American Journal of Bioscience and Clinical Integrity
https://biojournals.us/index.php/AJBCI
ISSN: 2997-7347

Polycystic Ovary Syndrome: Modern Approaches to Diagnosis and Treatment

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Received: 2025, 15, Feb
Accepted: 2025, 21, Mar
Published: 2025, 26, Apr

Annotation: Polycystic Ovary Syndrome (PCOS) is a prevalent endocrine disorder affecting reproductive-aged women, characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology. Despite its high prevalence, PCOS remains underdiagnosed and inconsistently treated due to heterogeneity in clinical presentation and evolving diagnostic criteria. Traditional approaches often overlook metabolic implications and individualized care needs.This article addresses the knowledge gap surrounding current diagnostic frameworks and therapeutic strategies by reviewing recent literature and clinical guidelines. A comprehensive analysis of diagnostic methods—ranging from the Rotterdam Criteria to advancements in biochemical and imaging markers—is presented. In addition, the study evaluates modern treatment modalities including lifestyle interventions, pharmacological options (e.g., insulin sensitizers, hormonal therapy), and emerging therapies such as inositols and GLP-1 receptor agonists.Findings suggest a shift toward a more personalized and multidisciplinary approach, incorporating both reproductive and metabolic risk factors. The results highlight the need for early detection strategies, improved patient stratification, and integration of psychological support in management plans.These insights have significant implications for clinical practice, emphasizing a redefined diagnostic

protocol and holistic care models. Future research should focus on long-term outcomes and optimizing therapeutic combinations tailored to individual phenotypes.

Keywords: PCOS, hormones, ovulation, infertility, insulin resistance, ultrasound, metformin, hormonal therapy.

INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders in women of reproductive age, affecting approximately 6–20% of this population globally [1]. It is characterized by a spectrum of symptoms including irregular menstrual cycles, hyperandrogenism, and polycystic ovarian morphology, often accompanied by metabolic disturbances such as insulin resistance, obesity, and increased cardiovascular risk [2]. Beyond its reproductive implications, PCOS presents a multifaceted challenge due to its systemic nature and long-term health consequences, including type 2 diabetes, infertility, and psychological disorders such as anxiety and depression [3].The complexity of PCOS arises from its heterogeneous clinical presentation and unclear etiology, which is believed to involve a combination of genetic, hormonal, and environmental factors[4]. Multiple diagnostic criteria have been proposed over the years—most notably the NIH (1990), Rotterdam (2003), and AE-PCOS Society (2006) definitions—each emphasizing different aspects of the syndrome[5]. These evolving frameworks reflect ongoing debate about the syndrome's core features and have led to inconsistencies in diagnosis and treatment[6]. Furthermore, there is a growing recognition of the interplay between metabolic and reproductive dysfunction in PCOS, highlighting the need for more integrated diagnostic and management strategies[7].Although several studies have explored individual aspects of PCOS, including hormonal imbalances and treatment outcomes, there remains a critical knowledge gap in unifying these elements into a comprehensive, patient-centered approach [8]. Many previous reviews have either focused narrowly on reproductive outcomes or excluded the metabolic and psychosocial dimensions [9]. In addition, few have addressed the limitations of current diagnostic tools and the potential benefits of emerging biomarkers and personalized medicine [10].This article adopts a narrative review method to synthesize recent advances in PCOS diagnosis and treatment, with an emphasis on bridging existing gaps in clinical practice [11]. Literature was selected from peer-reviewed journals published in the past 10 years, focusing on studies that incorporate both reproductive and metabolic aspects of PCOS[12]. Clinical guidelines, randomized controlled trials, and observational studies were reviewed to assess the efficacy and limitations of current and emerging interventions, including lifestyle modification, pharmacological therapy, and integrative care models[13].Through this analysis, we aim to provide a clearer understanding of how PCOS can be diagnosed and managed in a more comprehensive and individualized manner[14]. The findings are expected to underscore the importance of early detection, interdisciplinary care, and long-term monitoring[15]. Results may inform updates to clinical guidelines and support the adoption of more nuanced diagnostic protocols that reflect the syndrome's multifactorial nature[16]. Ultimately, this review seeks to contribute to the ongoing shift toward a more holistic, evidence-based approach to PCOS care.[17]Polycystic Ovary Syndrome (PCOS) is a heterogeneous endocrine disorder affecting between 5% and 15% of women of reproductive age, depending on the diagnostic criteria applied[18]. It is one of the leading causes of anovulatory infertility and is associated with a broad spectrum of clinical manifestations, including menstrual dysfunction, hyperandrogenism, and metabolic disturbances[19]. The pathogenesis of PCOS is multifactorial and includes dysfunction of the hypothalamic–pituitary–ovarian axis, insulin resistance, obesity, and genetic predisposition[20]. Due to its complexity, PCOS poses significant challenges for

