SURGERY VS. LASER: A LITERATURE REVIEW ON THE TREATMENT OF URINARY INCONTINENCE

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ABSTRACT

Urinary incontinence (UI) is a common condition among climacteric women, negatively impacting quality of life and physical and emotional health. Therapeutic approaches vary, the most common being sling surgery and laser therapies, both erbium laser (Er-YAG) and CO^2 laser. This study aims to compare the efficacy of sling surgery and laser therapies in the treatment of urinary incontinence in middle-aged women, aged 40 to 60 years, evaluating their results and impacts on quality of life. The research consists of a literature review, considering recent studies that evaluate the effectiveness of treatments for UI. Clinical data, success rates, and quality of life of the patients were analyzed. The data reveal that sling surgery has a success rate of more than 80% in one year of follow-up, providing significant relief from symptoms. Laser therapies, although less invasive, have shown promising results, with an improvement in the quality of life of up to 70% of patients, although their long-term effectiveness still needs more research. The choice between surgery and laser therapy should be individualized, considering the preferences and health conditions of each woman. Promoting a multidisciplinary approach is essential to optimize treatment and support for patients with urinary incontinence.

Keywords: Urinary incontinence. Women. Treatment. Suburethral slings. Laser therapies.

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INTRODUCTION

Urinary incontinence is a condition that impacts millions of women around the world, especially those in middle age, in the age group of 40 to 60 years. This problem significantly compromises quality of life, causing discomfort, embarrassing situations, and restrictions on daily activities (1). In middle-aged women, the predominance of incontinence is associated with several physiological conditions, including hormonal and structural changes, such as atrophy of the pelvic muscles, which accompany the aging process and even previous surgical procedures (2). The effects of urinary incontinence transcend the physical aspects, profoundly affecting the emotional and social well-being of individuals. This condition often results in social isolation and reduced self-confidence (3). With the arrival of menopause and other factors associated with gynecological health, the need to provide effective and specific treatments for this audience grows.

Over the decades, multiple therapeutic strategies aimed at urinary incontinence in women have been elaborated. Among the most conventional techniques, sling surgery stands out, an invasive procedure that aims to use a synthetic polypropylene tape without tension to reinforce the pubourethral ligament, with the objective of providing support to the pelvic floor muscles, improving continence (4). However, the evolution of medical technology has brought less invasive alternatives, such as laser therapies. The Erbium YAG laser is a non-ablative laser that has a wavelength of 2940 nm and uses SMOOTH® technology, which are controlled bursts and long pulses. The use of such technology for the treatment of urinary incontinence has been widely used, leading to several studies on this therapy. The CO^2 laser, on the other hand, has a wavelength of 10600 nm, which is one of the first gas lasers produced and widely used for the treatment of vaginal atrophy present in the climacteric (5). However, the choice of the most appropriate treatment for each patient still generates conflict among health professionals, making it essential to investigate which therapeutic approach offers the best results in terms of efficacy and safety.

In a panorama full of therapeutic alternatives, the following question arises: what would be the most effective approach for the treatment of urinary incontinence in women who fill this age group? The urgency to answer this question becomes even more crucial in the face of the growing number of patients affected by this condition, requiring interventions that not only relieve symptoms, but also promote a full and lasting recovery. This problem is the guiding axis of this investigation, since each therapeutic modality has unique characteristics, distinct benefits and potential limitations that need to be carefully analyzed. Hypotheses that can be raised in this study include the possibility that sling surgery remains the best option for more severe cases of urinary incontinence, while laser therapies may prove to be more suitable for moderate and mild cases, or for patients who

do not wish to undergo invasive procedures. In addition, another assumption is that different types of laser may present different levels of efficacy, and it is necessary to understand which one offers a superior or safer therapeutic response.

The main purpose of this study is to perform a comparative analysis of the efficacy and safety of the treatments available for urinary incontinence in climacteric women, with emphasis on evaluating the differences between sling surgery and laser therapies. Specific objectives include reviewing the literature on surgical and laser treatment for urinary incontinence and comparing the efficacy and side effects of the two types of laser versus sling surgery.

The literature review allowed us to gather crucial information for the understanding of the existing therapeutic alternatives, as well as for the comparative analysis between them. The methodology adopted ensured the selection of articles that reflected current clinical practices and emerging trends in the treatment of urinary incontinence, contributing to the construction of a robust and up-to-date theoretical framework.

