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NORMAL PHYSIOLOGY AND PATHOLOGY OF THE MENSTRUAL CYCLE

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ABSTRACT

The menstrual cycle is a highly regulated physiological process essential for female reproductive health. It is governed by the hypothalamic-pituitary-ovarian (HPO) axis and involves cyclical hormonal changes that prepare the endometrium for potential pregnancy. Disruptions in this cycle can lead to a variety of pathological conditions, including amenorrhea, dysmenorrhea, menorrhagia, and endocrine disorders such as Polycystic Ovary Syndrome (PCOS). This article reviews both the normal physiology and pathological alterations of the menstrual cycle, highlighting their mechanisms, clinical implications, and management strategies.

Keywords: menstrual cycle, physiology, pathology, amenorrhea, dysmenorrhea, PCOS, reproductive health

INTRODUCTION

The menstrual cycle is a cornerstone of female reproductive physiology, reflecting the functional integrity of the hypothalamic-pituitary-ovarian (HPO) axis. A normal cycle ranges from 21 to 35 days and is characterized by coordinated hormonal fluctuations involving estrogen, progesterone, follicle-stimulating hormone (FSH), and luteinizing hormone (LH).

According to the World Health Organization, menstrual health is an important indicator of overall health and well-being in women.

Any disruption in this finely tuned system may lead to menstrual disorders, which are among the most common gynecological complaints worldwide.

MATERIALS AND METHODS

This article is based on a narrative review of literature from PubMed, Scopus, and Web of Science.

Inclusion Criteria:

- Studies published between 2010 and 2024
- Research on menstrual physiology and disorders
- Clinical and experimental studies

RESULTS

1. Normal Physiology of the Menstrual Cycle

The menstrual cycle is divided into four main phases:

1. Menstrual phase
2. Follicular phase
3. Ovulation
4. Luteal phase

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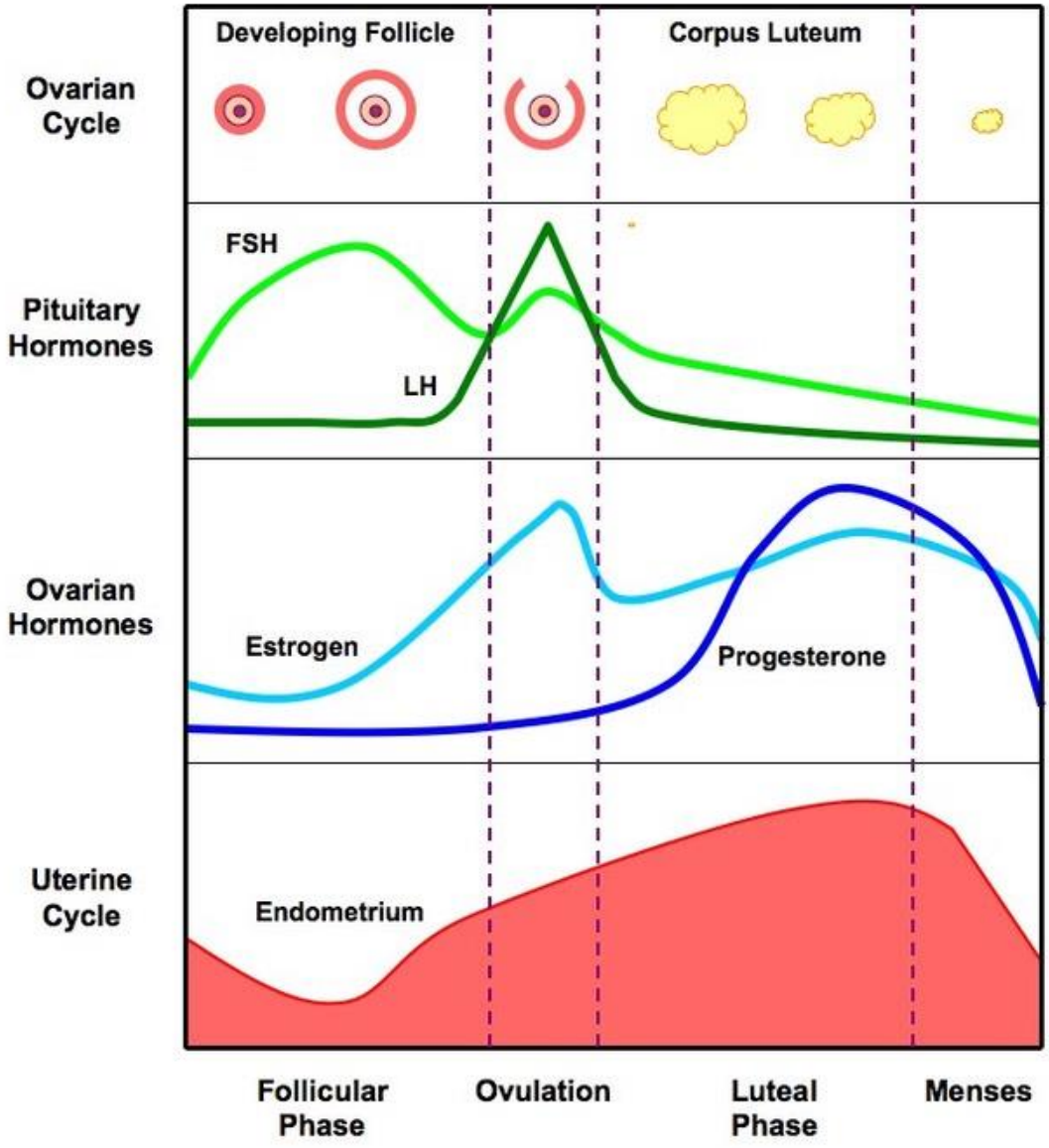

