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editorial-office@sciformat.ca

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CO₂ AND Er:YAG LASERS AND PLATELET-RICH PLASMA FOR VAGINAL ATROPHY IN MENOPAUSAL WOMEN: CLINICAL EVIDENCE, SAFETY, AND GUIDELINE PERSPECTIVES

Agnieszka Maria Korzeniewska (Corresponding Author, Email: akorzeniewska22@gmail.com)
Military Medical Institute – National Research Institute, Warsaw, Poland
ORCID ID: 0009-0006-0337-961X

Julia Agnieszka Dębczak
Military Medical Institute – National Research Institute, Warsaw, Poland
ORCID ID: 0009-0004-4574-8466

Magdalena Korba
St. Anne's Hospital in Miechów, Miechów, Poland
ORCID ID: 0009-0002-5577-9923

Adrianna Kowalik
Independent Public Healthcare Complex in Płońsk, Płońsk, Poland
ORCID ID: 0009-0001-4092-5839

Agnieszka Krajewska
Maria Skłodowska-Curie Voivodeship Specialist Hospital in Zgierz, Zgierz, Poland
ORCID ID: 0009-0003-2961-7565

Karolina Łuczak
Międzyleski Specialist Hospital in Warsaw, Warsaw, Poland
ORCID ID: 0009-0000-5952-8457

Natalia Malicka
Independent Public Healthcare Centre of the Ministry of the Interior and Administration, Kielce, Poland
ORCID ID: 0009-0002-3045-2908

Wiktoria Polkowska
Central Clinical Hospital of the Medical University of Łódź, Łódź, Poland
ORCID ID: 0009-0006-3812-9573

Katarzyna Tlustochowicz
Independent Public Healthcare Centre of the Ministry of the Interior and Administration, Kielce, Poland
ORCID ID: 0009-0006-4209-2558

ABSTRACT

Background: Genitourinary syndrome of menopause (GSM) affects approximately 50% of postmenopausal women and arises from estrogen deficiency, causing vaginal epithelial thinning, Lactobacillus depletion, and increased vaginal pH, which collectively elevate infection risk. Local estrogen therapy (LET) is standard but may be limited. Interest is growing in non-hormonal regenerative therapies, including CO₂ and Er:YAG lasers and PRP.

Aim: This narrative review aims to evaluate the current evidence on the efficacy and safety of CO₂ and Er:YAG laser therapies, as well as platelet-rich plasma (PRP), in the management of GSM with a focus on clinical guidelines and expert recommendations.

Methods: A narrative review of the literature was conducted, including clinical trials, systematic reviews, expert opinions, and international society guidelines. Outcomes of interest included symptom severity (VAS), Vaginal Health Index (VHI), Female Sexual Function Index (FSFI), vaginal pH, patient satisfaction, and reported adverse events.

Results: CO₂ and Er:YAG laser therapies, as well as PRP, demonstrate promising efficacy in reducing symptoms of genitourinary syndrome of menopause, with improvements observed in clinical parameters (VHI, FSFI, VAS) and high patient satisfaction. The safety profile reported in available studies is favorable, with adverse events generally mild and transient.

Conclusions: CO₂ and Er:YAG laser therapies and PRP represent promising non-hormonal approaches for GSM, particularly in women with contraindications to estrogen. Due to limited high-quality evidence, these modalities remain experimental, and their efficacy and protocols require confirmation in long-term, sham-controlled studies.

KEYWORDS

Genitourinary Syndrome Of Menopause, CO₂ Laser, Er:YAG Laser, Platelet-Rich Plasma, Non-Hormonal Therapy

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1. Introduction

The genitourinary syndrome of menopause (GSM) is a condition affecting approximately half of postmenopausal women and is characterized by symptoms such as vaginal and vulvar mucosal atrophy, vaginal dryness, dyspareunia, urinary urgency, dysuria, and recurrent urinary tract infections [1]. The etiology of this condition is closely associated with postmenopausal estrogen deficiency, the loss of physiological *Lactobacillus* flora, and a reduction in the acidic vaginal pH [2].

