

CLINICAL STUDY

The importance of lipid spectrum changes in women with polycystic ovary syndrome (PCOS)

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Abstract: *Aim of the study* was to compare levels of blood lipids, anthropometric characteristics and their relationship in women with PCOS with a group of healthy women.

Methods and results: We determined anthropometric indicators (BMI – body mass index, waist measurement, waist/hip ratio), blood lipid levels (total cholesterol TCH, high density cholesterol HDL, low density cholesterol LDL and triglycerides TAG) in a group of women with PCOS and a healthy control group.

Levels of evaluated blood lipids in women with PCOS and the healthy control group were within the normal range. Women with PCOS differed statistically significantly from the control group in a higher concentration of triglycerides (control 1.01 ± 0.7 mmol.l⁻¹, PCOS 1.17 ± 0.58). In women with PCOS we proved a positive correlation between BMI, total cholesterol, LDL cholesterol and levels of triglycerides. In women with PCOS waist measurement showed a statistically significant relationship to values of LDL cholesterol, HDL cholesterol and level of triglycerides.

Conclusions: All women with PCOS in our study had very good levels of blood lipoproteins (total cholesterol, LDL and HDL cholesterol, triglycerides) so we are not sure if there is any importance of changes in blood lipid metabolism in these patients (Tab. 1, Fig. 2, Ref. 16). Text in PDF www.elis.sk.

Key words: polycystic ovary syndrome, total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, anthropometric characteristics.

With its incidence of about 6–8%, the polycystic ovary syndrome (PCOS) is one of the most common endocrine illnesses in women of fertile age (1, 2). It is characterised by hyperandrogenism, oligo/anovulation, presence of polycystic ovaries despite the elimination of other conditions with overproduction of androgens (3, 4). Despite the fact that more than 70 years have passed since its summary definition, PCOS is still an illness of uncertain etiology and pathogenesis (5).

Affected women have a higher probability of infertility, more frequent miscarriages, and certain metabolic changes with an increased risk of glucose-tolerance disorder, occurrence of diabetes mellitus type 2, hyperlipidemia, obesity, and arterial hypertension. With regard to cumulation of the stated risk factors, the possibility of a higher risk of cardiovascular illness can be anticipated (6, 7). Deficient production of progesterone together with chronic estrogen stimulation is the precondition for endometrial hyperplasia and endometrial cancer.

The clinical, laboratory and morphological manifestations (discovery of polycystic ovaries) in women with PCOS are diverse, ranging from an image of an obese woman with distinct hirsutism and amenorrhea, expressed in metabolic changes (glucose toler-

ance disorder, possible DM, hyperlipidemia), to that of a slim woman with no visible evidence of hirsutism, with oligomenorrhea, who nonetheless becomes spontaneously pregnant (8, 9). It can be anticipated that further discoveries in the field of molecular genetics and biology will divide PCOS into several separate categories which will have a mutual clinical resemblance, but will be of different aetiology. The development of the illness is determined by mutual interactions of numerous genetic abnormalities and factors of the external environment.

Women with PCOS were expected to have changes in blood lipid metabolism manifested in various types and degrees. Several studies find typical atherogenic dyslipidemia, which can be found in both obese and diabetic patients with increased levels of triglycerides (TAG) and reduced levels of HDL cholesterol; some studies point out increased levels of LDL cholesterol (10) but the results seem to be inconclusive as well as are the views on the cardiovascular risk in these patients.

In our study we focused on changes in levels of blood lipids and their relationship to anthropometric parameters in women with PCOS treated at our clinic. The results obtained were then compared with the control group.

Material and methods

Patient base

The observed group comprised women referred for examination at endocrinologic and internal departments in years 2008–2010 due to hirsutism, disorder of menstrual cycle and alopecia.

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All included women fulfilled the criteria for PCOS according to the Rotterdam consensus. There were 72 patients with an average age of 31.6. The control group comprised 43 healthy women without disorder of menstrual cycle, without hirsutism or hyperandrogenism. Both groups comprised only women who were not taking hormonal contraceptives or who had stopped taking them at least three months before, at their own decision.

