ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN-POLONIA
VOL. LX, N1, 10 SECTIO D 2005

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Frequency of dyslipidemia in patients with type 2 diabetes mellitus

Lipid abnormalities such as elevated cholesterol levels (LDL fraction), elevated triglyceride levels, low HDL-cholesterol, as well as hypertension and obesity are major modifiable risk factors for cardiovascular disease. Changes in people's lifestyle and dietary habits in highly developed countries have caused a rapid increase in the prevalence of type 2 diabetes mellitus. It is estimated that there are about 100 million people with type 2 diabetes mellitus in the world and that the number may double by the year 2010. Patients with diabetes often have dyslipidemia, which significantly increases the risk of an early development of atherosclerosis. Many studies show that at least half of the patients with type 2 diabetes mellitus have lipid disorders (5,6).

The aim of the present study was to estimate the frequency of dyslipidemia in patients with type 2 diabetes mellitus treated in the Internal Medicine Department of Radom Specialistic Hospital.

MATERIAL AND METHODS

We examined 198 patients with type 2 diabetes mellitus treated in the Internal Medicine Department of Radom Specialistic Hospital. Lipid profile abnormalities were diagnosed in 103 patients aged 21 to 86, mean 60.2 ± 13.4 years. Patients taking lipid lowering agents (statins and fibrates) as well as those suspected of cancer or chronic inflammatory diseases were excluded from the study.

Apart from participating in a physical examination, in all individuals body mass index (BMI) was calculated as weight (kg)/(height)^2 (m^2). Venous blood was obtained in the morning after at least 12-hour fasting. Total cholesterol, HDL, and triglyceride levels were determined colorimetrically using Randox kits. LDL cholesterol level was calculated using the Friedewald formula (when triglyceride level did not exceed 4.5 mmol/l). The following diagnostic criteria were adopted for the respective types of hyperlipidemia: hypercholesterolemia – LDL-chol $\geq$ 3.5 mmol/l (135 mg/dl) and TG < 1.7 mmol/l (150 mg/dl), hypertriglyceridemia – LDL-chol < 3.5 mmol/l and TG $\geq$ 1.7 mmol/l, and mixed hyperlipidemia – LDL-chol $\geq$ 3.5 mmol/l and TG $\geq$ 1.7 mmol/l.

All calculations were performed using the Statistica 5.5 software for Windows. The differences between groups were assessed by Student's two-tailed unpaired *t* test. The χ^2 test was used to test the differences in frequencies. Triglycerides were log transformed before statistical analysis to meet a normality assumption. Associations among variables were evaluated by Pearson's rank correlation test. $p < 0.05$ was considered as statistically significant.

RESULTS

The characteristics of the examined group are presented in Table 1. Men were, on average, 10 years younger than women. However, no differences in BMI between men and women were ob-

served (30.6±5.0 vs. 29.7±5.0). Lipid metabolism disorders were diagnosed in 103 (52%) type 2 diabetic patients. The frequency of lipid abnormalities was similar for men and women: 44.7% and 55.3% (p=0.125), respectively.

Table 1. Age, BMI and frequency of dyslipidemia in men and women with type 2 diabetes mellitus

	Men	Women	p
n	46	57	
Age (yr)	54.8 ±12.4	64.5 ±12.7	0.0002
BMI (kg/m^2)	30.6 ± 5.0	29.7 ± 5.0	0.383
Dyslipidemia (%)	44.7	55.3	0.125

Figure 1 shows the incidence of the respective types of hyperlipidemia in patients with diabetes. Hypertriglyceridemia was observed in 14.6%, hypercholesterolemia in 18.7%, and mixed hyperlipidemia also in 18.7% of patients with diabetes.

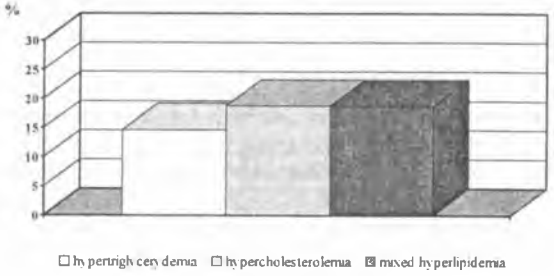

Fig. 1. The occurrence of hypertriglyceridemia, hypercholesterolemia, and mixed hyperlipidemia in patients with type 2 diabetes mellitus