The relevance of this study lies in the growing search for less invasive treatments and rapid recovery, especially for women who want to preserve their quality without their routine being impaired by long periods of rehabilitation. In addition, the work contributes to the deepening of knowledge about the available therapeutic options, providing comparative data that can help health professionals in clinical decision-making, in addition to favoring the progress of medical practices related to women's health.

METHODOLOGY

The present study was based on an exploratory literature review, with the aim of identifying and analyzing the existing scientific evidence on the treatment of urinary incontinence in middle-aged women. Thus, for its elaboration, a search was carried out in the following databases: Virtual Health Library (VHL) and PubMed. Thus, of the total of 627 articles found, fifty-one were selected, using the following descriptors searched in Medical Headings (MeSH): In the VHL "Urinary Incontinence", "Treatment" and "CO^2 Laser", and "Urinary Incontinence" and "Erbium Laser" and "Urinary Incontinence", "Suburethral Slings". In addition, "Urinary Incontinence" and "CO2 Laser", and "Urinary Incontinence" and "Erbium YAG Laser", and "Urinary Incontinence" and "Suburethral Slings" were used in PubMed.

The inclusion criterion was articles published in the period between 2014 and 2024, being original articles, available in English, Portuguese and Spanish, which addressed the results of sling surgery and Erbium lasers and CO^2 in the treatment of urinary incontinence.

Thus, there were 19 publications with duplicate obtainment in the searched databases. All articles that, after a preliminary analysis of the titles, abstracts and methodologies, were characterized as literature reviews and that did not specifically address the topic in question were excluded.

THEORETICAL FRAMEWORK

TYPES OF URINARY INCONTINENCE

Urinary Incontinence (UI) is defined as the complaint of any involuntary loss of urine, and is classified into the main subtypes: Stress Urinary Incontinence (SUI), Urge Urinary Incontinence (UUI), Mixed Urinary Incontinence (SUI) and Overflow Incontinence. SUI, the most prevalent subtype, occurs due to urethral sphincter weakness or urethral hypermobility, which leads to involuntary urine loss in situations that increase intra-abdominal pressure, such as coughing, sneezing, laughing, lifting weights, or performing physical activities (6). In the later stages, loss can occur even during lower-impact activities, such as walking or changing positions (7).

UUI is characterized by involuntary contractions of the detrusor muscle, and may be caused by neurogenic or idiopathic hyperactivity of the detrusor. Patients report urine loss preceded by an urgent need to urinate, which is commonly associated with neurological disorders (6). UUI combines characteristics of SUI and UUI, presenting symptoms of urinary loss associated with both effort and urgency to urinate (7). On the other hand, Overflow Incontinence occurs due to underactivity of the detrusor muscle or obstruction of the bladder outlet, resulting in the accumulation of urine beyond the maximum capacity of the bladder, which leads to extravasation. This type is common in men with benign prostatic hyperplasia (7).

Several risk factors are associated with UI, such as advanced age, obstetric history, gynecological conditions (dystopias, sphincter dysfunction, and urogenital syndrome of menopause), obesity, diabetes, cardiorespiratory diseases, chronic cough, obstructive sleep apnea, and smoking (6). Additionally, medications such as angiotensin-converting enzyme (ACE) inhibitors, antidepressants, antihistamines, antimuscarinics, antiparkinsonians, antipsychotics, opioids, muscle relaxants, and calcium channel blockers can aggravate UI by reducing bladder contractility or inducing conditions such as chronic cough (6).

Given the significant impact on quality of life, the diagnosis and management of UI should consider risk factors, associated conditions, and possible drug causes, in addition to seeking specific interventions for each subtype of the condition.

URODYNAMIC STUDY

The urodynamic study, also known as urodynamic evaluation, is an exam that aims to analyze the performance of the urethrovesical system in the phases of storage and elimination of urine. This method contributes to an accurate diagnosis of lower urinary tract dysfunctions (LUTD), since its pathophysiology provides an essential performance in defining the therapeutic method to be used(8).

Therefore, this urodynamic test should be indicated in some circumstances, namely: complex urinary incontinence, genital prolapses, and neurological disorders. Thus, it is not indicated as a routine procedure for all patients with urinary incontinence. It should be noted that the request for this urodynamic investigation must be carried out by a specialist physician (9).

For the results of the test to be considered reliable, it is essential that the procedure accurately reproduces the symptoms presented by the patient, or that it requires the patient's voluntary cooperation. The patient must be physically and emotionally comfortable, and to ensure this state, a set of specific measures must be implemented by the patient.

