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REGULATION OF THE MENSTRUAL CYCLE AND FUNCTIONAL DIAGNOSTIC TESTS: INTEGRATING OVARIAN, UTERINE AND ENDOCRINE SIGNALS

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ABSTRACT

Background: Menstrual-cycle regulation is a core topic in gynecology because irregularity, pain and abnormal bleeding often reveal endocrine or structural disease. Objective: This article reviews the hypothalamic-pituitary-ovarian axis, ovarian and uterine cycles, and functional diagnostic tests. Methods: International epidemiological sources and clinical review evidence were synthesized in an IMRAD format. Results: The menstrual cycle reflects coordinated follicular development, ovulation, luteal function and endometrial transformation; basal temperature, ultrasound folliculometry, hormonal assays and ovulation tests provide complementary information. Discussion: Functional tests are useful only when interpreted with history and clinical context. Conclusion: Cycle assessment should move beyond calendar counting toward integrated endocrine and endometrial reasoning.

Keywords: menstrual cycle; ovarian cycle; uterine cycle; functional diagnostics; ovulation; dysmenorrhea

INTRODUCTION

The menstrual cycle is a monthly clinical report generated by the hypothalamus, pituitary, ovaries and endometrium. Its timing, bleeding pattern, pain profile and associated symptoms can reveal ovulation, endocrine disruption, pregnancy-related problems, infection, structural disease or systemic illness. Treating menstruation as a simple calendar event is therefore clinically weak.

Cycle regulation depends on pulsatile gonadotropin-releasing hormone, pituitary secretion of follicle-stimulating hormone and luteinizing hormone, ovarian follicular development, estrogen production, ovulation, corpus luteum progesterone and endometrial response. A disruption at any level can change the pattern. That is why irregular menstruation is not a diagnosis; it is a sign requiring interpretation.

Functional diagnostic tests are useful because they translate physiology into measurable signals. Basal body temperature reflects the thermogenic effect of progesterone after ovulation. Serum progesterone can support evidence of luteal activity. LH urine tests may predict ovulation. Ultrasound folliculometry directly observes follicle growth and endometrial thickness. No single test is perfect.

This article reviews menstrual-cycle regulation, the ovarian and uterine cycles, and functional diagnostic tests, using epidemiological statistics to show why cycle assessment matters in general medical education.

METHODS

A narrative review was performed using international evidence on infertility, PCOS, endometriosis, dysmenorrhea and reproductive health. The review emphasized clinically relevant physiology and diagnostic reasoning rather than specialist infertility treatment.

The analysis was structured around three questions: how is the cycle regulated, what do ovarian and uterine phases represent, and how should functional tests be interpreted? Statistical data were used to prioritize common conditions connected with cycle disturbance.

This educational article does not replace gynecologic consultation. It is intended to improve student-level reasoning before referral or specialist evaluation.

RESULTS

The ovarian cycle includes follicular, ovulatory and luteal phases. In the follicular phase, FSH supports follicle recruitment and estrogen production. Rising estrogen stimulates endometrial proliferation and eventually contributes to the LH surge. Ovulation follows the LH surge, after which the corpus luteum produces progesterone.

The uterine cycle includes menstrual, proliferative and secretory phases. Menstruation occurs after withdrawal of progesterone and estrogen when pregnancy has not occurred. The proliferative phase rebuilds the endometrium under estrogen influence. The secretory phase prepares the endometrium for implantation under progesterone influence.

Functional diagnostic testing must match the clinical question. If the question is whether ovulation occurs, mid-luteal progesterone, LH testing or ultrasound can help. If the question is abnormal bleeding, endometrial assessment and broader evaluation may be needed. If the question is pain, cycle timing and secondary causes such as endometriosis become central.

Basal body temperature is inexpensive but vulnerable to poor measurement, sleep disruption, illness and interpretation errors. It may confirm that ovulation likely occurred, but it is less useful for precise prospective prediction. Urinary LH tests are more convenient for predicting ovulation but can be misleading in conditions with chronically abnormal LH patterns.

Ultrasound folliculometry provides direct visualization of follicular growth, ovulation signs and endometrial development. It is more informative but requires equipment, trained personnel and repeated visits. Hormonal panels can assess FSH, LH, estradiol, progesterone, prolactin, thyroid function and androgens depending on the suspected disorder.

