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Adipokines in Relation to Weight, Lipid Profile and Glycemic State in Women with Polycystic Ovary Syndrome

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ABSTRACT

Background & Objective: Polycystic ovary syndrome (PCOS) is a common disease in women of childbearing age. The inflammation has participated in the metabolic disorders and irregular menstruation associated with this disease. This study was carried out to correlate between the disturbance of pro-inflammatory markers resistin, adiponectin and metabolic parameters in women with PCOS.

Materials & Methods: Fasting blood samples were collected from 100 PCO married infertile women (23.30±4.659 years) attending Bint AL-Hoda and Al-Shatra hospitals in Thi- Qar province - Iraq, in addition to 50 healthy age matched (23.84±4.804 years) control, through the period from June 2022 to December 2022.

Results: The BMI of PCO patients (27.22±7.20) was significantly (<0.001) more that BMI of the healthy control (22.84±4.63). PCO patients showed significantly elevation of serum levels of resistin (470.00±114.00 vs 350.00±90.60 ng/l, P<0.01) and significant decline of adiponectin (5.13±1.22 vs 11.00±1.40 mg/l, P<0.001) in comparison with healthy control. PCO patients also showed significant elevation of the serum glucose (P<0.01), total cholesterol (P<0.05), triglycerides (P<0.001) and LDL (P<0.001). However, serum HDL level was insignificantly declined and VLDL was insignificantly elevated in PCO group compared with healthy control group.

Conclusion: Adiponectin and resistin represented part of the pathophysiology of PCO, and may serve as beneficial indicator in the diagnosis and treatment.

Keywords: Polycystic ovary syndrome, Body mass index, Resistin, Adiponectin, Glucose

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Introduction

Polycystic ovary syndrome (PCOS) is a common endocrine disturbance in women of childbearing age, with several combinations of symptoms and signs included reproductive, endocrine, and metabolic disorders. PCOS is manifested by hypothalamic-pituitary-ovarian axis disorders and anovulation, but unlike other ovulatory disorders that characterized by insufficient ovarian follicle growth or suppressed gonadotropin secretion (or both), PCOS was associated with hyperandrogenism and alterations in gonadotropins and estrogens secretion, with serious consequences **(1, 2)**.

In PCO, various genes interacted with each other and with the environmental factors to enhance the development of PCO. Mutagenic studies revealed that genes associated with folliculogenesis and genes involved in steroid synthesis and insulin pathway could contribute to this syndrome **(3)**. The majority of women with PCOS showed dyslipidemia, characterized by elevated levels of various blood lipids, with low HDL cholesterol **(4-6)**. Obesity, hyperandrogenism and insulin resistance, the important disturbances in PCOS, possessed marked pathophysiological roles on lipid disorders associated with the disease. The correlation of the hormonal changes, metabolic abnormalities and lipid in PCOs have not been investigated extensively, and the recorded results were inconclusive **(7)**.

Patients, with obesity and diabetes type-2, showed high serum resistin levels and high expression of resistin in adipocytes (8-12). However, the results of investigation of resistin levels in patients with PCOS were controversial **(13)**. In some, the serum resistin levels didn't change **(14)**, in others it was significantly increased compared with healthy control group **(15)**.

Current investigations also focused on adiponectin, which exerted its function by binding to its AdipoR1 and AdipoR2 receptors **(16)**. Fifteen studies suggested that adiponectin acted as a biomarker in PCO and provided a way for early intervention. It was produced by adipose tissue, and its level was decreased in insulin resistance and obesity **(17)**. In healthy women, the level of adiponectin was declined when BMI was increased **(18)**.

This study was carried out to investigate the relationship between the inflammatory markers (resistin and adiponectin) and metabolic disturbances in women with PCOS.

Methods

Blood samples (after 12 hrs fasting) were collected by venipuncture from 100 PCO married infertile women (23.30±4.659 years) visiting Al-Shatra and Bint AL-Hoda hospitals in Thi-Qar province-Iraq, they were diagnosed by gynecologists according to Rotterdam criteria, from June 2022 to December 2022. The patients with suspicion of androgen-secreting tumor, Cushing syndrome, thyroid dysfunction, congenital adrenal hyperplasia, hyperprolactinemia, and women used anti-diabetics, contraceptives, hormonal, and hypolipidemic drugs were excluded.

