

Peripheral hematological parameters in women with polycystic ovary syndrome

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Abstract

Objective: There have been few studies on hematological parameters (e.g., hemoglobin, red cell distribution width, white blood cells, and mean platelet volume), and polycystic ovary syndrome (PCOS). This study aimed to compare hematological parameters between women with PCOS and controls.

Methods: We performed an age-matched case–control study in Faisal bin Mishal Center for Infertility, Buraidah (Kingdom of Saudi Arabia). The cases were women with PCOS and an equal number of healthy women were enrolled as controls. The basic gynecological history was recorded and blood samples were analyzed for blood parameters using an automated hematology analyzer.

Results: The two groups (60 women in each arm of the study) were similar in age. However, body mass index was significantly higher in women with PCOs compared with controls. There were no significant differences in any of the hematological parameters (hemoglobin, red blood cells, red cell distribution width, white blood cells, platelets, and mean platelet volume) between the two groups.

Conclusion: There does not appear to be a significant difference in hematological parameters in Saudi women with PCOS and healthy controls. A larger study on this issue is required in the future.

Keywords

Hemoglobin, mean platelet volume, polycystic ovary syndrome, red cell distribution width, white blood cells, body mass index

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Introduction

Polycystic ovary syndrome (PCOS) is essentially a group of endocrine disorders that commonly affect women during their reproductive age.¹ PCOS is characterized by irregular, anovulatory, menstrual cycles, features of hyperandrogenism, and polycystic ovaries.²

Although the exact etiology and pathophysiology of PCOS are not yet fully understood, various and many hypotheses, such as genetic susceptibility, and environmental and inflammatory process, have been proposed.¹ The association between hematological parameters and PCOs is still an area of active research. Previous studies on hematological values,^{3–9} such as hemoglobin,¹⁰ the white blood cell (WBC) count,⁶ mean platelet volume (MPV), red cell distribution width (RDW), the basophil count^{4,11}, and PCOS, have shown different results. Therefore, further research on blood parameters and PCOS needs to be conducted. Moreover, analyses of peripheral blood parameters were previously performed using a manual procedure, which was time-consuming and required personnel with high technical skills, and the results were doubtful. Currently, analyses and interpretation of peripheral blood parameters are conducted using automated analyzers. The current study was conducted to assess if there is a difference in blood parameters (hemoglobin, RDW, WBCs, and MPV) between women with PCOS and healthy women.

Methods

Study design and setting

A case-control study was conducted to compare hematological values between women with PCOS and healthy women in Faisal bin Mishal Center for Infertility, Buraidah, Kingdom of Saudi Arabia (KSA). There are

7 governmental and 11 private centers for assisted reproductive technology in KSA. The study received ethical approval from the Regional Research Ethics Committee of Qassim Province (#1440-1458966), Buraidah, KSA.

Selection of participants

The inclusion criteria were infertile women (age: 19–42 years) with PCOS (cases) who were diagnosed in accordance with the Rotterdam criteria.² Two or more of the following criteria had to be met: oligomenorrhea/anovulation, detection of clinical or biochemical hirsutism, and the presence of morphology of polycystic ovaries on ultrasonography (≥ 12 follicles in each ovary measuring 2–9 mm in diameter).² Age-matched, healthy, non-pregnant women who presented to the center for male infertility were the controls. The exclusion criteria (for cases and controls) were women with diabetes, hematological disease, hypertension, thyroid problems, endometriosis, and any systemic disease. At presentation and after signing an informed consent form, a detailed clinical gynecological history and examinations were performed for each participant. Transvaginal ultrasonography was then performed for each woman in privacy with attendance by a nurse.

Measurements

Weight and height measurements were taken, and body mass index (BMI) was computed using the following equation: $BMI = \text{weight in kg}/(\text{height in meters})^2$.

A volume of 2 mL of blood was withdrawn from every participant in a tube with ethylenediaminetetraacetic acid. The blood was analyzed for a complete blood count using an automated hematology analyzer and by following the manufacturer's instructions (Sysmex KX-21;

Sysmex Co., Ltd., Kobe, Japan) as previously described.^{12,13}

The total sample size of 60 women in each arm of the study (cases and controls) was calculated according to the expected difference in the mean of the investigated variables (WBC count, hemoglobin, platelets, red blood cells [RBCs], and RDW) that would provide 80% power to detect a 5% difference at $\alpha=0.05$. We assumed that 10% of women would not respond or have incomplete data.

