

Laboratory Assessment of Insulin Resistance in Polycystic Ovary Syndrome (PCOS): Clinical Cases and Diagnostic Implications

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Abstract:

Background: Polycystic Ovary Syndrome (PCOS) is one of the most prevalent endocrine disorders affecting women of reproductive age. Insulin resistance (IR) is a central metabolic feature of PCOS, often present even in non-obese individuals.

Objective: This article explores the role of laboratory markers in the diagnosis and management of IR in PCOS through clinical cases and discusses their implications in clinical practice.

Methods: A review of key biochemical markers associated with PCOS and IR was conducted, followed by the presentation of two clinical cases illustrating the utility of these parameters in diagnosis and treatment.

Results: Elevated fasting insulin, HOMA-IR >2.5, and altered androgenic and gonadotropin profiles were observed. Treatment with metformin and ovulation-induction agents proved effective in managing IR and reproductive dysfunction.

Conclusion: Laboratory testing is essential in the comprehensive evaluation of PCOS. Early identification of IR allows for timely interventions that can improve metabolic outcomes and fertility.

Key words: PCOS; insulin resistance; HOMA-IR; hyperandrogenism; infertility, laboratory medicine

Introduction

Polycystic Ovary Syndrome (PCOS) is a multifactorial endocrine disorder affecting 6–20% of women of reproductive age, depending on the diagnostic criteria used. The syndrome is characterized by reproductive, metabolic, and psychological components, with insulin resistance (IR) being a major underlying contributor to its pathophysiology.[1]

Despite being traditionally associated with obesity, IR in PCOS can occur independently of body mass index (BMI), emphasizing the importance of

biochemical assessments even in lean women.[2] The Rotterdam criteria (2003) define PCOS based on the presence of at least two of the following: oligo/anovulation, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasound.[3]

2. Laboratory Evaluation of Insulin Resistance in PCOS

2.1 Key Metabolic Markers

Test	Normal Range	Findings in IR
Fasting Glucose	70–99 mg/dL	>100 mg/dL (prediabetes)
Fasting Insulin	2–20 µIU/mL	>10–15 µIU/mL
HOMA-IR = (Glucose × Insulin)/405	<2.5	>2.5 indicates IR
HbA1c	<5.7%	5.7–6.4% (prediabetes)

Test	Normal Range	Findings in IR
OGTT (2h post-glucose)	<140 mg/dL	140–199 mg/dL (impaired tolerance)
C-peptide	0.5–2.0 ng/mL	Often elevated in IR

HOMA-IR is a widely used surrogate index for IR in clinical and research settings due to its simplicity and non-invasiveness.⁴

2.2 Hormonal and Endocrine Profile in PCOS

Parameter	Normal Range	Alteration in PCOS
LH/FSH Ratio	~1:1	>2:1 suggests PCOS
Total Testosterone	<0.7 ng/mL	Elevated
Free Testosterone	0.3–1.9 pg/mL	Elevated – more specific
DHEA-S	35–430 µg/dL	Elevated in 20–30%
Androstenedione	0.3–3.5 ng/mL	Elevated
SHBG	18–114 nmol/L	Decreased
Prolactin	4.8–23.3 ng/mL	May be elevated
TSH	0.4–4.5 mIU/L	To rule out hypothyroidism
17-OH Progesterone	<200 ng/dL (follicular phase)	Elevated in adrenal hyperplasia

3. Imaging and Additional Testing

- **Transvaginal Ultrasound:** Ovarian volume >10 cm³ or ≥12 small follicles (2–9 mm) per ovary
- **Ferritin and CRP:** May be elevated in PCOS due to chronic low-grade inflammation [5]

4. Clinical Case Presentations

Case 1: Young Woman with Metabolic and Reproductive Symptoms

- Age: 24 years
- BMI: 32
- Irregular menstrual cycles, acne
- LH/FSH ratio: 3:1
- Fasting insulin: 19 µIU/mL
- HOMA-IR: 4.5
- **Diagnosis:** PCOS with significant insulin resistance
- **Management:** Lifestyle modification + Metformin

Case 2: Infertility and Hyperandrogenism

- Age: 30 years
- Chief complaint: Infertility
- DHEA-S and free testosterone: Elevated
- SHBG: Low
- **Treatment:** Metformin + Letrozole → Successful ovulation induction

5. Management Strategies in PCOS

Effective PCOS management must address both hormonal imbalance and metabolic dysfunction:

- **Lifestyle interventions:** Diet and physical activity are first-line treatments
- **Insulin sensitizers:** Metformin improves ovulatory function and insulin response
- **Hormonal therapy:** Oral contraceptives for cycle regulation and hyperandrogenism
- **Ovulation induction:** Letrozole or clomiphene citrate in women seeking pregnancy

6. Conclusion

PCOS is a heterogeneous disorder that significantly impacts women's health across reproductive, metabolic, and emotional domains. Insulin resistance plays a critical role in its pathogenesis and should be systematically evaluated even in normoglycemic patients.

Laboratory assessment is vital for both diagnosis and personalized management. Early identification of IR allows for timely interventions that can reduce long-term complications, including infertility, type 2 diabetes, and cardiovascular disease.

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