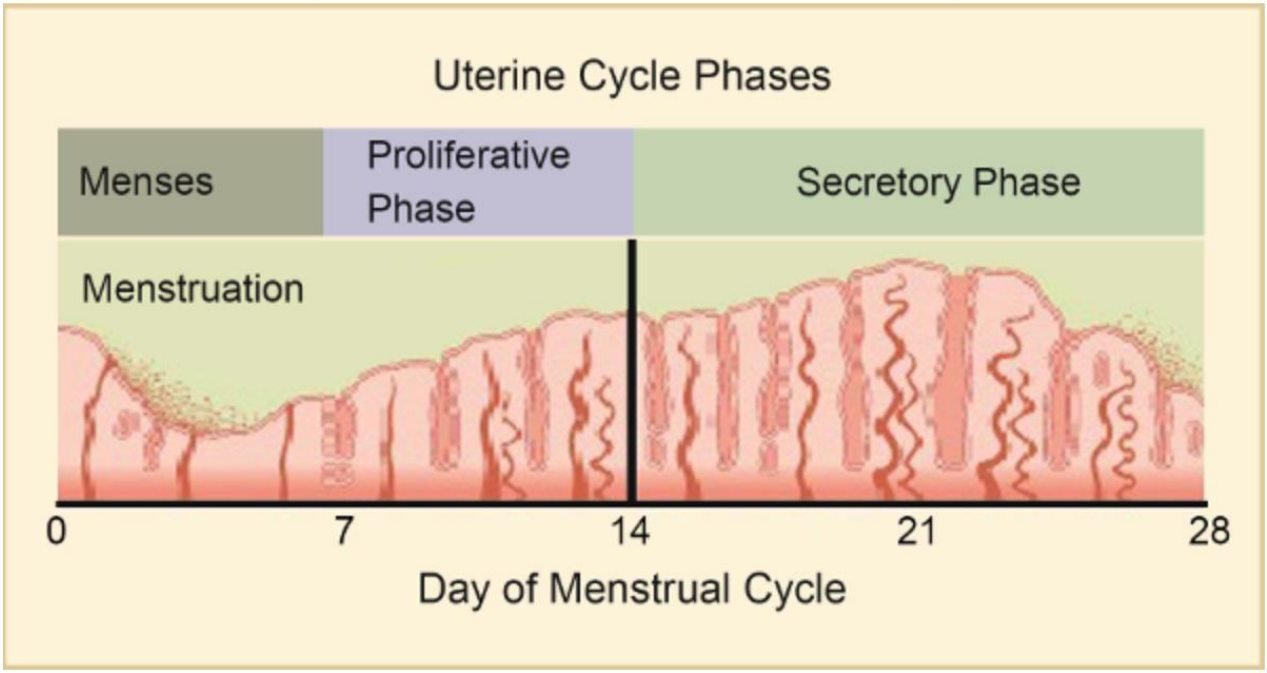

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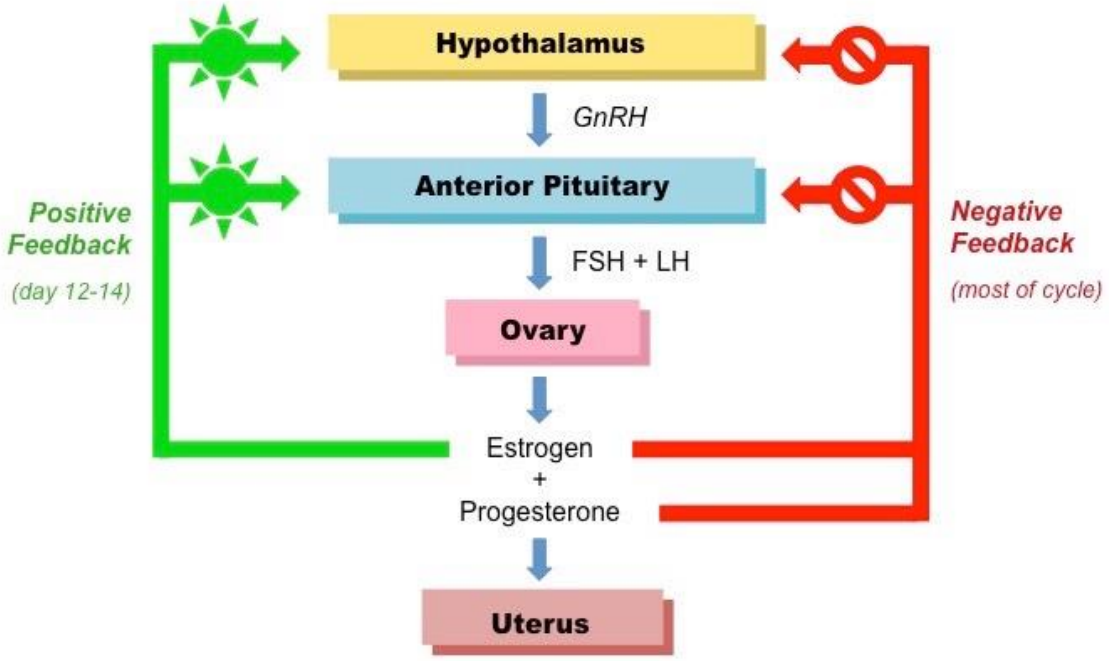
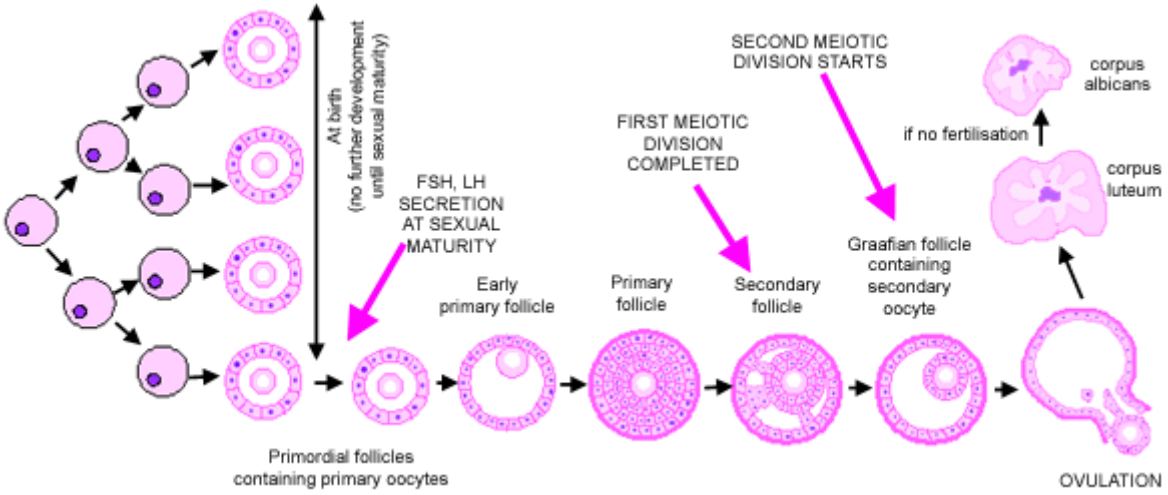
Hormonal Regulation (HPO Axis)

The cycle is regulated by the hypothalamic-pituitary-ovarian axis:

- Hypothalamus → GnRH
- Pituitary → FSH and LH
- Ovaries → Estrogen and Progesterone

These hormones interact via feedback mechanisms to maintain cycle regularity.





