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Review Article

Hormonal Modulation and Transient Sacroiliac Joint Inflammation: A Narrative Review With a Hypothesis on Premenstrual Sacroiliitis in Hyperandrogenic Women

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Abstract

Background: Sacroiliitis, as the inflammation of sacroiliac joints (SIJ), is a central feature of axial spondyloarthritis. Nonetheless, its occurrence in women without inflammatory rheumatic disease, particularly in relation to cyclic hormonal fluctuations, remains poorly understood. Thus, this review evaluated data on the influence of relaxin, estradiol, and other sex steroids on SIJ biomechanics, extracellular matrix integrity, and bone marrow edema (BME). Accordingly, a hypothesis was proposed suggesting that the premenstrual hormonal milieu may induce transient sacroiliitis in a subset of women, especially those with hyperandrogenic conditions, including polycystic ovary syndrome or idiopathic hirsutism.

Methods: PubMed and related databases were searched to identify studies addressing SIJ MRI findings in women, hormonal regulation of pelvic ligaments, molecular pathways of connective-tissue remodeling, and endocrine abnormalities in hyperandrogenic states. Human, animal, biomechanical, and imaging studies were synthesized qualitatively.

Results: MRI investigations in pregnancy and postpartum demonstrated a high prevalence of SIJ BME, with 58–80% of women affected in early postpartum months. Although many cases met ASAS criteria for sacroiliitis, erosions were rare, and progression to structural damage was limited, indicating a non-inflammatory, hormonally driven mechanism. Relaxin and estradiol induced collagen breakdown, increased ligamentous laxity, and activated matrix metalloproteinases. Evidence from other joints revealed that cyclic relaxin peaks can produce micro-instability and chronic microtrauma.

Conclusion: It is hypothesized that the cyclical elevations of relaxin and estradiol, especially during the late luteal phase, may transiently remodel SIJ-associated connective tissues, provoking BME or subclinical sacroiliitis. Hyperandrogenic women may be particularly vulnerable due to altered sex hormone receptor profiles, increased inflammatory tone, and pelvic biomechanical variations. Prospective studies combining hormonal assays, serial MRI, and inflammatory biomarkers are essential to verify this proposed premenstrual, hormone-sensitive sacroiliitis phenotype.

Keywords: Sacroiliac joint, Sacroiliitis, Menstrual cycle, Bone marrow edema, Hyperandrogenism, Polycystic ovary syndrome

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Introduction

The sacroiliac joints (SIJ) constitute a major load-bearing complex linking the spine to the pelvis [1-2]. Their mixed synovial-ligamentous architecture makes them uniquely responsive to mechanical forces and hormonal influences. While sacroiliitis is conventionally studied within the framework of axial spondyloarthritis, mounting imaging evidence suggests that not all sacroiliac bone marrow edema (BME) detected on magnetic resonance imaging (MRI), especially in women, represents immunologically mediated inflammation.

One prominent example is pregnancy and the postpartum period; a remarkably high prevalence of SIJ BME is observed during this period. The postpartum period involves marked fluctuations of relaxin, estradiol, and progesterone, combined with altered pelvic biomechanics [3-6]. Nevertheless, the potential role of non-pregnancy hormonal cycles, particularly the menstrual cycle, remains almost unexplored despite biological plausibility.

Both relaxin and estradiol modulate pelvic ligament elasticity, extracellular matrix (ECM) turnover, and collagen integrity. Likewise, hyperandrogenic conditions, such as polycystic ovary syndrome, may induce shifts in hormonal receptor signaling and systemic inflammatory tone, potentially increasing susceptibility to SIJ micro-injury.

Objectives

This review synthesizes the available evidence related to hormonal influences on the SIJ and presents a focused hypothesis proposing a link between the premenstrual hormonal environment and transient sacroiliitis in hyperandrogenic women.

Methods

A targeted literature review was conducted using PubMed, Scopus, and manual reference screening in order to identify relevant studies. The inclusion criteria encompassed research examining MRI findings of the SIJ during pregnancy and the postpartum period, the effects of relaxin, estradiol, and other sex steroids on ligament biomechanics, matrix metalloproteinase (MMP)-mediated ECM remodeling, and hormonal and inflammatory alterations in hyperandrogenic conditions. Both human studies and pertinent animal models were considered in this regard. Due to the heterogeneity of methodologies across the included studies, the findings were synthesized descriptively rather than quantitatively.

Results

MRI studies consistently indicated that 58–80% of postpartum women exhibit SIJ BME during the early months following delivery [3-6]. While many cases met the Assessment of SpondyloArthritis International Society criteria for sacroiliitis, it was revealed that erosions and ankylosis are rare, and long-term structural progression is minimal. These findings indicate a hormonally mediated, reversible joint response rather than a chronic inflammatory condition.

