

# MODERN APPROACHES TO THE EARLY DIAGNOSIS AND MANAGEMENT OF POLYCYSTIC OVARY SYNDROME: CLINICAL AND REPRODUCTIVE OUTCOMES

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## Abstract

Polycystic ovary syndrome (PCOS) is a heterogeneous endocrine and reproductive disorder that affects women of reproductive age and is characterized by disturbances in ovulatory function, androgen activity, and ovarian morphology. Beyond reproductive manifestations, PCOS is frequently associated with metabolic abnormalities, insulin resistance, obesity, dyslipidemia, psychological distress, and an increased long-term risk of cardiometabolic disease. Early recognition of the syndrome is therefore important not only for the management of infertility and menstrual irregularity but also for prevention of long-term complications. Modern diagnostic approaches emphasize the integration of clinical history, menstrual characteristics, signs of androgen excess, biochemical hormone assessment, and pelvic ultrasonography, while carefully excluding alternative endocrine disorders. Early diagnosis can be challenging because clinical manifestations vary substantially between individuals and may change with age. Management should consequently be individualized according to the predominant reproductive, metabolic, dermatological, and psychological manifestations and according to the patient's reproductive goals. Lifestyle modification remains an important component of management, particularly in patients with excess weight or metabolic risk. Pharmacological options include combined hormonal contraceptives for appropriate patients with menstrual irregularity and hyperandrogenic symptoms, insulin-sensitizing therapy in selected metabolic settings, and ovulation-induction treatment for women seeking pregnancy. Letrozole is generally considered the preferred first-line pharmacological option for ovulation induction in many women with anovulatory infertility associated with PCOS. More advanced reproductive interventions may be considered when first-line treatment is unsuccessful. The integration of early diagnosis, metabolic screening, reproductive planning, and individualized treatment can improve clinical outcomes and support long-term health. A patient-centered approach is essential because PCOS is a chronic condition requiring continuing assessment rather than a single therapeutic intervention.

**Keywords:** polycystic ovary syndrome, PCOS, early diagnosis, hyperandrogenism, anovulation, infertility, insulin resistance, reproductive outcomes, metabolic health, ovulation induction.

## 1. Introduction

Polycystic ovary syndrome is one of the most common endocrine disorders affecting women of reproductive age. Its clinical importance extends beyond reproductive dysfunction because the syndrome is associated with metabolic, psychological, dermatological, and cardiovascular risk factors. The diverse manifestations of PCOS make diagnosis and management particularly challenging and require an individualized clinical approach.

The syndrome may become apparent during adolescence or early adulthood, although its manifestations can change over time. Menstrual irregularity is one of the most frequent presenting features and may reflect chronic anovulation. Some patients seek medical attention because of infertility, while others initially present with acne, hirsutism, obesity, or unexplained metabolic abnormalities. In some cases, PCOS is discovered incidentally during evaluation for another medical problem.

Hyperandrogenism represents another important component of the syndrome. It may be clinically expressed through excessive terminal hair growth, acne, or androgen-dependent alopecia. Biochemical hyperandrogenism can be detected through measurement of circulating androgen concentrations, although laboratory interpretation requires consideration of assay quality and physiological variation.

The ovarian component of PCOS is characterized by altered follicular development and, in some patients, polycystic ovarian morphology on ultrasonographic examination. Importantly, the presence of polycystic-appearing ovaries alone does not establish the diagnosis. Ovarian morphology must be interpreted together with clinical and biochemical findings.

The heterogeneity of PCOS is one of the principal reasons why early diagnosis may be difficult. Two patients with the same diagnosis may have substantially different symptoms and risk profiles. One may have prominent reproductive dysfunction with relatively normal metabolic parameters, whereas another may have obesity, insulin resistance, dyslipidemia, and marked hyperandrogenism.

Insulin resistance and compensatory hyperinsulinemia may contribute to the pathophysiology of PCOS, although they are not diagnostic requirements. Altered insulin signaling can promote ovarian androgen production and may contribute to metabolic abnormalities. The relationship between insulin resistance and PCOS is complex and is influenced by body composition, genetic predisposition, lifestyle, and other biological factors.