It constitutes a significant social concern, as feelings of embarrassment and discomfort associated with discussing intimate symptoms lead many patients to refrain from reporting their complaints, resulting in substantial underdiagnosis of the condition. Many patients perceive their symptoms as a natural consequence of the aging process, which leads to their trivialization and delays in seeking medical attention. Only approximately one quarter of women seek medical consultation to obtain a diagnosis, while nearly one third are reluctant to discuss their symptoms. Early identification and appropriate therapeutic intervention are crucial for improving quality of life and preventing the progression and exacerbation of symptoms in affected women.

There are numerous effective treatment options available for managing GSM symptoms, including physiotherapy, hormonal, and non-hormonal methods. Recently, the use of laser therapies and platelet-rich plasma (PRP) has gained popularity, and extensive research is ongoing to evaluate their efficacy [2].

The aim of this review is to analyze current evidence regarding the efficacy and safety of CO₂ and Er:YAG lasers, as well as platelet-rich plasma (PRP), in the treatment of vaginal atrophy in GSM, taking into account the most recent clinical guidelines and recommendations, in order to clarify the current role of these technologies in clinical practice.

2. Genitourinary Syndrome of Menopause (GSM)

2.1 Definition and Clinical Significance of GSM

In the past, changes in the genital organs associated with menopausal estrogen deficiency were referred to as vulvovaginal atrophy (VVA). Due to the limited precision and negative connotation of this term, in 2014 the International Society for the Study of Women's Sexual Health (ISSWSH) and the North American Menopause Society (NAMS) introduced the concept of the GSM, which more comprehensively describes the spectrum of clinical symptoms associated with the estrogen deficiency characteristic of the postmenopausal period [1].

GSM is a chronic condition affecting more than half of postmenopausal women and results from the estrogen deficiency accompanying menopause [2]. It can lead to vaginal and vulvar dryness, genital organ dysfunction, and urinary symptoms, including urgency, dysuria, and recurrent urinary tract infections. The symptoms are progressive and do not resolve spontaneously, although they may fluctuate over time [3].

Significant symptoms of GSM also include pain during sexual intercourse, delayed orgasm, and reduced vaginal lubrication, which may result in decreased sexual satisfaction, particularly among younger women, as well as depressive and anxiety symptoms. A physiological response that may occur in reaction to high levels of anxiety before sexual intercourse is vaginismus, characterized by painful involuntary contraction of the vaginal muscles. Hypoactive sexual desire disorder (HSDD) is a clinical condition characterized by persistently or recurrently low or absent sexual desire, leading to distress or impaired quality of life. HSDD can be both a cause and a consequence of painful sexual intercourse, creating a bidirectional relationship between reduced libido and dyspareunia.

During the Fifth International Consultation on Sexual Medicine, it was reported that the most common symptoms are vaginal dryness and dyspareunia. The severity of GSM symptoms is influenced by multiple factors, including overall physical and mental health, type and age of onset of menopause, sexual activity, and various personal characteristics. The presence of GSM symptoms, particularly when accompanied by dyspareunia, correlates with a higher risk of mood disorders, including depression and anxiety [4].

2.2 The Role of Estrogen Deficiency in the Pathophysiology of GSM

Estrogens play a key role in maintaining the normal structure and function of the vagina and lower urinary tract [5]. This hormone exhibits vasoactive properties, enabling proper vascular reactivity within the genital organs and lower urinary tract, which promotes increased secretion, adequate tissue hydration, and stimulates epithelial proliferation, mucin synthesis, and remodeling of collagen fibers [6]. The desquamating epithelial cells release glycogen, which serves as a substrate for *Lactobacillus* species that produce lactic acid, thereby maintaining the acidic vaginal pH [2, 7].

After menopause, estrogen deficiency causes progressive thinning of the genital tissues, a decline in collagen and elastin content, reduced blood supply, and decreased vaginal lubrication leading to vaginal atrophy, shortening, and narrowing, as well as the occurrence of dyspareunia. Atrophic changes also affect the bladder and urethra, resulting in urinary symptoms [8]. The reduction in estrogen levels also leads to a decrease in *Lactobacillus* populations and an increase in vaginal pH (≥ 5.0), disrupting the microbial balance and facilitating colonization by enteric bacteria, thereby increasing the risk of vaginal and urinary tract infections [7].

