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CLINICAL ARTICLE

Gynecology

Pelvic floor dysfunction at transperineal ultrasound and chronic constipation in women with endometriosis

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Abstract

Objective: To assess the association between sonographic findings at transperineal ultrasound (TPU) and chronic constipation (CC) in women with endometriosis.

Methods: An observational prospective cohort study was performed by enrolling all women with endometriosis scheduled for surgery between September 2019 and October 2020. Women underwent TPU at rest and during Valsalva maneuver evaluating levator-hiatal-area (LHA), antero-posterior diameter (APD), and levator ani muscle (LAM) coactivation. Ultrasound findings were compared between women with and without CC in the whole study population, and subsequently in two subgroups (only ovarian endometriosis and deep infiltrating endometriosis [DIE]).

Results: In all, 87 women were enrolled: 29 (33%) with CC and 58 (67%) without CC. Women with endometriosis and CC showed a smaller LHA during Valsalva, less LHA and APD enlargement from rest to maximum Valsalva, and a higher prevalence of LAM coactivation compared with women without CC. In the ovarian subgroup, women with CC had smaller LHA at Valsalva, less enlargement of LHA and APD from rest to maximum Valsalva, and higher prevalence of LAM coactivation compared with non-CC patients. In the DIE subgroup, TPU did not significantly differ between CC and non-CC patients.

Conclusion: TPU signs of pelvic floor muscle hypertonia are more frequent in endometriosis patients with CC compared with those without constipation, particularly in women affected by isolated ovarian endometriosis.

KEYWORDS

bowel symptoms, deep infiltrating endometriosis, levator ani muscle coactivation, pelvic floor dysfunction, transperineal ultrasound

1 | INTRODUCTION

Endometriosis is a chronic and recurrent disease defined as the presence and proliferation of endometrial glands and stroma outside the uterine cavity. It can be classified into superficial, ovarian, and deep infiltrating endometriosis (DIE).[1,2] DIE is characterized by the infiltration of ectopic endometrial tissue under the peritoneum, pelvic structure, and organ walls. DIE most frequently involves the posterior pelvic compartment including the uterosacral ligaments, rectosigmoid colon, vagina, and rectovaginal septum.[2,3]

The major clinical problems of endometriosis are chronic/recurrent pelvic pain during menstruation, sexual intercourse, and defecation, with significant negative impact on women's health and quality of life.[4,5] Endometriosis can cause digestive complaints, including abdominal pain, bloating, diarrhea, constipation, rectal bleeding, and dyschezia.[6-8] In particular, the prevalence of chronic constipation (CC) in women with endometriosis varies from 12% to 85%.[9,10] CC in women with endometriosis is multi-factorial and possible involved pathophysiologic mechanisms include cyclic inflammatory phenomena, reduction of intestinal lumen dimensions, fixation and angulation of intestinal wall, and damage of pelvic autonomic nerves.[4,6-8]

It is acknowledged that women with endometriosis are more likely to have pelvic floor muscle dysfunctions.[11,12] Improper pelvic floor muscle relaxation or coordination may contribute to defecation dysfunctions characterized by consistent contraction.[11] In these cases, several authors used the terms obstructed defecation syndrome or dyssynergic defecation.[13]

Three-dimensional/four-dimensional (3D/4D) transperineal ultrasound is a feasible and reproducible tool in the assessment of pelvic floor muscle integrity, contraction, and relaxation.[14-16] Women affected by endometriosis were recently shown to have transperineal ultrasound signs of pelvic floor muscle hypertonia.[17,18] These include smaller levator hiatal dimensions at rest and a higher prevalence of levator ani muscle (LAM) contraction at Valsalva in comparison with controls, a phenomenon called also LAM coactivation.[18] These effects are more pronounced in women with DIE.[17,18] To the best of our knowledge, no data exist on the association between transperineal ultrasound findings and CC in women affected by endometriosis.

The aim of our study was to evaluate the correlation between CC and 3D/4D pelvic floor ultrasound findings in women affected by endometriosis.