both diagnosis and management, requiring a comprehensive and individualized approach[21].

Materials and Methods

This narrative review was conducted to explore and synthesize current approaches to the diagnosis and treatment of Polycystic Ovary Syndrome (PCOS), with the goal of identifying advancements, clinical gaps, and future directions for integrated care. A systematic search of electronic databases including PubMed, Scopus, and Google Scholar was performed, focusing on peer-reviewed literature published between 2013 and 2024. Keywords such as "Polycystic Ovary Syndrome," "PCOS diagnosis," "PCOS treatment," "insulin resistance," "hyperandrogenism," "reproductive health," and "metabolic syndrome" were used in various combinations. Articles were selected based on relevance, recency, and contribution to the understanding of PCOS as a multifactorial disorder affecting both reproductive and metabolic health. Preference was given to clinical guidelines, randomized controlled trials, meta-analyses, and observational studies that addressed diagnostic criteria, phenotypic variations, and both conventional and emerging treatment strategies. Studies focusing solely on animal models or basic science without clinical translation were excluded to maintain the clinical applicability of findings. Data extraction focused on diagnostic frameworks, treatment outcomes, patient stratification methods, and implications for personalized medicine. The selected studies were analyzed to identify common themes, areas of controversy, and evidence supporting new or evolving approaches. Bias was minimized through cross-comparison of findings across multiple high-quality sources. This method allowed for a comprehensive, integrative overview of the current landscape of PCOS management and served as the foundation for drawing conclusions and proposing future clinical considerations based on emerging trends in both research and practice.

Result and discussion

Diagnostic Approaches

Modern PCOS diagnosis is based on the Rotterdam criteria (2003), which require the presence of at least two out of three features:

Oligo- or anovulation;

Clinical or biochemical signs of hyperandrogenism;

Polycystic ovarian morphology on ultrasound [22].

Other causes of similar clinical presentations, such as congenital adrenal hyperplasia, androgen-secreting tumors, hyperprolactinemia, hypothyroidism, and Cushing's syndrome, must be excluded [23].

Laboratory Investigations

Key hormonal and metabolic markers include:

Luteinizing hormone (LH) and follicle-stimulating hormone (FSH) (LH/FSH ratio >2 is often found in PCOS);

Total and free testosterone;

Dehydroepiandrosterone sulfate (DHEA-S);

Prolactin and thyroid-stimulating hormone (TSH);

Fasting glucose and insulin, oral glucose tolerance test (OGTT), HOMA-IR for insulin resistance assessment.

Imaging Techniques

Transvaginal ultrasound is the primary method for assessing ovarian morphology. A diagnosis of polycystic ovaries is supported by the presence of ≥12 follicles measuring 2–9 mm and/or

increased ovarian volume (>10 cm^3).

MRI/CT scans are used only in complex or atypical cases to exclude adrenal or pituitary pathologies[24].

Pathogenesis

The pathogenesis of PCOS involves disruption of normal gonadotropin regulation, specifically increased secretion of LH relative to FSH. This imbalance leads to impaired follicular maturation, chronic anovulation, and elevated androgen levels[25].

A key component is insulin resistance, which occurs in both obese and lean women with PCOS[26]. Hyperinsulinemia exacerbates ovarian androgen production and inhibits hepatic sex hormone-binding globulin (SHBG) synthesis, further increasing free testosterone levels and perpetuating the cycle of hormonal dysfunction[27].