2.3 Diagnosis and Diagnostic Criteria of GSM

The diagnosis of GSM is primarily clinical and is based on the analysis of reported symptoms and physical examination of patients. Gynecological examination typically reveals features of hypoestrogenism, including thinning and pallor of the epithelium, loss of tissue elasticity, contact bleeding, and changes in the vaginal vestibule and urethral meatus, usually accompanied by an increase in vaginal pH above 5 [3].

Uterine ultrasonography is also an important clinical diagnostic tool, as an endometrial thickness ≤ 5 mm may indicate low estrogen exposure [7].

In clinical practice, the most commonly used methods for quantitative assessment of GSM symptom severity and treatment efficacy include the visual analog scale (VAS) for GSM symptoms, the vaginal health index (VHI), and the female sexual function index (FSFI), which serve as patient-reported outcome measures (PROMs) [6]. These tools help monitor disease progression, although their utility in guiding therapeutic decisions remains limited [3].

2.4 Differential Diagnosis

In the diagnostic process of GSM in women, differential diagnosis should include vaginal infections such as bacterial vaginosis, trichomoniasis, and candidiasis, as well as irritations resulting from exposure to irritants, the presence of foreign bodies, and trauma related to sexual activity. Neoplastic and precancerous changes of the genital organs, as well as hormonal disorders, should also be considered. Other potential causes of GSM-like symptoms include vaginal stenosis secondary to radiotherapy and vulvar dermatoses, such as lichen sclerosus and lichen planus [2].

2.5 Standard Treatment Approaches for GSM

Therapeutic management of GSM depends on the severity of symptoms, patient preferences, and the presence of contraindications to therapy. A holistic approach is essential. The foundation for initiating any treatment involves obtaining a thorough medical history to identify potential contraindications and modifiable risk factors [9].

2.5.1 Non-hormonal Therapy

Non-hormonal therapy is considered first-line treatment for women with mild to moderate symptoms, as well as for patients who cannot use or have contraindications to hormonal therapy. It includes the use of vaginal lubricants and moisturizers, hyaluronic acid-based formulations, and pelvic floor physiotherapy interventions.

In cases of high pelvic floor muscle tension, physiotherapy may be beneficial and should ideally be implemented prior to starting pharmacological treatment.

Oral administration of prasterone and ospemifene also represents a non-hormonal therapeutic option in the management of genitourinary syndrome of menopause. Ospemifene is a selective estrogen receptor modulator (SERM) approved for the treatment of genitourinary syndrome of menopause (GSM). It improves the condition of the vaginal epithelium, thereby reducing vaginal dryness, lowering elevated vaginal pH, and alleviating dyspareunia.

Prasterone is a steroid that, through its conversion into estradiol and testosterone, improves vaginal dryness and reduces dyspareunia [10].

These methods are safe and widely used; however, their efficacy is generally lower and their effects shorter in duration compared with hormonal therapy [3].

2.5.2 Local Hormonal Therapy

Local hormonal therapy is the standard approach for moderate to severe cases of GSM. The 2025 guidelines from the AUA/SUFU/AUGS clearly recommend the use of low-dose LET in the form of vaginally administered preparations, which effectively improve vaginal lubrication, epithelial atrophy, and normalize vaginal pH. In local therapy, estrogen is most commonly administered directly into the vagina in the form of creams, vaginal tablets, gels, or vaginal rings [11]. Locally administered estrogens carry a much lower systemic risk and do not require routine endometrial monitoring [12].

2.5.3 Systemic Hormone Therapy

Systemic hormone therapy is indicated for women with GSM coexisting with vasomotor symptoms or other systemic menopausal complaints [9]. This therapy can alleviate vasomotor symptoms, improve quality of life, prevent excessive bone loss, reduce the risk of osteoporosis and fractures, and also mitigate specific genitourinary symptoms [13]. The systemically administered dose should be the lowest effective dose, as excessive estrogen levels may lead to endometrial proliferation, hyperplasia, or cancer [9].

2.5.4 Innovative and Alternative Approaches

Innovative and alternative methods, such as fractional CO₂ and Er:YAG lasers, as well as PRP, are currently under investigation. Currently, there is insufficient evidence to confirm their long-term efficacy and safety [14].