Therefore, it may be relevant to prepare a document, written in accessible language, which explains in detail the technique of urodynamic study, so that patients can progressively understand the method and do not forget the instructions. It is worth noting that the availability of this prior information can, in a variable way, influence the patient's cooperation during the procedure.

It is considered an invasive exam that causes discomfort to the patient due to exposure of her reactions during the procedure and, mainly, because it causes the act of urination in a strange scenario, in front of the doctor or a nurse (10). This functional examination of the urinary tract is considered the gold standard for identifying the etiology of incontinence (11).

URINARY INCONTINENCE IN MIDDLE-AGED WOMEN: RISK FACTORS AND IMPACTS ON QUALITY OF LIFE

Urinary incontinence is a widely prevalent condition among women aged 40 to 60 years, being linked to a multitude of risk factors that compromise both the functioning of the urinary system and the structural integrity of the pelvic region. Among the main factors, the physiological changes resulting from aging stand out, such as decreased tissue elasticity and loss of pelvic floor strength. Menopause, for example, causes a reduction in estrogen levels, which directly impacts the integrity of the urinary tract and the muscles that support

the urethra (12). Additional factors, such as the number of vaginal deliveries, are closely related to the occurrence of urinary incontinence, as they can result in lesions to the pelvic floor and perineal nerves (13).

In addition to the biological aspects, it is essential to consider the psychosocial dimension associated with urinary incontinence. Women facing this condition often report feelings of shame, anxiety, and even depression, stemming from difficulty controlling urination. These factors can result in social isolation and reduced self-esteem (14). The restriction on daily activities is another significant impact, as many women avoid leaving the house or participating in social events for fear of experiencing episodes of incontinence in public. Thus, the disorder goes beyond the physical aspects, impacting the quality of life in a broad way(15). The literature emphasizes that the intensity with which UI occurs (small, moderate or severe) will influence the quality of life of incontinent women, that is, the greater the urine volume lost, the greater the negative implication (13).

In addition, obesity is considered a relevant risk factor for urinary incontinence, especially in women in this age group. Excess weight increases intra-abdominal pressure, which can contribute to pelvic floor overload and favor the appearance of incontinence episodes (16). Studies indicate that weight reduction can result in a substantial improvement in symptoms, emphasizing the importance of weight control as a preventive and therapeutic measure (13). This data reinforces the need for a multifactorial approach to treatment, considering both clinical interventions and lifestyle changes.

The difficulty of accessing adequate treatments also exacerbates the situation. In many cases, middle-aged women fail to seek medical help due to embarrassment or misperception that urinary incontinence is an inherent aspect of the aging process (13). However, early detection and timely intervention can prevent the progression of the problem, promoting a substantial improvement in the quality of life of these patients. Interventions, when successful, have the potential to restore urinary control and, consequently, promote physical and emotional well-being.

Another crucial point is the relationship between urinary incontinence and sexual activity. Many women report a reduction in sexual desire and start avoiding intimate relationships. Feelings of anxiety, fear of urinary leakage during sexual intercourse and concern about embarrassing odors are difficulties frequently mentioned by patients with urinary incontinence, especially among those who have significant volumes of urinary leakage (17). This condition carries a variety of implications for sexual and reproductive health, highlighting the significant impact that urinary incontinence can impact in various spheres of a woman's life. Despite the relevance of this aspect, it is often underestimated

or disregarded by health professionals. However, its inclusion as an essential element in the planning and therapeutic approach is essential to provide a more comprehensive care centered on the patient's needs

Understanding the risk factors and impact of urinary incontinence on the lives of middle-aged women is essential for the development of effective therapeutic strategies. The recognition of the complexity of the challenges faced by these women should guide clinical decisions, taking into account not only the physical aspects of the symptoms, but also the emotional and social impacts associated with this condition (12). Thus, it is essential that health professionals offer a multidisciplinary and humanized approach, with the aim of providing an overall improvement in the quality of life of these patients.

Analyzing the repercussion of UI on the health-related quality of life (HRQoL) of incontinent women is a relevant approach to understand this pathology not only from a clinical perspective, but also from the point of view of the patients themselves. Therefore, it enables the development of an efficient therapeutic process, in search of the recovery of continence and quality of life (QoL) of the patients. To conduct this assessment, it is possible to use specific, validated and reliable questionnaires that assess the intensity and impact of UI symptoms on QoL, such as: the International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF), the Incontinence-Specific Quality of Life Instrument (I-QOL) and the King's Health Questionnaire (KHQ) (14).