Reproductive consequences represent one of the most important clinical concerns. Chronic anovulation may reduce the frequency of spontaneous conception and contribute to infertility. At the same time, women with PCOS may become pregnant spontaneously, meaning that the syndrome should not be equated with absolute infertility.

PCOS is also associated with pregnancy-related risks, including an increased likelihood of certain metabolic and obstetric complications. Appropriate preconception assessment and optimization of health before pregnancy are therefore important components of modern management.

Early diagnosis provides an opportunity to address both immediate symptoms and future health risks. Patients with irregular menstrual cycles can receive appropriate evaluation before prolonged reproductive difficulties develop. Identification of metabolic risk can also facilitate early interventions directed toward nutrition, physical activity, weight management, and cardiometabolic prevention.

The modern concept of PCOS management has therefore shifted from symptom suppression alone toward comprehensive long-term care. Treatment goals should be determined according to the individual patient's priorities, including cycle regulation, fertility, management of hyperandrogenic symptoms, metabolic health, psychological well-being, and prevention of endometrial complications. The objective of this article is to analyze contemporary approaches to early PCOS diagnosis and individualized management, with particular emphasis on clinical manifestations, reproductive function, metabolic characteristics, and treatment outcomes.

## 2. Materials and Methods

This article is based on a structured scientific analysis of contemporary diagnostic and therapeutic approaches to polycystic ovary syndrome. The methodological framework incorporates clinical assessment, biochemical investigation, ultrasonographic evaluation, reproductive assessment, metabolic screening, and evaluation of therapeutic outcomes.

Clinical assessment begins with a detailed medical history. Menstrual cycle characteristics are

documented, including cycle length, frequency, duration, variability, and periods of amenorrhea or oligomenorrhea. The age at menarche and changes in menstrual regularity over time should also be considered.

A reproductive history includes previous pregnancies, spontaneous abortions, infertility duration, previous ovulation-induction attempts, and the presence of other reproductive disorders. Family history may provide information regarding diabetes, metabolic disease, infertility, and endocrine conditions.

Clinical evaluation of hyperandrogenism includes assessment of hirsutism, acne, and androgen-dependent hair loss. Standardized clinical scoring systems may be used when appropriate to improve objectivity. The degree and distribution of excessive hair growth should be documented rather than relying solely on subjective descriptions.

Anthropometric assessment includes body weight, height, body mass index, and waist circumference. These parameters provide information regarding general and central adiposity and can contribute to assessment of metabolic risk.

Biochemical evaluation may include total testosterone and, where appropriate, free testosterone or an estimate of free androgen availability. Additional androgen-related investigations can be selected according to the clinical presentation. Laboratory interpretation should account for the characteristics and reliability of the assay.

Because PCOS is a diagnosis of exclusion, alternative causes of menstrual dysfunction and hyperandrogenism should be considered. Depending on the clinical presentation, evaluation may include thyroid function, prolactin, adrenal androgen-related testing, and assessment for non-classic congenital adrenal hyperplasia. Markedly elevated androgen concentrations or rapidly progressive virilization require evaluation for other causes, including androgen-secreting tumors.

Pelvic ultrasonography can be used to assess ovarian morphology and endometrial characteristics. Modern high-resolution transvaginal ultrasound provides detailed visualization of ovarian follicles and ovarian volume in patients for whom this examination is appropriate. In adolescents and selected patients, interpretation of ovarian morphology requires particular caution because normal pubertal physiology may overlap with features associated with PCOS.

Metabolic assessment includes evaluation of blood pressure, glucose metabolism, lipid profile, and other cardiovascular risk factors. An oral glucose tolerance test may provide useful information regarding glucose abnormalities in patients at increased metabolic risk.

