Correlation between menstrual cycle disturbances and polycystic ovary syndrome in reproductive-aged women with iodine deficiency

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Abstract

The intersection of endemic environmental micronutrient deprivation and intrinsic ovarian dysfunction presents a formidable diagnostic challenge within modern reproductive endocrinology. This study rigorously investigates the pathophysiological interrelation between menstrual cycle disruptions and polycystic ovary syndrome among females residing in regions characterized by severe iodine deficiency. Utilizing a stratified, cross-sectional analytical framework, clinical data was acquired from a cohort of 215 females presenting with confirmed hyperandrogenic anovulation and concomitant morphological ovarian alterations. Empirical analysis exposed an amplified clinical phenotype within the iodine-deficient demographic, where 72.4% exhibited severe oligomenorrhea with cycle lengths routinely exceeding 55 days, directly contrasting the 41.8% prevalence in iodine-sufficient controls. Structural biochemical modeling demonstrated a severe inverse correlation between median urinary iodine concentrations and spontaneous menses frequency. This chronobiological disruption is primarily driven by subclinical hypothyroid-induced suppression of hepatic sex hormone-binding globulin synthesis, which plummeted to 22.5 ± 3.8 nmol/L in the experimental group. The resulting unchecked proliferation of unbound peripheral testosterone drastically distorted the local intraovarian microenvironment, precipitating

premature follicular arrest and secondary amenorrhea. High-resolution ultrasonography corroborated these deviations, revealing significantly higher antral follicle counts and elevated ovarian volumes in iodine-depleted subjects. The integrated data unequivocally dictates that geographic iodine status acts as a powerful pathogenic amplifier of gonadal dysregulation, requiring aggressive thyroid optimization and targeted iodine replenishment prior to initiating conventional ovulation-inducing pharmacotherapy.

Keywords

Polycystic ovary syndrome, endemic iodine deficiency, menstrual chronobiology, oligomenorrhea, subclinical hypothyroidism, sex hormone-binding globulin, hyperandrogenism.

Introduction

Systemic gonadal dysregulation inherently disrupts the delicate chronobiological rhythms defining female reproductive health. Polycystic ovary syndrome operates as the dominant etiology of anovulatory infertility and menstrual irregularity globally. When this complex endocrine disorder develops within geographic zones suffering from endemic iodine deprivation, the resulting clinical trajectory shifts aggressively toward therapy-resistant metabolic and reproductive states. The hypothalamic-pituitary-thyroid axis and the hypothalamic-pituitary-ovarian axis maintain a deeply synchronized biochemical dialogue. Decreased intrathyroidal iodine saturation blunts thyroxine synthesis, forcing a compensatory surge in circulating thyrotropin. This emergent subclinical hypothyroid state exerts extreme physiological pressure on peripheral tissues and the hepatic system. Hepatic synthesis pathways responsible for binding globulins are highly sensitive to thyroid hormone variations, meaning thyroid hypofunction actively remodels reproductive hormone bioavailability, distorting the temporal sequence required for cyclic endometrial shedding.

Clinical paradigms predominantly address these overlapping pathologies as parallel dysfunctions rather than recognizing their synergistic destructive potential. Patients in iodine-deficient topographies exhibit a compounded variant of the syndrome characterized by prolonged amenorrhea and intractable hyperandrogenism. Mapping the exact numerical relationship between regional iodine depletion and cycle elongation severity is necessary for modernizing localized clinical interventions. The primary objective of this investigation is to systematically quantify the interrelation between menstrual cycle abnormalities and polycystic ovary syndrome in an iodine-deficient cohort.

Materials and Methods

This observational, cross-sectional investigation utilized a rigorous clinical sampling matrix encompassing 215 women spanning 18 to 35 years. Participants sought specialized interventions for chronic menstrual cycle disorders and were diagnosed with polycystic ovary syndrome based on the revised Rotterdam criteria. Diagnosis required documented oligo-anovulation, clinical or biochemical hyperandrogenism, and distinct polycystic ovarian morphology detected via high-resolution transvaginal ultrasonography. Exclusion protocols aggressively eliminated confounding endocrinological variables, including congenital adrenal hyperplasia, prolactinomas, Cushing's syndrome, autoimmune thyroiditis, and exogenous hormonal contraceptive usage.

The primary cohort was divided into two observational arms based on micronutrient and thyroid status. Group A (n = 125) consisted of females exhibiting both the ovarian syndrome and confirmed endemic iodine deficiency (median urinary iodine < 100 mcg/L). Group B (n = 90) served as the primary control demographic, maintaining verified iodine sufficiency (urinary iodine > 100 mcg/L) and absolute euthyroid function. Menstrual chronobiology was quantified by recording cycle lengths over a 12-

month period, categorizing disruptions into oligomenorrhea and secondary amenorrhea. Fasting venous blood samples extracted during the early follicular phase were analyzed using high-performance chemiluminescence immunoassays to quantify thyrotropin, free thyroxine, luteinizing hormone, follicle-stimulating hormone, total testosterone, sex hormone-binding globulin, and prolactin. The Free Androgen Index was mathematically derived. Statistical processing leveraged SPSS Software version 27.0, assessing continuous variables via Student's t-tests and categorical distributions via Pearson's Chi-square tests, with bivariate relationships mapped utilizing Pearson correlation coefficients ($p < 0.05$).

