The Review of DIABETIC STUDIES

ORIGINAL DATA

Quality of Care for First-Degree Relatives of Type 2 Diabetes Patients Diagnosed with Diabetes at a Screening Program One Year After Diagnosis

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■ Abstract

AIMS: Diabetes screening is an effective tool for diagnosing patients who are unaware of their diabetes and for providing them with optimal treatment. The quality of care and treatment of diabetic patients diagnosed at a screening program during one year in Isfahan, a centrally located Iranian city, was assessed. METHODS: In a prospective study, 1640 first-degree relatives of diabetic patients (aged 35-55) were screened for diabetes mellitus at Isfahan Endocrine and Metabolism Research Center during 2003-2004. All patients diagnosed with diabetes during screening were selected and their height, weight, blood pressure, fasting plasma glucose, lipids and HbA1c were recorded at the time of diagnosis and one year later. The values at the time of screening were subsequently compared with those collected one year later. RESULTS: Eighty-three subjects (5.06%) were diagnosed with diabetes during screening. Of these patients, 78.3% were dyslipidemic and 45% were hypertensive. One year after diagnosis, 77.1% of patients were receiving treatment for hyperglycemia. However, only 49.2% of dyslipidemic and 45% of hypertensive patients were being treated for these conditions. Body mass index, fasting plasma glucose, lipids and HbA1c had improved one year after diagnosis, but no significant improvement was observed in blood pressure. CONCLUSIONS: The evaluation of the quality of care for newly diagnosed diabetic patients revealed that more attention should be paid to glycemic control and reducing cardiovascular risk factors, in particular hypertension.

Keywords: type 2 diabetes · screening · glycemic control · hypertension · risk factors · healthcare

Introduction

There has been a marked increase in the global prevalence of diabetes mellitus during the last two decades. The prevalence of type 2 diabetes is expected to increase faster than the other types. A large number of type 2 diabetic patients are asymptomatic and unaware of their condition (approximately 35-50% of cases) [1-3]. Optimum follow-up care and treatment can alter the course of diabetes significantly. The American Diabetes Association (ADA) recommends that individuals aged above 45 years undergo triennial diabetes screening, ADA also recommends diabetes screening in younger people with the following risk factors: positive family history of diabetes, obesity, inactivity, high risk races, impaired glucose tolerance (IGT), gestational diabetes, hypertension, serum triglyceride (TG) > 2.82 mmol/l or high-density lipoprotein (HDL) cholesterol < 0.91 mmol/l, polycystic ovary syndrome, acanthosis nigricans and vascular diseases [2].

The cost-effectiveness of diabetes screening programs is questioned by some authorities worldwide [4]. Previous studies indicated that screening for type 2

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diabetes might be cost-effective. However, the effectiveness of early detection and treatment of type 2 diabetes has not yet been demonstrated, and the course of diabetes that is detected early has received little emphasis [5]. The cost-effectiveness of diabetes screening depends on the proper establishment of effective treatment for screen-detected patients. Glycemic control and screening for potential diabetic complications in these patients can prevent microvascular complications of diabetes [6, 7]. Existing evidence indicates that glycemic control can slow down the progression of microvascular and macrovascular complications in diabetic patients [8-10]. ADA recommends strict glycemic control [11], a recommendation that remains unheeded in most centers [12]. More than 80% of diabetic patients have uncontrolled plasma glucose concentrations [13], which are caused by the suboptimal treatment provided by health professionals and by non-compliant patients [14].

Strict anti-hypertensive treatment in people with diabetes can reduce microvascular and macrovascular complications [15-17]. Although recent studies have encouraged strict hypertension control in diabetic patients, there is no report demonstrating that blood pressure levels can be reduced to optimal values [18]. Strict treatment of dyslipidemia is more likely to reduce the risk of cardiovascular diseases (CVD) in type 2 diabetic than in non-diabetic patients [19].

