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Article

Assessment Antioxidant and Oxidative Stress in Women with Polycystic Ovary

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Abstract: Background: Increased oxidative stress and hormonal dysregulation have been implicated in polycystic ovarian syndrome (PCOS), a contributing cause to adverse pregnancy outcomes and related problems in women. Aim of the study: The study aims to evaluate the level of Malondialdehyde (MDA), glutathione(GSH), catalase (CAT) and other hormons in women with polycystic ovarian syndrome (PCOS). Methods: The study was conducted in the Gynecology Consulting Clinics in Sammara Hospitals. The study involved 60 participants aged 20-40 years, including 30 women diagnosed with severe PCOs and 30 women were incorporated into the healthy women. Results: The present study showed decrease level of both glutathione, and catalase level in PCOs women (0.11±0.08, 215±18.2) respectively as compared with control (0.3±0.05, 412±20.8) respectively, at p-value <0.05. While level of Malondialdehyde and LH increase in PCOs women (5.45±1.3, 11.3± 1.5) as compared with control (2.3± 0.9, 8, 7.51±1.1) respectively, at p- value <0.05. The present study showed non significant differences in the level of FSH, in PCOs women (7.87±0. 8) as compared with control (7.9±1.4), at p- value <0.05. Conclusion: Malondialdehyde (MDA), glutathione(GSH), catalase(CAT) are a potential biomarker in women with PCOS and metabolic dysfunction condition.

Keywords: Polycystic Ovary Syndrome, Glutathione, Catalase, Malondialdehyde (MDA).

Introduction

Polycystic ovarian syndrome (PCOS) is a prevalent endocrine condition in women of reproductive age, impacting between 6% to 10% of this demographic. It is defined by irregular menstrual periods, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology observed via ultrasonography [1]. Oxidative stress (OS) is characterised by an imbalance between antioxidant defence systems and reactive oxygen species (ROS). This imbalance leads to excessive generation of reactive oxygen species (ROS), which damages cell membrane lipids via lipid peroxidation, resulting in the development of malondialdehyde (MDA). Research indicates that oxidative stress is significantly elevated in the tissues of animals exhibiting zinc shortage and copper overload [3].

The detrimental consequences of severe oxidative stress can be alleviated by antioxidant enzymes like superoxide dismutase (SOD) and catalase (CAT), which transform reactive oxygen species (ROS) into less damaging compounds. When reactive oxygen species (ROS) production

surpasses the capacity of the innate antioxidant defence system, an unstable environment is established for reproductive cells and tissues [4].

Reactive oxygen species (ROS) are produced as byproducts of aerobic metabolism of oxygen and encompass critical species with physiological roles, including hydrogen peroxide (H2O2), superoxide anion (O2−), hydroxyl radical (•OH), organic hydroperoxides (ROOH), alkoxyl and peroxyl radicals (RO and ROO), peroxynitrite (ONOO−), and hypochlorous acid (HOCl) [5]. Reactive oxygen species (ROS) can arise from both endogenous and external sources. Endogenous causes encompass mitochondrial leakage during oxidative phosphorylation, compromised detoxification within the hepatic cytochrome P450 enzyme system, peroxisomal oxidases, and NAD(P)H oxidase activity. In polycystic ovary syndrome (PCOS), these regulatory processes are impaired, leading to increased concentrations of luteinizing hormone (LH) and follicle-stimulating hormone (FSH). As a result, antral follicles collect, have rapid initial growth, and then face premature developmental arrest, which is characteristic of polycystic ovarian morphology [7].

The primary aim of this study is to examine the correlation between PCOS, oxidative stress (OS), and the function of antioxidants in alleviating these effects.

Materials and Methods

Subjects

This study was conducted in the Gynecology Consulting Clinics in Samara Hospital from the end of February 2024 to July 2025. The study involved 60 participants aged 20-40 years. The diagnosis of PCOS was confirmed via data obtained from the history, physical examination, biochemical testing, and ultrasound results. Conversely, 30 women were incorporated into the control group, including healthy individuals with regular menstrual cycles and normal ovaries, as confirmed by ultrasound, alongside normal biochemical and clinical evaluations, thereby categorizing them as free from PCOS.

Blood samples collection and biochemical variable examination

Five millilitres of venous blood were obtained from each case and control following an overnight fast. The blood samples were maintained at room temperature without agitation for approximately 1 hour to facilitate clotting, followed by centrifugation at 3000 rpm for 15 minutes to collect serum. The serum samples were subsequently stored at -80°C until utilised.