Epidemiological data show the importance of this topic. Infertility affects roughly one in six adults globally during their lifetime. PCOS is common and frequently undiagnosed. Dysmenorrhea and endometriosis create pain and fertility burdens. Menstrual-cycle history is therefore not a minor complaint but a gateway to reproductive and systemic health assessment.

Case-based result 1: A patient reports bleeding every 35 to 60 days with acne and increased hair growth. The cycle history suggests possible ovulatory dysfunction and hyperandrogenism, but PCOS should not be diagnosed until mimicking disorders are considered.

Case-based result 2: A patient has regular monthly bleeding but infertility. Regular bleeding does not prove ovulation or rule out tubal, uterine or male-factor causes. The menstrual calendar is only one part of fertility assessment.

Case-based result 3: Severe pain begins several years after menarche and worsens over time. This pattern is not typical reassurance-level primary dysmenorrhea. Secondary causes, including endometriosis, should be considered.

Case-based result 4: A progesterone test is ordered without attention to ovulation timing. The result is low and is misread as luteal failure. This case demonstrates that a poorly timed test can create a false diagnosis.

These cases show that menstrual assessment requires pattern recognition. Cycle length, bleeding volume, pain, systemic symptoms and fertility goals must be interpreted together.

The practical result is a one-page cycle worksheet with four rows: rhythm, bleeding, pain and endocrine signs. This makes history structured and reduces the chance that important clues are missed.

Table 1. Statistical indicators used for clinical interpretation

Indicator	Reported value	Interpretation in this article
Infertility global lifetime prevalence	about 17.5% of adults	Ovulatory disorders are a major diagnostic category.
PCOS prevalence	about 10-13% of women globally	Common cause of irregular cycles and anovulation.
Undiagnosed PCOS	up to 70% of affected women	Cycle irregularity may be missed or normalized.
Dysmenorrhea worldwide prevalence	pooled estimate about 71.3%	Pain history should be part of cycle assessment.
Endometriosis burden	about 10%, or 190 million reproductive-age women	Secondary pain may signal structural disease.

Table 2. Practical clinical matrix for student use

Clinical question	Most useful first assessment	Escalation trigger
Is ovulation likely?	Cycle history, LH/progesterone or ultrasound	Infertility or persistent irregularity
Is pain primary or secondary?	Timing, severity and response to treatment	Progressive or non-cyclic pain
Which hormone test is useful?	Test based on clinical question and timing	Contradictory or unexplained results

DISCUSSION

The first diagnostic trap is relying only on cycle length. A 28-day cycle can be anovulatory; a longer cycle can still include ovulation. Bleeding does not automatically prove normal ovulation. Students must separate menstrual bleeding, ovulation and luteal adequacy as related but distinct events.

The second trap is using tests without timing. Progesterone measured at the wrong point in the cycle may be falsely interpreted. LH tests may be confusing in PCOS. Ultrasound findings must be related to cycle day and symptoms. A test result without timing is often a weak result.

The third trap is normalizing pain. Dysmenorrhea is common, but common does not mean harmless. Severe, progressive, treatment-resistant or non-cyclic pain should raise concern for secondary causes. Endometriosis remains under-recognized partly because menstrual pain is often dismissed.

Functional diagnosis also has a counseling role. Patients benefit when clinicians explain what a test can and cannot show. For example, an LH test can suggest imminent ovulation, but it cannot prove

tubal patency or endometrial receptivity. This prevents false reassurance and unrealistic expectations.

Cycle apps and calendars can support history, but they can also create false precision. A predicted ovulation date generated by an application is not equivalent to biological confirmation. Clinicians should use digital records as patient-reported data, not as diagnostic proof.

Adolescent menstrual assessment requires sensitivity. Early cycles after menarche may be irregular, but severe bleeding, extreme pain, anemia symptoms or prolonged absence of menstruation should not be ignored. The clinician must balance reassurance with detection of disease.

The endocrine axis is pulsatile, not static. A single hormone value can be misleading if the timing is wrong. This is why endocrine interpretation requires cycle day, bleeding pattern and medication history.

The edge case is amenorrhea with negative pregnancy test but systemic symptoms. Thyroid disease, hyperprolactinemia, undernutrition or chronic illness may be present. The menstrual cycle can be the first visible sign of broader disease.