Table 1. Comparison of Standard Treatment Approaches for GSM.

	Systemic Hormone Therapy	LET	Non-hormonal Methods
Main Indications	Hot flashes, night sweats, vasomotor symptoms, osteoporosis prevention	GSM symptoms: vaginal dryness, dyspareunia, recurrent Urinary Tract Infections, vulvovaginal discomfort	Mild GSM symptoms, patients with contraindications to hormones
Route of Administration	Oral, transdermal (patch/gel), implants	Creams, suppositories, vaginal tablets, rings	Vaginal moisturizers, lubricants, education and behavioral interventions
Efficacy	Most effective treatment for vasomotor symptoms	Most effective treatment for GSM with minimal systemic absorption	Moderate efficacy, mainly supportive
Risk factors	Thrombosis, stroke, increased breast cancer risk	Minimal systemic risk, no routine endometrial monitoring required	No systemic effects, limited efficacy
Selection	Women <60 years or <10 years since menopause with severe symptoms	Women with predominant GSM symptoms	Women not eligible for hormone therapy

2.6 Limitations of Standard GSM Treatments

Standard treatment approaches for GSM, including LET and non-hormonal methods, despite demonstrated efficacy, have significant limitations [11].

Long-term use of systemic estrogens increases the risk of thromboembolic events, stroke, and breast cancer, necessitating careful clinical evaluation and safety monitoring. Low-dose vaginal estrogens improve symptoms and parameters such as vaginal pH and the VHI. However, in some patients, the clinical response is incomplete or short-lived. Estrogen therapy is contraindicated in women with a history of hormone-dependent breast cancer, or in those with concerns regarding long-term safety [5].

Non-hormonal methods, such as lubricants and moisturizers, provide only symptomatic and temporary relief without reversing atrophic changes in the vaginal mucosa. Consequently, research into regenerative technologies including CO₂ and Er:YAG lasers and PRP has been initiated to identify a safe, effective, and acceptable therapeutic alternative for patients with GSM [10-13].

3. CO₂ Laser Therapy in the Treatment of Vaginal Atrophy in GSM

3.1 Mechanism of Action

Fractional lasers differ primarily in their wavelength and degree of tissue ablation. In recent years, this technology has been increasingly applied in the management of genitourinary symptoms [14]. Vaginal laser therapy has emerged as a novel therapeutic option for the treatment of vaginal atrophy. Intravaginal lasers exert their effects by inducing a controlled thermal response within the tissues. The increased expression of heat shock proteins (HSPs) triggered by this thermal stimulus promotes the activation of growth factors, as well as neovascularization and neocollagenesis [15].

The CO₂ laser emits light with a wavelength of approximately 10,600 nm, which is strongly absorbed by water in the tissue. This can result in a profound thermal effect and intensive ablation. It induces a controlled tissue injury, which in turn initiates biological repair processes [16]. This device is particularly effective in promoting remodeling of both the skin and deeper tissue structures, as well as collagen remodeling. As a result of this response, there is improvement in tissue elasticity, density, and quality, accompanied by neovascularization and neocollagenesis [15].

3.2 Clinical Efficacy

In a prospective clinical study of 18 postmenopausal women who underwent CO₂ laser treatments over 3 months, the vulva and vagina were evaluated for 12 months following the treatment series. A statistically significant increase in the VHI was observed in all participants ($P \leq 0.0003$), which persisted up to 12 months after therapy, with a slight decline between months 6 and 12. The mean VHI score increased from a baseline value of 11.8 to mean values of 22.5, 22.8, and 21.4 (an improvement of 93.2%). Higher VHI scores were achieved in women in early postmenopause, while lower scores were observed in women >3 years postmenopause ($P < 0.05$). These results also correlated with subjective improvement in sexual function, as

measured by the FSFI. At 12 months, 94% of patients reported a high level of treatment satisfaction. Vaginal pH returned to normal in the majority of participants [17].

VHI was one of the key endpoints in a clinical study involving 72 postmenopausal women. After 14 weeks, the mean VHI score was higher in the CO₂ laser group (18.68) compared to the lubricant group (10.44), with statistically significant differences ($P < 0.001$). In the CO₂ laser group, improvement in FSFI scores was observed exclusively in the domains of desire and lubrication [18].