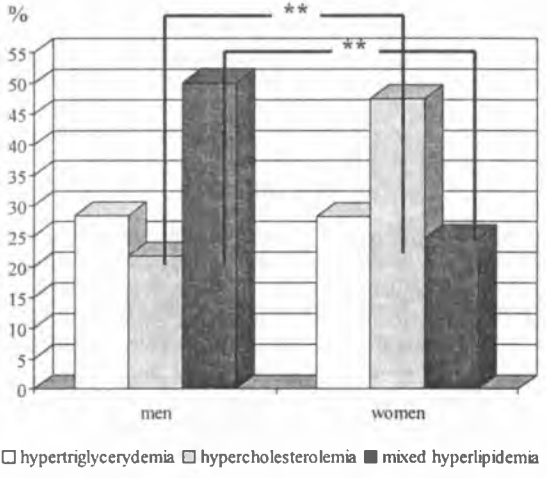

Fig. 2. The frequency of occurrence of hypertriglyceridemia, hypercholesterolemia, and mixed hyperlipidemia in men and women with diabetic dyslipidemia

Figure 2 shows the share of the individual types of hyperlipidemia in lipid disorders in type 2 diabetic patients. Hypertriglyceridemia had a similar incidence in men and women and was observed in 28.3% and 28.1% of the examined persons, respectively. Hypercholesterolemia was significantly more frequent in women than in men, 47.4% and 21.7%, ($p<0.01$), respectively. On the other hand, mixed hyperlipidemia was observed more often in men (50%) than in women (24.6%), $p<0.01$.

In Table 2 we show correlation coefficients between age and BMI and the levels of triglycerides, total cholesterol, and LDL-cholesterol. A positive correlation was observed between BMI and the level of triglycerides in the group of men with hypertriglyceridemia ($r=0.8$; $p<0.001$) and a negative correlation was observed between age and the level of triglycerides in the group of men with mixed hyperlipidemia ($r= -0.52$; $p<0.05$).

Table 2. Pearson correlation coefficients between age and BMI and triglyceride, cholesterol, and LDL-cholesterol in men and women with type 2 diabetes mellitus and dyslipidemia

Hypertriglyceridemia						
	men			women		
	triglyceride	cholesterol	LDL-chol	triglyceride	cholesterol	LDL-chol
Age	-0.46			0.12		
BMI	0.80***			0.07		
Hypercholesterolemia						
	men			women		
	triglyceride	cholesterol	LDL-chol	triglyceride	cholesterol	LDL-chol
Age		-0.01	0.12		-0.20	-0.02
BMI		0.03	0.11		0.07	0.24
Mixed hyperlipidemia						
	men			women		
	triglyceride	cholesterol	LDL-chol	triglyceride	cholesterol	LDL-chol
Age	-0.52*	-0.37	0.12	-0.52	-0.29	0.08
BMI	0.25	-0.22	-0.35	-0.35	-0.03	-0.09

* $p<0.05$
** $p<0.01$
*** $p<0.001$

DISCUSSION

Lipid disorders in patients with type 2 diabetes mellitus are both quantitative and qualitative in nature. They contribute to the increase of macrovascular complications in those patients. The most frequent lipid disorder in patients with type 2 diabetes is an elevated level of triglycerides and a lowered level of HDL-cholesterol (3, 9). Various studies suggest that as many as 54–77% of patients with non-insulin dependent diabetes mellitus have elevated levels of total cholesterol (6). The level of lipoproteins may be normal, however, there is an increase in the percentage of small, dense LDL particles particularly sensitive to oxidation, and, therefore, more atherogenic. There is also an increase in cholesterol-rich VLDL lipoproteins and an overproduction of apolipoprotein B.

In our study, dyslipidemia was diagnosed in 52% of patients with type 2 diabetes mellitus. Hypercholesterolemia was observed in 18.7% of the examined individuals and it was twice as frequent in women as in men, even though there was no accompanying difference in overweight between men and women. Similar observations had been made by Egede and Zheng. They

analysed data for 9.5 thousand patients with type 2 diabetes mellitus and observed more cases of hypercholesterolemia in women (43%) than in men (39%) in spite of the fact that obesity values were similar for both groups (5). According to many authors, cholesterol increases with age. This could explain the greater incidence of hypercholesterolemia in the group of women as the women were older than the men. However, our study has shown no correlation between age and the level of total cholesterol and LDL-cholesterol in either women or men. If we take into account the elevated levels of cholesterol in the group of patients with hypercholesterolemia and mixed hyperlipidemia, we observe that hypercholesterolemia was present in over 37% of the examined patients being the most frequent lipid disorder in patients with type 2 diabetes mellitus.

