Opinion

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The Role of Hormonal Imbalances in Female Infertility: Diagnostic and Therapeutic Perspectives

Kinsley Chen*

Department of Obstetrics and Gynecology, Palacky University Olomouc, Olomouc, Czech Republic

Corresponding author: Kinsley Chen, Department of Obstetrics and Gynecology, Palacky University Olomouc, Olomouc, Czech Republic, **E-mail:** chen.kinsley@palacky.cz

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Introduction

Infertility affects nearly 10–15% of couples worldwide, with female factors contributing to about half of the cases. Among these factors, hormonal imbalances play a critical role, as they disrupt the finely tuned processes of ovulation, endometrial receptivity and implantation. Female reproductive physiology relies on a dynamic interplay between the hypothalamus, pituitary gland, ovaries and peripheral endocrine signals. Any disruption within this hormonal axis can impair follicular development, ovulation and luteal support, leading to subfertility or infertility. Unlike structural causes of infertility, hormonal abnormalities are often functional and potentially reversible, highlighting the importance of timely diagnosis and effective treatment. The spectrum of hormonal imbalances linked to infertility includes disorders of gonadotropins, prolactin, thyroid hormones and androgens. Conditions such as polycystic ovary syndrome (PCOS), hyperprolactinemia, thyroid dysfunction and luteal phase deficiency exemplify how hormonal dysregulation interferes with reproductive outcomes. Advances in endocrinology and reproductive medicine have significantly improved the ability to diagnose these imbalances through biochemical markers, imaging modalities and functional assessments. Equally, therapeutic strategies now encompass a wide array of pharmacological, surgical and lifestyle-based interventions tailored to the underlying cause. This article explores the pathophysiological role of hormonal imbalances in female infertility, along with diagnostic and therapeutic perspectives that shape modern clinical management [1].

Description

Several hormonal abnormalities interfere with ovulation and fertility. One of the most prevalent conditions, PCOS, is characterized by hyperandrogenism, chronic anovulation and insulin resistance. Elevated Luteinizing Hormone (LH) secretion and ovarian androgen production disrupt follicular maturation, leading to anovulatory infertility. Hyperprolactinemia, often caused by pituitary adenomas or medication side effects, suppresses Gonadotropin-Releasing Hormone (GnRH) pulsatility and impairs ovulation. Thyroid dysfunction is another major contributor; hypothyroidism causes anovulation, luteal phase deficiency and hyperprolactinemia, whereas hyperthyroidism alters Sex Hormone-Binding Globulin (SHBG) levels and menstrual regularity [2].

Ovarian insufficiency and diminished ovarian reserve, frequently associated with abnormal Follicle-Stimulating Hormone (FSH) and estradiol levels, contribute to infertility by impairing oocyte quality and quantity. Adrenal disorders, such as congenital adrenal hyperplasia and Cushing's syndrome, may also disrupt normal reproductive physiology by altering androgen and cortisol levels. Collectively, these hormonal abnormalities highlight the interconnectedness of endocrine pathways and the delicate balance required for optimal fertility. Diagnosis of hormonal causes of infertility requires a systematic evaluation involving clinical history, physical examination and targeted investigations. Menstrual history, ovulatory patterns and symptoms such as galactorrhea, hirsutism, or weight changes provide initial clues. Biochemical assessments are central, with measurements of FSH, LH, estradiol, progesterone, prolactin, Thyroid-Stimulating Hormone (TSH) and androgens helping identify abnormalities. Mid-luteal serum progesterone levels confirm ovulation, while Anti-Müllerian Hormone (AMH) and antral follicle counts provide insights into ovarian reserve [3].

Dynamic tests, such as GnRH stimulation or dexamethasone suppression, may be used to evaluate hypothalamic-pituitary or adrenal dysfunction. Imaging studies, including pelvic ultrasound, detect polycystic ovarian morphology or structural abnormalities, whereas magnetic resonance imaging (MRI) can identify pituitary adenomas in hyperprolactinemia. Endometrial biopsy may be used in suspected luteal phase defects, though it is less commonly performed today. Advances in molecular and genetic diagnostics are enhancing the ability to identify underlying causes, particularly in cases of premature ovarian insufficiency. Importantly, diagnosis must integrate both laboratory and clinical findings, as hormonal fluctuations and inter-individual variability may complicate interpretation. Therapeutic approaches to

hormonal infertility are diverse and depend on the underlying etiology. Insulin sensitizers like metformin provide additional benefits by improving insulin resistance and restoring ovulatory cycles. Hyperprolactinemia is effectively managed with dopamine agonists such as cabergoline or bromocriptine, which normalize prolactin levels and restore ovulation. Thyroid dysfunction is addressed with levothyroxine for hypothyroidism or antithyroid drugs for hyperthyroidism, restoring hormonal balance and fertility potential. For luteal phase defects, progesterone supplementation supports endometrial receptivity and implantation. In premature ovarian insufficiency, options are more limited, with assisted reproductive technologies (ART), particularly oocyte donation, often being the most effective solution. Adrenal-related infertility may require glucocorticoid therapy to suppress androgen overproduction. Emerging therapies targeting endocrine signaling pathways, immunomodulation and personalized medicine approaches hold promise for more precise management in the future [4,5].

Conclusion

Hormonal imbalances are a leading cause of female infertility, disrupting ovulation, endometrial receptivity and reproductive outcomes. Conditions such as PCOS, hyperprolactinemia, thyroid disorders, ovarian insufficiency and luteal phase defects exemplify the diverse mechanisms by which endocrine dysfunction affects fertility. Advances in diagnostics have enabled earlier and more accurate detection through biochemical, imaging and molecular tools, while therapeutic options range from lifestyle modification and pharmacological treatments to advanced ART techniques. An individualized, multidisciplinary approach that integrates endocrinology, reproductive medicine and patient-centered care is essential for optimizing outcomes. As research advances, emerging therapies and precision medicine are expected to further improve diagnostic accuracy and therapeutic success, offering renewed hope to women struggling with infertility caused by hormonal imbalances.

Acknowledgment

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Conflict of Interest

None.

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