Studies conducted by the Montepriincipe University Hospital Laser Unit on a cohort of 21 women with GSM symptoms demonstrated a statistically significant increase in VHI scores in all participants over a 12-week observation period. At baseline, it was 17.7 ± 1.6 . In six women, the VHI exceeded 20 ($P < 0,05$). Eighty-one percent of patients reported improved sexual satisfaction. During the 24-week follow-up period, the improvement was sustained and remained statistically significant; overall treatment satisfaction among the cohort was 88%. [19].

An Italian study evaluating the effect of CO₂ laser therapy on vaginal pH demonstrated a significant Increase in the number of normal vaginal epithelial cells >5 per field of view compared to baseline. Statistically significant improvements ($p < 0.0001$) were observed in six aspects: dyspareunia, vaginal dryness, RUI, burning sensation during urination, post-coital bleeding, and vaginal pruritus. A significant improvement was also recorded in the Female Sexual Distress Scale (FSDS) (-4.45 ± 8.73 , 95% CI = $-2.28-6.70$, $p < 0.0001$) [20].

3.3 Safety and Tolerability

Adverse events associated with laser therapy have been infrequently reported in clinical studies [17-20]. Immediate post-treatment reactions were occasionally observed, but these were mild and limited to transient erythema in the vaginal vestibule and vulvar area, resolving within one week [17]. One patient developed a mild urinary tract infection after the first treatment [18]. Two patients (2.2%) experienced dysuria within seven days following the procedure, and one patient (1.1%) reported dizziness immediately after the treatment. Other reported adverse effects included itching, burning sensation, bruising, swelling, brief stabbing sensations and purpura [19]. In all cases, the symptoms resolved spontaneously [17-19].

4. Er:YAG Laser Therapy in the Treatment of Vaginal Atrophy in GSM

4.1 Mechanism of Action

The Er:YAG laser, with a wavelength of 2,940 nm, utilizes light energy absorption by water, but with a significantly lower thermal effect and approximately 15 times higher water absorption compared to the CO₂ laser. This results in a more superficial tissue effect, faster tissue healing, fewer side effects, reduced pain, and improved safety compared to CO₂ laser treatment [15]. These characteristics provide patients with a shorter recovery time and a lower risk of thermal tissue damage. The Er:YAG laser is particularly advantageous for areas requiring more delicate intervention [16].

4.2 Clinical Efficacy

A study conducted in Thailand included 44 women over 40 years of age with GSM. The effects of Er:YAG laser therapy on vaginal atrophy symptoms, vaginal pH, and the number of Lactobacillus bacteria in the vagina were evaluated. In the laser-treated group, a significant reduction in the severity of vaginal atrophy symptoms was observed, as assessed using the VAS, with a mean change of -2.28 points. Changes in vaginal pH were minimal and not statistically significant ($p = 0.86$) [15].

A prospective study on Er:YAG laser therapy was conducted in Pisa involving 205 patients. Eight participants (3.9%) reported the treatment as ineffective. Eighteen women (8.8%) experienced therapeutic effects for up to 6 months, while 151 participants (73.6%) reported effective results up to 18 months. Only five participants (2.4%) were satisfied with the treatment outcomes two years after therapy. Overall, 174 patients (84.9%) chose to undergo a repeat full laser treatment procedure [21].

In a retrospective study conducted between 2019 and 2022 on 32 women diagnosed with GSM who had contraindications to hormone therapy, Er:YAG laser treatment was applied. In 84.4% of the participants, symptoms were reduced to an acceptable level. Complete resolution of symptoms was observed in 14 patients (43.8%). A statistically significant decrease in vaginal pH was also observed ($p < 0.001$) [22].

In a pilot study by Gaspar et al., 29 patients were evaluated for improvement in GSM symptoms following Er:YAG laser therapy. Pain and discomfort were assessed using the VAS. A statistically significant reduction in VAS scores for GSM symptoms was observed after three Er:YAG therapy sessions, with improvements maintained during 12–18 months of follow-up. Mean VAS scores decreased from approximately 6.5–7.5 points before treatment to 1.5–2.5 points post-treatment. In women with predominant dyspareunia, VAS scores decreased from 6–8 to 2–3 points shortly after the completion of therapy [23].

