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SHORT COMMENTARY

Common Inflammatory Markers in Polycystic Ovary Syndrome (PCOS): A BMI (Body Mass Index)-Matched Case–Control Study

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Increased inflammatory activities have been reported in women with PCOS. Attie et al. [1] found that obesity associated with chronic inflammation may contribute to insulin resistance (IR) through the actions of inflammatory adipocytokines. They had mentioned the role of adipokines

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in autocrine and paracrine signaling. Adipose tissue and the liver form an important organ pair that is in constant communication with each other via adipokines, lipids, and lipoprotein particles. The present study compared levels of common inflammatory markers between PCOS patients and body mass index (BMI)-matched controls.

Between January 2015 and October 2016, 193 cases of PCOS (Rotterdam criteria, 2003) aged 14–30 years, visiting the first author's clinic, were enrolled. Cases with secondary causes of hyperandrogenism like hyperprolactinaemia, thyroid disorders, adrenal diseases or already on hormonal treatments were excluded. One hundred and fifteen women (control) in the same age range with regular cycles and no features of hyperandrogenism were also studied. Informed consent was taken from every participant. Permission was obtained from the Ethical Committee at S. C. Das Memorial Medical and Research Center. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the 1975 Declaration Helsinki Declaration, as revised in 2008 (5). Informed consent was obtained from all patients for being included in the study. No animals were involved in this study.

The cases and controls were matched based on their BMI [2] categories: high BMI (BMI $\geq$ 23 kg/m^2; 168 cases and 83 controls) or normal BMI (18.5–22.9 kg/m^2; 25 cases and 32 controls). The parameters studied included: highly sensitive C-reactive protein (hsCRP), absolute counts (per cc) of neutrophil (N), lymphocyte (L), white blood cells (WBC), and N-to-L ratio (NLR). These non-specific inflammatory markers are commonly studied in any branch of medicine in routine clinical practice. These measurements are cheap and can be easily performed in any clinical laboratory more so in resource-poor setup.

Based on a pilot study with high-BMI patients, a sample size of 64 per group was estimated to have 90% power and 95% confidence level with two-sided test of significance to

Table 1 Comparison between the PCOS cases and BMI-matched controls

High-BMI group	PCOS (n = 168) Control (n = 83)	Mean	SD	p value (independent-samples t test)
HOMA	PCOS	4.78	4.25	**<0.001**
	Control	3.39	1.89	
Total count	PCOS	8155.30	1739.63	0.086
	Control	7740.36	1902.64	
Polymorphonuclear neutrophil (N, %)	PCOS	61.51	7.94	0.595
	Control	60.94	8.17	
Lymphocyte (L, %)	PCOS	32.67	7.38	0.959
	Control	32.72	7.14	
N-to-L ratio	PCOS	2.04	0.74	0.916
	Control	2.03	0.87	
hsCRP	PCOS	0.67	0.62	0.190
	Control	0.56	0.64	
Normal-BMI group	PCOS (n = 25) Control (n = 32)	Mean	SD	p value (independent-samples t test)
HOMA	PCOS	3.69	4.59	0.076
	Controls	1.96	1.10	
Total count	PCOS	7785.60	1710.78	0.866
	Controls	7881.25	2380.59	
Polymorphonuclear neutrophil (N, %)	PCOS	60.28	7.67	0.333
	Controls	62.50	9.13	
Lymphocyte (L, %)	PCOS	33.20	7.85	0.459
	Controls	31.56	8.50	
N-to-L ratio	PCOS	1.98	0.79	0.309
	Controls	2.27	1.17	
hsCRP	PCOS	0.29	0.32	0.536
	Controls	0.35	0.42	

Bold value indicates p value <0.05

detect mean HOMA difference of 2.28 (6.38 ± 4.2 in PCOS v/s 4.1 ± 3.7 in controls). The homeostatic model assessment (HOMA) was calculated as [fasting glucose (mg%) × fasting insulin (mcu/ml)/405].

Table 1 demonstrates the comparison of studied parameters in the high- and normal-BMI groups. No evidence of increased inflammatory activity among PCOS patients compared to controls was found. This is particularly an important finding for the high-BMI group which had sufficient sample size to strengthen this evidence.

Inflammation is increasingly being implicated in conditions like heart disease and pre- and type 2 diabetes, all of which are often closely linked with PCOS. Diamanti-Kandarakis et al. [3] had reported evidences of low grade inflammation in PCOS by elevated levels of sIVAM-1 and Se—selectin. They stressed the importance of long-term studies whether the early presence of markers of chronic inflammation in young women with PCOS has any clinical significance. Keskin et al. [4] had found increased inflammatory markers in both lean and obese PCOS patients in a BMI-matched case–control study. They had studied highly sensitive CRP, neutrophil, lymphocyte, white blood cell count, and neutrophil–lymphocyte ratio.

Homeostatic model assessment (HOMA) is considered a surrogate marker of insulin resistance (IR) [5]. Though this study found significant difference in HOMA values in the high-BMI groups only, still no evidence of increased inflammatory activities was found among high-BMI and normal-BMI Indian PCOS patients. Gutch et al. [5] had reported that inflammation may be one of the causes of increased androgenism in PCOS patients, but it remains unclear whether increased inflammatory activity is a consequence of the disorder itself or of the accompanying obesity. They had suggested that HOMA-IR, QUICKI, and Matsuda are suitable for clinical uses.

This study shows that the inflammatory markers measured in routine clinical practice do not add any extra information in PCOS cases. More detailed investigations with other specific inflammatory markers like adropine and xanthine oxidase are warranted.

Author Contributions SMB collected the data and drafted the manuscript. AB contributed to statistical analysis and revision of the manuscript.

Compliance with Ethical Standards

Conflict of interest Authors have no conflict of interest.

Ethical Statement Permission was obtained from the Ethical committee of S.C.Das Memorial Medical and Research Center.

Human and Animal rights No experimental study was done. Data were generated from the routine checkups in the outpatient clinic.

Informed Consent Informed verbal consents were obtained from the patients. This was for academic interest.

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