It was found that sex steroid hormones, particularly 17β-estradiol and relaxin, have substantial effects on ligamentous structures. Based on systematic reviews, these hormones reduce ligament stiffness, modify collagen integrity, increase viscoelasticity, and activate MMPs, especially MMP-1 and MMP-9 [7]. Moreover, relaxin receptors (RXFP1) are widely expressed in pelvic structures, including the uterosacral ligaments and acetabular labrum [8, 9], thereby mediating collagen degradation, ECM reorganization, and reduced load-bearing capacity. Additionally, the peaks of relaxin have been associated with micro-instability in other joints (e.g., the trapeziometacarpal joint) [9], supporting the concept of transient ligamentous laxity.

Discussion

Considering these observations, it is proposed that premenstrual hormonal fluctuations may transiently induce sacroiliitis, particularly in women with hyperandrogenic conditions. The late luteal phase is characterized by increased relaxin and fluctuating estradiol levels, which may lead to ligamentous laxity, ECM turnover, and susceptibility to microtrauma. Given the exposure of the SIJ to substantial axial and shear forces, these hormonal changes can manifest as BME, subclinical inflammation, or premenstrual SIJ pain. Hyperandrogenic states (e.g., polycystic ovary syndrome or hirsutism) may further enhance this susceptibility through altered estrogen and relaxin receptor signaling, low-grade systemic inflammation, changes in pelvic muscle tone, and amplified androgen–cytokine interactions.

The current literature increasingly highlights the profound influence of sex hormones on ligament biomechanics and connective tissue remodeling. Pregnancy and postpartum studies provide compelling evidence that hormonal shifts can produce MRI abnormalities mimicking axial spondyloarthritis sacroiliitis without representing true inflammatory pathology [3-6]. Relaxin-mediated collagen degradation, combined with the estradiol-driven modulation of ligament viscoelasticity, offers a biologically coherent mechanism for SIJ micro-instability (Figure 1) [7-9]. Although direct evidence during the menstrual cycle is limited, analogies with other joints and pregnancy-associated changes strongly support the plausibility of transient, hormone-mediated sacroiliitis.

Recognizing this potential hormone-sensitive phenotype is clinically relevant. The identification of at-risk women could prevent misdiagnosis and unnecessary immunosuppressive therapy while guiding management toward hormonal assessment, pelvic stabilization, and targeted physiotherapy. This approach may improve patient outcomes by addressing the underlying biomechanical and endocrine contributors rather than focusing solely on inflammation.

Strengths and Limitations of the Study

The study had several notable strengths. It effectively integrated evidence from imaging, biomechanics,

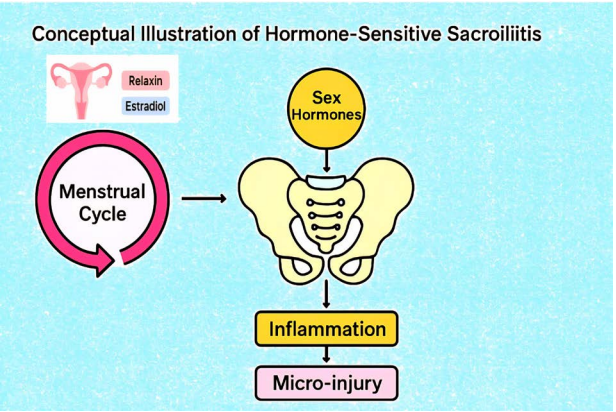

Figure 1. A Schematic Pattern of Premenstrual Hormonal Peak Inducing Transient Sacroiliitis (Hypothesis)

endocrinology, and molecular biology, thereby providing a comprehensive perspective on the topic. Furthermore, it proposed a novel hypothesis with relevance across multiple fields, including rheumatology, endocrinology, and women's health. The work also addressed the diagnostic challenges associated with interpreting BME on MRI, providing valuable insights for clinical practice.

However, there were some limitations to consider. There was a lack of direct MRI studies examining changes across different menstrual phases, which may have constrained the understanding of cyclic variations. Additionally, extrapolating findings from pregnancy models may not have accurately reflected the hormonal dynamics of non-pregnant individuals. Finally, the study included no dedicated imaging investigations in hyperandrogenic populations, thereby limiting the generalizability of its conclusions to this subgroup.

Conclusion

It was revealed that sex steroid hormones, particularly relaxin and estradiol, have substantial effects on pelvic connective tissues and SIJ biomechanics. It was hypothesized that premenstrual hormonal peaks can induce micro-instability and transient sacroiliitis in women, with heightened susceptibility observed in those with hyperandrogenism. Nonetheless, prospective research using serial MRI, hormonal profiling, and inflammatory biomarkers is essential to validate this proposed premenstrual, hormone-sensitive sacroiliitis phenotype.

Ethics statement

Not applicable.

Disclosure of funding source

None.

Conflict of interests declaration

The authors declare they have no conflict of interests.

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The authors declare they have nothing to report.

Data availability statement

The patient details are available in the electronic medical records and can be made available upon request from the authors.

Author contributions

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Consent for publication

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