Blood samples were also taken from 50 healthy women, age matched, with regular menstrual cycle, non-pregnant, to serve as control. The research was confirmed by an ethical committee of health directorate of Thi-Qar governorate, Iraq. Furthermore, written consents were signed by all participants. Pro-inflammatory markers resistin and adiponectin were determined by using Enzyme-Linked Immunoassay (BIO TEK 800 analysis instrument, USA). Glucose and lipid profile were determined by using spectrophotometer (Apel analysis instrument, Japan), while the equation (VLDL=TG (mg)/5) was used to determine the level of VLDL.

Statistical analysis

The significance between PCO and healthy control groups for each parameter was determined by using a student t-test (SPSS version 26). P-value 0.05 or lower, is considered as significant.

Results

There was no significant variation between the mean of age of PCO patients (23.30±4.66 years) and the mean of age of healthy control (23.84±4.80 years) (P=0.509). The mean BMI of PCO patients (27.22±7.20 kg/m^2) was significantly (<0.001) more than BMI of the healthy control (22.84±4.63 kg/m^2). PCO patients showed significantly elevation of serum levels of resistin (470.00±114.00 vs 350.00±90.60 ng/l, P<0.01)and significant decline of adiponectin (5.13±1.22 vs 11.00±1.40 mg/l, P<0.001) compared with healthy control (Table 1).

In comparison with healthy control group, the patients with PCO showed elevated level of total cholesterol (215.50±12.12 vs 206.86±16.15 mg/dl, P<0.05), triglycerides (184.25±16.23 vs 150.12±14.24 mg/dl, P<0.001), and LDL (215.75±24.12 vs 205.28±23.14 mg/dl, P<0.001). However, HDL was insignificantly declined (30.57±16.38 vs 36.18±20.84 mg/dl), while VLDL was insignificantly elevated (36.55± 4.22 vs30.18±3.16 mg/dl) in PCO group compared with the healthy control group. Serum glucose level was significantly elevated in PCO women compared with healthy control (114.81±12.21 vs 96.14±10.23 mg/dl, P<0.01). According to the results of PCO patients, there was a positive relationship between resistin and serum levels of total cholesterol, triglycerides, LDL and glucose, while there was an inverse relationship between adiponectin and these parameters (Table 2).

Table 1. Serum adipokines in patients with PCO and healthy control.

Parameters	Control group	Patient group	P. value
Age (years)	23.84±4.80	23.30±4.66	(NS)
BMI (kg/m^2)	22.84±4.63	27.22±7.20	<0.001
Resistin (ng/l)	350.00±90.60	470.00±114.00	<0.01
Adiponectin (mg/l)	11.00±1.40	5.13±1.22	<0.001

NS: Non Significant difference.

Table 2. The serum lipid profile and glucose in PCO patients compared to healthy control group.

Parameters	Control group	Patient group	P. value
Triglycerides (mg/dl)	150.12±14.24	184.25±16.23	<0.001
Total cholesterol (mg/dl)	206.86±16.15	215.50±12.12	<0.05
HDL (mg/dl)	36.18±20.84	30.57±16.38	NS
LDL (mg/dl)	205.28±23.14	215.75±24.12	<0.001
VLDL (mg/dl)	30.18±3.16	36.55± 4.22	NS
Glucose (mg/dl)	96.14±10.23	114.81±12.21	<0.01

NS: non-significant

Discussion

The increasing incidence of PCOS, its effects on the quality of life, and the coexisting disorders are increasing problems of the societies **(19, 20)**. PCOS is often associated with obesity and insulin resistance, which led to many health risks included dyslipidemia, cardiovascular disease and type 2 diabetes. The diagnosis of diseases associated with disorders in hormones and metabolism was dramatically increased, in developed and developing countries. Moreover, the prevalence of female infertility is steadily increasing and PCOS was identified as one of its causes **(21)**.