In an attempt to investigate the current status of diabetes management in Iran, a one-year prospective study of the quality of care and treatment has been carried out with type 2 diabetic patients newly diagnosed in a recent screening program. The results will provide a tool to evaluate the efficacy of diabetes screening.

Patients and methods

A prospective study was performed on 1640 first-degree relatives of type 2 diabetic patients (aged between 35-55 year-old) in Isfahan Endocrine and Metabolism Research Center (IEMRC) during 2003-2004. A questionnaire on demographics, history, clinical examination and laboratory tests was filled out for each patient. Height and weight were measured barefoot with a Seca scale. Body mass index (BMI) was calculated as weight (kg) divided by the square of height (m). A Richter sphygmomanometer with a 13×24 cm bladder was used to measure blood pressure after 5 minutes of rest in a sitting position. Six milliliters of blood were collected from all participants to measure fasting plasma glucose (FPG), lipid profile and HbA1c. In order to confirm the diagnosis of diabetes, fasting plasma glucose was measured or an oral glucose tolerance test (OGTT) was performed the next day [20]. Plasma glucose was measured using the GOD-PAP enzymatic method.

Serum cholesterol and HDL were measured by the CHOD-PAP enzymatic method using kits from Chem Enzyme (Tehran, Iran) and Pars Azmoun (Tehran, Iran). TG was measured by the GPO-PAP method using kits from Chem Enzyme. Low-density lipoprotein (LDL) cholesterol was calculated using the Friedewald formula: LDL = total cholesterol - HDL-cholesterol - TG/5. The DS5 system was used to measure HbA1c via the ion exchange chromatography method by adding EDTA to 2 cc of blood. An internist visited and examined all patients diagnosed as diabetic (n = 83) and verified the laboratory test results. The importance of treating diabetes, including dyslipidemia and hypertension, was explained to patients. They were encouraged to follow a regular course of treatment, either at IEMRC or any other center, under the care of a general practitioner, internist or endocrinologist of their choice. We took no further steps to treat the patients ourselves, because our aim was to evaluate the quality of diabetes care and management provided by physicians in our society.

The patients were invited for re-examination one year after diabetes di-

Table 1. Clinical characteristics of first-degree relatives of type 2 diabetes patients diagnosed with diabetes at the time of screening and one year after diagnosis of diabetes

Characteristic	At screening time (n = 83)	1 yr after diagnosis (n = 83)	p
BMI (kg/m²)	30.0 ± 4.2	29.0 ± 4.2	0.0001
FPG (mmol/l)	9.0 ± 3.9	7.7 ± 2.5	0.002
HbA1c (%)	7.4 ± 2.1	6.5 ± 1.9	0.003
Total cholesterol (mmol/l)	5.6 ± 1.2	5.1 ± 0.1	0.003
Triglyceride (mmol/l)	2.3 ± 1.5	1.9 ± 0.9	0.001
LDL-cholesterol (mmol/l)	3.3 ± 0.8	2.8 ± 0.7	0.001
HDL-cholesterol (mmol/l)	1.2 ± 0.3	1.3 ± 0.3	0.001
SBP (mmHg)	126.1 ± 16.5	128.7 ± 22.1	0.2
DBP (mmHg)	78.6 ± 12.5	83.9 ± 13.3	0.002

Legend: Data are mean ± SD. FPG: fasting plasma glucose. LDL: low-density lipoprotein cholesterol. HDL: high-density lipoprotein cholesterol. SBP: systolic blood pressure. DBP: diastolic blood pressure.

