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ORIGINAL ARTICLE

The beneficial effects of fractional CO_2 laser treatment on perineal changes during puerperium and breastfeeding period: a multicentric study

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Abstract

Childbirth is a great change in woman life because of hormonal, physical and psychological alterations that are associated with this process. Dyspareunia and perineal pain are commonly reported symptoms in the postpartum period, mainly due to perineal trauma, lacerations, episiotomy, and forceps or vacuum use at delivery. Among non-pharmacological treatment, a new trend is gaining popularity, which is the energy-based therapy, including fractional micro-ablative CO_2 laser. We conducted a multicentric retrospective study to assess the efficacy and the possible side effects of CO_2 laser treatment on transient vulvovaginal atrophy and perineal postpartum pain related to puerperium and breastfeeding period. All patients were submitted to 3 or 4 sessions of CO_2 laser treatment. As per protocol, an initial, intermediate (after 2 sessions) and final (3 months after the last cycle) evaluation of the symptoms were made, using a VAS (Visual Analogue Scale 0–10). We also compared this group of patients with a control group with no treatment. At the final evaluation, patients showed a significant improvement for dyspareunia (VAS from 7.95 to 3.14, $p < 0.0001$). A significant improvement was also registered in pain at the vaginal orifice (VAS from 6.94 to 2.05, $p = 0.0001$), dryness (VAS from 6.6 to 2.9, $p = 0.0022$), itching (VAS from 4.5 to 1.16, $p = 0.0053$), heat (VAS from 3 to 0, $p = 0.0119$) and burning (VAS from 5.5 to 1.6, $p = 0.0013$) if compared with the control group. Quality of life for the women during the breastfeeding and puerperium is important and training is mandatory to avoid side effects in order to improve the CO_2 laser performance.

Keywords Puerperium · Co2 laser · Lactation · Vaginal atrophy · Dyspareunia

Introduction

Childbirth presents a great change in a woman's life because of the hormonal, physical and psychological changes associated with this process. Dyspareunia and perineal pain are commonly reported symptoms in the postpartum period, mainly due to perineal trauma, postpartum tears, episiotomy, and forceps or vacuum use at delivery [1–3].

According to previous studies on postpartum pain, prevalence is estimated at around 90% of women who have had a vaginal delivery [4, 5].

A further factor implicated in the onset of these symptoms is breastfeeding. This is accompanied by low oestrogen levels, which are in turn responsible for urogenital syndrome that manifests, especially with decreased vaginal lubrication and vulvovaginal atrophy [6–8].

According to ISTAT data, the rate of breastfeeding mothers has increased in recent years up to 85%, while the mean duration of breastfeeding has also risen [9].

According to a recent study conducted by the Italian National Institute of Health, based on the analysis of two populations, the prevalence of breastfeeding at discharge is estimated at about 91% [10].

These findings could shed some light on the size of the problem of post-delivery vulvovaginal atrophy, which in turn

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results in dyspareunia, a common symptom more frequent in breastfeeding women than in non-breastfeeding women according to clinical studies [7, 11].

Barrett et al. studied a population of 796 primiparous women over a 6-month period post-delivery and found that 62% experienced dyspareunia in the first 3 months postpartum, decreasing to 31% at 6 months. He also highlighted that dyspareunia in the first 3 months was significantly associated with vaginal delivery and a previous experience of dyspareunia, while at 6 months it was significantly associated with breastfeeding and pre-pregnancy dyspareunia but not the delivery type [12].

This delicate puerperium and breastfeeding period implies that many of the changes have numerous commonalities with menopausal vulvovaginal atrophy (VVA), which is part of the more complex genitourinary syndrome of menopause (GSM). Thus, as in the case of postmenopausal women, breastfeeding women experience a decline in oestrogen levels immediately after delivery, which is transient but may persist as long as lactation is continued.

This hormonal change, which occurs either naturally or artificially (in medically induced menopause), plays a key role in the pathophysiology of vulvovaginal atrophy, resulting in loss of tissue elasticity, thinning of the vaginal epithelium and an increase in vaginal pH due to the low percentage of lactobacilli and increase in anaerobic bacteria. In addition, there is also a significant reduction in vascular support, leading to a decrease in vaginal and other glandular secretions [13].

Because of these histological changes, women often present with vaginal dryness, redness, loss of elasticity, ulceration and inflammation. Symptoms include perineal pain, dyspareunia, itching, chronic cystitis, a burning sensation and increased susceptibility to physical, chemical and mechanical insults. The burden of all the changes involved in vulvovaginal atrophy has a significant impact on a woman's sexuality and relationships, leading to a reduction in their quality of life [14, 15].

