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ORIGINAL ARTICLE

Evaluation of high sensitive C-reactive protein levels in patients with polycystic ovary syndrome

[1]Tamer TOPALOĞLU
[1]Cansu ÖNAL KANBAŞ
[2]Taha OKAN
[3]Caner TOPALOĞLU

[1]Department of Obstetrics and Gynecology, Kartal Lutfi Kirdar City Hospital, Istanbul, Turkey

[2]Department of Cardiology, Kardiya Medical Center, Izmir, Turkey

[3]Department of Cardiology, Izmir Economics University, Faculty of Medicine, Izmir, Turkey

ORCID ID
TT : 0009-0005-7956-0477
CÖK : 0009-0000-4638-7907
TO : 0009-0001-6281-5681
CT : 0000-0002-5481-3328

ABSTRACT

Objective: The aim of this study was to investigate high sensitive C-reactive protein (hsCRP) levels in patients with polycystic ovary syndrome (PCOS) without insulin resistance (IR) and metabolic syndrome (MS).

Material and Methods: This retrospective study involved 90 patients aged 18–35 years who applied to a tertiary clinic between March 2022 and December 2023. A total of 45 PCOS patients without IR and MS and 45 healthy women were enrolled in the study. All participants underwent medical history review, clinical physical examination, gynecological ultrasonographic evaluation, and laboratory testing. Laboratory screening tests included measurements of follicle-stimulating hormone (FSH), luteinizing hormone (LH), total testosterone (T), free testosterone, sex hormone-binding globulin (SHBG), dehydroepiandrosterone sulfate (DHEAS), and low-density lipoprotein (LDL), which is a cardiovascular risk factor. Normal insulin sensitivity was defined on the basis of fasting serum glucose, fasting insulin level, serum insulin response to the oral glucose tolerance test, and the homeostatic model of insulin resistance. hsCRP levels were evaluated using the enzyme-linked immunosorbent assay (ELISA) technique.

Results: There were no significant differences between the groups in terms of age, systolic and diastolic blood pressure, FSH, LH, free T, total T, DHEAS, or SHBG. PCOS patients had increased hsCRP, waist-to-hip ratio (WHR), body mass index (BMI), and LDL levels compared to the control group. hsCRP was positively correlated with WHR, BMI, and LDL. A strong correlation was found between hsCRP and PCOS.

Conclusion: Elevated hsCRP is associated with cardiovascular risk factors in PCOS patients without IR and MS.

Keywords: Cardiovascular risk factor, high sensitive c-reactive protein, polycystic ovary syndrome.

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Correspondence: Caner TOPALOĞLU, MD. İzmir Ekonomi Üniversitesi Tıp Fakültesi, Kardiyoloji Anabilim Dalı, İstanbul, Türkiye.
Tel: +90 532 516 65 53 **e-mail:** topalolu@gmail.com
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INTRODUCTION

Polycystic ovary syndrome (PCOS) affects approximately 5–10% of women of reproductive age. It is an endocrine and metabolic disorder with polygenic inheritance, modulated by both epigenetic and environmental factors. Although the exact etiology remains unclear, multiple pathophysiological mechanisms are thought to be involved.[1,2]

Intestinal microbiota plays an important role in human health and contributes to various diseases. It has been shown that microbiota imbalance leads to metabolic and immune system dysfunction.[3] Dysbiosis has been associated with several conditions, including pregnancy complications, endometriosis, cancer, and PCOS.[4] Recent research suggests that chronic low-grade inflammation in lean PCOS patients may result from altered gut microbiota, ovarian steroidogenic dysregulation, or hyperandrogenemia.[3,4]

PCOS is frequently associated with abdominal fat, obesity, insulin resistance (IR), mood disorders, metabolic disorders, and increased cardiovascular risk.[1–3] PCOS is associated with cardiovascular risk, and cardiovascular diseases (CVD) are the major cause of morbidity and mortality. Atherosclerosis, an inflammatory disease in the intima layer of the arterial wall, is the leading cause of cardiovascular diseases.[5,6] It is known that C-reactive protein (CRP) plays an active role in atherogenesis, causes plaque instability, contributes to thrombosis, and ultimately to the formation of acute coronary syndromes.[7] CRP is an important independent risk factor for myocardial infarction, stroke, and peripheral vascular diseases. High sensitive C-reactive protein (hsCRP) is an established marker of low-grade chronic inflammation and is especially elevated in patients with acute coronary syndrome.[8]