Statistical analysis

Data were entered in a computer and we used SPSS for Windows, version 21 (IBM Corp., Armonk, NY, USA) for data analysis. Data are expressed as the proportion, mean (standard deviation), or median (interquartile range). Continuous variables were assessed for normality using the Shapiro test. The *t*-test and Mann–Whitney U-test were used to compare continuous data between cases and the controls when the data were normally and abnormally distributed, respectively. The χ^2 test was used to compare categorical variables. Two-tailed tests were used and $P < 0.05$ was considered statistically significant.

Results

The women's mean age was 29.8 ± 3.9 years. There were no significant differences

in age, residence, and education between the cases and the controls. BMI was significantly higher in women with PCOS compared with the controls ($P = 0.024$, Table 1).

There were no significant differences in any of the hematological parameters (e.g., hemoglobin, RBCs, WBCs, and platelets) between women with PCOS and controls (Table 2).

Discussion

The current study showed no significant differences in various hematological values between women with PCOS and controls. This finding is consistent with that of Ucakturk et al.¹⁴ who reported no significant differences in hemoglobin, RBCs, the platelet count, and WBCs between women with PCOS and women without PCOS. Similarly, Rashidi et al.¹⁵ reported no significant difference in serum iron levels between cases (PCOS) and controls. However, Han et al.¹⁰ reported significantly higher hemoglobin levels in women with PCOS compared with controls. Hormone levels in women with PCOS affect hemoglobin levels. Testosterone is a hematopoietic hormone and has a dose-dependent stimulatory effect on erythropoiesis.^{16,17} Moreover, androgen affects bone marrow cells via androgen receptor in the bone marrow.¹⁸ The reduced frequency of menstruation in women with PCOS is thought

Table 1. Comparison of the sociodemographic characteristics in women with polycystic ovarian syndrome with controls.

Variables	Polycystic ovarian syndrome (n = 60)	Controls (n = 60)	P
Age, years	29.8 ± 3.9	30.3 ± 5.1	0.549
Body mass index, kg/m ²	30.5 ± 7.8	27.8 ± 5.8	0.378
Rural residence, n (%)	16 (26.6)	12 (20.0)	0.388
Education level \leq secondary level, n (%)	11 (18.3)	14 (23.3)	0.500
Housewives, n (%)	34 (56.6)	36 (60.0)	0.711

Values are mean \pm standard deviation or n (%).

Table 2. Median (interquartile range) hematological values in women with polycystic ovarian syndrome and controls.

Variables	Polycystic ovarian syndrome (n = 60)	Controls (n = 60)	P
White blood cells, $\times 10^9/L$	6400 (5300–7892)	6375 (5312–7475)	0.987
Neutrophils, $\times 10^9/L$	2645 (1907–4165)	3100 (1977–4110)	0.671
Lymphocytes, $\times 10^9/L$	2770 (2290–3107)	2425 (1932–2205)	0.333
Monocytes, $\times 10^9/L$	470 (367–652)	455 (375–600)	0.532
Eosinophils, $\times 10^9/L$	145 (70–222)	100 (70–1850)	0.186
Basophils, $\times 10^9/L$	20 (10–30)	20 (10–30)	0.989
Red blood cells, $\times 10^6/mm^3$	4800 (4555–5155)	4730 (4527–5010)	0.411
Hemoglobin, mmol/L	7.82 (7.18–8.7)	7.73 (7.25–8.25)	0.858
Hematocrit, %	38.20 (36.45–39.93)	38.15 (36.10–40.58)	0.669
MCV, fL	80,665 (73,100–84,650)	80,550 (74,450–85,850)	0.467
MCH, pg	26,300 (23,375–28,125)	26,500 (24,375–27,850)	0.971
MCHC, g/L	328 (318–333)	324 (313–330)	0.184
Red cell distribution width, %	13,500 (12,850–15,200)	13,650 (12,775–14,825)	0.758
Platelet count, $10^3/\mu L$	312 (2678–368)	324 (291–371)	0.423
Mean platelet volume, fL	10,700 (9900–11,400)	10,500 (9800–11,200)	0.351
Platelet distribution width, %	15.4 (15.1–15.7)	15.4 (15.1–15.7)	0.861

MCV, mean cell volume; MCH, mean cell hemoglobin; MCHC, mean cell hemoglobin concentration.

to cause differences in hemoglobin levels between women without PCOS.