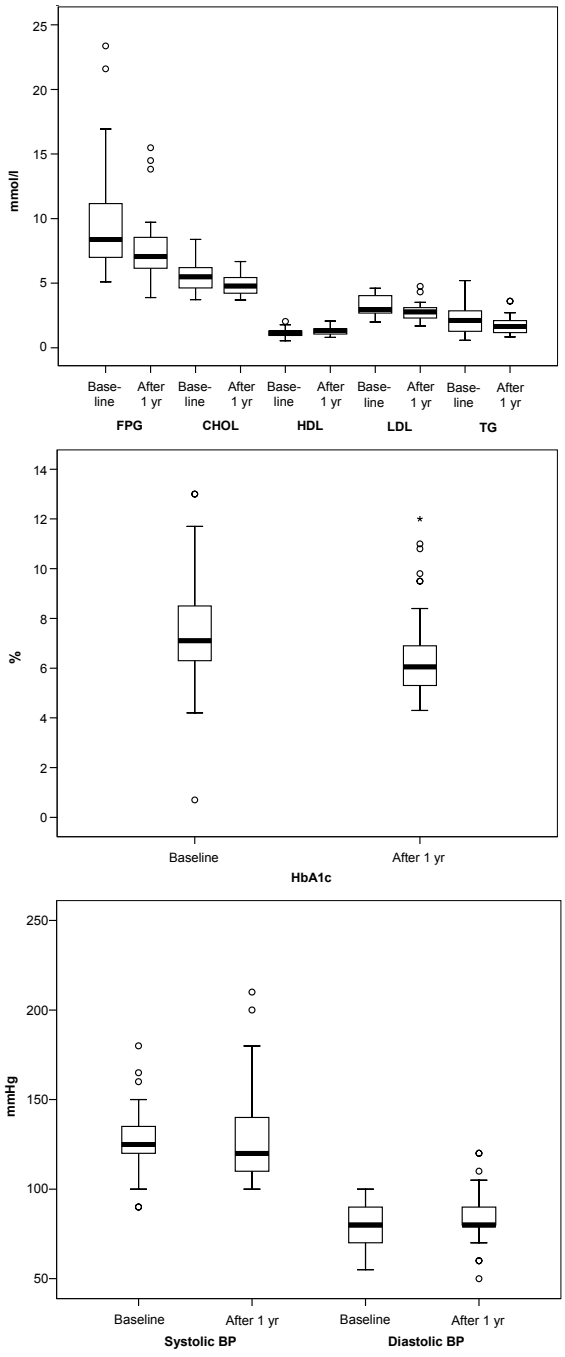

Figure 1. Box plot of clinical characteristics at the time of screening and one year later. The figure shows the distribution of glycemic (**A** and **B**), lipid (**A**) and blood pressure values (**C**) in box plot diagrams. Bar: median (50th percent ile). Rectangle, lower part: 25th percentile. Rectangle, upper part: 75th percentile. Line below rectangle: smallest value that is not an outlier. Line above rectangle: largest value that is not an outlier. Circles: minor outliers. Asterisk: extreme outlier [24]. p-values are given in Table 1. FPG: fasting plasma glucose. CHOL: total cholesterol. HDL: high-density lipoprotein. LDL: low-density lipoprotein. TG: triglyceride.

agnosis and additional questionnaires were filled out [21]. All patients accepted the invitation and were asked about the type of treatment they received for hyperglycemia, hypertension and dyslipidemia, regardless of the center providing the treatment. They were also asked whether or not they had undergone ophthalmologic examinations (either by regular ophthalmologists or ophthalmologists who were trained in retinal subspecialties), a 24-hour urinary protein assay or electrocardiography (ECG), similar to the procedures carried out the previous year. Body weight, height, blood pressure, fasting plasma glucose, lipid profiles and HbA1c were recorded again and compared to last year's findings.

According to the National Cholesterol Education Program Adult Treatment Panel (NCEP ATPIII) guidelines [22], dyslipidemia was defined as total cholesterol ≥ 5.17 mmol/l, TG ≥ 1.69 mmol/l or LDL ≥ 2.59 mmol/l and HDL < 1.03 mmol/l for men and HDL < 1.29 mmol/l for women.