IR is a common pathogenetic factor in PCOS. Approximately 30–47% of patients with PCOS exhibit IR and meet the criteria for metabolic syndrome (MS), including obesity, hypertension, impaired glucose tolerance, dyslipidemia, and hypertriglyceridemia.[9,10]

There is an association between increased cardiovascular risk factors and PCOS. Patients with PCOS, even at an early age, have cardiovascular risk factors such as IR, dyslipidemia, hypertension, impaired cardiac and pulmonary functional capacity, autonomic dysfunction, and low-grade chronic inflammation. These risk factors increase with obesity. The risk of cardiovascular disease is higher in patients with obesity and PCOS.[11] hsCRP is closely related to MS criteria and has been shown to be increased in PCOS patients.[10,12] However, the relationship between hsCRP and PCOS in normoinsulinemic, non-obese women without MS remains underexplored. This study aims to evaluate hsCRP levels in such patients.

MATERIAL AND METHODS

This retrospective, single-center study included 90 women aged 18–35 years with a body mass index (BMI)<30 kg/m² who presented to the Kartal Lütfi Kırdar City Hospital Gynecology and Obstetrics Outpatient Clinic between March 2022 and December 2023. The study group consisted of 45 women with PCOS without IR or MS and 45 normoandrogenic, ovulatory women attending for routine gynecological examination. The study was approved by the İzmir Bakırçay University Ethics Committee, and informed consent was obtained from all participants before the start of the study. The study was conducted in accordance with the principles of the Declaration of Helsinki. Artificial intelligence (AI)-supported technologies were not used in this study.

Exclusion criteria included the presence of IR, MS, hypertension, hyperlipidemia, hyperprolactinemia, hypothalamic amenorrhea, premature ovarian failure, thyroid hormone dysfunction, congenital or acquired adrenal dysfunction, diabetes mellitus, pregnancy, smoking, alcohol or substance use, psychiatric illness, neoplastic disease, infections, autoimmune diseases, liver or kidney disease, diagnosed cardiovascular disease, a family history of early coronary artery disease, or the use of hormonal or psychoactive medications.

All participants underwent gynecological ultrasound evaluation. Mid-luteal phase progesterone measurements of less than 3 ng/mL in regular menstrual cycles were indicative of oligo/anovulation. Clinical hirsutism was defined as a score of ≥8 according to the modified Ferriman-Gallwey scoring system. Biochemical hirsutism was defined as total testosterone (T)>80 ng/dL or dehydroepiandrosterone sulfate (DHEAS)>350 ng/dL.[13] PCOS patients without hirsutism were included in the study. The diagnosis of PCOS was made according to the 2003 Rotterdam Consensus Criteria.[14] BMI was used as an assessment measure of obesity. BMI (kg/m²) was calculated using weight and height (weight divided by height squared). Abdominal obesity was calculated as the waist-to-hip ratio (WHR).[15]

Insulin sensitivity was defined according to serum fasting plasma glucose, serum fasting insulin level, serum insulin response to the oral glucose tolerance test (OGTT), and homeostatic model of insulin resistance (HOMA-IR). Fasting insulin and fasting plasma glucose levels were used for the calculation of HOMA-IR (insulin×glycemia in µmol/L/22.5). Patients with fasting insulin>25 μIU/mL, peak serum insulin>100 μIU/mL during OGTT, and HOMA-IR>4 were classified as IR. The 2-hour OGTT value was <140 mg/dL in all participants.[16–19]

All participants with normal serum follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactin, thyroid function tests, spontaneous menstruation, or a positive bleeding response to progestogen withdrawal were included in the study. All participants underwent clinical and ultrasonographic evaluation. Hormone and biochemical tests were performed by taking blood samples. Endocrine screening included serum assays for glucose, insulin, 75 g OGTT, prolactin, FSH, LH, thyroid function tests, estradiol, progesterone, free T, total T, sex hormone-binding globulin (SHBG), and DHEAS. All tests administered to the participants were performed between days 3 and 5 of the menstrual cycle. Fasting venous blood samples were taken after 12 hours of overnight fasting.

