POLYCYSTIC OVARY SYNDROME: PATHOGENETIC FOUNDATIONS, DIAGNOSTIC OPPORTUNITIES, AND INNOVATIVE THERAPEUTIC APPROACHES

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Abstract. Polycystic ovary syndrome (PCOS) is one of the most prevalent endocrine disorders affecting women of reproductive age. It is typically associated with persistent anovulation, elevated androgen levels, and distinctive morphological alterations in the ovaries. This article explores the current understanding of the syndrome's underlying mechanisms, its clinical features, diagnostic frameworks, and contemporary treatment modalities. Particular emphasis is placed on the contribution of insulin resistance, the impact of micronutrient deficiencies—especially vitamin D—and the psychological and emotional dimensions of the disorder. The paper highlights modern approaches in pharmacologic, surgical, and assisted reproductive therapies, including the use of insulin sensitizers, anti-androgenic agents, hormonal contraceptives, and minimally invasive laparoscopic procedures. Future research directions aimed at enhancing diagnostic accuracy and developing personalized therapeutic strategies are also discussed.

Diagnosis of Polycystic Ovary Syndrome (PCOS) is established when at least two out of the three main diagnostic criteria are present. However, the absence of characteristic ultrasound signs of polycystic ovaries does not rule out the diagnosis, as in some patients, the number of antral follicles or the ovarian size may not meet the established thresholds. The clinical presentation remains a crucial aspect of diagnosing PCOS, while imaging techniques play only a supportive role in confirming the diagnosis [1]. Like most chronic conditions, PCOS is characterized by both short-term and long-term manifestations. Short-term symptoms include irregular menstrual cycles, hirsutism, acne, infertility, alopecia, seborrhea, obesity,

depressive states, and a reduced quality of life [2,3]. It is important to consider the significant psycho-emotional impact PCOS has on women. Studies have shown a high prevalence of depressive and bipolar disorders among patients with PCOS, which negatively affects their quality of life. In recent years, the psycho-emotional aspects of PCOS have been actively studied. Women with this condition are four times more likely to experience chronic depression and seven times more likely to suffer from generalized anxiety disorder compared to the general population [4].

In this context, comprehensive medical rehabilitation, including psychological support for PCOS patients, becomes particularly important. The main goal of pathogenetically based rehabilitation programs is not only to restore ovarian function but also to improve the patients' quality of life, making this aspect of therapy highly relevant. Polycystic Ovary Syndrome (PCOS) is associated with a range of long-term complications that require timely diagnosis and management. Among these, the most notable are: type 2 diabetes (risk of 10%), prediabetes (40%), metabolic syndrome (40%), increased risk of cardiovascular diseases, blood hypercoagulation (raising the likelihood of venous thromboembolism), as well as endometrial hyperplasia and cancer [5]. The choice of PCOS treatment strategy requires an interdisciplinary approach. Although prescribing treatment is traditionally within the gynecologist's domain, the involvement of an endocrinologist is considered beneficial for a comprehensive management plan. In recent years, studies have highlighted the important role of vitamins and nutraceuticals in the therapy of PCOS. For instance, Vitamin D has been found to improve lipid profiles and reduce insulin resistance [6]. Vitamin B12, according to research, may enhance insulin sensitivity in women with PCOS who also have metabolic syndrome [7,8]. A low-carbohydrate diet has shown a positive effect on the severity of atherosclerosis. Studies have demonstrated that in patients with PCOS, the number of receptors for advanced glycation end products (AGEs) in granulosa cells exceeds the average population levels, making these cells more vulnerable to the damaging effects of metabolic byproducts [9].

Keywords: polycystic ovary syndrome, androgen excess, insulin resistance, hormone therapy, diagnostics, laparoscopy, anti-androgens, vitamin D deficiency, emotional wellbeing, reproductive health

Objective: To study the clinical features, diagnostic criteria, and modern treatment methods of polycystic ovary syndrome.

Materials and Methods: This study was conducted between 2022 and 2024 at a regional specialized obstetrics and gynecology center among women diagnosed with polycystic ovary syndrome (PCOS) in both outpatient and inpatient settings. A total of 48 reproductive-aged women (18–35 years) were included. The diagnosis of PCOS was made based on the Rotterdam criteria (2003), which require at least two of the following three features:

- Chronic anovulation or oligomenorrhea;
- Clinical or biochemical signs of hyperandrogenism;
- Polycystic ovarian morphology on ultrasound.

Clinical Assessment: A complete medical history was collected, including menstrual cycle characteristics, family history, general health status, and development milestones. Body mass index (BMI), signs of hyperandrogenism such as hirsutism, acne, and alopecia were recorded and evaluated.

Laboratory Investigations:

-Blood levels of LH, FSH, prolactin, testosterone, estrogen, insulin, and glucose;

-Oral glucose tolerance tests with insulin measurements;

-Assessment for metabolic syndrome and signs of diabetes mellitus.

Ultrasound Diagnostics (USG): The presence of 12 or more small follicles (2–9 mm) or an increased ovarian volume (greater than 10 cm^3) was considered indicative of polycystic ovaries.