Patients who were on antihypertensive therapy prior to the study, or those whose blood pressure exceeded 130/80 mmHg [23] were considered to be hypertensive. With regard to the ADA criteria [2], the treatment objectives were as follows: HbA1c to < 7%, FPG < 7.22 mmol/l, blood pressure < 130/80 mmHg, cholesterol < 5.17 mmol/l, TG < 2.30 mmol/l, LDL < 2.59 mmol/l, HDL > 1.29 mmol/l (women) and HDL > 1.03 mmol/l (men).

Data were expressed as the mean (SD), unless stated otherwise. Statistical analysis was performed using the *t*-test for quantitative and chi-square test for qualitative variables using SPSS version 10 and Epi Info 6.04. We considered p-values less than 0.05 to be statistically significant. Informed consent was obtained from all participants according to the Declaration of Helsinki.

Results

We found that 83 (5.06%) participants (out of 1640 first-degree relatives of type 2 diabetic patients; 546 men and 1094 women) were diabetic at screening. Mean (SD) age was 43.4 (5.6) years. 12 out of 83 patients were male (aged 43.6 (5.6) years) and 71 were female (aged 43.3 (5.6) years). During one year, only 38 (45.8%) patients had received an ophthalmologic examination, 40 (49.4%) had been given an ECG and 44 (53%) a 24-hour urinary protein measurement. Of the 83 patients diagnosed with diabetes at screening, 19 (22.9%) remained untreated, 26 (31.3%) were on diet therapy only, 37 (44.6%) were receiving oral hypoglycemic agents and one patient was treated by insulin.

Sixty-five patients (78.3%) were found to be dyslipidemic at the beginning of the study, i.e. at screening. One year after the first examination, 33 of these patients (50.8%) were still not receiving treatment for dyslipidemia, 19 (29.2%) were on diet therapy only and 13 (20%) were receiving lipid-lowering medication.

Thirty-six patients (45%) were hypertensive at the beginning of the study. After one year, 25 (69.4%) remained untreated and only 11 patients (30.6%) were receiving antihypertensive medication.

A comparison between the treatment of hyperglycemia, hypertension and dyslipidemia demonstrated that a higher percentage of patients had been treated for hyperglycemia (77.1%) than for hypertension (30.6%) or dyslipidemia (42.2%) ($p < 0.01$). Table 1 shows mean BMI, blood pressure, FPG, lipid profiles and HbA1c in diagnosed patients at screening and one year later.

The distribution of glycemic and lipid parameters as well as blood pressure at screening time and one year after diagnosis of diabetes is shown in Figure 1. Mean FPG, HbA1c, LDL, cholesterol, TG and BMI decreased significantly a year after diagnosis. There is no marked improvement in systolic or diastolic blood pressure. Diastolic blood pressure even increased (Table 1 and Figure 1).

Table 2 represents the frequency of patients with controlled hyperglycemia and other risk factors (according to ADA criteria) at the time of screening and one year after diagnosis. The percentage of patients with FPG < 7.2mmol/l, HbA1c < 7% and cholesterol < 3.9mmol/l increased significantly one year after diagnosis. Changes in the number of patients with lipid and hypertension parameters below ADA thresholds were not significant. Ideal BMI (<25kg/m^2) was observed in 7.6% of the patients at the time of screening and in 15.2% at the end of the study, i.e. one year later ($p = 0.2$).

Table 2. Frequency of controlled risk factors in newly diagnosed type 2 diabetes patients

Characteristic	At screening time (n = 83)	1 yr after diagnosis (n = 83)	p
FPG < 7.2 mmol/l	37.0	53.4	0.04
HbA1c < 7%	46.7	78.6	0.003
Cholesterol < 3.9 mmol/l	33.8	58.5	0.005
Triglyceride < 1.7 mmol/l	40.0	49.2	n.s.
LDL < 2.6 mmol/l	21.2	39.4	n.s.
HDL > 1.03 mmol/l (men) HDL > 1.3 mmol/l (women)	46.5	60.5	n.s.
SBP < 130 mmHg	72.3	67.7	n.s.
DBP < 80 mmHg	61.5	58.5	n.s.