The current study revealed that the patients with PCO showed significantly elevated level of triglycerides, total cholesterol, LDL and BMI with significant elevation of serum glucose level compared with healthy control. Many previous studies reveled that several metabolic disturbances such as insulin resistance, compensatory hyperinsulinemia, hyperglycemia, obesity and lipid disturbance (low HDL and high total cholesterol, TG, LDL and VLDL) were associated with PCO **(22, 23)**.

Adipose tissue participated in regulation of the cells function via endocrine, paracrine, and autocrine signals. It secreted different adipokines, depending on its location. Adipokines possessed hormonal functions, modulated insulin resistance, participated in glucose and fat metabolism and play an important role in anti- and proinflammatory responses. Changes in adipokines secretion contributed to metabolic disturbances and development of diabetes type-2 **(24, 25)**. Adiponectin is one of these adipokines. Our study revealed that adiponectin was significantly declined in PCO patients. It was negatively correlated with lipid profile and serum glucose level. Many studies showed that the level of adiponectin is lower in insulin resistance and obesity **(25, 26)**. It inversely correlated to visceral adiposity and adipocyte mass **(27, 28)**. In subjects with insulin-sensitivity, the adipose tissue secreted more adiponectin **(29)**, while the level of adiponectin and adiponectin receptors were decreased with the development of resistance to insulin, diabetes, obesity related cardiovascular diseases and metabolic syndrome **(30)**. There are two adiponectin membrane receptors (adipoR1 and adipoR2) which mediated its anti-inflammatory effects and glucose-lowering effect **(31)**. Fat tissue examination of PCOS patients showed that the expression of messenger RNA of adiponectin is markedly decreased in PCOS compared with BMI matched healthy women. The declined of messenger RNA, which occurs in both visceral and subcutaneous fatty tissue, is proportionate with the declined adiponectin levels **(32)**.

Our study also revealed that resistin was significantly increased in PCOS patients. The high level of resistin in PCO patients, and a positive relationship between resistin levels and lipid profile, BMI and serum glucose in our study were compatible with the literature **(13, 15, 33)**. The expression of resistin mRNA was approximately twice as high in the PCOS patient group as compared to the control group **(34)**. Resistin treatment interfered with the insulin signaling pathways, it inhibited the phosphorylation of insulin-receptor substrate, and increased expression of the protein tyrosine phosphatase 1 B (PTP1B) and the suppressor of cytokine signaling 3 (SOCS3), the insulin signaling negative regulators **(35)**. On the other hand, it was documented that PCOS was associated with low grade chronic inflammations **(36, 37)**. This could explain the decline of adiponectin which possesses anti-inflammatory and anti-diabetic effects **(28)**, and elevation of resistin which promoted chronic inflammation and insulin resistance **(38, 39)**. Adiponectin minimized the inflammatory response by inhibiting TNF-α-induced activation of nuclear factor kappa-B as well as preventing the migration of monocytes/ macrophages and their conversion into foam cells in the vessel wall **(40)**. While, recombinant human resistin, upregulated the proinflammatory cytokines expression, and played a role in the response to acute inflammation, by a nuclear factor kappa B-dependent pathway **(41, 42)**. Accordingly, both adipokines could be involved in the pathophysiology of PCO. The disturbances of the anti- and pro-

inflammatory adipokines led to insulin resistance and occurrence of metabolic syndrome and type-2 diabetes **(39)**.

Conclusion

According to our results, adiponectin and resistin represented part of the pathophysiology of PCO, and may serve as beneficial indicator in the diagnosis and treatment. Furthermore, the results also confirmed that resistin was positively correlated with serum levels of total cholesterol, triglycerides, VLDL, LDL, and glucose, while adiponectin was inversely correlated with these parameters.

Abbreviations

HDL: High Density Lipoprotein, IL: Interleukin, LDL: Low Density Lipoprotein, TC: total cholesterol, TG: triglycerides.

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Availability of data and materials

Not applicable.

Authors' Contributions

Shalan HB Al-Mayoofee carried out the laboratory investigation. Nabiha Missaoui, Sihem Hmissa and Al-Snafi Ali Esmail participate in opinion, designing, supervision, interpretation, discussion and drafting the manuscript.

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Ethical Consideration

The ethical committee at Thi-Qar Health Directorate (2022156 in 31 /5/ 2022) has approved the research, and informed consents were taken from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interest.

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