4.3 Safety and Tolerability

Adverse events associated with the therapy were infrequently reported in clinical studies, and the procedure was generally well tolerated [15, 21-23]. One participant reported mild discomfort during the procedure, which resolved immediately after the treatment [15].

Less than 3% of participants discontinued the therapy due to adverse events, although the authors did not provide detailed information regarding the nature of these occurrences [21]. In a small subset of patients, local and transient adverse events were observed—15.6% experienced mucosal injury, while 6.3% reported vaginal burning. All reported symptoms resolved spontaneously without the need for intervention [22]. Four participants experienced dysuria and mild hematuria, while one participant developed a urinary tract infection that required antibiotic treatment [23].

5. Platelet-Rich Plasma in the Treatment of Vaginal Atrophy in GSM

5.1 Mechanism of Action

Platelet-rich plasma (PRP) is a concentrated platelet preparation obtained from the patient's own blood. It contains a high concentration of seven key growth factors (GFs): PDGF, TGF- β , VEGF, EGF, HGF, fibroblast growth factor, and IGF-1. Their presence initiates tissue repair and regeneration. Activated platelets release various bioactive molecules, which confer reparative and regenerative properties to tissues [24].

Autologous PRP therapy accelerates wound healing and reduces tissue inflammation. This effect is further supported by the leukocytes present in PRP, which exhibit antimicrobial properties. PRP activates platelets, leading to the release of these active molecules. This process facilitates cell migration, proliferation, angiogenesis, and tissue regeneration. By inhibiting pro-inflammatory cytokines, it helps prevent the development of inflammation [25].

PRP injections are currently being employed as a novel therapeutic approach for the management of genitourinary syndrome of menopause (GSM) [26].

5.2 Clinical Efficacy

In a prospective clinical study conducted by Oyardı and Ural, 35 postmenopausal women with GSM symptoms received two injections of injectable platelet-rich fibrin (i-PRF) into the posterior vaginal wall. Treatment outcomes were assessed using two validated questionnaires: the FSFI and the SLQQ. Six months after the procedure, a significant improvement in sexual function and quality of life parameters was observed, as measured by both the FSFI and the sexual quality of life questionnaire ($p < 0.001$). In the FSFI, the parameters evaluated included desire, arousal, lubrication, orgasm, pain, and satisfaction with sexual life [27].

In a similar randomized controlled trial involving 60 women with vaginal atrophy, PRP injections were administered into the vaginal mucosa and compared with a placebo (saline). After four months, the PRP group demonstrated a significant improvement in overall sexual function (FSFI: 19.0 ± 4.5 vs 9.7 ± 4.3 in the control group; $p < 0.001$) as well as significant benefits in specific domains, including lubrication, satisfaction, and pain during intercourse. PRP therapy was also associated with significant improvements in emotional well-being and social functioning compared to baseline values ($p < 0.001$) [28].

Additionally, in a phase II pilot study involving women after breast cancer treatment, a single PRP application along the full length of the vagina demonstrated a significant improvement in GSM symptoms, sexual function parameters measured by the FSFI, VHI, and quality of life after six months of follow-up. Analysis of the individual components of the VHI revealed statistically significant improvements in tissue elasticity, vaginal discharge, pH, epithelial integrity, and lubrication. All secondary outcomes also showed statistically significant improvement ($P \leq 0.002$) [29].

In a Romanian study, 90 postmenopausal women were evaluated 12 weeks after receiving PRP injections. The primary endpoint was sexual function, assessed using the FSFI, which showed a mean increase of 10.1 ± 3.4 points, reaching a post-treatment mean of 28.3 ± 4.1 . The secondary endpoint was the VHI, which improved from a baseline mean of 12.3 ± 2.8 to 18.5 ± 3.2 , corresponding to a mean increase of 6.2 ± 2.1 points.

Treatment satisfaction was assessed using a 5-point Likert scale and was high. This scale evaluates parameters such as vaginal moisture, tissue elasticity, pH, epithelial integrity, and secretion volume, with total scores ranging from 5 to 25. Among women receiving PRP therapy, 64.4% reported very high satisfaction, while an additional 28.9% expressed general satisfaction with the treatment [30].