Legend: Data are percentages of newly diagnosed patients reaching the goals for diabetes-related risk factors according to ADA criteria. FPG: fasting plasma glucose. LDL: low-density lipoprotein cholesterol. HDL: high-density lipoprotein cholesterol. SBP: systolic blood pressure. DBP: diastolic blood pressure.

Discussion

The quality of care and treatment of patients diagnosed with diabetes in screening programs has not been sufficiently addressed [5]. In the current study, 1640 first-degree relatives of diabetic patients were screened and eighty three new cases of diabetes (5.06%) were detected. We evaluated the quality of care for these patients one year after diagnosis. We found that 45.8% of the patients had undergone ophthalmologic examination, 53% 24-hour urinary protein measurement and 44.9% ECG recording. These results are similar to those obtained in another study carried out on 1,253 subjects in 1996-1999 by Edelman and colleagues. The authors of this study detected 56 new cases (4.47%) of diabetes during screening. One year after diagnosis, 55% of the patients had undergone ophthalmologic examination and 30% 24-hour urinary protein measurement [21].

In the present study, 77.1% of the diabetic patients were being treated for hyperglycemia one year after diagnosis. 31.3% were treated by diet only and 45.8% changed their diet and were given antidiabetic agents (oral hypoglycemic agents: 44.6%, insulin: 1.2%). The results seem to be comparable with those obtained in similar studies in other countries [21, 25]. In the Edelman study, 72% of the patients were also treated for hyperglycemia by diet therapy or medication within the first year after diagnosis [21]. A different outcome was found by O'Conner and colleagues who examined disease management for diabetic patients diagnosed in a larger screening program, where 55,121 subjects were screened for diabetes in 1993-1996. They found that 46% of 514 new cases of diabetes detected among the 55,121 screened subjects were treated for hyperglycemia; 5% received insulin, 39% were taking oral hypoglycemic agents and 2% were given both [25].

In our study, mean systolic blood pressure did not change and mean diastolic blood pressure had increased one year after diagnosis (Table 1 and Figure 1). Nor had systolic and diastolic hyper-

tension improved after one year (Table 2). This is not surprising given the fact that only 30.6% of hypertensive diabetic patients in the present study were receiving antihypertensive medication (limited just to one type of drug) and most had been left untreated.

It is evident that our patients did not receive appropriate antihypertensive treatment despite the important role of blood pressure control in reducing morbidity and mortality in diabetic patients. However, the failure to control newly diagnosed diabetic patients for hypertension seems to be a prevalent problem. Edelman and colleagues reported similar results. They also detected an increase in blood pressure (5 mmHg) during the study period, while there was no increase in the frequency of cases with controlled hypertension [21].

It seems that diabetes screening failed to improve hypertension control in this study. The reasons for the failure to initiate appropriate drug treatment in a large percentage of hypertensive diabetic patients should be further explored. Also, the lack of treatment for hypertension in newly diagnosed diabetic patients needs to be remedied as a matter of urgency. It is also essential to investigate the reasons for the administration of inadequate doses of antihypertensive medications and the failure to adjust the dosage in uncontrolled hypertensive patients. Clearly, identifying and remedying shortcomings in the treatment of hypertension in diabetic patients will lead to better disease management and a reduction in late complications and mortality.

A more positive picture emerges for the glycemic control of newly diagnosed diabetic patients. In our study, 77.1% of the newly diagnosed diabetic patients were being treated for hyperglycemia when re-examined one year later. A significant increase was detected in the number of patients achieving ADA criteria for FPG (< 7.2 mmol/l) and HbA1c (< 7%) one year after diagnosis. Compared with the 49.2% of dyslipidemic and 30.6% of hypertensive diabetic patients who were receiving medication for dyslipidemia and hypertension ($p < 0.01$), it is possible to conclude that there is a greater tendency to treat hyperglycemia than dyslipidemia and hypertension. This tendency was also found by Heisler, who studied diabetes care processes, outcomes and treatment intensity in 1998-2000 [26].

