

The Impact of Yoga on Inflammatory Pathways and Central Sensitization in Endometriosis: A Clinical Pain Phenotypes Narrative Review

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ABSTRACT

Endometriosis is a long-term inflammatory condition that can cause severe menstrual pain, chronic pelvic pain, fatigue, poor sleep, emotional distress, and reduced quality of life. Pain in endometriosis does not always match the visible amount of disease. This means that pain is not caused only by lesions. Ongoing inflammation, irritation of local nerves, pelvic floor overactivity, and increased sensitivity in the central nervous system may all play a role. For this reason, many women continue to have pain even after hormonal treatment or surgery. This short narrative review explains how inflammatory pathways and central sensitization contribute to endometriosis-related pain and highlights the role of yoga as an adjunctive supportive therapy. Yoga combines gentle movement, breathing regulation, relaxation, and mindful attention. These practices may lower stress arousal, improve autonomic balance, reduce guarding, and influence inflammatory signaling. Endometriosis-specific evidence is still limited, but one randomized trial reported lower pain and better quality of life after Hatha yoga practice. Evidence from other chronic pain and stress-related conditions also supports possible benefits for inflammation, mood, sleep, and pain coping. Based on the available evidence, yoga should be viewed as an adjunct, not a replacement, for guideline-based medical care. A gentle, pain-informed, and individualized yoga approach appears most suitable, especially for women with persistent pain, stress-related flares, or signs of central sensitization.

Keywords: endometriosis, yoga, pelvic pain, inflammation, central sensitization.

INTRODUCTION

Endometriosis affects nearly one in ten women of reproductive age worldwide and is increasingly recognized as a chronic inflammatory condition that can significantly affect daily life and well-being [1]. It commonly causes dysmenorrhea, non-cyclical pelvic pain, pain during intercourse, painful bowel or bladder symptoms, tiredness, and reduced day-to-day functioning. Current guidance supports long-term care that may include analgesics, hormonal treatment, surgery, and non-drug supportive care when symptoms continue [2].

A major clinical problem is that pain severity often does not match the visible extent of lesions. Some women with limited disease have severe pain, while others with more extensive disease report much less pain. This mismatch suggests that lesions are only one part of the problem. Repeated inflammation, nerve irritation, pelvic floor guarding, and changes in pain processing within the nervous system can all contribute to the final pain experience [3,4].

Over time, repeated pain can make the nervous system more sensitive. This process is often called central sensitization. In simple terms, the body's pain alarm becomes easier to trigger and harder to calm down. A systematic review of endometriosis-associated pain has shown evidence of central amplification through sensory testing, neuroimaging, and clinical assessment [5]. Woolf described central sensitization as an increase in the responsiveness of pain pathways in the central nervous system, leading to pain hypersensitivity and prolonged pain responses [6].

AIM OF THE REVIEW

This review aims to summarize the role of inflammatory pathways and central sensitization in endometriosis-related pain and examine the potential role of yoga in modulating these mechanisms as a supportive approach within multidisciplinary care.

METHOD

This is a narrative review based on the article already prepared by the author. The content was condensed and rewritten for clarity, simplicity, and better readability. Priority was given to studies and reviews that explain inflammatory pathways, sensitization, pain mechanisms, and yoga-based supportive care in endometriosis and related chronic pain conditions.

INFLAMMATION AND PERIPHERAL SENSITIZATION IN ENDOMETRIOSIS

Endometriosis lesions exist in an inflammatory pelvic environment. Research shows changes in immune cell behavior, cytokines, growth factors and tissue remodeling within the peritoneal cavity and around lesions [7]. This inflammatory setting supports lesion survival, but it also matters for pain because inflammatory chemicals can irritate and sensitize nearby nerve endings.

Another important point is that immune and nerve pathways interact closely. Macrophages and other immune cells can release factors that promote nerve growth and nerve sensitization. Forster and colleagues showed that macrophage-derived insulin-like growth factor-1 can act as a key nerve-sensitizing factor in endometriosis-associated pain [8]. This helps explain why pain may continue even when lesion size is not very large.