Functional Significance

- Regulates ovulation
- Prepares endometrium for implantation
- Maintains fertility

2. Pathology of the Menstrual Cycle

Menstrual disorders arise from dysfunction at any level of the HPO axis.

a. Amenorrhea

Absence of menstruation:

- Primary amenorrhea → no menstruation by age 15
- Secondary amenorrhea → cessation for ≥3 months

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Causes:

- Hormonal imbalance
- Stress
- Endocrine disorders

b. Dysmenorrhea

Painful menstruation:

- Primary → due to prostaglandin excess
- Secondary → due to underlying pathology (e.g., Endometriosis)

c. Menorrhagia (Heavy Menstrual Bleeding)

Excessive menstrual blood loss (>80 mL per cycle)

Causes:

- Hormonal imbalance
- Uterine fibroids
- Coagulation disorders

d. Oligomenorrhea and Irregular Cycles

Often associated with:

- Polycystic Ovary Syndrome
- Thyroid dysfunction
- Obesity

3. Pathophysiological Mechanisms

a. Hormonal Imbalance

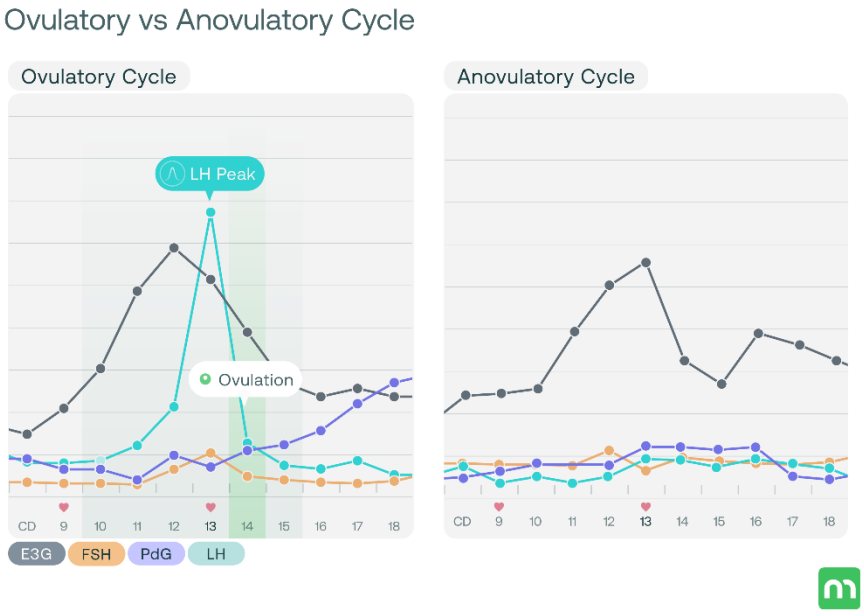
Disruption in estrogen and progesterone levels leads to irregular cycles.

b. Anovulation

Failure to ovulate results in absent or irregular menstruation.

c. Structural Abnormalities

Conditions such as fibroids and endometriosis alter normal uterine function.



