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Original scientific paper

Obesity – a Risk Factor for Diabetic Retinopathy in Type 2 Diabetes?

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A B S T R A C T

The aim of the study was to investigate whether obestiy, independently or associated with other risk factors, increases the risk for the diabetic retinopathy in type 2 diabetic persons. Data of 156 diabetic persons that have consecutively attended the Outpatient Department in the Vuk Vrhovac Institute in Zagreb during two months period were studied. According to their body mass index (BMI) they were divided into three groups: group 1 (BMI≤25; n=49), group 2 (BMI 26–29.9; n=52) and group 3 (BMI≥30; n=55). The three groups did not differ in age, duration of diabetes, treatment, cholesterol, HDL-cholesterol and triglycerides. With increase in BMI, we observed a significant deterioration of HbA1c and a significant increase in LDL-cholesterol, systolic and diastolic blood pressure. Statistical analyses shown that the prevalence of retinopathy increased significantly with higher body weight (gr. 1: 40.8%, gr. 2: 63.4%, gr. 3: 63.6%; p<0.05), but also with correlation to quality of metabolic control (HbA1c) and systolic blood pressure. Therefore, obesity may be, because of its significant correlation to quality of metabolic control (HbA1c) and systolic blood pressure, considered as risk factor for diabetic retinopathy in type 2 diabetic persons.

Key words: *Diabetic retinopathy, BMI, HbA1c, blood pressure*

Introduction

Diabetes mellitus is a common disease that is associated with high mortality and morbidity from macrovascular and microvascular complications[1,2]. While macrovascular complications substantially reduce the life expectancy of diabetics in all age groups, microvascular complicatins lead to blindness, renal failure and amputation, which require expensive health care resources. As the diagnosis of type 2 diabetes is usually preceded by years of undignosed hyperglycaemia, at the time of first diagnosis 37% of patients already have microaneurysms or more severe retinopathy in one eye and 18% have retinopathy in both eyes[3,4]. The frequency of diabetic retinopathy is clearly correlated to duration of diabetes, quality of metabolic control (HbA1c) and blood pressure[5–7]. Besides these risk factors, obesity, hiperlipidemia and insulin resistance have considerable impact on the development and progression of macrovascular diabetic complications[8–10].

Only a few investigations have focused on the role of obesity in the development or progression of diabetic retinopathy. However, it is known that obesity correlate with deterioration of metabolic control and with a higher prevalence of hyperlipoproteinaemia and hypertension, which are considered to be risk factors for microvascular diabetic complications[11–13]. The aim of the present study was to investigate whether obestiy, independently or associated with other risk factors, increases the risk for the diabetic retinopathy in type 2 diabetic persons.

Subjects and Methods

The study was conducted in collaboration of the Outpatient Department, Vuk Vrhovac Institute in Zagreb and Department of Ophthalmology, Clinical Hospital Centar Zagreb. A total of 156 persons with type 2 diabetes that have consecutively attended both Departments during two months period were included. Their age ranged from 50 to 70 years, and diabetes duration from 10 to 15 years. They were on either oral hypoglycemic

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agent (OHA) therapy or insulin therapy. According to their body mass index (BMI) they were divided into three groups: group 1 (BMI≤25; n=49), group 2 (BMI 26–29.9; n=52) and group 3 (BMI≥30; n=55).

The biochemical parameters in the analysis were HbA1c, cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides and albumin. HbA1c was determined by an automated imunoturbidimetric assay (reference values 3.5–5.7%) (14). Cholesterol was measured by an ensymatic cholorimetric test (reference value <5.18 mmol/l) (15), HDL-cholesterol by method based on precipitation with polyethylene glycol (reference value > 1.40 mmol/l) (16) and LDL-cholesterol by Friedwald method (reference value < 3.37 mmol/l) (17). Triglycerides were determined by a colorimetric method with peroxidase (refer. values m: 0.45–1.81 mmol/l, f: 0.40–1.53 mmol/l)[18].

Blood pressure was measured during every attendance using an ambulatory sphygmomanometric device and the average of three measurements was calculated. Each diabetic patient was examined by a two ophthalmologist. Visual aquity (Snellen chart), aplanation tonometry, fundoscopy and fluorescein angiography were performed. Data were analyzed with Statistica for Windows software version 6.0. Values are reported as mean ± standard deviation. Relationship between the level of obesity and diabetic complications was analysed using Pearsonžs correlation. Comparison between groups was performed using ANOVA for continuous variables. Nominal scaled data was tested with the chi-square-test.