Statistical Analysis

Statistical analyses were performed using IBM SPSS for Windows version 25.0 software. Baseline characteristics of both groups were presented as mean±SD. Laboratory and anthropometric parameters of patients were compared using Student's t-test. Independent relationships between PCOS and hsCRP, BMI, WHR, and LDL were assessed by multiple linear regression analysis. Correlations between hsCRP and BMI, WHR, and LDL were assessed by Pearson correlation analysis, and the correlation between hsCRP and PCOS status was assessed by Spearman's rank test. Statistical significance was set at $p<0.05$.

Table 1: Clinical and laboratory parameters of women with normoinsulinemic PCOS and control group

Parameters	PCOS (n=45) Mean±SD	Controls (n=45) Mean±SD
Age (years)	27.5±4.1	27.3±4.0
Blood pressure (mmHg)	113.5±11.4	111.2±11.5
	74.1±8.6	73.5±9.0
BMI (kg/m^2)	28.1±1.7*	25.1±2.0*
WHR	0.82±0.0*	0.72±0.0*
FSH (mIU/mL)	4.8±2.0	4.9±2.1
LH (mIU/mL)	7.0±3.1	6.8±3.0
Free testosterone (ng/dL)	8.8±2.3	8.0±2.5
Testosterone (ng/dL)	61.1±11.7	55.5±11.9
SHBG (nmol/L)	58.8±12.4	63.3±12.3
DHEAS (μg/dL)	168.1±43.9	158.1±44.3
LDL (mg/dL)	110.2±20.9*	90.1±20.3*
hsCRP (mg/L)	1.7±0.7*	0.5±0.4*

PCOS: Polycystic ovary syndrome; SD: standard deviation; *: P<0.05; BMI: Body mass index; WHR: Waist to hip ratio; FSH: Follicle stimulating hormone; LH: Luteinizing hormone; SHBG: Sex hormone binding globulin; DHEAS: Dehydroepiandrosterone sulfate; LDL: Low density lipoprotein; hsCRP: High sensitive C reactive protein.

RESULTS

The clinical and laboratory parameters are shown and summarized in Table 1. No differences were observed between the groups in terms of age, systolic and diastolic blood pressure, FSH, LH, androgens, or DHEAS. SHBG levels were lower in PCOS patients compared to the control group, but this difference was not statistically significant. PCOS patients exhibited significantly higher BMI, WHR, LDL, and hsCRP levels than the control group. hsCRP was positively correlated with BMI, WHR, and LDL. A significant association was also found between hsCRP and PCOS status (p<0.05) (Table 1).

DISCUSSION

PCOS is a complex endocrine disorder that affects not only reproductive health but also long-term cardiometabolic health. There are data showing an increased incidence of cardiovascular disease in patients with PCOS. An increased risk of atherosclerotic heart disease has been reported multiple times in patients with PCOS compared to healthy controls. Previous studies have investigated the relationship between PCOS and coronary artery disease, and most have found that PCOS patients have more extensive coronary artery disease than controls. It has also been reported that PCOS patients have a higher risk of myocardial infarction than controls.[20]

Circulating inflammatory markers have been found to be elevated in PCOS compared with controls.[12] Markers of low-grade inflammation such as tumor necrosis factor-alpha (TNF-α), hsCRP, and white blood cell counts were increased in PCOS patients.[9] CRP was related to both BMI and PCOS.[21] It is known that hsCRP is a cardiovascular risk biomarker. hsCRP, one of the independent cardiovascular risk factors, is an indicator of chronic vascular inflammation and plays a role in the development of thrombovascular events.[22] Studies have shown that hsCRP is elevated in PCOS patients.[12] A meta-analysis of 48 studies concerning CRP levels in women with PCOS reported that CRP levels were significantly higher in the study group.[23] In this study, it was demonstrated that hsCRP levels were significantly higher in PCOS patients without IR or MS compared to normoandrogenic ovulatory women. Our findings suggest that low-grade chronic inflammation may be associated with PCOS independent of well-established risk factors such as obesity or IR. The presence of these biomarkers suggests that PCOS may not only be a hormonal disorder but also a systemic inflammatory condition.