Similarly, these changes affect a woman's life after childbirth, contributing to sexual disfunction. According to clinical studies, various elements contribute to the onset of postpartum sexual disfunction, including systemic (breastfeeding, anaemia, lack of sleep, depression) and psychosexual (decreased sexual impulse) factors; however, perineal damage due to episiotomy or spontaneous laceration remains the major cause of dyspareunia and chronic perineal pain [7, 8, 16].

The therapeutic approach to vulvovaginal atrophy is personalised according to a patient's characteristics and provides for a wide range of treatment options. These can be divided into two main groups: non-hormonal therapies (pelvic-floor physiotherapy, local lubricants or moisturisers, topical use of growth factors) and hormonal therapies (local or systemic oestrogen therapy, ospemifene, phytoestrogens). Among the non-pharmacological treatments, a new trend is gaining popularity: this is energy-based therapy, including micro-ablative fractional CO_2 laser, non-ablative YAG laser and radiofrequency (RF)-based energy devices [13, 14, 17].

The idea to use energy-based therapy for menopausal vulvovaginal atrophy emerged from the well-established beneficial effects of heat on tissues. In fact, heat is known to reduce tissue inflammation and related symptoms by intervening in cellular signalling, which is responsible for pain message transmission [18].

In gynaecology, the most widely used treatment is micro-ablative fractional CO_2 laser; this combines the micro-remodelling of superficial nociceptive terminations with the stimulation of dermal-epidermal trophism, resulting in epithelial thickening and fibroblast and matrix stimulation.

Many studies have shown the efficacy of CO_2 laser in postmenopausal women, demonstrating a reduction in vulvovaginal atrophy-related signs and symptoms, and urogenital syndrome in general, with no side effects, allowing an improvement in quality of life [15, 18]. Only one pilot study has been recently published by Filippini et al. regarding the postpartum period [16].

Considering the beneficial effects of CO_2 laser on tissue remodelling and its safety profile, we conducted a multicentric retrospective study to assess the effect and possible side effects of CO_2 laser treatment on transient vulvovaginal atrophy and perineal postpartum pain related to the puerperium and breastfeeding period.

Materials and methods

Between November 2012 and June 2018, data from all women affected by perineal pain (especially deep dyspareunia and pain at the orifice) and vulvovaginal atrophy with dryness during the postpartum period or breastfeeding, and treated with laser therapy, were analysed. Four centres were involved in our retrospective multicentric study:

1. Gynecology department of Università Campus Biomedico, via Alvaro del Portillo, 200, Rome
2. Gynecology department of Ospedale di Stato della Repubblica di San Marino, via la Toscana 1, San Marino
3. Gynecology department of Azienda Ospedaliera Careggi, Largo Brambilla, 3, Florence
4. Gynecology department of Ospedale San Raffele, Via Olgettina, 60, Milan

Before treatment, all patients underwent a gynaecological examination, urinalysis, pH testing, (optionally) a Vaginal Health Index Score (VHIS) evaluation and a high vaginal swab for infection research. Patients symptomatic for any vaginal infection (vaginal discharge, itch, burning) were started on preventive therapy with vaginal lactobacilli.

Inclusion criteria were as follows:

1. Female patients > 18 years and of reproductive age
2. Women in puerperium or breastfeeding with persistent chronic perineal pain and/or deep dyspareunia, and/or vaginal atrophy after at least 90 days from delivery
3. One or more vulvovaginal symptoms and a VAS evaluation before and after treatment
4. Patients who have undergone 3 or 4 sessions of CO_2 laser treatment
5. Patients without symptomatic genital infection
6. ECOG performance status < 2

The exclusion criteria were as follows:

1. Pregnancy
2. Haematuria or urine clotting
3. Alcohol- or drug-dependent patients
4. Abscess, fistula or any anatomical anomaly that could interfere with treatment
5. Prolapse stage > 2 according to the pelvic organ prolapse quantification
6. Use of any form of local therapy within the previous 15 days
7. Uncontrolled psychiatric disorders
8. Cancer

All patients were subjected to 3 or 4 sessions of CO_2 laser treatment each 30 days, at least after 90 days from the delivery (vaginal or caesarean section) with the following settings:

- For vaginal atrophy and deep dyspareunia: 360° probe, power 40 W, scan time 1000 μs, spacing 1000 μm, Smart stack 1
- To treat vulvar atrophy and postpartum perineal pain: power 25 W, scan time 500 μs, spacing 500 μm, Smart stack 1

All patients enrolled signed an informed consent form. Ethical approval was waived by the local Ethics Committee of University Campus Bio Medico of Rome; in view of the retrospective nature of the study, all the procedures being performed were part of the routine care.