SURGICAL SLING TREATMENT FOR URINARY INCONTINENCE: EFFICACY AND SAFETY

Urinary incontinence (UI) is a prevalent condition that affects millions of women worldwide, negatively impacting their quality of life (QoL) (18). A study that evaluated 391 women with different degrees of UI aimed to measure the impact of the severity of the condition on QoL. Severity was classified according to the weight of the pad used in 24 hours: mild (4–20 g), moderate (21–74 g), and severe (>75 g). Notably, it was observed that even cases classified as mild already caused significant impairments in QoL, which was evidenced by validated instruments, such as the King's Health Questionnaire (KHQ) and the International Consultation on Incontinence Questionnaire – Short Form (ICIQ-SF). Although a linear relationship was not found between UI severity and the degree of QoL impairment, the study revealed that minimal urinary losses are enough to negatively affect women's physical, emotional, and social well-being. Regarding the type of UI, the data showed that urge urinary incontinence (UUI) had the greatest impact on QoL, followed by mixed incontinence and, finally, stress incontinence (SUI). This reinforces the notion that

the presence of UI itself, regardless of its volume, plays a more relevant role in the deterioration of QoL than the amount of urinary loss itself (19).

Regarding the management of SUI, a longitudinal study conducted between 2019 and 2024 evaluated the outcomes of surgical treatment. The results indicated that the choice of surgical technique should be based on individual characteristics of the patient, such as age, severity of incontinence and personal expectations regarding the results. Personalization of treatment is essential for therapeutic success (7). Historically, since its first description in 1907, numerous surgical techniques have been proposed and improved (18).

Among the most used techniques, the retropubic sling (RP) and the transobturator sling (TOT) stand out. A systematic review comparing these two approaches looked at three robust studies with a total of 6,040 patients. The data showed that the objective cure rate was higher with the retropubic technique, ranging from 76.36% to 95%, compared to the TOT, which presented rates between 69.18% and 93%. However, OTT had an advantage in terms of safety, with a lower incidence of immediate complications, such as urinary retention and bladder perforation. In addition, a lower frequency of pain in the thigh and groin was observed with this approach. Regarding the improvement of quality of life, both techniques were effective, and no statistically significant differences were observed between them (21).

Based on these findings, it is concluded that surgical treatment of SUI is highly effective and may, in some cases, be indicated as the first line of intervention. The retropubic sling performs better in more severe cases of the disease, being associated with a higher long-term cure rate. On the other hand, the transobturator sling stands out for its lower risk of urethral and bladder injuries, which reinforces its safety (22). The Cochrane systematic review deepened this analysis, revealing that the transobturator route has lower complication rates, while the retropubic route is more frequently related to vascular and visceral lesions, longer surgical time, and greater intraoperative bleeding. Regarding the subjective cure rate, there was a variation between 62% and 98% for the transobturator sling and between 71% and 97% for the retropubic sling (23). Although retropubic is associated with complications such as hematomas, vascular lesions, and bladder perforation, TOT is more closely related to muscle pain in the legs and groin, as well as possible neurological lesions and vaginal perforation (21). In addition, evidence indicates that, even after surgery with a transobturator sling, symptoms of overactive bladder may persist, requiring prior counseling to patients about this possibility(24). In addition, the

performance of concomitant vaginal surgeries did not significantly impact the success rates of the procedure (25).

The current literature reinforces that transobturator techniques are effective in the treatment of SUI, with good cure rates and a favorable safety profile. The choice between the outside-in and inside-out approaches should consider, in addition to the patient's characteristics, the surgeon's experience (25). At the same time, new minimally invasive approaches have emerged, such as mini-slings and single-incision slings (SIMS), which offer advantages such as shorter surgical time, less postoperative pain, and rapid recovery. Despite these advantages, studies indicate that mini-slings have lower subjective efficacy when compared to other slings (OR: 0.58; 95% CI: 0.39–0.86) (22) (26).

In this context, the work of Jelovsek et al. (2016) stands out, whose objective was to develop and validate predictive models to estimate the risks of SUI, SUI, and adverse complications up to 12 months after midurethral sling surgery. Based on 1,499 patients from four randomized controlled trials, the authors used bootstrap-validated logistic regression models. The models performed well (agreement rates between 0.64 and 0.73) and indicated lower rates of complications associated with transobturator slings. The results offer important subsidies for clinical practice, by enabling individualized planning and personalized pre-surgical counseling (1).