All the patients consented to undergoing more extensive laboratory investigation, and to the results being used for the purpose of our study.

The women underwent clinical examination including the determination of BMI in kg/m², waist measurement in cm and waist/hip ratio. Blood samples were taken in the morning on an empty stomach in the follicular period of the cycle (2nd – 5th day of menstruation) or during amenorrhea. Levels were determined in the serum for follicle-stimulating hormone (FSH), luteinizing hormone (LH), estradiol, total testosterone and free testosterone, androstenedione, dehydroepiandrosterone sulphate (DHEAS), prolactin, thyroid function (TSH thyroid-stimulating hormone, free thyroxine, autoantibodies against thyroperoxidase and thyroglobulin), level of 17-hydroxyprogesterone, level of total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides, glycaemia (blood sugar) and glycated haemoglobin.

Laboratory analysis

Tests were performed for total cholesterol, LDL cholesterol, triglycerides and thyroglobulin with the use of Advia 1650 biochemical analyser (Erba Lachema reagents), HDL cholesterol was determined via direct immunoinhibition method. To determine levels of FSH, LH, estradiol, progesterone, prolactin, total testosterone, DHEAS, C peptide, TSH, free thyroxine, autoantibodies against thyroperoxidase and thyroglobulin an Architect analyser was used (Abbott reagents) via chemiluminescent immunoanalysis method on microparticles – CMIA (Chemiluminescent Microparticle Immunoassay). Free testosterone and androstenedione were determined via the Competitive immunoenzymatic colorimetric method (DiaMetra company); 17-hydroxyprogesterone was determined via ELISA method. Glycated haemoglobin was determined via the turbidimetric immunoinhibition method.

Statistical processing

Calculations were carried out using statistical systems by StatSoft CR s.r.o. (2007). STATISTICA Cz (a software system for data analysis) version 8.0 www.statsoft.cz and SPSS v.12.0. Non-parametric methods were chosen on the basis of results of the Shapiro-Wilk W test (verification of normal distribution). Differences between the groups were determined via the Mann-Whitney test, relationships between values of serial (Spearman) correlation coefficients. Differences between occurrence as percentages were calculated using the χ^2 test or via the Fisher test (sometimes as the difference between two ratios). Comparison with levels stated by other authors was carried out as a comparison with a reference constant (t-test, STATISTICA program procedure). We consider significance for $p < 0.05$, i.e. a 5% level of significance.

Results

In terms of age and anthropometric characteristics there was no statistically significant difference in the groups of women. Anthropometric, metabolic and hormonal characteristics of the group of women with PCOS and the control group are stated in Table 1.

We found statistically significant higher levels of triglycerides in women with PCOS (control average 1.01 ± 0.7 mmol.l⁻¹, PCOS average 1.17 ± 0.58 mmol.l⁻¹, $p < 0.05$) (Fig. 1). The two groups did not differ in levels of total, HDL and LDL cholesterol.

In our study we also looked at the relationship between levels of blood lipids and anthropometric indicators in both observed groups. In women with PCOS there was a statistically significant increase in total and LDL cholesterol along with BMI values (positive correlation), in women in the control group this correlation was not proven. In both groups of women we proved a statistically significant relationship between BMI values and levels of triglycerides (positive correlation) (Fig. 2). A negative correlation was proven in the control group between BMI and level of HDL cholesterol, while in women with PCOS this relationship was not proven. In women with PCOS and in the control group there was a statistically significant increase in levels of TAG along with waist measurement, while the level of HDL cholesterol fell. A statistically significant positive correlation between levels of LDL cholesterol and waist measurement was evident only in women with PCOS.

Tab. 1. Monitored anthropometric, metabolic and hormonal parameters and comparison of their statistical significance in a group of women with PCOS and a control group (U test). Results in bold are significant in level $p < 0.05$.