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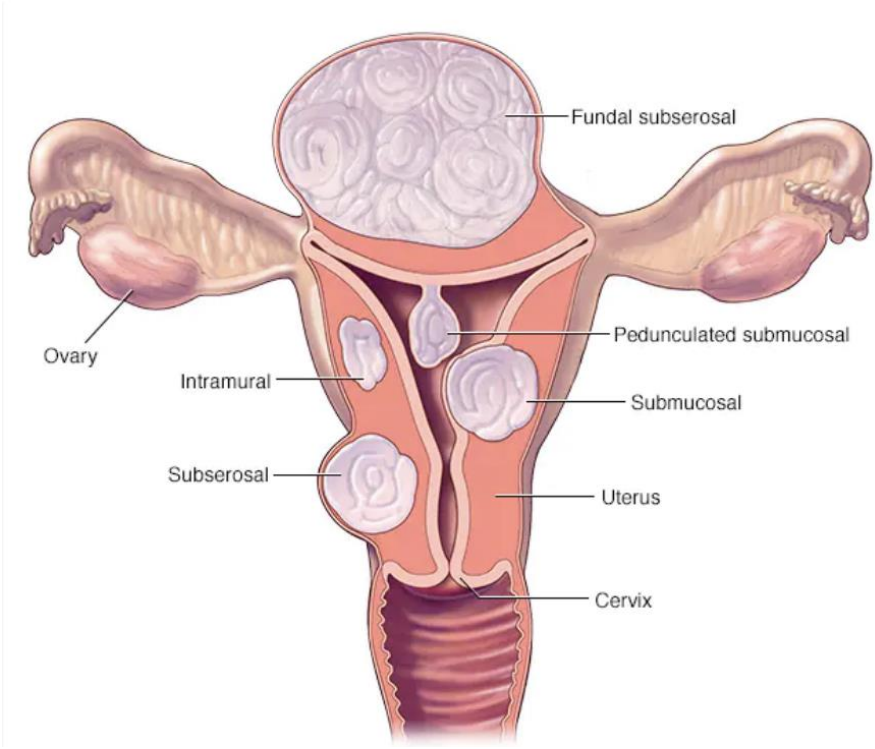

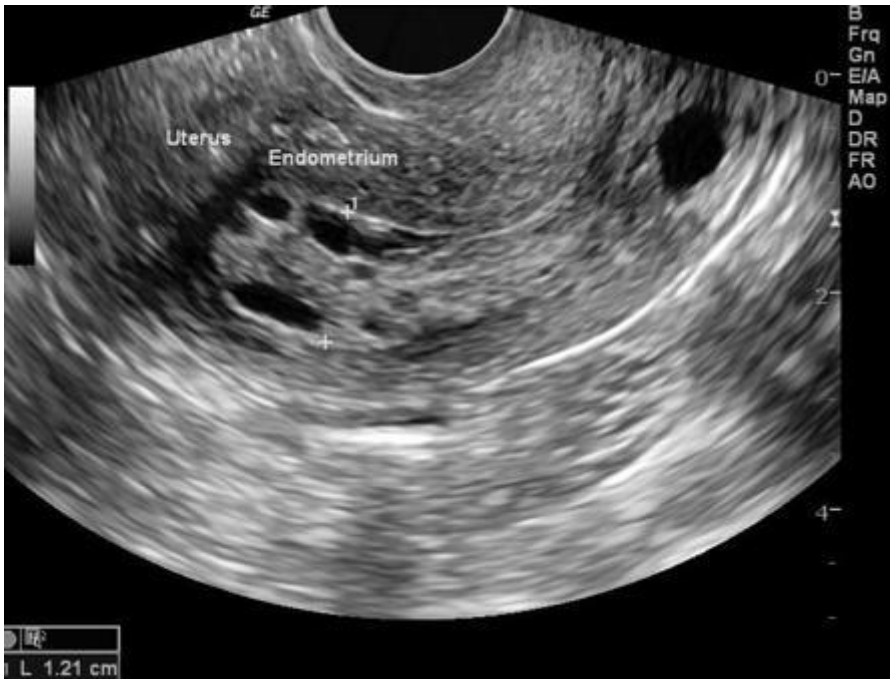

4. Clinical Significance

Menstrual irregularities may indicate:

- Endocrine disorders
- Metabolic diseases
- Reproductive dysfunction

Impact:

- Infertility
- Reduced quality of life
- Increased risk of chronic disease

5. Diagnosis and Management

Diagnosis:

- Menstrual history
- Hormonal assays
- Ultrasound imaging

Management:

- Hormonal therapy
- Lifestyle modification
- Treatment of underlying cause

DISCUSSION

The menstrual cycle reflects a complex interaction of hormonal, metabolic, and structural factors. While normal physiology ensures reproductive function, pathological disruptions can have significant clinical consequences.

Early identification and management of menstrual disorders are essential to prevent long-term complications such as infertility and metabolic disease.

CONCLUSION

The menstrual cycle is a vital indicator of female health. Understanding both its normal physiology and pathological alterations is crucial for effective clinical practice. Early diagnosis and appropriate treatment can significantly improve reproductive and overall health outcomes.

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