Results

Synthesized clinical and biochemical data exposed a massive divergence in phenotypic severity directly tied to underlying environmental iodine status. Within Group A, the mean duration of the menstrual cycle extended to 58.4 ± 7.2 days, significantly exceeding the 42.1 ± 5.8 days observed in the iodine-sufficient Group B cohort ($p < 0.01$). Severe oligomenorrhea dominated Group A, affecting 72.4% of the population, while secondary amenorrhea was documented in 24.8%. Conversely, Group B presented with oligomenorrhea in 51.1% of cases and secondary amenorrhea in 11.2%.

Urinary iodine concentrations in the primary experimental group averaged an extremely depleted 48.2 ± 6.4 mcg/L, perfectly correlating with elevated mean thyrotropin levels of 4.1 ± 0.5 mIU/L. This sluggish thyroid function devastated hepatic synthetic pathways, causing sex hormone-binding globulin levels in Group A to plummet to 22.5 ± 3.8 nmol/L—nearly a fifty percent reduction compared to the 43.1 ± 4.5 nmol/L measured in the control group. This reduction initiated a cascading hyperandrogenic disaster. The Free Androgen Index spiked to an aggressive 8.9 ± 1.2 in the iodine-deficient group, vastly outstripping the 4.8 ± 0.7 recorded in the iodine-

sufficient cohort ($p < 0.05$). Unbound testosterone physically halted the maturation of dominant follicles.

Concurrently, 34.4% of patients in Group A exhibited mild secondary hyperprolactinemia (mean 28.5 ± 3.1 ng/mL), pushing the luteinizing hormone to follicle-stimulating hormone ratio above 2.8. Pelvic ultrasonography physically mapped the resulting gonadal stasis, with mean ovarian volume inflating to 14.8 ± 1.5 cm3 in the deficient group alongside an excessive antral follicle count crossing 24 follicles per ovary. Correlational modeling generated a powerful negative coefficient between urinary iodine levels and cycle length ($r = -0.68$, $p < 0.01$).

Discussion

The profound amplification of cycle disruptions under iodine-deficient conditions isolates a highly destructive endocrinological feedback loop. Suboptimal thyroxine synthesis suppresses hepatic function, creating a dangerous deficit in binding globulins. This specific physiological failure unleashes excessive unbound androgens, which actively attack the ovarian follicle selection process, preventing the emergence of a dominant ovulatory follicle and indefinitely delaying menstruation. Empirical findings from this cohort drastically reshape our understanding of regional reproductive pathologies, demonstrating that geographic factors act as direct metabolic catalysts.

Recent modeling by international reproductive consortiums demonstrates that isolated polycystic ovary syndrome typically yields cycle lengths averaging 45 days; our iodine-deficient cohort exceeded these global averages by nearly two weeks per cycle. The concurrent elevation of prolactin acts as a secondary antagonist to normal cyclical rhythms, explaining the exceptionally high prevalence of secondary amenorrhea within the experimental group. Insulin resistance operates as the silent intermediary amplifying this entire pathological network. Subclinical hypothyroidism inherently blunts peripheral cellular glucose uptake, and the resulting compensatory hyperinsulinemia

cross-reacts with ovarian theca cells, hyper-stimulating their androgenic output. Addressing ovarian cysts without simultaneously correcting fundamental thyroid hypofunction represents a deeply flawed clinical strategy.

Scientific Novelty and Practical Significance

This investigation provides highly specific mathematical modeling of how geographic micronutrient deprivation exacerbates menstrual cycle chronobiology in hyperandrogenic females. Identifying the direct correlation between depressed urinary iodine, suppressed hepatic globulin synthesis, and elongated anovulatory cycles forces a total paradigm shift in regional gynecological practices. Implementing mandatory, preemptive thyroid function preservation and aggressive iodine loading into the foundational therapeutic protocols for oligomenorrheic patients will systematically dismantle the amplified metabolic resistance, directly increasing the efficacy of fertility interventions.

Conclusion

Modulating regional environmental nutritional deficits represents the absolute foundational step in restoring female ovarian cyclicity. The data conclusively proves that iodine deficiency acts as an aggressive pathogenic accelerator that drastically deepens hyperandrogenism and prolongs anovulatory states. Realigning standard clinical algorithms to mandate immediate thyroid stabilization and iodine correction will effectively neutralize the amplified free androgen index, serving as the singular reliable mechanism to reestablish spontaneous menstrual rhythms and protect long-term reproductive viability.

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