In the current study, there was no significant difference in WBCs between women with PCOS and controls. A previous study reported a positive predictive effect of WBCs and a negative predictive effect of lymphocytes on insulin resistance in women with PCOS.¹⁹ In the total population (n = 279), WBCs were significantly higher in the PCOS group compared with age-matched healthy women.⁶ In a large study (1016 women with PCOS and a similar number of controls), Shi et al.⁷ reported that the total WBC count and lymphocyte count were significantly higher in women with PCOS compared with age-matched controls. The findings of a higher total WBC count and lymphocyte count remained significant when adjusted by BMI.⁷ Notably, a previous study showed that increased inflammatory biomarkers in women with PCOS were equal in lean and obese women compared with BMI-matched

women who had no PCOS.²⁰ Moreover, higher circulating WBCs in women with PCOS are reversed by aerobic exercise.²¹

Our study showed no significant differences in MPV and RDW between the two groups. In a previous study, women with PCOS had a higher MPV, neutrophil to lymphocyte ratio, neutrophil count, neutrophil to total leucocyte ratio, and basophil count compared with controls.¹¹ Yilmaz et al.¹¹ showed that MPV and the neutrophil to lymphocyte ratio were significantly higher in women with PCOS, despite similar high-sensitivity C-reactive protein levels, compared with patients without PCOS. A positive correlation of high-sensitivity C-reactive protein levels and the WBC count and a negative correlation of MPV with BMI were also reported. Interestingly, Peker et al.²² reported that the RDW-coefficient of variation was not only a marker of inflammation in PCOS, but also an accessible marker for prediction of clomiphene citrate resistance. Perhaps

many factors, such as BMI, high sensitivity C-reactive protein, and the homeostasis model assessment of insulin resistance, are confounding factors that affect the monocyte count to high-density lipoprotein cholesterol ratio. Moreover, an increased monocyte count to high-density lipoprotein cholesterol ratio is more sensitive than other known risk factors in predicting inflammation in women with PCOS.⁵ Notably, a previous study showed that although there were no significant differences in the WBC count, MPV, and high sensitivity C-reactive protein levels in women with PCOS compared with controls, a higher NLR, MPV, and basophil count were detected in the lean PCOS group compared with controls.⁴ Unlike our findings, a significantly higher RDW (another inflammatory marker) was reported in women in the PCOS group compared with the control group.⁴

This study has a limitation. Other hematological variables, such as serum ferritin, other inflammatory markers, such as C-reactive protein, and other biochemical variables, such as insulin resistance, were not investigated.

Conclusion

This study shows no significant difference in hematological parameters in Saudi women with PCOS and healthy controls. A study with a larger sample size is required in the future to confirm this finding.

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Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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References

1. Ganie M, Vasudevan V, Wani I, et al. Epidemiology, pathogenesis, genetics & management of polycystic ovary syndrome in India. *Indian J Med Res* 2019; 150: 333–344. doi: 10.4103/ijmr.IJMR_1937_17
2. 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.
3. Pergialiotis V, Trakakis E, Parthenis C, et al. Correlation of platelet to lymphocyte and neutrophil to lymphocyte ratio with hormonal and metabolic parameters in women with PCOS. *Horm Mol Biol Clin Investig* 2018; 34. doi: 10.1515/hmbci-2017-0073
4. Yilmaz Ö, Mehmet C, Kelekci S, et al. Association between red blood cell distribution width and polycystic ovary syndrome. *Endocr Res* 2015; 40: 181–187. doi: 10.3109/07435800.2014.987398
5. Usta A, Avci E, Bulbul CB, et al. The monocyte counts to HDL cholesterol ratio in obese and lean patients with polycystic ovary syndrome. *Reprod Biol Endocrinol* 2018; 16: 34. doi: 10.1186/s12958-018-0351-0
6. Papalou O, Livadas S, Karachalios A, et al. White blood cells levels and PCOS: Direct and indirect relationship with obesity and insulin resistance, but not with