2 | MATERIALS AND METHODS

2.1 | Study protocol and selection criteria

The study was performed according to an a priori defined study protocol and was designed as a single-center observational prospective cohort study. The whole study was reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines and checklist.[19]

We recruited all consecutive nulliparous women with a clinical and sonographic diagnosis of endometriosis scheduled for surgery at our tertiary level referral Academic Center, between September 2019 and October 2020, in order to assess 3D/4D pelvic floor ultrasound findings in women with endometriosis with and without CC. Women were excluded if they had any of the following criteria: age <18 years or older than 45 years, current or previous pregnancy, postmenopausal status, other confirmed cause of chronic pelvic pain, pelvic organ prolapse, vulvodynia, previous rectal surgery, or rectosigmoid endometriosis with bowel stenosis more than 50% detected by magnetic resonance imaging.

The diagnosis of endometriosis was based on clinical and transvaginal/transabdominal ultrasound examinations by experienced operators according to the International Deep Endometriosis Analysis (IDEA) consensus.[1] In the case of a bowel nodule diameter greater than 3 cm, rectal implants involving the inner muscularis propria at transvaginal ultrasound scan, or severe bowel symptoms, magnetic resonance imaging was performed in order to plan the type of rectal surgery (segmental versus conservative procedures) and ask for multidisciplinary consultation in the operating room. All patients were administered hormonal therapy until surgery.

During the preoperative examination, we collected demographic, anthropometric, and clinical data for each woman. These included the presence of dysmenorrhea, dyspareunia, chronic pelvic pain, dysuria, and dyschezia assessed using a numerical rating scale from 0 to 10. A Knowles-Eccersley-Scott-Symptom (KESS) questionnaire was obtained. The KESS questionnaire includes 11 questions about bowel symptoms, with a total score ranging from 0 (no symptoms) to 39 (high symptom severity). A cut-off score of 10 or more indicates CC.[8,20] Patients were divided into two groups according to the presence of CC as detected using the validated KESS questionnaire.[20] We performed 3D/4D transperineal ultrasound for each woman.

2.2 | Transperineal ultrasound

Before the scan, participants received information about pelvic floor anatomy and physiology; moreover, an investigator explained to each women the technique to perform Valsalva maneuver. Before the acquisition of ultrasound images, each women underwent coaching through ultrasound visual feedback. During visual feedback, each woman was allowed to watch the ultrasound screen to follow the movement of LAM during the Valsalva maneuver. An investigator explained to each woman that an appropriate Valsalva maneuver is associated with an increase in levator hiatal dimensions, whereas a reduction in levator hiatal dimensions with Valsalva is a sign of undesired LAM contraction. 3D/4D transperineal ultrasound was performed with women in the dorsal lithotomy position after voiding, at rest and under maximum Valsalva maneuver as previously described.[18,21] No bowel preparation was needed. For each acquisition, we measured levator hiatal area (LHA) and antero-posterior diameter (APD) of the levator hiatus (Figure 1). Each difference in these parameters during Valsalva maneuver was calculated as