Regarding SIMS, specifically, it is one of the most common subtypes of UI in women and represents a challenge of great relevance to public health. This condition significantly compromises the autonomy, self-esteem and social participation of patients, impairing simple daily activities. According to the literature, SUI has a multifactorial etiology, involving anatomical and hormonal changes. It is most often seen in women with a history of vaginal births, obesity and procedures such as hysterectomy (20). The diagnosis of SUI should be comprehensive, encompassing detailed clinical examinations, laboratory investigations and, when necessary, urodynamic study, in order to confirm the type of incontinence and appropriately direct the therapeutic plan (18) (20).

The data indicate that its efficacy in terms of objective cure is similar to that of OTT, with the added advantage of lower occurrence of serious complications. The absence of statistical difference in subjective cure may be related to the self-assessment character of this indicator. In general, the benefits of SIMS in relation to quality of life are significant and reinforce the positive impact of minimally invasive techniques on the well-being of patients (26). In a follow-up of up to three years, the SIMS technique was comparable to the middle urethral sling (SUM) in subjective and objective cure rates, with shorter surgical time and

less postoperative pain. However, there was a higher incidence of mesh exposure and the need for surgical reinterventions (27).

In addition to industrial approaches, one study compared two types of retropubic sling: the Safyre™ business model and a handmade handmade model (HMS). The sample, consisting of 351 women, revealed that both methods showed significant improvements in the ICIQ-UI SF scores, with subjective cure rates of 79.3% (Safyre™) and 68.7% (HMS). However, the Safyre™ sling had a higher incidence of intraoperative bladder lesions (4.2% versus 0%) and a greater tendency to urinary retention. Overall satisfaction and vaginal extrusion rate did not show statistical differences between the groups (23).

Regarding the use of autologous tissue, a prospective cohort study conducted in Uruguay evaluated the efficacy of the autologous transobturator sling, made with fascia of the rectus abdominis. Eighteen women with an average age of 51 years were followed for nine months, and 94% showed significant improvement in symptoms. No serious intraoperative complications were recorded, with statistically significant reductions in incontinence scores and quality of life at 3, 6, and 12 months postoperatively. Among the postoperative complications, urinary tract infection, abdominal seroma, and colpotomy dehiscence stand out, all of which are managed clinically without the need for reintervention (28).

Another relevant aspect analyzed was the influence of sling surgery on sleep quality. In a study with 36 women with a mean age of 48.2 years, the ESS and PSQI questionnaires were applied before and after the procedure. The Epworth Sleepiness Scale (ESS) and Pittsburgh Sleep Quality Index (PSQI) questionnaires were used to measure the results. There was a significant improvement in overall sleep quality after surgery, as indicated by the reduction in the ESS score (median before: 12; after: 5.5; $p = 0.0401$). In the PSQI, the specific domain of sleep disorders also showed significant improvement (median before: 1.5; after: 1.0; $p = 0.0127$. (3,15). However, other parameters, such as sleep latency and duration, did not show statistically significant differences. The study suggests that surgical treatment of SUI can contribute to improving the quality of life of these patients, reducing symptoms related to sleep fragmentation and sleep-wake disorders (29).

Finally, the impact of the TOT technique on quality of life and symptoms of overactive bladder was studied in 104 women with predominant exertional IUM, followed for 30.47 months. Objective cure was observed in 96.2% of the cases and improvement in QoL in 80.7% of the patients, with a significant reduction in the scores of the SEAPI and IIQ-7 questionnaires (24). The results showed that 96.2% of the patients had objective cure

of stress urinary incontinence, while subjective cure was reported in 56.7% of the cases. In addition, 80.7% of the patients showed a significant improvement in quality of life, with a 15-point reduction in the scores of the SEAPI and IIQ-7 questionnaires (24). Burch surgery may also be an option when slings are not available, with good success rates. It is concluded that surgical treatment not only corrects urinary incontinence, but also contributes to improving the quality of life of patients, reducing the social and psychological impacts associated with the condition (22).

Another study comparing TOT and Burch's colposuspension with 81 women revealed a higher success rate in the TOT group (69%) compared to Burch (45%) in the stress test, with better results. Quality of life, as measured by the UDI-6 and IIQ-7 questionnaires, showed significant improvements only in the TOT group. The Patient Global Impression of Improvement (PGI-I) questionnaire also indicated higher satisfaction in the TOT group ($p = 0.031$). Although both groups demonstrated a reduction in urine loss and an improvement in ICIQ-SF, the TOT was superior in terms of overall impact and higher patient satisfaction, with no significant differences in complication rates (30).