	PCOS group (n=72) Average±SD	Control group (n=43) Average±SD	p
Age (years)	31.6±7.64	31.4±7.00	0.991
BMI (kg.m ⁻²)	26.76 ±6.08	24.73±5.66	0.055
Waist (cm)	84.43±15.55	79.44±12.42	0.116
Waist/hip	0.79±0.08	0.76±0.07	0.185
Cholesterol (mmol.l ⁻¹)	4.76±0.81	4.68±0.8	0.608
LDL (mmol.l ⁻¹)	2.66±0.61	2.67±0.72	0.995
HDL (mmol.l ⁻¹)	1.57±0.33	1.57±0.4	0.857
TAG (mmol.l ⁻¹)	1.17±0.58	1.01±0.7	0.021
Glycaemia (mmol.l ⁻¹)	5.04±0.95	4.91±0.43	0.802
C peptide (nmol.l ⁻¹)	0.99±0.93	0.58±0.21	0.009
GlyHb (%)	3.53±0.76	3.5±0.5	0.303
TSH (mU.l ⁻¹)	2.02±1.49	2.07±1.61	0.965
fT4 (pmol.l ⁻¹)	13.61±2.51	14.67±2.86	0.043
FSH (U.l ⁻¹)	5.95±3.49	5.05±2.38	0.240
LH (U.l ⁻¹)	8.37±7.21	6.34±6.01	0.045
E2 (pmol.l ⁻¹)	183.91±112.56	213.4±219.39	0.424
Progesterone (nmol.l ⁻¹)	4.13±8.59	9.91±21.9	0.260
Total test. (nmol.l ⁻¹)	2.68±1.56	1.43±1.1	0.000
SHBG (nmol.l ⁻¹)	59.16±50.2	62.47±44.71	0.264
Vol. test. (pg.ml ⁻¹)	5.51±4.6	1.41±1.37	0.000
A-dion (ng.ml ⁻¹)	4.79±3.95	2.5±1.58	0.000
DHEAS (μmol.l ⁻¹)	232.13±149.49	223.96±144.96	0.993
17 OH prog. (nmol.l ⁻¹)	5.46±4.77	1.64±1.82	0.000
PRL (mU.l ⁻¹)	381.88±215	407.55±325.56	0.421
Hct	0.41±0.03	0.41±0.02	0.615

SD – standard deviation

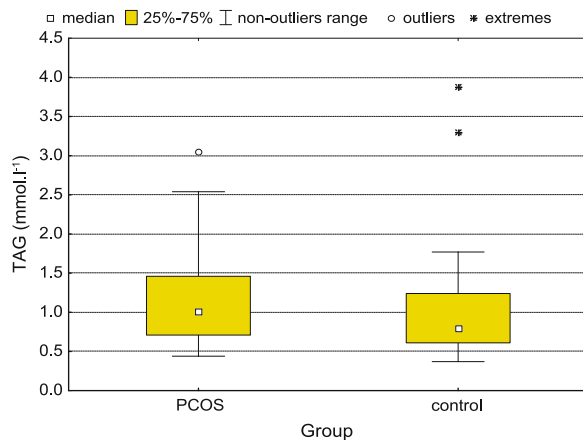


Fig. 1. Levels of triglycerides (TAG) in women with PCOS and control group.

