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Association of Serum FSH and Estradiol Levels with Genitourinary Syndrome of Menopause: A Cross-Sectional Observational Study

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Abstract

Background: Genitourinary Syndrome of Menopause (GSM) is a prevalent condition among postmenopausal women, characterized by vaginal, urinary, and sexual symptoms due to hypoestrogenism. The hormonal alterations involving serum Follicle Stimulating Hormone (FSH) and estradiol levels play a critical role in the pathophysiology of GSM. This study aims to evaluate the association between serum FSH and estradiol levels with GSM and its objective markers, including vaginal pH and Vaginal Maturation Index (VMI).

Methods: A cross-sectional descriptive study was conducted among 102 postmenopausal women at the Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur. Participants were divided into two groups based on the presence or absence of GSM symptoms. Serum FSH and estradiol levels were measured using immunoenzymometric assay. Vaginal pH and VMI were assessed through vaginal swab cytology. Statistical analysis included unpaired t-test and Chi-square test, with $p < 0.05$ considered significant.

Results: The mean serum FSH level was significantly higher among GSM-positive women (46.11 ± 2.57 IU/L) compared to GSM-negative women (43.95 ± 2.09 IU/L, $p = 0.0001$). Serum estradiol levels were significantly lower among GSM-positive cases (12.01 ± 1.40 pg/mL) compared to GSM-negative (13.13 ± 1.05 pg/mL, $p = 0.0002$). Serum FSH showed a positive association with vaginal pH ($p = 0.03$) and a negative association with VMI ($p < 0.0001$), whereas estradiol exhibited a negative association with pH ($p = 0.001$) and a positive association with VMI ($p < 0.0001$).

Conclusion: Elevated serum FSH and reduced estradiol levels are significantly associated with the presence and severity of GSM. These hormonal markers, in conjunction with vaginal pH and VMI, can serve as reliable biochemical indicators for early detection and management of GSM in postmenopausal women.

Keywords: Genitourinary syndrome of menopause, FSH, Estradiol, Vaginal pH, Vaginal maturation index.

Introduction

Menopause represents the permanent cessation of menstruation resulting from the depletion of ovarian follicles and decline in estrogen production. This transition, while physiological, is associated with a variety of systemic and local changes. Among the most bothersome local manifestations is the Genitourinary Syndrome of Menopause (GSM), encompassing vaginal dryness, irritation, burning, dysuria, urgency, and dyspareunia. These symptoms arise primarily from estrogen deficiency and contribute substantially to reduced quality of life in postmenopausal women. The loss of ovarian function results in a marked reduction in circulating estradiol and inhibin, leading to a compensatory increase in Follicle Stimulating Hormone (FSH) secretion from the anterior pituitary. Serum FSH levels typically rise 10–20 fold after menopause, while estradiol levels fall below 20 pg/mL. These hormonal alterations exert profound effects on the vaginal and urinary epithelium, resulting in epithelial thinning, loss of elasticity, and increased vaginal pH. While serum FSH and estradiol are well-established markers of ovarian function, their specific relationship with the degree of GSM symptoms has been less well-defined. This study aims to explore the association of these serum hormonal markers with objective clinical parameters such as vaginal pH and Vaginal Maturation Index (VMI) among postmenopausal women.

Materials and Methods

This descriptive cross-sectional observational study was conducted in the Department of Obstetrics and Gynaecology, Sawai Man Singh Medical College, Jaipur, following institutional ethical clearance. The study population comprised 102 postmenopausal women (≥1 year of amenorrhea, <5 years since menopause) attending the gynecology outpatient department. Inclusion criteria: Women with intact uterus and at least one ovary, not on hormone therapy, and willing to provide informed consent. Exclusion criteria included active genital infection, use of vaginal medications, recent intercourse (<3 days), malignancy, or systemic disease. Clinical data were collected using a structured questionnaire assessing GSM symptoms — vaginal dryness, itching, discharge, dyspareunia, and difficulty during micturition. Severity was self-graded as mild, moderate, or severe. Vaginal pH was measured using micro-range pH indicator strips applied to the lateral vaginal wall. Vaginal cytology smears were prepared and stained to calculate the VMI, expressing the relative proportions of parabasal, intermediate, and superficial cells. Serum FSH and estradiol levels were measured using Immunoenzymometric Assay (IEMA). Statistical analysis was performed using SPSS v23, employing Student's t-test for continuous variables and Chi-square test for categorical variables, with $p < 0.05$ considered statistically significant.