In view of the set of clinical and scientific evidence analyzed, it is concluded that the choice of the ideal therapeutic approach for the treatment of female stress urinary incontinence (SUI) should be guided by a careful and individualized evaluation (11). Several factors should be considered in this decision-making process, including the patient's age, symptom severity, presence of comorbidities, gynecological-obstetric history, previous pelvic surgeries, as well as the expectations and preferences of women regarding surgical outcomes and postoperative recovery. The expertise of the medical team and the available infrastructure also play a decisive role in the selection of the most appropriate technique (22).

Recent advances in the literature highlight the importance of incorporating predictive tools into clinical practice, such as the statistical models developed by Jelovsek et al. (1), which allow for more accurate estimation of the risks of complications and recurrence of SUI, promoting a more personalized and patient-centered medicine (20). In addition, the emergence of minimally invasive techniques — notably mini-slings and single-incision slings (SIMS) — represents a significant advance in the therapeutic arsenal, by offering less aggressive alternatives, with shorter surgical time, less postoperative pain, and faster recovery. However, such methods still lack robust long-term evidence to support their clinical efficacy compared to conventional techniques, especially regarding the subjective cure rate and durability of results (27).

As amply demonstrated throughout this analysis, sling surgery, whether retropubic or transobturator, remains the gold standard for the treatment of SUI refractory to conservative interventions, such as pelvic floor physical therapy, bladder reeducation, and behavioral changes (31). Both techniques have excellent success rates, both in objective and subjective terms, with significant improvement in the quality of life, self-esteem and social integration of the patients. Such interventions not only restore voiding function, but also rescue women's dignity and autonomy, which are often compromised by the chronicity and stigmatization associated with urinary incontinence (32).

Thus, the treatment of SUI should be understood as a continuous and multidimensional process, which requires a sensitive, technical and interdisciplinary look on the part of health professionals. It is essential to promote not only the remission of symptoms, but also the physical, emotional, and social well-being of patients, through safe, evidence-based conducts supported by a humanized and woman-centered model of care.

LASER THERAPIES FOR URINARY INCONTINENCE: TYPES, MECHANISMS OF ACTION, AND CLINICAL OUTCOMES

Genitourinary Menopause Syndrome (GBS) can be defined as menopausal symptoms associated with physical changes in the vulva and vagina, in addition to urinary problems related to estrogen deficiency (33). It is a chronic condition that tends to worsen over time, affecting up to 50% of postmenopausal women (34). One of the consequences of GBS can be Stress Urinary Incontinence (SUI), which in turn is characterized by the involuntary loss of urine during physical activities or effort, impacting 25% to 45% of women throughout their lives (35), its prevalence increases with age and is the most common form of female enuresis (36).

The need for a definition of GBS came with the aim of more accurately describing the urogenital changes and local symptoms that arise in menopause, compared to the terms vulvovaginal atrophy (AVV)/atrophic vaginitis (37). GBS involves morphological changes in the vaginal mucosa, such as thinning of the epithelium, loss of vaginal folds, reduced blood flow, and decreased vaginal secretions (38), leading to symptoms such as dryness, itching, burning, irritation, dysuria, dyspareunia, in addition to urinary symptoms such as urgency and incontinence, especially in menopausal women due to the drop in estrogens (39).

In addition to being caused by SGM, SUI can also occur due to deterioration of the muscles, nerves, and connective tissue that sustains and controls the function of the pelvic organs (40). Even though its exact cause is not yet fully understood, factors such as

genetic history, pregnancy, childbirth, menopause, obesity, and aging are recognized as risk factors for MGS or SUI. It is estimated that, globally, the prevalence of urinary incontinence in women is around 35% in Europe and 50% in the United States (41).

The use of the Er:YAG (Erbium YAG) laser in gynecological treatments began in 2000, and it was initially used to treat vaginal tissues (42). The non-ablative Er:YAG laser is seen as a non-invasive intervention, its form of action would be by creating heat pulses that are transferred to the vaginal mucosa without overheating the tissue surface (43), making this type of laser indicated for the treatment of SUI, both with conservative and surgical methods, being the IncontiLase technology, which uses the Er:YAG laser, one of the most recent and minimally invasive options, the two forms will be discussed in this article (36).