Discussion

In the question of the level of blood lipids in women with PCOS the results of available studies are inconclusive. Higher levels of triglycerides in women with PCOS have been found in other studies (6, 11, 12, 14). Another study (13) focusing on weight difference between American and Italian women with PCOS also observed levels of blood lipids. American women had pathologically increased levels of triglycerides (1.76 mmol.l^{-1}); they were distinctly obese women with an average BMI of 40.3 kg.m^{-2} . The level of triglycerides in our women with PCOS (1.17 mmol.l^{-1}) and the Sicilian women in that study (1.03 mmol.l^{-1}) differs statistically significantly ($p = 0.040$), i.e. in comparison with the Italian women, our women had higher levels despite the fact that they were slimmer. This difference could be due to the different structure of diet in the Czech Republic and Mediterranean region. The role of the diet could be a rather important factor playing a protective role even in overweight and obese women. In the Czech study, the differences in triglyceride levels were found when women with PCOS were divided into patients with or without insulin resistance (IR), namely without IR 1.05 mmol.l^{-1} triglyceride, with IR 1.52 mmol.l^{-1} (12). In our study we proved a statistically significant relationship between BMI value and visceral obesity characterised by waist measurement and triglyceride level. This discovery corresponds with studies dealing with metabolic syndrome.

Increased levels of triglycerides in women with PCOS cannot be explained simply by obesity and accumulation of visceral fat. Several studies found no difference in TAG even with significant differences in anthropometric characteristics (15).

Inconsistent results also relate to HDL cholesterol – with dyslipidemia combined with metabolic syndrome HDL cholesterol is generally lower. Nevertheless, studies carried out on women with PCOS, including those who are overweight or obese, provide inconclusive results. In our study we did not find any difference in HDL cholesterol levels between the two groups of women. In

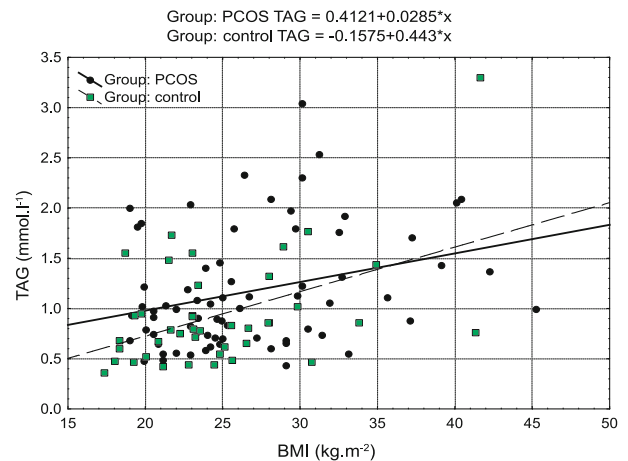


Fig. 2. Correlation graph with regression lines between BMI – body mass index (kg.m^{-2}) and triglyceridemia – TAG (mmol.l^{-1}) in women with PCOS ($r = 0.304$, $p < 0.05$) and control group ($r = 0.333$, $p < 0.05$).

women with PCOS there was a statistically significant correlation between HDL cholesterol and waist measurement (negative correlation, as with the control group). Average levels of HDL cholesterol were relatively high – 1.57 mmol.l^{-1} in the control group and women with PCOS.

Overall we can state that with increasing BMI the pathologies in blood lipids can be anticipated in women with PCOS, especially in triglyceride levels. Women with PCOS can have surprisingly higher levels of HDL cholesterol than the control group, or they may have comparable levels. When comparing the results of studies it seems that women with PCOS have specific features of metabolic syndrome (16).

Observation of lipoprotein levels as a risk factor of cardiovascular illness in women with PCOS is significant in terms of observing their cardiovascular risk. No distinctly higher incidence of cardiovascular illness has so far been proven in women with PCOS, but few studies have been carried out (14).

Conclusion

In our study we did not prove any statistically significant differences in anthropometric parameters (BMI, waist measurement, waist/hip ratio) between women with PCOS and a healthy control group of similar age. Lipid metabolism results showed that although the blood triglycerides were within the normal range, a statistically significant difference in their levels was proven between the women with PCOS and control group. The diet could still play a rather underestimated role. Other parameters (total, HDL and LDL cholesterol) did not differ in the two groups.

The importance of changes in blood lipid metabolism in PCOS has been still inconclusive.

Further studies are necessary, especially long-term observation of patients to enable conclusions to be made on the relationship of blood lipid metabolism disorder in women with PCOS and its importance in the risk of cardiovascular illness.

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