In our study, significant reductions in BMI, FPG, plasma lipids and HbA1c were observed one year after diabetes diagnosis (Table 1 and Figure 1). However, the frequency of controlled parameters according to ADA criteria showed a significant increase for FPG, HbA1c and cholesterol only (Table 2). Despite an apparent decrease in the mean values for other parameters, control of these parameters had not improved one year after diagnosis. Thus, it can be concluded that the treatment of patients within the first year after diagnosis had been effective in lowering plasma glucose, HbA1c and cholesterol, but not in controlling body weight, TG, LDL and HDL. Further studies are necessary to identify the cause of this inadequacy and efforts should be made to improve the quality of care in relation to lipid and obesity parameters in diabetic patients. In the study carried out by O'Conner and coworkers, BMI, HbA1c, LDL, cholesterol, systolic and diastolic blood pressure also showed significant decreases one year after diagnosis. Furthermore, an obvious increase in the frequency of controlled parameters was observed [25].

One of two similar studies disagreed that diabetes screening was cost-effective in controlling hyperglycemia and hypertension [21], while the other considered diabetes screening to be effective in achieving glycemic control and reducing the risk of CVD [25]. Our study evaluated the quality of care for newly diagnosed type 2 diabetes patients within one year of diagnosis in a screening program. It did not focus on the cost-effectiveness of such a program. In order to evaluate cost-effectiveness, investigators would need a long study period to include treatment costs for possible long-term complications and deterioration of risk factors caused by the failure to provide adequate early treatment.

In general, diabetes screening is an effective means of detecting unknown cases of diabetes, improving glycemic control and mitigating CVD risk factors. Hypertension seems to be a condition that is normally disregarded in this kind of screening program; appropriate treatment should be a higher priority. This would make diabetes screening programs even more effective. It is recommended that anti-hyperglycemic treatment should be accompanied by other therapeutic interventions, especially hypertension control [21], to improve the effectiveness in achieving diabetes control in screen-detected patients.

In general, the findings from the present study are similar to those reported by other authors. However, the studies with a similar research setting [21, 25, 26] are some years older and did not use the same diagnostic criteria and treatment goals [1, 2]. Furthermore, these studies were not performed in a high-risk population, i.e. in relatives of type 2 diabetic patients [2-5]. This could, to some extent, explain the difference in findings. It is to be expected that predisposed subjects are more likely to follow advice on medical treatment,

diet, exercise etc. than non-predisposed ones. The possibility that the findings may be related to country-specific aspects should also be considered.

The duration of our study (1 year) was one of its limitations. The overall follow-up status of patients may change in the long term as a result of an improvement or deterioration in risk factors during the course of several years. On the other hand, the 1-year follow-up period applied in our study enabled us to compare our findings with those from the most similar studies, which used the same follow-up period [21, 25].

Another limitation of this study was that blood pressure was measured at just two visits, before and one year after diabetes diagnosis. Multiple visits during one year and measurements of their mean values would be a more appropriate way to evaluate hypertension control. Applying the same approach (i.e. multiple measurements) to plasma glucose, lipids and HbA1c could also have increased accuracy of evaluation. On the other hand, it has been demonstrated that results from a single visit can provide a reliable reproduction of real values, especially for hypertension [27].

Conclusions

It is evident that more attention should be paid to improving glycemic control and reducing cardiovascular risk factors, especially hypertension, in newly diagnosed diabetics. We recommend that health authorities develop and establish a health system for the more effective identification and treatment of diabetic individuals and individuals at risk of developing CVD and for the prevention of late complications. Adherence to diabetes control criteria and continuous process monitoring are also critical.

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