Obesity is another contributing factor for CVD.[24] Obesity and excess abdominal fat are often associated with low-grade chronic inflammation. In adipose tissues, many proinflammatory cardiovascular risk markers such as interleukin-6 (IL-6) and hsCRP are secreted.[12] We also found significant positive correlations between hsCRP levels and BMI, WHR, and LDL cholesterol levels. Notably, since all PCOS patients included in our study were non-obese, our findings indicate that the inflammatory process may occur independently of IR or MS.

It has been previously shown that there is a strong association between hyperinsulinemia and an increased risk of cardiovascular disease in patients with PCOS.[25] IR is associated with atherosclerotic processes.[26] MS in women with PCOS is also associated with an increased risk of atherosclerosis, and this results in a higher risk of cardiovascular disease.[27] Cardiovascular risk factors in patients with PCOS without IR or MS have not been adequately studied before. Therefore, we conducted our study on this group to exclude the possible effects of these factors on cardiovascular risk. Dyslipidemia is very common in PCOS.[28] In our study, we found that LDL levels were higher in PCOS patients compared to controls. It is known that blood lipid levels are correlated with CRP levels.[21] Lipid-lowering therapy is known to be effective in reducing inflammatory markers.[29] In our study, we also found significant correlations between hsCRP and LDL.

One of the key strengths of this study is its design, which excluded major confounding cardiovascular risk factors such as IR and MS. This allowed us to isolate and directly assess the potential inflammatory contribution of PCOS itself. Our findings support the hypothesis that PCOS may be an independent inflammatory condition.

However, our study has several limitations. It was a single-center study with a relatively small sample size, and future studies with larger groups are needed. In addition, only hsCRP was evaluated as an inflammatory marker. Therefore, further multicenter, prospective studies with larger populations and comprehensive inflammatory profiling are warranted.

CONCLUSION

This study revealed that hsCRP levels were significantly higher in PCOS patients without insulin resistance or metabolic syndrome. These findings suggest that PCOS itself may act as an independent

inflammatory and cardiovascular risk factor. Therefore, even in the absence of classical risk indicators, cardiovascular risk assessment and regular monitoring should be considered in patients with PCOS. Preventive strategies based on early intervention and lifestyle modifications should be prioritized in this population.

Statement

Ethics Committee Approval: The İzmir Bakırçay University Ethics Committee granted approval for this study (date: 24.01.2024, number: 1441/1421)

Informed Consent: Informed consent was obtained from all participants before the study began.

Conflict of Interest: The authors declare that there is no conflict of interest.