Results

This study included 156 persons with type 2 diabetes (74 males, 82 females). The three groups, devided according to their body mass index, did not differ in age, duration of diabetes and temporary therapy. Women had signicantly higher BMI than men (Table 1). After about 12 years of diabetes, in the age of about 62 years 56,4% of all patients had diabetic retinopathy (Table 2). The prevalence of this diabetic microvascular complication increased significantly up to a BMI of 26–29,9 kg/m² (Figure 1). To analyse the other factors having an influence on the development of diabetic retinopathy we classified metabolic and clinical parameters devided by groups according to body mass index (Table 3). With increasing obesity, we observed a significant deterioration of HbA1c and a significant increase in LDL-cholesterol, systolic and diastolic blood pressure. The other parameters were not influenced by BMI.

Statistical analyses shown that the prevalence of retinopathy increased significantly with higher body weight, but also in correlation to quality of metabolic control (HbA1c) and systolic blood pressure.

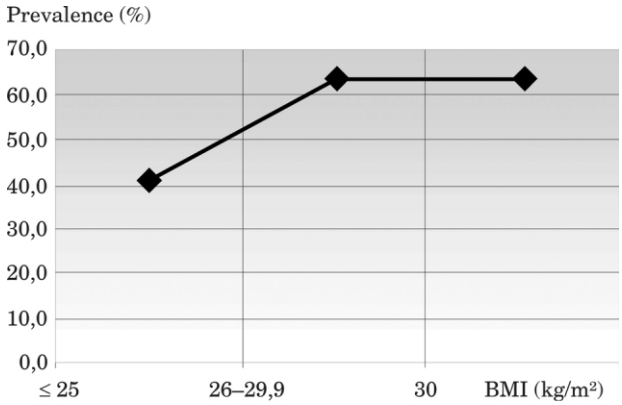

Fig. 1. Diabetic retinopathy in relation to BMI. A significant increase of retinopathy (p<0,05) with obesity.

TABLE 1
BASIC CHARACTERISTICS OF TYPE 2 DIABETICS (N=156) DIVIDED INTO THREE GROUPS ACCORDING TO THEIR BODY MASS INDEX (BMI)

	BMI ≤ 25 (n=49)	BMI 26–29.9 (n=52)	BMI ≥ 30 (n=55)	p
Sex (m/f) *	57.1 / 42.9	61.5 / 38.5	25.5/ 74.5	< 0.01
Age (years) **	62.9 ± 7.3	62.1 ± 6.1	61.8 ± 6.5	n.s.
Diabetes duration (years) **	11.8 ± 1.6	12.3 ± 1.7	12.0 ± 1.9	n.s.
Therapy (OHA / insulin) *	42.9 / 57.1	42.3 / 57.7	41.8/ 58.2	n.s.

* (%), ** mean ±SD, OHA – oral hypoglycaemic agent

TABLE 2
DIABETIC RETINOPATHY IN TYPE 2 DIABETICS (N=156) DIVIDED INTO THREE GROUPS ACCORDING TO THEIR BODY MASS INDEX (BMI)

	Total (n=156)	BMI ≤ 25 (n=49)	BMI 26–29.9 (n=52)	BMI ≥ 30 (n=55)	p
Retinopathy	56.4%	40.8%	63.4%	63.6%	< 0.05

TABLE 3
METABOLIC AND CLINICAL PARAMETERS OF TYPE 2 DIABETICS (N=156) DIVIDED INTO THREE GROUPS ACCORDING TO THEIR BODY MASS INDEX (BMI). RESULTS ARE EXPRESSED AS MEAN ±SD

	BMI ≤ 25 (n=49)	BMI 26–29.9 (n=52)	BMI ≥ 30 (n=55)	p
HbA1c (%)	7.55 ± 1.1	8.28 ± 1.1	8.57 ± 1.0	< 0.01
Cholesterol (mmol/l)	5.60 ± 0.8	6.01 ± 1.2	5.92 ± 1.0	n.s.
HDL-cholesterol (mmol/l)	1.28 ± 0.3	1.18 ± 0.2	1.20 ± 0.3	n.s.
LDL-cholesterol (mmol/l)	3.41 ± 0.7	3.76 ± 1.1	3.77 ± 0.9	< 0.05
Triglycerides (mmol/l)	1.92 ± 1.1	2.45 ± 1.3	2.35 ± 1.5	n.s.
Syst. blood pressure (mmHg)	136.6 ± 13.5	150.9 ± 11.7	156.7 ± 13.0	< 0.01
Diast. blood pressure (mmHg)	82.2 ± 7.1	85.9 ± 7.1	89.2 ± 7.6	< 0.01

Discussion

Type 2 diabetes is, because of its high incidence and high risk of diabetic microvascular complications, one of the potentially most damaging diseases. Diabetic eye disease and its complications, especially diabetic retinopathy which leads to macular edema and retinal neovascularization, are a leading cause of blindness and visual dysfunction in adults in economically developed societies[19,20].