Results

The mean age of the study population was 50.57 ± 2.79 years. Of 102 participants, 74 (72.5%) reported GSM symptoms while 28 (27.5%) were asymptomatic. Most participants (46%) were between 46–50 years of age.

The mean serum FSH level in GSM-positive women was 46.11 ± 2.57 IU/L, significantly higher than 43.95 ± 2.09 IU/L in GSM-negative women ($p = 0.0001$). The mean serum estradiol level was significantly lower in GSM-positive women (12.01 ± 1.40 pg/mL) compared to GSM-negative women (13.13 ± 1.05 pg/mL; $p = 0.0002$). Vaginal pH was higher among GSM-positive women (mean 5.96 ± 0.36) compared to GSM-negative (5.57 ± 0.4, $p < 0.0001$). VMI was lower in GSM-positive women (49.86 ± 6.08) compared to GSM-negative (56.71 ± 5.44, $p < 0.0001$). Serum FSH showed a positive

correlation with vaginal pH ($p = 0.03$) and negative correlation with VMI ($p < 0.0001$). Conversely, estradiol showed an inverse relationship with vaginal pH ($p = 0.001$) and a positive correlation with VMI ($p < 0.0001$).

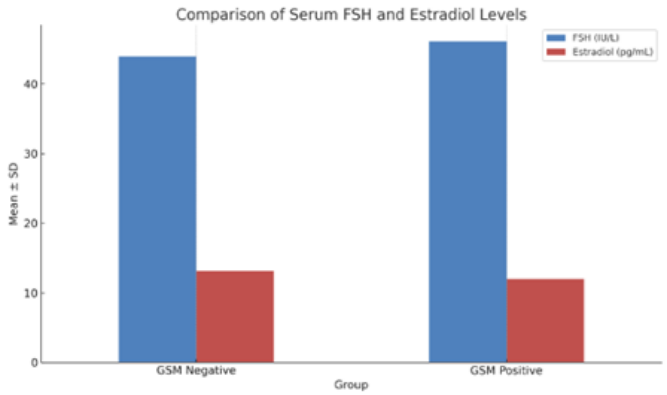

Figure 1: Comparison of mean serum FSH and estradiol levels between GSM-positive and GSM-negative women.

Discussion

The present study demonstrated a significant association between elevated serum FSH, reduced estradiol levels, and the presence of Genitourinary Syndrome of Menopause. These findings are consistent with the well-established endocrinological basis of GSM, where estrogen deficiency leads to progressive atrophic changes in the genital and urinary tract epithelium. Our findings align with those of Kaur et al. (2019) who reported mean serum FSH levels of 55.7 IU/L and corresponding mean vaginal pH of 6.13, suggesting that elevated FSH is a reliable indicator of menopausal hypoestrogenism. Similarly, Panda et al. (2014) found a positive correlation between serum FSH ≥40 IU/L and vaginal pH >4.5 in menopausal women, supporting the hormonal link to GSM.

Estradiol decline plays a pivotal role in altering the vaginal microenvironment. As shown by Mitchell et al. (2021), local estradiol replacement therapy significantly reduces vaginal pH and restores superficial epithelial cells, corroborating the positive correlation between estradiol and VMI observed in our study. Our data reinforce that serum FSH and estradiol levels, when interpreted alongside vaginal pH and VMI, serve as sensitive biomarkers for early detection of GSM. This combined evaluation could aid clinicians in identifying women at risk for symptomatic GSM even before severe clinical manifestations appear. The significant negative association between FSH and VMI ($p < 0.0001$) reflects the direct inverse relationship between pituitary gonadotropin activity and estrogenic effect on vaginal epithelium. Similar relationships have been described by Vahidroodsari et al. (2010) and Lumbanraja et al. (2021). The clinical implication is that objective hormonal and cytological measures can be integrated for a more comprehensive assessment of GSM severity.

Conclusion

Elevated serum FSH and reduced estradiol levels are strongly associated with increased vaginal pH and reduced vaginal maturation index in postmenopausal women, indicating an underlying estrogen deficiency. These hormonal parameters, combined with cytological and clinical assessment, can serve as practical, objective tools for diagnosing and grading the severity of Genitourinary Syndrome of Menopause. Timely identification of hormonal and cytological changes can guide early therapeutic intervention such as localized estrogen therapy, thereby improving vaginal health and quality of life in postmenopausal women.

Limitations

The study was limited by its cross-sectional design and single-center setting, restricting causal inference and generalizability. The sample size, though adequate for statistical analysis, could be expanded in future multicentric studies. Longitudinal follow-up assessing hormonal variations pre- and post-treatment would further clarify causal pathways.

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