Still on the Er:YAG laser, it is important to discuss that this form of treatment improves bladder support and relieves incontinence symptoms, promoting collagen reconstruction and stimulating neocollagenesis, strengthening pelvic floor structures, such as the urethra and anterior vaginal wall (44).

Although there are initial non-surgical options for the treatment of SUI, such as behavioral changes (weight reduction, smoking cessation), physical therapy, pelvic floor exercises, and the use of pressaries (45), long-term adherence by patients is usually low (46). It is important to emphasize that therapies and medications can also be useful to alleviate the symptoms of SUI (47). Therefore, the ideal path is for the treatment to be non-invasive, focusing on behaviors and exercises, in addition to electrical stimulation of the pelvic floor, however, many patients do not obtain good results due to lack of adherence (48).

Although the role of CO2 laser in the treatment of GMS or SUI is still controversial, it is approved by bodies such as the FDA to promote tissue effects such as ablation, vaporization and coagulation (49). Therefore, non-invasive treatments, such as behavioral changes and exercise, should be considered as the first line of treatment for female UI. The vaginal application of CO2 laser has been mainly explored in studies on GBS, aiming at the treatment of medical conditions related to the vaginal epithelium (50).

Fractional microablative laser therapy has been shown to be a promising non-surgical alternative for SUI, stimulating collagen and elastin synthesis, which results in a thicker vaginal epithelium with more glycogen-rich cells (51). Training your pelvic floor muscles can help prevent urinary loss by strengthening them and improving bladder control (52). However, it is observed that like any procedure, vaginal laser treatment has mild and transient side effects, such as pain during the procedure, temporary irritation, light bleeding

and a burning sensation. However, in studies, permanent lesions such as vaginal stenosis and laceration have been observed (53).

In a study recently developed with eight patients, it was possible to notice that patients with a higher degree of incontinence had worse results, at this point, it was where laser treatment stood out demonstrating efficacy and prevention of urinary incontinence associated with urogenital prolapse. Once the treatment is finished, it will be possible to observe an improvement in the elasticity and turgor of the vulvar region, collagen remodeling, elevation of the urethral angle, and reduction of the opening of the vaginal introitus (54). In addition, studies indicate that laser treatment to restore vaginal function can improve women's quality of life, being effective and safe when applied correctly, however second-generation technologies, such as SMOOTH VEL, offer an effective and outpatient option for the treatment of GSM, mild to moderate SUI and pelvic organ prolapse.

However, more randomized trials are needed to compare these treatments with other therapies and evaluate the duration and safety of treatment (55). Thus, it is concluded that vaginal laser is promising, and should be recommended for the treatment of GBS, SUI, recurrent urinary infections or genital prolapses outside of a research context, however, as with any procedure, the patient is aware of the risks and efficacy of the treatment (56).

RESULTS AND DISCUSSION

Stress urinary incontinence (SUI) represents a significant health problem for women, negatively impacting quality of life (QoL) and requiring effective and personalized therapeutic approaches. The reviewed findings demonstrate that even mild urinary losses are sufficient to compromise the physical, emotional, and social well-being of patients, as evidenced by validated instruments such as the King's Health Questionnaire (KHQ) and the International Consultation on Incontinence Questionnaire – Short Form (ICIQ-SF). Although a linear relationship between the severity of incontinence and the degree of QoL impairment was not identified, it is noteworthy that the presence of the condition, regardless of the volume of urinary loss, is a determining factor in the deterioration of QoL (19).

Regarding treatment, the long-term study conducted between 2019 and 2024 reaffirms the efficiency of surgical techniques for SUI. Among the most commonly used procedures, the retropubic sling (PR) and the transobturator sling (TOT) demonstrate high success rates, with objective cure rates ranging from 76.36% to 95% for PR and from

69.18% to 93% for OTT. Although PR had a slightly higher cure rate, the TOT technique showed a lower incidence of postoperative complications, such as urinary retention and bladder perforation, in addition to a lower occurrence of thigh and groin pain (21). These findings reinforce the need for individualization of treatment, considering not only the efficiency of the intervention, but also the postoperative safety and comfort for patients. However, PR is still considered the gold standard in treatment.