Many epidemiological studies have already shown that the frequency of microvascular complications in diabetes is clearly correlated to duration of diabetes, quality of metabolic control and systolic blood pressure[5–7]. As the onset of type 2 diabetes occurs at least 4 to 7 years before clinical diagnosis and at the time of diagnosis many patients already have microvascular complications, the period of undiagnosed disease is considered to be even more harmful[3,4]. Therefore screening for diabetic late complications in type 2 diabetes is performed from the time of its diagnosis. The strict metabolic control in both, type 1 and type 2, diabetes unequivocally and significantly delays the onset and slows the progression of diabetic retinopathy[4,21–23]. Aggressive treatment of even mild-to-moderate hypertension also reduces significantly the risk of microvascular complications[24].

Besides those well-known risk factors, overweight and obesity are also very frequently found in type 2 diabetic patients. Obesity is a chronic, stigmatised disease whose incidence has increased nearly 50% in the past decade[25,26]. Overweight is commonly defined as a BMI 25–30 kg/m^2 and obesity as a BMI>30 kg/m^2. Obesity increases the risk of type 2 diabetes, its macrovascular complications: cardiovascular, cerebrovascular, peripheral vascular diseases and reduces life expectancy in all age groups[8–10,27]. An increase in BMI also correlated significantly with deterioration of HbA1c, a decrease in HDL-cholesterol, an increase in tryglicerides, and with a higher prevalence of hypertension[11–13]. As described previously, our evaluation also demonstrated a significant deterioration of HbA1c and a significant increase in systolic and diastolic blood pressure with increase in BMI, but instead of the typical characteristics of type 2 diabetics lipid disorders, we observed a significant increase in LDL-cholesterol with increasing obesity, whereas HDL-cholesterol and tryglicerides were not influenced by BMI[11,28,29].

According to our evaluation, the prevalence of diabetic retinopathy increases significantly with higher body weight, but also correlates with a deteriorating HbA1c level and higher systolic blood pressure. The other studies also support a correlation between obesity and diabetic microvascular complications in patients with type 2 diabetes[11,30–33]. Some of these results and conclusions are different and contradictory, likely because microvascular complications in diabetes are not necessarily a direct result of obesity, but a consequence of a multiplicity of other risk factors. The heterogeneity of diabetic complications of still unclear aetiology and pathogenesis, and the multifactoral genetic and environmental influences such as obesity, complicate diabetic care management and demand more aggressive treatment and also more seriousness of patient's understanding of diabetes and obesity as well.

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PRETILOST – RIZIČNI FAKTOR ZA DIJABETIČKU RETINOPATIJU U TIPU 2 DIJABETES MELITUSA?

S A Ž E T A K

Cilj istraživanja je bio ispitati da li pretilost neovisno ili udružena sa drugim rizičnim faktorima povećava rizik za pojavu dijabetičke retinopatije kod bolesnika sa 2 tipom dijabetes melitusa. Uvidom u povijesti bolesti bolesnika sa 2 tipom dijabetes melitusa koji su pregledani u Institutu Vuk Vrhovac, Zagreb tijekom dva mjeseca, u studiju je uključeno 156 bolesnika. S obzirom na njihov indeks tjelesne mase (BMI) podijeljeni su u tri skupine: skupina 1 (BMI ≤ 25; n=49), skupina 2 (BMI 26–29,9; n=52) i skupina 3 (BMI ≥ 30; n=55). Bolesnici po skupinama se nisu razlikovali u godinama starosti, trajanju bolesti, liječenju, serumskoj koncentraciji kolesterola, HDL-kolesterola i triglicerida. Bolesnici sa povećanim BMI su imali povećanu serumsku koncentraciju HbA1c i LDL-kolesterola te povećane vrijednosti sistoličkog i dijastoličkog krvnog tlaka. Statističkom obradom je utvrđeno da pojavnost dijabetičke retinopatije se značajno povećava sa povećanom tjelesnom težinom (skup.1: 40,8%, skup.2: 63,4%, skup.3: 63,6%; p<0,05), te također je u korelaciji sa serumskom koncentracijom HbA1c i vrijednostima sistoličkog krvnog tlaka. Pretilost bi se mogla, zbog statistički značajne korelacije sa serumskim vrijednostima HbA1c i vrijednostima sistoličkog krvnog tlaka smatrati rizičnim faktorom u nastanku dijabetičke retinopatije kod bolesnika oboljelih od 2 tipa dijabetes melitusa.