We also retrospectively compared results of this group of patients with a control group in which patients did not receive any laser treatment but only common lubricants or vaginal hormone tablets or cream.

A fractional CO_2 laser system (SmartXide2V2LR, Deka m.e.l.a., Florence, Italy) with a Vulvo Vaginal Laser Reshaping (V2LR) scanning system and appropriate probes for the vaginal and vulvar area were used. This treatment modality is based on the interaction between a specific CO_2 pulsed laser and the vaginal mucosa. The CO_2 laser beam, emitted fractionally, is focused on small spots (called DOTs) that are separated by healthy tissue.

Every pulse is composed of a constant high-energy peak power to produce rapid ablation of the epithelial component of atrophic mucosa, followed by longer emission times that allow the CO_2 laser to penetrate deeper into the mucosa. The effect of fractional CO_2 laser is to stimulate fibrocytes, matrix proteins such as collagen and angiogenesis to restore the connective tissue, hydration, and tropism, and reduce the vaginal pH. In the same mechanism, the neocollagenesis leads to an increase in epithelial thickness, removing the nociceptors from the surface.

In order to treat the vaginal area completely, it is necessary to emit multiple laser spots while progressively extracting the probe from the vaginal fundus. Each treatment spot consists of two passages. After the first energy release, the probe is rotated approximately 2 cm clockwise (using the regulatory tool) while remaining at the same vaginal distance [15].

For vulvar treatment, the laser pulse beam was applied to the external perineal area, in particular, the scarred skin of the episiotomy or previous lacerations.

Before each laser treatment session, a gynaecological evaluation was performed.

As per protocol, an initial, interim (after 2 sessions) and final (3 months after the last cycle) evaluation of the symptoms were done using a VAS (Visual Analogue Scale 0–10).

Each session took 6 min on average. No local therapy was recommended during and after the vaginal laser sessions, while for vulvar sessions a local anaesthetic was optional.

For the statistical analysis, we used the INSTAT3 program.

The pre- and post-treatment means of the symptoms, with the mean differences and CI, the standard deviation and the p value have been calculated as significant if < 0.05.

Moreover, we conducted an additional analysis using the Mann-Whitney test: two-tailed p value.

The side effects were evaluated as a pain greater than VAS > 6 after and during the treatment, a deterioration in sexual function after and during the treatment, and/or the presence of vaginal or vulvar abrasions or ulcerations after the laser treatment.

Results

According to the inclusion and exclusion criteria, 44 women in puerperium and/or breastfeeding, affected by persistent vaginal atrophy, chronic perineal pain and deep dyspareunia after 90 days from delivery, were enrolled. We retrospectively compared results of this group of women with a control group in which 42 patients did not receive any laser treatment but only common lubricants or vaginal hormone tablets or cream. We collected the VAS value 3 and 10 months after delivery.

Specifically, in the experimental group, 26 patients presented postpartum tears or had had episiotomies, and a total of 30 patients were breastfeeding. The mean age of the patients was 34.5. Seventy percent of the women had uncomplicated vaginal delivery (31/44), 4% operative delivery (2/44) and 26% (11/44) caesarean sections. Patients' characteristics are shown in Table 1 for both groups.

In the experimental arm, all 44 patients were subjected to 3 or 4 sessions of laser treatment.

Patients reported vulvovaginal atrophy in terms of dryness, chronic perineal pain and deep dyspareunia. The median number of treatments was 3.2 sessions.

Similarly, in both groups, patients which had undergone spontaneous deliveries experienced deep dyspareunia and also chronic perineal pain located near the region with episiotomy or tears (28/33, 84% in the experimental group vs 25/31, 80% in the control group), while during breastfeeding the most commonly cited symptom was dryness and pain at the vaginal orifice (46/58, 80%).