Psychological assessment may also be appropriate because anxiety, depressive symptoms, reduced self-esteem, body-image concerns, and eating-related difficulties may occur more frequently among women with PCOS. Psychological well-being should therefore be considered part of comprehensive disease management.

Reproductive outcomes are assessed according to the patient's reproductive goals. In women seeking pregnancy, ovulatory function, duration of infertility, partner-related factors, tubal status, and other potential causes of infertility should be considered rather than attributing infertility automatically to PCOS.

Treatment evaluation includes menstrual regularity, reduction of androgen-related symptoms, metabolic parameters, ovulation, pregnancy, live birth, patient satisfaction, and adverse effects. Long-term management should also consider adherence and sustainability of lifestyle and pharmacological interventions.

### 3. Results

The integrated assessment demonstrates that early recognition of PCOS is most effective when clinical, biochemical, and ultrasonographic information is interpreted together rather than relying on a single diagnostic parameter.

Menstrual dysfunction represents one of the most useful early clinical indicators. Persistent irregular cycles may suggest chronic anovulation, particularly when accompanied by clinical or biochemical evidence of androgen excess. However, menstrual irregularity alone is not sufficient to establish PCOS because it may occur in several other endocrine and gynecological conditions.

Clinical hyperandrogenism provides an additional diagnostic pathway. Hirsutism and persistent acne may indicate increased androgen activity, although the severity of symptoms can be influenced by genetic and ethnic factors. Some women may have biochemical hyperandrogenism without pronounced clinical manifestations.

Biochemical testing can strengthen diagnostic confidence when interpreted appropriately. Assessment of androgen concentrations is particularly useful in patients with symptoms suggesting hyperandrogenism. However, laboratory variation means that results should be evaluated according to validated reference ranges and appropriate testing methods.

Ultrasonography provides additional information about ovarian morphology. Increased follicle number or ovarian volume may support the diagnosis in appropriate clinical circumstances, but polycystic ovarian morphology can also occur in women without the full syndrome. Consequently, imaging should complement rather than replace clinical and biochemical assessment.

The analysis also demonstrates the importance of metabolic evaluation at the time of diagnosis. Excess body weight is common among women with PCOS, although the syndrome can also occur in individuals with normal body mass index. Therefore, absence of obesity does not exclude metabolic abnormalities or PCOS.

Insulin resistance may contribute to both reproductive and metabolic manifestations. Increased insulin activity can stimulate ovarian androgen production and may interfere with normal follicular development. The resulting endocrine environment can contribute to anovulation and menstrual irregularity.

Lifestyle modification is associated with broad clinical benefits, particularly in women with excess weight or metabolic risk. Improved dietary quality, regular physical activity, adequate sleep, and sustainable weight management can support metabolic health and may improve reproductive function in some patients.

For women who do not currently seek pregnancy, treatment is generally directed toward cycle control, prevention of endometrial complications, and management of androgen-related symptoms. Combined hormonal contraceptives may be appropriate for many patients when there are no contraindications.

Patients with prominent hirsutism may require additional management. Cosmetic methods can provide immediate symptom control, while hormonal therapy may reduce the biological stimulus for excessive hair growth over time. Antiandrogen therapy may be considered in selected patients with appropriate contraceptive protection because of potential fetal risks during pregnancy.

For women seeking pregnancy, restoration of ovulation is a major therapeutic objective. Letrozole has become an important first-line pharmacological treatment for anovulatory infertility associated with PCOS and may provide favorable ovulation and live-birth outcomes compared with older approaches. Metformin may have a role in selected patients, particularly when metabolic abnormalities or impaired glucose regulation are present. However, it should not be regarded as a universal substitute for fertility-specific ovulation-induction therapy.

When first-line ovulation induction is unsuccessful, treatment can be escalated according to individual circumstances. Gonadotropin therapy or laparoscopic ovarian surgery may be considered in selected cases, while assisted reproductive technologies may be appropriate when other approaches fail or additional infertility factors are present.

Pregnancy outcomes are influenced by preconception health. Identification and management of obesity, glucose abnormalities, hypertension, nutritional deficiencies, and other risk factors before conception may contribute to safer pregnancy.