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REFERENCES

1. Ehrmann DA. Polycystic ovary syndrome. N Engl J Med 2005;352:1223–36.
2. Escobar-Morreale HF. Polycystic ovary syndrome: definition, aetiology, diagnosis and treatment. Nat Rev Endocrinol 2018;14:270–84.
3. Gonzalez-Rodriguez LA, Casas Loyola CM, Martinez-Hernandez CI, El Musa Penna L, Romaguera J, Godoy-Vitorino F. 12468 loss of enterococcus and faecalibacterium associate with polycystic ovary syndrome and hirsutism in a sample of hispanic patients. J Endocr Soc 2024;8(Suppl 1):bvae163.1715.
4. Qi X, Yun C, Pang Y, Qiao J. The impact of the gut microbiota on the reproductive and metabolic endocrine system. Gut Microbes 2021;13:e1894070.
5. Cascella T, Palomba S, De Sio I, Manguso F, Giallauria F, De Simone B, et al. Visceral fat is associated with cardiovascular risk in women with polycystic ovary syndrome. Hum Reprod 2008;23:153–9.
6. Bevc S, Sabic S, Hojs R. Atherosclerosis in hemodialysis patients--the role of microinflammation. Ren Fail 2008;30:1012–6.
7. Ikonomidis I, Stamatelopoulos K, Lekakis J, Vamvakou GD, Kremastinos DT. Inflammatory and non-invasive vascular markers: the multimarker approach for risk stratification in coronary artery disease. Atherosclerosis 2008;199:3–11.
8. Hansson GK. Atherosclerosis--an immune disease: the anitschkov lecture 2007. Atherosclerosis 2009;202:2–10.
9. Thomann R, Rossinelli N, Keller U, Tirri BF, De Geyter C, Ruiz J, et al. Differences in low-grade chronic inflammation and insulin resistance in women with previous gestational diabetes mellitus and women with polycystic ovary syndrome. Gynecol Endocrinol 2008;24:199–206.
10. Fröhlich M, Imhof A, Berg G, Hutchinson WL, Pepys MB, Boeing H, et al. Association between C-reactive protein and features of the metabolic syndrome: a population-based study. Diabetes Care 2000;23:1835–9.
11. Giallauria F, Orio F, Palomba S, Lombardi G, Colao A, Vigorito C. Cardiovascular risk in women with polycystic ovary syndrome. J Cardiovasc Med (Hagerstown) 2008;9:987–92.
12. Puder JJ, Varga S, Kraenzlin M, De Geyter C, Keller U, Müller B. Central fat excess in polycystic ovary syndrome: relation to low-grade inflammation and insulin resistance. J Clin Endocrinol Metab 2005;90:6014–21.
13. Coskun A, Ercan O, Arikan DC, Özer A, Kilinc M, Kiran G, et al. Modified Ferriman-Gallwey hirsutism score and androgen levels in Turkish women. Eur J Obstet Gynecol Reprod Biol 2011;154:167–71.
14. Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. Fertil Steril 2004;81:19–25.
15. Yildirim B, Sabir N, Kaleli B. Relation of intra-abdominal fat distribution to metabolic disorders in nonobese patients with polycystic ovary syndrome. Fertil Steril 2003;79:1358–64.
16. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC. Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia 1985;28:412–9.
17. Baillargeon JP, Jakubowicz DJ, Iuorno MJ, Jakubowicz S, Nestler JE. Effects of metformin and rosiglitazone, alone and in combination, in nonobese women with polycystic ovary syndrome and normal indices of insulin sensitivity. Fertil Steril 2004;82:893–902.
18. Comim FV, Spritzer PM. Increased growth hormone response to clonidine in nonobese normoinsulinemic patients with polycystic ovary syndrome. Fertil Steril 2004;81:108–13.
19. World Health Organization. WHO study group prevention of diabetes mellitus. Technical report series 844. World Health Organization, Geneva. 1994
20. Boulman N, Levy Y, Leiba R, Shachar S, Linn R, Zinder O, et al. Increased C-reactive protein levels in the polycystic ovary syndrome: a marker of cardiovascular disease. J Clin Endocrinol Metab 2004;89:2160–5.
21. Wu Y, Zhang J, Wen Y, Wang H, Zhang M, Cianflone K. Increased acylation-stimulating protein, C-reactive protein, and lipid levels in young women with polycystic ovary syndrome. Fertil Steril 2009;91:213–9.
22. Gusev DE, Ponomar' EG. The role of C-reactive protein and other acute phase markers in atherosclerosis. Klin Med (Mosk) 2006;84:25–30. [Article in Russian]
23. Humphrey LL, Fu R, Rogers K, Freeman M, Helfand M. Homocysteine level and coronary heart disease incidence: a systematic review and meta-analysis. Mayo Clin Proc 2008;83:1203–12.
24. Maharjan P, Dan Hong P. The effects of plasma homocysteine in PCOS women: A review. Open J Obstet Gynecol 2018;8:39–50.
25. Mather KJ, Kwan F, Corenblum B. Hyperinsulinemia in polycystic ovary syndrome correlates with increased cardiovascular risk independent of obesity. Fertil Steril 2000;73:150–6.
26. Haffner SM. Epidemiology of insulin resistance and its relation to coronary artery disease. Am J Cardiol 1999;84:11J–14J.
27. Apridonidze T, Essah PA, Iuorno MJ, Nestler JE. Prevalence and characteristics of the metabolic syndrome in women with polycystic ovary syndrome. J Clin Endocrinol Metab 2005;90:1929–35.
28. Berneis K, Rizzo M, Hersberger M, Rini GB, Di Fede G, Pepe I, et al. Atherogenic forms of dyslipidaemia in women with polycystic ovary syndrome. Int J Clin Pract 2009;63:56–62.
29. König D, Deibert P, Winkler K, Berg A. Association between LDL-cholesterol, statin therapy, physical activity and inflammatory markers in patients with stable coronary heart disease. Exerc Immunol Rev 2005;11:97107.