At the final evaluation, patients showed a significant improvement in dyspareunia in terms of VAS in the experimental group (VAS from 7.95 to 3.14, $p < 0.0001$ 3 months after the last cycle) vs VAS from 8 to 7.2; $p > 0.05$, not statistically significant in the control group (Fig. 1). Regarding the pain at the vaginal orifice, a significant improvement was also recorded (VAS from 6.94 to 2.05, $p = 0.0001$) in the laser group if compared to the control group (VAS from 7.1 to 5, $p = 0.5$), dryness (VAS from 6.6 to 2.9, $p = 0.0022$ in the experimental arm vs VAS from 7 to 5.8, $p > 0.05$), itching (VAS from 4.5 to 1.16, $p = 0.0053$ in the laser group compared to VAS from 5.6 to 1.9, $p = 0.002$), perineal pain (VAS from 3 to 0, $p = 0.0119$ in the experimental group vs VAS from 4.1 to 2, $p = 0.05$ in the control group) and burning (VAS from 5.5 to 1.6, $p = 0.0013$ in the laser arm, vs VAS from 6.9 to 2, $p = 0.0001$ in the control group).

Only 8 women reported urinary incontinence after delivery, and there did not appear to be any significant improvement in this symptom in the experimental arm (VAS from 3.2 to 1). All results are summarised in Table 2.

No side effects were observed in any of the CO_2 laser sessions. Patients did not report any deterioration in sexual function after and during the treatment, and/or the presence of vaginal or vulvar abrasions or ulcerations after the laser therapy.

Only 6% of the total 44 women have been treated, repeating the therapy cycle after 12 months (range 8–16 months).

In conclusion, patients with the persistence (> 90 days) of perineal pain, dyspareunia and vaginal atrophy and using the common lubricants and local or systemic oestrogen during breastfeeding and puerperium included as the control group showed not significant improvement for vaginal atrophy and dyspareunia.

Slightly improvement showed for perineal pain and a statistically significant improvement for burning.

Discussion

Pregnancy and breastfeeding represent a very delicate period for women due to multiple causes: psychological changes, hormonal changes and delivery-associated mechanical trauma.

In particular, dyspareunia and perineal pain are commonly reported symptoms in the postpartum period, mainly due to perineal trauma, postpartum tears, episiotomy, and forceps or vacuum use at delivery [1–3].

In addition, the literature data show that breastfeeding women experience dyspareunia 6 months post-delivery more frequently than women who use artificial feeding [11].

The cause is the reduction in hormone levels due to the high level of prolactin, with a consequent menopause-like status including dryness, itching, mucosal thinning, burning and pallor.

Table 1 Patient characteristics

Characteristics	Experimental group	Control group
Number of patients	44	42
Age (mean ± SD)	34.5 ± 5.1	35.5 ± 6.1
Parity (mean ± SD)	1.7 ± 2.4	2 ± 1.9
Laser treatment sessions (mean ± SD)	3.2 ± 1.1	None
Spontaneous vaginal delivery (*n*, %)	31/44, 70%	28/42, 68%
Operative delivery (*n*, %)	2/44, 4%	3/42, 7%
Caesarean section (*n*, %)	11/44, 26%	11/42, 23%
Episiotomy (*n*, %)	22/33, 66%	20/31, 65%
Spontaneous perineal lacerations (*n*, %)	11/33, 34%	11/31, 35%
Perineal lacerations II–III degree (%)	82%	84%
Breastfeeding (*n*, %)	30/44, 68%	28/42, 66%

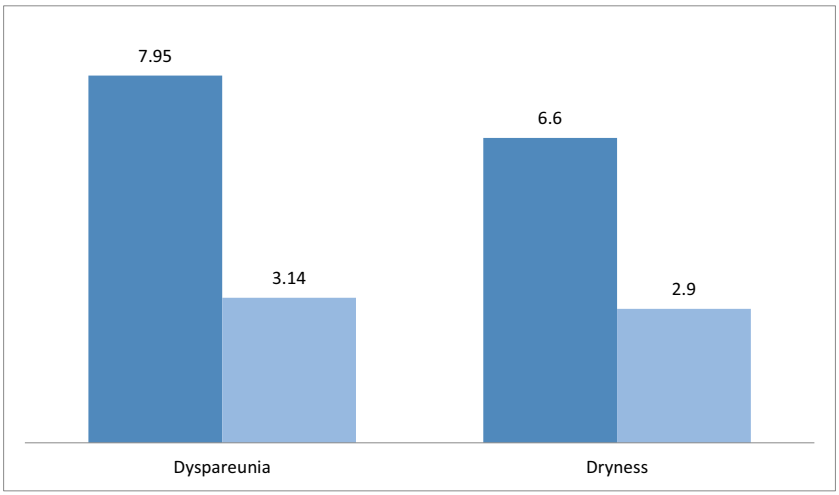

Fig. 1 Final evaluation 3 months after the last cycle. VAS (pre-treatment) from 7.95 to 3.14 (post-treatment), $p < 0.0001$

Dyspareunia and perineal pain seem to be caused by the reduction in mucosal thickness that exposes pain receptors to the surface, causing a hypersensitivity of nerves [16].