- hyperandrogenemia. *Hormones* 2015; 14: 91–100. doi: 10.14310/horm.2002.1563
7. Shi Y, Han T, Cui L, et al. White blood cell differential counts in patients with polycystic ovary syndrome: A pilot study on Chinese women. *Eur J Obstet Gynecol Reprod Biol* 2013; 170: 162–164. doi: 10.1016/j.ejogrb.2013.06.002
 8. Rashad NM, El-Shal AS and Abdelaziz AM. Association between inflammatory biomarker serum procalcitonin and obesity in women with polycystic ovary syndrome. *J Reprod Immunol* 2013; 97: 232–239. doi: 10.1016/j.jri.2012.10.007
 9. Herlihy AC, Kelly RE, Hogan JL, et al. Polycystic ovary syndrome and the peripheral blood white cell count. *J Obstet Gynaecol (Lahore)* 2011; 31: 242–244. doi: 10.3109/01443615.2011.553693
 10. Han Y, Kim HS, Lee HJ, et al. Metabolic effects of polycystic ovary syndrome in adolescents. *Ann Pediatr Endocrinol Metab* 2015; 20: 136. doi: 10.6065/apem.2015.20.3.136
 11. Yilmaz MA, Duran C and Basaran M. The mean platelet volume and neutrophil to lymphocyte ratio in obese and lean patients with polycystic ovary syndrome. *J Endocrinol Invest* 2016; 39: 45–53. doi: 10.1007/s40618-015-0335-2
 12. Standard Operating Procedure References Applicable To. Available: <https://www.gundersenhealth.org/app/files/public/6473/Lab-Policies-Complete-Blood-Count-of-Whole-Blood-on-the-Sysmex-KX-21N—RB-Lab-1535.pdf>
 13. Rayis DA, Ahmed MA, Abdel-Moneim H, et al. Trimester pattern of change and reference ranges of hematological profile among Sudanese women with normal pregnancy. *Clin Pract* 2017; 7: 888. doi: 10.4081/cp.2017.888
 14. Ucakturk A, Demirel F, Tayfun M, et al. Complete Blood Count Parameters in Girls with Polycystic Ovary Syndrome | ESPE2014. In: *ESPE Abstracts* (2014) 82 P-D-3-3-80. Available: <http://abstracts.eurospe.org/hrp/0082/hrp0082p3-d3-804>
 15. Hossein Rashidi B, Shams S, Shariat M, et al. Evaluation of serum hepcidin and iron levels in patients with PCOS: a case-control study. *J Endocrinol Invest* 2017; 40: 779–784. doi: 10.1007/s40618-017-0632-z
 16. Berria R, Gastaldelli A, Lucidi S, et al. Reduction in hematocrit level after pioglitazone treatment is correlated with decreased plasma free testosterone level, not hemodilution, in women with polycystic ovary syndrome. *Clin Pharmacol Ther* 2006; 80: 105–114. doi: 10.1016/j.clpt.2006.03.014
 17. Coviello AD, Kaplan B, Lakshman KM, et al. Effects of graded doses of testosterone on erythropoiesis in healthy young and older men. *J Clin Endocrinol Metab* 2008; 93: 914–919. doi: 10.1210/jc.2007-1692
 18. Claustres M and Sultan C. Androgen and erythropoiesis: evidence for an androgen receptor in erythroblasts from human bone marrow cultures. *Horm Res* 1988; 29: 17–22. doi: 10.1159/000180959
 19. Tola EN, Yalcin SE and Dugan N. The predictive effect of inflammatory markers and lipid accumulation product index on clinical symptoms associated with polycystic ovary syndrome in nonobese adolescents and younger aged women. *Eur J Obstet Gynecol Reprod Biol* 2017; 214: 168–172. doi: 10.1016/j.ejogrb.2017.05.014
 20. Keskin Kurt R, Okyay AG, Hakverdi AU, et al. The effect of obesity on inflammatory markers in patients with PCOS: A BMI-matched case-control study. *Arch Gynecol Obstet* 2014; 290: 315–319. doi: 10.1007/s00404-014-3199-3
 21. Covington JD, Tam CS, Pasarica M, et al. Higher circulating leukocytes in women with PCOS is reversed by aerobic exercise. *Biochimie* 2016; 124: 27–33. doi: 10.1016/j.biochi.2014.10.028
 22. Peker N, Ege S, Bademkiran MH, et al. Can clomiphene citrate resistance be predicted by RDW-CV levels in infertile women with PCOS? *Niger J Clin Pract* 2019; 22: 1463–1466. doi: 10.4103/njcp.njcp_666_18