Psycho-emotional Evaluation: Mental and emotional health was assessed using standardized questionnaires such as the Beck Depression Inventory (BDI) and the General Anxiety Disorder-7 (GAD-7) scale.

Treatment Approaches: Combined oral contraceptives (COCs), anti-androgens (e.g., spironolactone), insulin sensitizers (e.g., metformin), and ovulation induction agents (letrozole or clomiphene citrate) were used based on individual indications.

Lifestyle Modification: All patients received personalized counseling on increasing physical activity, following a low-carbohydrate diet, and maintaining healthy body weight.

Surgical Intervention: Laparoscopic ovarian drilling was performed for patients with resistance to medical ovulation induction.

Data Analysis: The collected data were processed using SPSS software. Comparative and statistical analyses were performed, and p-values <0.05 were considered statistically significant.

Results: The average age of the 48 patients included in the study was 26.4 ± 4.1 years. The most frequent complaints were menstrual irregularities (85.4%), acne and oily skin (68.7%), weight gain (62.5%), and infertility (43.7%).

Clinical Findings: Clinical signs of hyperandrogenism were observed in 33 patients (68.7%). Oligomenorrhea was reported in 28 cases (58.3%), and amenorrhea in 13 (27%). Hirsutism, assessed using the Ferriman-Gallwey scale, was present in 27 women (56.2%).

Laboratory and Imaging Results: Insulin resistance was detected in 29 patients (60.4%), with an average BMI of 31.2 ± 3.7 kg/m². An elevated LH/FSH ratio ($\geq 2:1$) was found in 65% of cases. Polycystic ovarian morphology on ultrasound was confirmed in 44 patients (91.6%).

Psycho-emotional Status: According to the Beck Depression Inventory, mild to moderate depressive symptoms were observed in 20 patients (41.6%). Based on the GAD-7 scale, elevated anxiety levels were reported in 16 women (33.3%).

Therapeutic Outcomes: Among 22 patients treated with metformin, 16 (72.7%) experienced normalization of the menstrual cycle within 3 months. Ovulation was successfully induced in 12 patients (75%) undergoing ovulation therapy. Laparoscopic ovarian drilling resulted in restored ovulation in 4 of 6

patients (66.6%). Overall improvement in quality of life was noted in the majority of patients (79.1%).

Discussion: The findings of this study highlight the multifaceted nature of polycystic ovary syndrome (PCOS) and emphasize the need for individualized diagnostic and therapeutic approaches. The high prevalence of clinical hyperandrogenism, menstrual irregularities, and insulin resistance observed among participants aligns with previous research, reinforcing the view of PCOS as a complex endocrine and metabolic disorder.

The majority of patients demonstrated ultrasound-confirmed polycystic ovarian morphology, which remains a key diagnostic criterion. However, it should be noted that the Rotterdam criteria, while widely used, may lead to clinical heterogeneity and potential overdiagnosis. This suggests the need for a more stratified classification system in the future.

Insulin resistance was a prominent metabolic feature, present in over 60% of patients, consistent with literature indicating that metabolic dysfunction plays a central role in the pathophysiology of PCOS. The therapeutic use of insulin sensitizers such as metformin resulted in significant improvements in menstrual regularity and ovulation, highlighting the importance of targeting metabolic abnormalities in treatment protocols.

In terms of reproductive outcomes, ovulation induction with letrozole or clomiphene showed good efficacy, though a subset of patients required surgical intervention. Laparoscopic ovarian drilling proved beneficial for those who were resistant to pharmacologic ovulation induction, indicating its continued relevance as a second-line treatment.

Psychological assessments revealed that a significant proportion of patients experienced symptoms of anxiety and depression, underscoring the need for mental health support as an integral part of PCOS management. This aspect is often underrecognized in clinical settings despite its profound impact on quality of life.

Lifestyle modification remained a cornerstone of management. Patients who adhered to diet and exercise recommendations showed better clinical outcomes, which reinforces the need for early behavioral intervention and continuous counseling.

Overall, the study supports a multidisciplinary approach to PCOS that addresses endocrine, metabolic, reproductive, and psychological domains. Future research should focus on refining diagnostic algorithms and developing personalized, patient-centered treatment models.

Conclusion: Polycystic ovary syndrome (PCOS) remains a prevalent and complex condition affecting women of reproductive age, with diverse clinical, metabolic, and psychological manifestations. This study confirms the high incidence of insulin resistance, hyperandrogenism, and menstrual disturbances in affected individuals, emphasizing the importance of early diagnosis and comprehensive management. The findings demonstrate that a combination of pharmacologic therapy, lifestyle modification, and, when necessary, surgical intervention can significantly improve reproductive function and quality of life. Moreover, addressing psycho-emotional well-being is essential for holistic care. An individualized, multidisciplinary approach that considers both clinical and metabolic profiles is key to optimizing treatment outcomes. Future research should aim to enhance diagnostic precision and expand therapeutic strategies tailored to the unique needs of each patient.

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