Clinically, this inflammatory mechanism is often seen as cyclical pelvic pain, menstrual flares, tenderness, and pain linked to bowel or bladder function. In the early stage, pain may remain closely tied to the menstrual cycle. With repeated flares, however, ongoing inflammatory input may push the nervous system toward a more persistent and widespread pain state [3,5].

CENTRAL SENSITIZATION AND MIXED PAIN PATTERNS

Persistent endometriosis pain is not always purely inflammatory. Many patients show signs that the pain system itself has changed. These signs may include pain outside the pelvis, pain that seems greater than expected from examination findings, sleep problems, fatigue, emotional distress, and poor response to lesion-focused treatment [4,5]. In this setting, central sensitization becomes clinically important.

It is also useful to think about nociplastic pain. Kosek and colleagues described nociplastic pain as pain that arises from altered nociceptive processing, even when tissue damage or nerve injury does not fully explain the severity of symptoms [9]. In endometriosis, inflammatory pain, neuropathic-like pain, and nociplastic features often overlap rather than appear separately. This is why one treatment is often not enough.

Central sensitization does not mean the pain is imaginary. It means that the nervous system has become more reactive. Repeated pain, fear, poor sleep, emotional stress, and constant guarding of the abdomen or pelvic floor can keep this cycle active. Women with endometriosis also commonly report anxiety, depressed mood, and reduced quality of life, all of which may worsen pain burden without making the pain any less real [4].

HOW YOGA HELPS IN ENDOMETRIOSIS-RELATED PAIN

Yoga is a mind-body practice that usually combines posture, breathing, relaxation, and focused attention. From a yoga therapy perspective, its value in endometriosis is not that it removes lesions. Its likely value is that it may calm the stress response, reduce muscle guarding, improve breathing patterns, restore confidence in movement, and support better pain regulation.

Slow breathing and relaxation may influence the autonomic nervous system and support vagal activity. Pavlov and colleagues described the cholinergic anti-inflammatory pathway as a neural route through which vagal activity can help limit inflammatory cytokine release [10]. Later reviews have continued to support this pathway as a meaningful bridge between the nervous system and inflammation [11]. This is relevant because chronic pelvic pain is often made worse by high stress arousal and poor recovery.

A Second possible pathway involves the regulation of inflammatory responses. A systematic review of yoga and inflammatory biomarkers reported that yoga was associated with reduced inflammatory activity across several chronic conditions, although the effects varied between studies [12]. In a randomized trial among fatigued breast cancer survivors, a restorative yoga program reduced inflammation-related gene expression [13]. Another randomized controlled trial reported improvements in inflammatory markers, fatigue, and vitality following yoga in breast cancer survivors [14]. Brief yogic meditation has also been linked with reduced pro-inflammatory transcriptome activity in chronically stressed caregivers [15]. These studies are not about endometriosis, but they strengthen the biological plausibility that yoga can influence systems relevant to pain.

A third pathway is change in pain processing. Endometriosis-related chronic pelvic pain has been associated with altered functional connectivity and altered brain chemistry in regions involved in pain and salience processing [16]. Research on mindfulness-based pain relief suggests that meditative attention can reduce pain through neural mechanisms that differ from placebo responses [17]. For women with endometriosis, this means that yoga may help not only through stretching or exercise, but also through repeated experiences of safety, slower breathing, and less fear around body sensations.

Yoga can also support pain management in simple, practical ways. Gentle movements help ease stiffness and muscle tension, while relaxation supports better sleep. Focusing on the breath helps people stay calmer during painful episodes. Practicing yoga with others can also improve confidence and reduce feelings of helplessness. Although these effects can seem small, they are helpful in managing long-term pain.