Recent advances also point to the development of minimally invasive techniques, such as mini-slings and single-incision slings (SIMS), which offer advantages such as shorter surgical time, less postoperative pain, and faster recovery. However, studies indicate that mini-slings may exhibit lower subjective efficacy compared to other approaches, with an Odds Ratio (OR) of 0.58 (95% CI: 0.39–0.86) (22, 26). In addition, although the SIMS technique has demonstrated cure rates similar to those of TOT, its higher incidence of mesh exposure and need for reintervention are factors that need to be considered in clinical decision-making (27).

Regarding the studies analyzed above on laser therapies, it is verified that there was an improvement in urinary incontinence through the structural reorganization of the vaginal tissue after applications with both the erbium and CO^2 lasers. Regarding the non-ablative laser (Erbium), it was found that, in two studies in which the patients had stress urinary incontinence and in the other due to stress, there was an increase in cell proliferation, increased collagen formation, as well as vascularization of the vaginal mucosa, thus improving tissue resistance. (54)

In addition, with regard to ablative laser (CO^2), it is noted that all studies were carried out in patients with stress urinary incontinence, with activation of the production of collagen and elastin fibers, improvement in the organization of connective tissue and improvement in the strengthening of vaginal walls. According to the author Nuno David Dias Pardal, there are superior methods, including microscopy, such as Polymerase Chain Reaction and immunohistochemistry, which show in the vaginal tissue an increase in pro-collagen messenger RNA, tumor necrosis factor, metalloproteinases and cytokines that stimulate the production of fibrosis after the application of lasers. Thus proving the efficiency of this therapy. (37)

Thus, laser treatment, although promising, requires careful evaluation as to its applicability in cases of UI. Current studies suggest that laser treatment may be especially beneficial for patients who do not wish to undergo invasive surgery or who have contraindications to surgical procedures. The evaluation of its efficacy compared to the

surgical sling is still an open field for research, requiring further studies that analyze both clinical efficacy and long-term patient satisfaction.

Regarding comorbidities, the study by Saboia et al. (2017) also revealed that 69.4% of women with SUI had comorbidities, while the rate was 73% among women with SUI. This points to the relevance of considering patients' general health status when planning interventions for UI. The presence of associated conditions, such as diabetes mellitus and systemic arterial hypertension, can impact the choice of treatment and the expectation of results (7). The literature suggests that these comorbidities may complicate the response to treatment, increasing the need for a multidisciplinary approach.

Therefore, when considering treatment options for urinary incontinence in middle-aged women, it is crucial for healthcare professionals to assess not only the severity and type of incontinence, but also patients' quality of life, associated comorbidities, and acceptance of interventions. Decisions should be patient-centered, fostering an open dialogue about expectations regarding available treatments, thus ensuring that choices are appropriate to their specific needs and circumstances.

CONCLUSION

Urinary incontinence (UI) in women, the study reports, poses a significant challenge to both public health and quality of life. The analysis of the various therapeutic approaches, such as sling surgery and laser therapies, reveals the complexity involved in choosing the most appropriate treatment. UI, which affects a significant portion of the female population in this age group, highlights the need for effective interventions that consider not only physiology, but also psychosocial and emotional aspects related to the condition.

Research data indicates that UI not only compromises women's physical health but also severely impacts their quality of life, reflecting on their daily activities, social life, and emotional well-being. Thus, it is essential that the therapeutic approach takes into account the uniqueness of each patient, including the presence of comorbidities and each woman's perspective on her treatment. Surgical interventions, especially the sling, have shown positive results in terms of efficacy, but the recovery and degree of patient satisfaction are factors that should not be underestimated.

On the other hand, laser therapies emerge as a promising alternative, offering less invasive options and often a faster recovery. However, the literature still lacks robust data on the long-term efficacy of these techniques compared to surgical procedures. Laser treatment can be especially advantageous for women who, for personal or medical reasons, choose to avoid more invasive surgeries. Thus, the choice between these options

must be made collaboratively, involving the patient in the decision-making process, so that they feel empowered and satisfied with their choices.

Promoting a multidisciplinary approach is essential for effective UI management. Healthcare professionals, including physicians, nurses, and therapists, should work together to develop an individualized treatment plan that considers the entirety of the patient's clinical picture. In addition, education and psychological support are essential to help women deal with the emotional impact of UI, favoring acceptance and coping with the condition.

Thus, the choice between surgical interventions and non-invasive therapies must be based on a multidisciplinary and personalized approach, ensuring a safe, effective treatment aligned with the individual needs of each patient. The advancement of therapeutic options reinforces the importance of evidence-based medicine, which aims not only at resolving symptoms, but also at the overall well-being of women affected by urinary incontinence.

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