The results also highlight the importance of long-term follow-up. PCOS does not end when menstrual cycles become regular or pregnancy is achieved. Metabolic risk and other health considerations may persist after reproductive symptoms improve.

#### 4. Discussion

Modern understanding of PCOS emphasizes that it is a complex systemic disorder rather than an isolated ovarian condition. The reproductive system, metabolic pathways, endocrine regulation, and psychological health can interact throughout the course of the disease.

One of the principal challenges in early diagnosis is the variability of presentation. Some patients have obvious menstrual irregularity and hyperandrogenism, whereas others have relatively subtle manifestations. This heterogeneity makes individualized diagnostic reasoning essential.

The diagnostic process should begin with identification of characteristic features and confirmation of appropriate diagnostic criteria while excluding alternative disorders. Overdiagnosis can occur when isolated ovarian morphology is interpreted as PCOS, while underdiagnosis may occur when symptoms are attributed to normal variation without appropriate evaluation.

Adolescence represents a particularly challenging period. Physiological menstrual irregularity and changes in androgen activity are common during puberty and can overlap with PCOS manifestations. Diagnostic assessment in adolescents therefore requires age-appropriate criteria and longitudinal clinical observation.

The role of ultrasonography has also evolved with technological improvements. Higher-resolution equipment can visualize ovarian follicles with greater detail, but increased sensitivity can make interpretation more complex. Diagnostic thresholds should therefore be applied according to current evidence and the specific patient population.

Hyperandrogenism remains an important component of diagnosis. Clinical manifestations can affect quality of life even when reproductive symptoms are mild. Hirsutism, acne, and hair loss may cause psychological distress and social difficulties, emphasizing the need to include patient-reported concerns in treatment planning.

The relationship between insulin resistance and PCOS is clinically important but should be interpreted carefully. Insulin resistance is common but is not itself a defining diagnostic feature. Furthermore, its severity cannot always be inferred accurately from body weight alone.

Metabolic screening is important because women with PCOS may have increased risk of impaired glucose regulation, dyslipidemia, hypertension, and other cardiometabolic abnormalities. Early identification creates an opportunity for preventive intervention before clinically significant disease develops.

Lifestyle intervention remains a central element of management. Importantly, lifestyle treatment should not be presented simply as a recommendation to lose weight. Dietary quality, physical activity, sleep, psychological well-being, and sustainable behavioral changes are relevant even in patients who do not lose substantial weight.

Weight reduction, when appropriate and achieved through sustainable methods, may improve insulin sensitivity and reproductive function in women with excess weight. However, treatment should avoid stigmatizing language because psychological distress and body-image concerns are already common in this patient population.

Hormonal contraceptive therapy is frequently used for menstrual regulation and hyperandrogenic symptoms in women who are not attempting pregnancy. These medications can reduce androgen activity and provide endometrial protection by promoting more predictable withdrawal bleeding. The choice of hormonal preparation should be individualized according to cardiovascular risk factors, migraine history, smoking status, age, blood pressure, thromboembolic risk, and patient preference. No single preparation is appropriate for every patient.

Management of hirsutism often requires patience because hair-growth cycles are prolonged. Pharmacological suppression of androgen activity may take several months before substantial clinical improvement becomes apparent. Combining medical therapy with appropriate cosmetic approaches can improve patient satisfaction.

Reproductive management requires a different therapeutic objective. In women seeking pregnancy, cycle regulation is secondary to achieving ovulation and conception. Treatment should therefore focus on identifying anovulation and addressing all relevant infertility factors.

Letrozole has become a preferred first-line ovulation-induction medication for many women with PCOS-related anovulatory infertility. Its mechanism involves temporary reduction of estrogen feedback, resulting in increased gonadotropin stimulation and follicular development. Clinical selection should still account for contraindications and individual reproductive circumstances.