CLINICAL EVIDENCE FOR YOGA IN ENDOMETRIOSIS

Direct research in endometriosis is still limited. However, the available trial evidence is encouraging. Goncalves and colleagues studied an eight-week Hatha yoga program in women with endometriosis-related chronic pelvic pain and reported reduced daily pain together with improved quality of life [18]. This trial does not prove that yoga works for every patient, but it does provide useful proof of concept. Evidence from other chronic pain conditions also matters. In fibromyalgia, which is often discussed as a condition with strong central sensitization features, a pilot randomized trial of the Yoga of Awareness program showed improvement in symptoms, coping, and function [19]. Although fibromyalgia is not the same as endometriosis, it suggests that yoga may be especially helpful when persistent pain includes fear, fatigue, poor sleep, and stress-related amplification.

At present, yoga should be presented as an adjunct to medical treatment, not as a cure and not as a replacement for gynecological care [2]. Its best role may be in women who continue to have pelvic pain after standard treatment, in those with stress-sensitive flares, and in those who appear to have mixed pain mechanisms rather than purely cyclical inflammatory pain.

A SIMPLE PHENOTYPE-INFORMED YOGA APPROACH

Because endometriosis pain is not the same in every patient, yoga should also not be the same in every patient. A phenotype-informed approach means that the teacher or therapist tries to understand what seems to drive the pain most strongly and then adjusts the practice accordingly. The goal is not intensity. The goal is safety, steadiness, and symptom-informed progression.

In inflammatory flares, the body often needs calming rather than challenge. During this time, restorative postures, supported rest, diaphragmatic breathing, and short relaxation practices may be more useful than strong stretching or demanding core work. In women with marked pelvic floor overactivity or dyspareunia, overly forceful hip opening may aggravate pain instead of helping it.

When central sensitization features are strong, consistency becomes more important than intensity. Short and regular practice is usually better than occasional hard sessions. Slow movement linked to breath, guided relaxation, body scanning, and simple mindfulness can help reduce overprotection by the nervous system. For women who are afraid of movement because movement has become linked with pain, yoga can also work as graded exposure if it is taught gently and without pressure.

A practical program may begin with three supervised or home-based sessions each week for 30 to 45 minutes, plus 10 minutes of daily breathing or relaxation. Sessions should stay within a comfortable range. Pain during practice should not be pushed through. Clinical monitoring should focus not only on pain intensity but also on sleep, flare frequency, fatigue, activity tolerance, and confidence in daily life.

PELVIC FLOOR, BREATHING, AND BODY GUARDING

One often overlooked part of endometriosis pain is the role of the pelvic floor and surrounding muscles. When pain repeats for months or years, many patients begin to guard the abdomen, buttocks, hips, and pelvic floor without realizing it. This guarding may initially protect the body, but over time it can become another source of pain. The result may be pressure, heaviness, pain during sitting, pain during intercourse, restricted breathing, or a feeling that the body is always tense.

From a yogic perspective, breathing pattern matters here. When breathing becomes shallow and high in the chest, the diaphragm moves less freely and the pelvic floor may stay braced. Gentle diaphragmatic breathing can therefore do more than relax the mind; it may also reduce mechanical overactivity in the

abdomino-pelvic region. This is one reason simple breathwork is often more useful than advanced postures in women with persistent pelvic pain.

Supported poses, slow transitions, and attention to comfort are especially important when pelvic floor overactivity is suspected. The aim is not to push the hips open, but to create a sense of ease in the lower abdomen, inner thighs, and pelvic bowl. This is best done through props, soft holds, and permission to stop when the body feels threatened. In real practice, this gentle approach is often better tolerated than ambitious flexibility work.

Teachers should also remember that some patients feel disconnected from the pelvis because pain has made that area feel unsafe. In such cases, mindfulness should be introduced carefully. Simple grounding, external focus, and short relaxation may be better at first than long internal observation practices. Trust is built slowly.

SAMPLE GENTLE YOGA PLAN FOR CLINICAL USE

The table below outlines one simple example of how a weekly yoga plan may be organized for women with endometriosis. It is not a strict protocol, but a practical guide that can be adapted based on pain pattern, fatigue, menstrual phase, and medical advice.