Another edge case is heavy bleeding in adolescents. It may reflect anovulatory cycles, but bleeding disorders must be considered when symptoms are severe. Reassurance without checking severity is unsafe.

The tradeoff in testing is cost versus clarity. Ordering broad hormone panels without a hypothesis wastes resources and may create incidental abnormalities. Targeted tests based on history are more defensible.

The follicular phase is more variable than the luteal phase in many cycles. This is why delayed ovulation often lengthens the whole cycle. Students who understand this are less likely to misinterpret every long cycle as the same disorder.

Endometrial response is the visible output of ovarian hormone patterns. Heavy, prolonged or irregular bleeding can reflect anovulation, structural lesions, pregnancy-related complications or systemic disease. The bleeding pattern should be described precisely.

A good menstrual history also asks about medications, including hormonal contraception, anticoagulants and drugs that affect prolactin. Without medication history, cycle interpretation is incomplete.

Functional diagnostic tests should be explained before ordering. Patients should know why a test is being done and what decisions may follow. Testing without explanation can increase anxiety and reduce trust.

Ovulatory dysfunction should be considered when cycles are persistently irregular, but the degree of concern depends on age, time since menarche, pregnancy possibility, symptoms and fertility goals. Context prevents both overdiagnosis and neglect.

Abnormal uterine bleeding terminology should be taught carefully. Frequency, regularity, duration and volume describe different dimensions. Saying only 'irregular bleeding' is often too vague for clinical reasoning.

Students should also understand that cycle concerns may be the first reason a young woman interacts with healthcare. The quality of that first response affects future trust in medical services.

The final added result is that functional diagnostic tests should be ordered only after the history has created a question. The test is the answer-seeking tool; it should not be the beginning of thinking.

The student should also recognize red flags: postcoital bleeding, intermenstrual bleeding, very heavy bleeding with anemia symptoms, pregnancy possibility, severe progressive pain and amenorrhea with systemic symptoms. These should not be treated as routine cycle variation.

Cycle disorders often overlap. A patient can have PCOS and endometriosis, or thyroid dysfunction and heavy bleeding. One diagnosis should not close thinking too early.

For education, graphing hormones and endometrial phases on the same line helps students understand why symptoms occur when they do. Visual integration is more effective than separate tables.

The final result is that menstrual-cycle assessment should be treated as a vital sign of reproductive endocrine health. It is not as immediate as pulse or blood pressure, but it carries diagnostic information that should not be ignored.

Cycle education should include what is normal variation and what is not. Patients need to know when irregularity, severe pain, intermenstrual bleeding or postcoital bleeding should prompt care. Education prevents delay.

Functional diagnostic tests also have emotional consequences. Infertility evaluation can create anxiety, especially if results are poorly explained. Students should learn to communicate uncertainty without blame.

A useful local student project would analyze anonymous menstrual-history patterns among university students and measure how many seek care for severe pain or irregularity. This could identify educational gaps.

The strongest teaching model is a cycle map that places hormones, ovarian events, endometrial changes and symptoms on one timeline. Separate memorization of each layer is less effective.

Functional tests should be interpreted alongside pregnancy possibility. In reproductive-age patients, abnormal bleeding or amenorrhea requires pregnancy exclusion when relevant. Skipping this step is a classic and avoidable diagnostic error.

The cycle also reflects general health. Weight change, stress, intense exercise, chronic disease, thyroid dysfunction and medications can all alter ovulation. A narrow gynecologic view may miss systemic causes.

The limitation of this review is that it does not cover advanced reproductive technologies or detailed endocrine treatment. Those require specialist protocols. The focus here is the first layer of reasoning that general medical students should master.

The smallest useful change is a structured menstrual history: age at menarche, cycle length and variability, bleeding volume, pain pattern, intermenstrual bleeding, pregnancy possibility, medications, weight change, acne or hirsutism, thyroid symptoms and fertility goals. This history makes later testing rational.

CONCLUSION

The menstrual cycle is a coordinated endocrine and endometrial process. Its disturbances can indicate ovulatory, structural, infectious, metabolic or systemic disease.

Functional diagnostic tests are valuable only when matched to the clinical question and timed correctly. Medical students should learn cycle assessment as integrated reasoning, not calendar memorization.

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