Metformin has a more selective role. Its effects on insulin sensitivity can be useful in patients with metabolic dysfunction, but its reproductive benefits are not equivalent to those of dedicated ovulation-induction therapy in all women. Combining therapies may be appropriate in selected cases. Assisted reproductive technologies represent an important option for women who do not achieve pregnancy with simpler approaches or who have additional infertility factors. Careful ovarian stimulation is particularly important in PCOS because some patients have an increased risk of excessive ovarian response.

Pregnancy itself requires continued attention. Women with PCOS may have increased risk of gestational metabolic complications and hypertensive disorders. Preconception counseling and appropriate antenatal surveillance can help identify problems at an earlier stage.

Endometrial health is another important consideration. Prolonged periods without ovulation can result in prolonged exposure of the endometrium to estrogen without adequate progesterone

opposition. Long-standing untreated amenorrhea may therefore increase the risk of endometrial hyperplasia. Regular assessment of menstrual patterns and appropriate cycle management are important preventive measures.

Psychological health should be incorporated into routine PCOS care. Depression, anxiety, reduced self-confidence, and body-image concerns may substantially affect quality of life and treatment adherence. Recognizing these issues can improve communication and facilitate timely psychological support.

The concept of shared decision-making is particularly important. PCOS affects different patients in different ways, and treatment goals may change over time. A patient who initially prioritizes acne control may later seek fertility treatment, while another may prioritize metabolic health or menstrual regulation.

Long-term follow-up should therefore be dynamic. Clinical evaluation can be repeated as reproductive goals, weight, metabolic status, medications, and symptoms change. This approach is more consistent with the chronic nature of PCOS than a single diagnostic consultation followed by indefinite treatment. Emerging research is increasingly focused on molecular phenotyping and biomarkers that may improve prediction of disease risk and treatment response. Genetic, metabolic, inflammatory, and reproductive characteristics may eventually allow more precise categorization of PCOS subtypes. Artificial intelligence and digital health tools may also contribute to future management. Electronic menstrual tracking, digital symptom monitoring, automated risk assessment, and remote lifestyle interventions could support continuous care. Nevertheless, technological tools should complement rather than replace clinical evaluation.

## 5. Conclusion

Polycystic ovary syndrome is a heterogeneous endocrine disorder with important reproductive, metabolic, dermatological, and psychological consequences. Early diagnosis is essential because timely recognition allows clinicians to address both immediate symptoms and long-term health risks. The most reliable diagnostic approach combines menstrual history, clinical assessment of hyperandrogenism, appropriate biochemical testing, and ultrasonographic evaluation when indicated. Because several endocrine and gynecological disorders can mimic PCOS, alternative diagnoses must be excluded before the syndrome is confirmed.

Management should be individualized according to the patient's dominant symptoms, metabolic risk profile, reproductive plans, and personal preferences. Lifestyle modification remains a fundamental component of long-term care, particularly in patients with excess weight or metabolic abnormalities. For patients not seeking pregnancy, treatment may focus on menstrual regulation, endometrial protection, and control of hyperandrogenic symptoms. For women seeking conception, ovulation-induction therapy represents a central treatment strategy, with letrozole serving as an important first-line pharmacological option for many patients with PCOS-related anovulatory infertility.

Metabolic screening and prevention should remain part of routine PCOS care regardless of body weight. Psychological health should also be addressed because the syndrome can significantly influence self-esteem, emotional well-being, and quality of life.

The achievement of pregnancy or temporary improvement in menstrual regularity should not be regarded as the end of treatment. PCOS requires continued attention because metabolic and reproductive risks may persist throughout the life course.

Future advances in molecular phenotyping, biomarkers, digital health, and individualized pharmacological treatment may improve early identification of high-risk patients and enable more precise therapeutic selection. Until such approaches become routinely available, comprehensive clinical assessment and patient-centered management remain the foundation of effective PCOS care. Overall, early recognition combined with individualized reproductive, metabolic, and psychological management can improve clinical outcomes and reduce the long-term burden associated with polycystic ovary syndrome.

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