TABLE 1. COMMON PAIN PATTERNS AND YOGA FOCUS

Pain pattern	Common presentation	Main yoga focus
Inflammation-dominant	Pain is more cyclical, linked to menstruation or pelvic organ symptoms; local tenderness and flare days are common.	Short restorative sessions, supported postures, diaphragmatic breathing, long exhalation, relaxation, and pacing during flare days.
Central sensitization or nociplastic features	Pain becomes more persistent, less closely tied to the cycle, and may coexist with fatigue, sleep problems, widespread pain, or high distress.	Consistent low-intensity practice, slow movement, mindfulness, body scanning, relaxation, and building safety with movement.
Mixed pattern	Most patients have some overlap of inflammatory pain, guarding, pelvic floor tension, and nervous system sensitization.	Blend both approaches; avoid overloading the body; adjust practice week by week according to symptoms and recovery.
Session part	Examples	Purpose
Breath (5-10 min)	Diaphragmatic breathing, slightly longer exhalation, quiet nasal breathing	Reduce arousal, improve body comfort, and support relaxation during flare-prone periods.

Gentle movement (10-15 min)	Cat-cow, pelvic tilts, supported child's pose, easy spinal and hip mobility	Reduce stiffness and guarding without provoking symptoms.
Supported rest (10-15 min)	Legs on chair, supported reclining bound angle, side-lying rest, yoga nidra	Settle the nervous system and support recovery, sleep, and pain coping.
Closing focus (3-5 min)	Simple mindfulness, gratitude, or body scan	Improve awareness without threat and help the patient leave practice feeling steady.

PRACTICAL POINTS FOR YOGA THERAPISTS AND CLINICIANS

First, language matters. Women with endometriosis often live with years of pain, repeated consultations, and sometimes invalidating experiences. A yoga-based approach should therefore be pain-informed, respectful, and free from blame. The aim is to support the person, not to suggest that the pain persists because she is not calm enough or not trying hard enough.

Second, practice must be adapted. Deep abdominal compression, painful end-range stretching, strong breath retention, and demanding postures during a flare may worsen symptoms. Props, shorter holds, slow transitions, and choice-based teaching are usually safer. Coordination with the treating gynecologist, physiotherapist, or pain specialist is advisable in severe cases.

Third, outcomes should be realistic. In some patients, yoga may lower pain. In others, the biggest gains appear in sleep, fatigue, mood, body awareness, and daily function. These changes still matter. In long-term pain conditions, a useful treatment is one that helps the patient live better, recover faster after flares, and feel less controlled by pain.

FUTURE DIRECTIONS

Future research should not test yoga as if all endometriosis pain is the same. Studies should separate women with mainly cyclical inflammatory pain from those with persistent pain, widespread symptoms, or clear signs of central sensitization. This may help identify who benefits most and what kind of yoga is best tolerated.

Longer follow-up is also needed. Many studies look only at short-term pain scores. Future work should include sleep, fatigue, flare frequency, daily function, medication use, and quality of life. It would also be valuable to measure biological markers, such as inflammatory mediators or autonomic indicators, so that the mechanism of benefit can be understood more clearly.

LIMITATIONS

This review is narrative in nature and does not replace a full systematic review. Direct endometriosis-specific yoga trials remain few, and the available studies are modest in size. Some mechanistic arguments are based on evidence from other chronic inflammatory or chronic pain populations. Therefore, yoga should be recommended carefully, honestly, and as part of integrated care rather than as a stand-alone solution.

CONCLUSION

Endometriosis pain is complex. It is shaped not only by lesions, but also by inflammation, nerve sensitization, central sensitization, sleep disturbance, stress, and emotional burden. This explains why pain may persist even after standard treatment. Yoga offers a meaningful supportive approach because it can address several of these dimensions at the same time through breathing, gentle movement, relaxation, and mindful attention. The present evidence suggests that yoga is most useful when it is simple, individualized, pelvic-friendly, and clearly integrated with medical care. Future studies should test phenotype-based yoga programs with longer follow-up and stronger biological and clinical outcome measures.

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