study, the prevalence of DRP was higher than in ours (28.8% in patients diagnosed with Type 2 diabetes for less than 5 years versus 12.5%).[19] These differences may be explained by differences in glycaemic control and in the methods used to detect retinopathy.

The high prevalence of cardiovascular risk factors (hypertension, dyslipidaemia and obesity) found in our study and in others should be a major concern for GPs. Type 2 diabetic patients have substantially more cardiovascular morbidity and mortality compared with patients who do not have Type 2 diabetes.[6–10,20] This is underlined by the high level of already-existing cardiovascular morbidity we found: for example, the prevalence of myocardial infarction and angina pectoris was high compared with that of the general Dutch population.[21]

In recent years, interventions on cardiovascular risk factors have shown to be effective in reducing morbidity and mortality in Type 2 diabetes.[22,23] In 1998, the UKPDS found that tight blood pressure control in hypertensive Type 2 diabetic patients reduces the risk for macro- and microvascular complications.[24] These findings emphasize that improvement of cardiovascular risk factors in Type 2 diabetes should get major attention of the GPs.

In conclusion, although most GPs are well acquainted with the (Dutch) guidelines on the management of Type 2 diabetes, the outcomes of diabetes care are still far from optimal. Efforts should be directed at improving the structure and process of diabetes care, for instance, by introducing a diabetes register and a recall system in general practice.[25,26] Easy referral of patients to other health care professionals who are specialized in diabetes care (diabetic nurse, etc.) is crucial, as is the consultation of specialists such as diabetologists and ophthalmologists. With regard to the outcome of care, the metabolic control of the disease and diabetes-related morbidity, attention should be paid to educating the GPs on how to achieve near-normoglycaemia in their patients (especially if insulin therapy is needed) and on how to treat cardiovascular risk factors in Type 2 diabetic patients in order to reduce cardiovascular morbidity and mortality in this high risk population.

Acknowledgement

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