Assessment of MDA, GSH and CAT

The serum concentrations were assessed using ELISA. The plate was pre-coated with antibodies specific to human MDA, GSH, and CAT. The concentrations of MDA, GSH, and CAT in the sample are presented. The levels of human MDA, GSH, and CAT demonstrated a positive association with the development of colour in the substrate solution. The process is terminated by the addition of an acidic stop solution, following which the absorbance is measured at a wavelength of 450 nm.

Statistical analysis

Statistical analysis was conducted using SPSS 22. The continuous variable format was expressed as means ± standard error (SE). The relationship between categorical variables was analysed. P-values less than or equal to 0.05 were deemed significant

Results

The present study showed decrease level of both GSH, and CAT level in PCOs women (0.11±0.08, 215±18.2) respectively as compared with control (0.3±0.05, 412±20.8) respectively, at p- value <0.05. While level of MDA increase in PCOs women as compared with control (5.45±1.3, 2.3± 0.9) respectively, at p- value <0.05. As shown in Table (2).

Table 1. Level of GSH, CAT, MDA in PCOs women.

Parameters	PCOs women	Control	P-value
GSH	**0.11±0.08**	**0.3±0.05**	**0.02**
CAT nmol/ml	**215±18.2**	**412±20.8**	**0.001**
MDA ng/ml	**5.45±1.3**	**2.3± 0.9**	**0.001**

The present study showed increased level of LH in PCOs women(11.3± 1.5) as compared with control (11.3± 1.5, 7.9±1.4) respectively, at p- value <0.05. While non significant differences in the level of FSH, in PCOs women (7.87±0. 8) respectively as compared with control (7.51±1.1) respectively, at p-value <0.05. As shown in Table (2).

Table 2. Level of LH, and FSH in PCOs women.

Parameters	PCOs women	Control	P-value	Parameters
LH mIU/ mL	**11.3± 1.5**	**7.9±1.4**	**0.8**	**LH mIU/ mL**
FSH mIU/ mL	**7.87±0. 8**	**7.51±1.1**	**0.04**	**FSH mIU/ mL**

Discussion

Glutathione (GSH), a tripeptide, is an essential intracellular antioxidant that acts as a radical scavenger in living cells. In the present study, a significant reduction in glutathione levels was observed compared with the control group. The elevation in GSH activity may represent a compensatory response to increased oxidative stress. These findings are consistent with [8], who reported a marked reduction in GSH levels in women with PCOS, suggesting that decreased glutathione may be linked to insulin resistance (IR).

Catalase (CAT), an endogenous antioxidant enzyme primarily located in cell peroxisomes (and to a lesser extent in the cytoplasm), catalyzes the decomposition of hydrogen peroxide into water and oxygen. This investigation revealed a significant decrease in serum catalase activity among PCOS women relative to controls. Similar results were reported by [9], who also demonstrated reduced catalase activity in PCOS patients. The reduction in catalase activity may result from increased lipid peroxidation and accumulation of malondialdehyde (MDA), which can inactivate membrane-bound enzymes. Alternatively, diminished catalase activity itself may contribute to elevated lipid peroxidation.

In contrast to these findings, [10] indicated no significant disparity in MDA levels between women with PCOS and healthy women. In the current investigation, increased MDA levels were detected in PCOS patients, corroborating the involvement of lipid peroxidation and heightened ROS production in the ovaries as factors contributing to oxidative stress. The findings align with [12], which showed markedly elevated advanced oxidation protein products and diminished total antioxidant status in Iranian women with PCOS relative to age- and BMI-matched healthy controls [13]. Moreover, [14] corroborated markedly increased MDA levels in women with PCOS, irrespective of BMI, aligning with our present findings.

MDA, the most prominent byproduct of lipid peroxidation, is pivotal in oxidative stress. Although reactive oxygen species are typically harmful, they can potentially have advantageous effects in specific physiological processes [15]. Elevated luteinizing hormone (LH) levels are regarded as a biochemical diagnostic indicator of PCOS and correlate with more severe disease characteristics. Prior research has demonstrated a favourable correlation among follicle count, ovarian volume, and LH levels, with elevated LH concentrations associated with heightened menstrual abnormalities and an increased risk of infertility in individuals with PCOS [16]. In typical circumstances, the hypothalamus releases gonadotropin-releasing hormone (GnRH) in a pulsatile fashion, prompting the pituitary gland

to secrete luteinizing hormone (LH) and follicle-stimulating hormone (FSH). LH predominantly influences ovarian theca cells, which possess LH receptors, to stimulate androgen synthesis [17]. FSH specifically targets granulosa cells, promoting the conversion of androgens into oestrogens, notably estradiol, which is essential for follicle maturation [18].

Conclusion

Malondialdehyde (MDA), glutathione(GSH), catalase(CAT) are a potential biomarker in women with PCOS and metabolic dysfunction condition.

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