5.3 Safety and Tolerability

In the studies, no serious adverse events related to the therapy were reported [27-30]. The observed adverse events resolved within 24 hours and included: vaginal spotting, irritation, discharge, burning, cramps, and mild pain [29]. Mild vaginal burning was reported in one participant (2.22%), while transient local discomfort occurred in three participants (6.66%), all resolving within 48 hours [30].

6. Current Guidelines and Expert Positions:

According to the BMS Consensus Statement 2025, CO₂ and Er:YAG lasers may represent a potential non-pharmacological option for the treatment of GSM, usually applied in a series of 3 procedures every 4–6 weeks, with the possibility of an annual maintenance session. However, the BMS emphasizes the need for further randomized studies with a sham control group before these technologies can be considered standard therapy [31].

In contrast, the latest AUA/SUFU/AUGS 2025 guidelines do not recommend CO₂ or Er:YAG lasers as routine therapy for GSM due to the low level of evidence (Grade C). Their use is only permissible experimentally in patients who decline standard therapy [32].

A similar position is presented by the FDA in its Safety Communication published in July 2018 [33], warning against the use of lasers for GSM because of the lack of clinically proven safety and efficacy. Reports of complications (FDA MAUDE) continue to indicate potential risks and adverse events. For this reason, laser technologies for GSM treatment in the U.S. are currently used off-label, outside of approved indications [34].

The position of NAMS also indicates that fractional lasers lack sufficient clinical data confirming their safety and efficacy. For the same reasons, Australia has removed laser devices from the registry for GSM treatment [35].

There are no formally established scientific society guidelines recommending PRP for GSM as a standard therapy [36].

7. Future Perspectives

Despite growing interest in CO₂ and Er:YAG laser therapies and PRP administration for the treatment of GSM, current evidence remains limited in both quality and consistency. Existing clinical studies differ not only in methodology but also in sample size, often including small cohorts, which restricts the generalizability of the findings. Additionally, the endpoints used to evaluate treatment efficacy have been heterogeneous some studies relied on objective clinical parameters, such as the VHI or vaginal pH, while others assessed PROMs, including the FSFI or VAS for GSM symptoms. This heterogeneity makes it difficult to compare results across studies and draw definitive conclusions.

Future research should focus on well-designed, randomized controlled trials (RCTs) with sham or placebo control groups, involving larger patient populations and longer follow-up periods. Standardization of efficacy assessment, incorporating both objective clinical measures and validated patient-reported outcomes, will enable more accurate evaluation of therapeutic effects and facilitate comparison across interventions.

Moreover, future studies should consider patient heterogeneity, including time since menopause, severity of GSM, comorbidities, and prior hormonal therapies. Defining optimal treatment protocols: number of sessions, intervals between treatments, laser device parameters, and PRP administration schedules will also be essential.

Ultimately, the development of high-quality clinical evidence will allow for the assessment of long-term efficacy and safety, as well as a clearer definition of the role of these therapies in standard GSM management. Only through rigorous research can these interventions be safely integrated into routine clinical practice and inform future guideline updates.

8. Conclusions

GSM is a common condition in postmenopausal women, leading to genitourinary symptoms and impaired quality of life, which do not resolve spontaneously and may negatively affect sexual and psychological well-being.

Standard hormonal and non-hormonal therapies are effective for most patients, but do not provide complete symptom relief for all, and the use of hormones may be limited due to contraindications or patient preferences. Emerging regenerative approaches, such as fractional CO₂ and Er:YAG laser therapy, as well as PRP injections, show potential as non-pharmacological options, improving GSM symptoms and clinical parameters with a relatively favorable safety profile.

Available clinical evidence suggests these technologies may enhance tissue elasticity and integrity, improve vaginal hydration, and support sexual function; however, data are limited by small sample sizes and short-term follow-up. Given the lack of long-term data and standardized treatment protocols, laser therapy and PRP should currently be considered experimental, with patients fully informed about the limitations of available evidence.

Future research should focus on larger, well-designed randomized controlled trials with control groups to define optimal treatment protocols, assess the durability of effects, and evaluate long-term safety, enabling these therapies to be integrated safely into routine clinical practice.

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