Based on the beneficial effects of heat on tissues, it is possible to use energy-based therapy for menopausal vulvovaginal atrophy, in order to reduce tissue inflammation and the related symptoms by intervening in cellular signalling, which is responsible for pain message transmission [18].

Many studies have shown the efficacy of micro-ablative fractional CO_2 laser in postmenopausal women, demonstrating a reduction in vulvovaginal atrophy with the stimulation of fibroblast, collagen and angiogenic activity, an increase in glycogen, a decrease in vaginal pH, and a reduction in dryness, so allowing an improvement in quality of life [15, 18].

Via the same mechanism, neocollagenesis leads to an increase in epithelial thickness, removing the nociceptors from the surface (involving also the sensory nerve ends in the perineal scar), and a subsequent reduction in the pain chronic syndrome.

In the literature, the use of conservative treatments to manage postpartum perineal and perineal pain has been widely investigated [19].

Data has shown that the use of cryotherapy for relieving episiotomy pain is less expensive and easier, resulting in this treatment being widely used [20–24].

Our study is the first multicentric study in the literature to investigate the effect of micro-ablative CO_2 laser use for perineal pain, dyspareunia and dryness in the puerperium and breastfeeding period, when a physiological transient loss of oestrogens occurs.

We have collected data by the interview of patients, using a VAS before each laser session and at the end of treatment.

The literature data widely report results in women suffering from genitourinary syndrome during menopause due to a permanent loss of hormones, with only one study by Filippini et al. reporting promising results for vaginal dryness, itching, vaginal burning and pain in postpartum trauma [16].

Efficacy data are similar to those recently reported by Filippini et al.; the treatment is safe, well-tolerated and effective [16]. The non-significant results for urinary incontinence are probably due to a possible effect, during spontaneous delivery, of the head pressing on the perineal nerves, resulting in trauma to the bladder's innervation. Data from the retrospective control group showed as patients did not use the laser CO_2 treatment a persistence of vaginal atrophy and dyspareunia for more than 10 months after delivery. A slight improvement was showed only for perineal pain and a good result for burning.

In conclusion, this is the largest study focused on this topic in the literature, although these results do need to be validated

Table 2 VAS results (pre-treatment and post-treatment) with p value

Sign/symptoms	Pre-treatment	Post-treatment	p value
Dyspareunia	7.95	3.14	< 0.0001
Pain at the vaginal orifice	6.94	2.05	0.0001
Dryness	6.6	2.9	0.0022
Itching	4.5	1.16	0.0053
Heat	3	0	0.0119
Burning	5.5	1.6	0.0013
Urinary incontinence	3.2	1	Not significant

Table 3 VAS results in control group with *p* value

Sign/symptoms	3 months	10 months	*p* value
Dyspareunia	8	7.2	> 0.05
Pain at the vaginal orifice	7.1	5	0.05
Dryness	7	5.8	> 0.05
Itching	5.6	1.9	0.002
Heat	4.1	2	0.05
Burning	6.9	2	0.0001
Urinary incontinence	4	2	Not significant

on a prospective trial, to also evaluate the long-term follow-up. We are aware of the limits of study, such as the retrospective nature of the study, and the small sample of patients. We are realising a prospective study with a largest case series.

We should remember that the quality of life for women during breastfeeding and the puerperium is very important, from both a psychological and a physical well-being perspective. This treatment can be offered to our patients to obtain a faster recover, but this device needs to be operated by "expert hands", and so training is very important to avoid side effects and improve the CO_2 laser performance, given that this is not a cosmetic or aesthetic treatment, but a truly regenerative therapy.

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Authors' contribution Daniela Luvero, writing original draft
Maurizio Filippini and Annalisa Pieralli, formal analysis and methodology
Roberto Angioli, conceptualisation, writing review and editing
Stefano Salvatore and Miriam Farinelli, supervision

Compliance with ethical standards

Ethical approval Ethical approval was waived by the local Ethics Committee of University Campus Bio Medico of Rome; in view of the retrospective nature of the study, all the procedures being performed were part of the routine care.

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent All patients enrolled signed an informed consent form.

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