Hypertriglyceridemia is commonly considered to be the most frequent lipid disorder in patients with type 2 diabetes. It is caused by an accelerated production of triglyceride-rich VLDL particles by the liver and impaired VLDL clearance (8). The elevated level of triglycerides remains in those patients even after correction of hyperglycemia. Observational studies suggest that a lifestyle modification leading to the weight loss and an increased physical activity can lower the level of triglycerides (1, 2). In our study, hypertriglyceridemia was present in 14.6% of subjects with type 2 diabetes mellitus. The frequency of hypertriglyceridemia was, then, lower than in the Framingham studies, where it had been diagnosed in 19% of men and 17% of women with type 2 diabetes, that is similarly frequently for both sexes (9). We have not observed any significant influence of gender on the frequency of hypertriglyceridemia in those patients, either. When we took into account elevated levels of triglycerides as an element of mixed hyperlipidemia, the frequency of hypertriglyceridemia in our patients rose to 33%, but was still less frequent than hypercholesterolemia.

Mixed hyperlipidemia was detected in 18.7% of patients with type 2 diabetes mellitus in our study. In a study conducted on patients with *atherosclerosis obliterans*, mixed hyperlipidemia was detected in 19% of men and 24% of women, that is in a number similar to that of the patients with type 2 diabetes examined by us (4). On the other hand, in the population of Warsaw, similar lipid disorders were observed in 14% of men and 5% of women (7). Similarly, in our study, mixed hyperlipidemia was twice as frequent in men as in women; it has been diagnosed in half of male patients with dyslipidemia. Mixed hyperlipidemia is a particularly strong atherosclerotic risk factor because of the small, dense LDL particles dominating in the LDL fraction in this type of dyslipidemia.

Diabetes is associated with increased morbidity and mortality. The leading cause of death are cardiovascular diseases. Research shows that, similarly to dyslipidemia, the prevalence of other modifiable risk factors such as decreased physical activity, hypertension, overweight and obesity, and smoking habit is greater among type 2 diabetic patients (5). That is why treating hyperlipidemia both through a lifestyle modification and through lipid lowering drugs, as well as influencing other modifiable risk factors may improve the quality of life and decrease mortality among patients with type 2 diabetes mellitus.

CONCLUSIONS

1. Dyslipidemia occurs in one half of patients with type 2 diabetes mellitus; equally frequently in men and women.

2. The most frequent lipid disorder in men is mixed hyperlipidemia; in women, on the other hand, hypercholesterolemia.

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SUMMARY

Diabetic patients often have lipid disorders which contribute to an early development of atherosclerosis and atherosclerotic complications. The aim of the present study was to estimate the frequency of dyslipidemia in patients with type 2 diabetes mellitus treated in the Internal Medicine Department of Radom Specialistic Hospital. It has been found that 52% of patients with type 2 diabetes mellitus had dyslipidemia, which occurred with similar frequency in men and women. Hypertriglyceridemia was observed in 14.6%, hypercholesterolemia in 18.7%, and mixed hyperlipidemia in 18.7% of type 2 diabetic patients. The most frequent lipid disorder in men was mixed hyperlipidemia; in women, on the other hand, hypercholesterolemia.

Częstość występowania zaburzeń lipidowych u pacjentów z cukrzycą typu drugiego

U chorych na cukrzycę często obserwuje się zaburzenia lipidowe, które przyczyniają się do wcześniejszego rozwoju miażdżycy i jej powikłań. Celem pracy była ocena częstości występowania zaburzeń lipidowych u pacjentów z cukrzycą typu drugiego, hospitalizowanych w oddziale wewnętrznym szpitala specjalistycznego w Radomiu. Stwierdzono, że dyslipidemia występowała u 52% chorych z cukrzycą typu drugiego, podobnie często u mężczyzn jak i u kobiet. Hipertriglicerydemię obserwowano u 14,6%, hipercholesterolemię u 18,7% i hiperlipidemię mieszaną u 18,7% chorych z cukrzycą typu drugiego. Najczęstszym zaburzeniem lipidowym u mężczyzn była hiperlipidemia mieszana, natomiast u kobiet hipercholesterolemia.