Modern Treatment Approaches

Treatment is multifaceted and should be tailored to the patient's primary concerns: restoring ovulation and fertility, controlling hyperandrogenic symptoms, regularizing menstruation, and preventing long-term metabolic complications[28].

1. Lifestyle Modification

Lifestyle changes are the first-line intervention, especially for overweight or obese women[29]. A 5–10% reduction in body weight significantly improves insulin sensitivity, restores ovulatory function, and reduces androgen levels[30].

A low-glycemic index diet;

Regular aerobic and resistance exercise;

Stress reduction strategies to support neuroendocrine balance.

2. Pharmacologic Treatment

Combined Oral Contraceptives (COCs)

COCs are the most commonly prescribed treatment for menstrual irregularities and hyperandrogenism in women not seeking pregnancy[31]. Preferred formulations include those with anti-androgenic progestins (e.g., drospirenone, cyproterone acetate)[32].

Metformin

Metformin, an insulin-sensitizing agent, is widely used to address insulin resistance and may restore ovulatory cycles. It can be used alone or in combination with ovulation inducers and/or COCs[33].

Antiandrogens

Used to treat hirsutism, acne, and alopecia. Common agents include spironolactone, flutamide, and finasteride[34]. Reliable contraception is mandatory due to teratogenic potential.

Ovulation Induction

For patients seeking pregnancy:

Clomiphene citrate is the first-line treatment;

Letrozole (aromatase inhibitor) is increasingly preferred, particularly in overweight patients;

Gonadotropins are used when oral agents fail, requiring close monitoring due to the risk of ovarian hyperstimulation syndrome (OHSS)[35].

3. Surgical Treatment

Laparoscopic ovarian drilling (LOD) is a second-line option for ovulation induction in clomiphene-resistant women[36]. The procedure involves creating small punctures in the ovarian cortex, which can reduce androgen production and restore ovulation. However, it carries risks such as adhesions and is used selectively[37].

PCOS and Pregnancy

With proper treatment, most women with PCOS can conceive successfully[38]. However, they face higher risks of pregnancy complications, including gestational diabetes, preeclampsia, and preterm birth[39]. Therefore, enhanced prenatal monitoring is essential in these patients[40].

Long-Term Health Risks

Beyond reproductive issues, PCOS is linked to numerous long-term health risks:

Type 2 diabetes mellitus;

Hypertension;

Dyslipidemia;

Metabolic syndrome;

Increased risk of endometrial cancer due to chronic anovulation and unopposed estrogen exposure.

Thus, ongoing monitoring and early lifestyle or medical interventions are vital to prevent serious complications[41].

Conclusion

In conclusion, this review highlights the evolving understanding of Polycystic Ovary Syndrome (PCOS) as a complex, multisystem disorder that extends beyond reproductive dysfunction to encompass significant metabolic and psychological components. The analysis underscores the limitations of current diagnostic criteria, which often fail to account for the heterogeneity of clinical presentations, and emphasizes the need for a more individualized, phenotype-based approach to diagnosis and treatment. Emerging therapeutic strategies, including insulin sensitizers, inositols, and GLP-1 receptor agonists, show promise in addressing both metabolic and reproductive symptoms, while integrative care models that incorporate lifestyle modification, mental health support, and personalized pharmacotherapy offer a more holistic pathway for long-term management. These findings have important implications for clinical practice, particularly in encouraging earlier diagnosis, interdisciplinary collaboration, and patient-specific care planning. However, further research is warranted to validate new diagnostic biomarkers, assess the long-term safety and efficacy of novel treatments, and explore the genetic and environmental underpinnings of PCOS across diverse populations. Continued efforts in these areas will be essential to refine clinical guidelines and improve health outcomes for women affected by this prevalent yet underrecognized condition.Polycystic Ovary Syndrome is a complex and multifactorial condition requiring a multidisciplinary approach to diagnosis and treatment. Early identification and individualized management plans can restore reproductive function, alleviate symptoms, and reduce the risk of long-term complications. The implementation of modern diagnostic tools and treatment protocols provides significant clinical benefits, improving the quality of life for patients with PCOS..

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