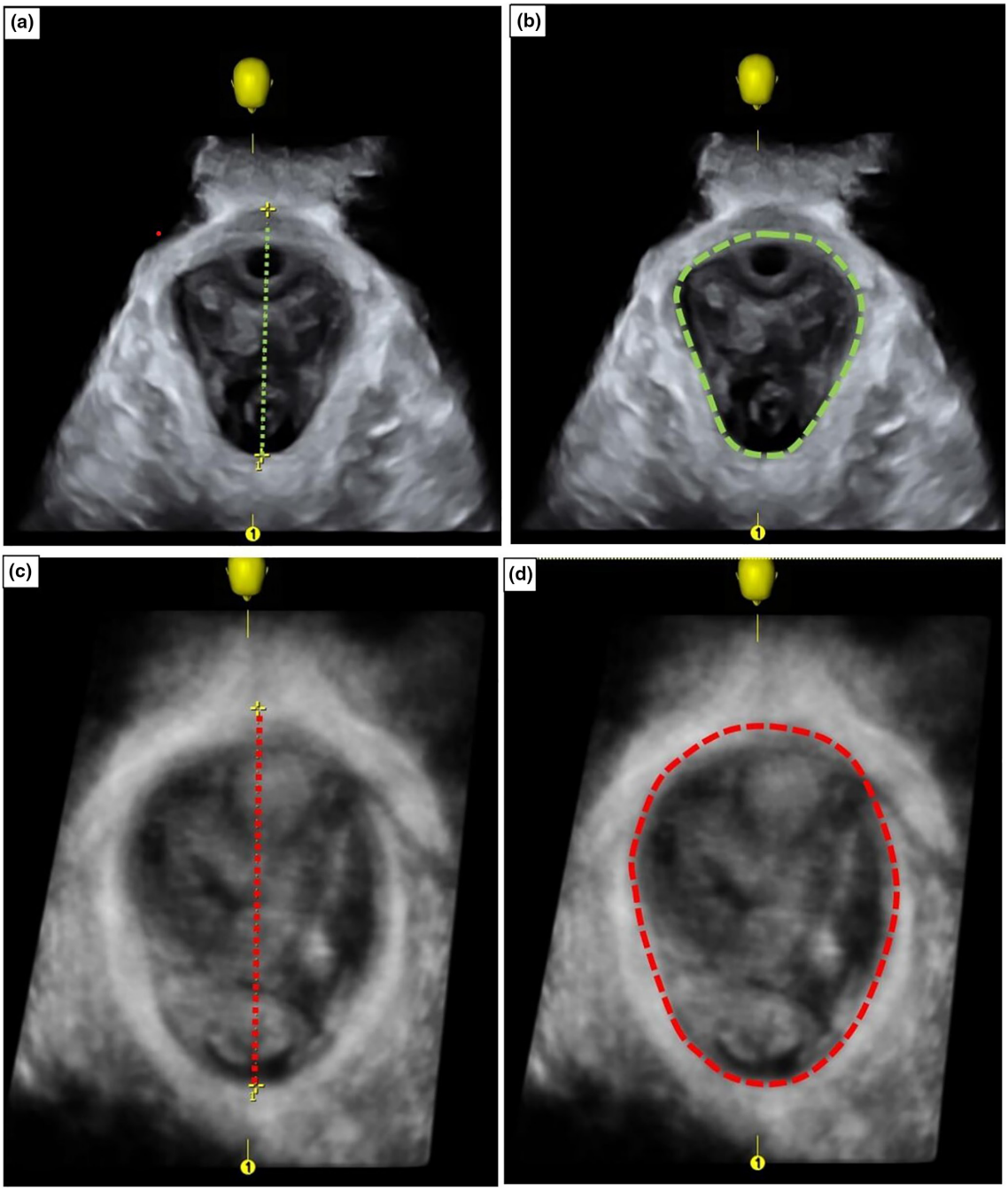

FIGURE 1 Three-dimensional/four-dimensional transperineal ultrasound showing the antero-posterior diameter and levator hiatus area at rest (a, b) and under maximum Valsalva (c, d)

absolute (cm^2 or cm) and proportional (%) change from resting state. LAM coactivation was defined as an APD at Valsalva smaller than that at rest.[18,22-24] This represents contraction of the pelvic floor muscle during the Valsalva maneuver rather than relaxation.[22,25]

All scans were performed by the same experienced operator (DR), using a Voluson E6 system (GE Healthcare, Chicago, IL, USA) with RAB 8- to 4-MHz volumetric transducer. All Measurements were evaluated offline anonymously using a dedicated software (4DView 14.4; GE) by one of the investigators, all blinded to the patient's clinical data.

2.3 | Study outcomes

Primary outcome was the difference in prevalence of LAM coactivation between women with endometriosis and CC and those without CC.

Secondary outcomes were:

- The difference in LHA during Valsalva maneuver between women with endometriosis and CC and those without CC;

- The difference in APD of the levator hiatus during Valsalva maneuver between women with endometriosis and CC and those without CC;
- The difference in absolute and proportional change of LHA from resting state to Valsalva maneuver between women with endometriosis and CC and those without CC;
- The difference in absolute and proportional change of APD of the levator hiatus from resting state to Valsalva maneuver between women with endometriosis and CC and those without CC.

2.4 | Statistical analysis

Continuous data were expressed as mean ± standard deviation or median (interquartile range). Categorical variables were expressed as numbers and percentages.

Student's *t*-test or Mann–Whitney *U*-test and χ^2 or Fisher's exact test were used for continuous and categorical data, as appropriate. A value of $P < 0.05$ was considered significant for all tests.

Additional analyses were performed as subgroup analysis based on endometriosis localization (ovarian versus DIE) confirmed by surgical visualization and histologic examination.

Statistical analysis was carried out using the SPSS software version 24.0 (IBM Corp., Armonk, NY, USA).

2.5 | Ethical statement

The study received approval from the local ethics committee (CE-AVEC 196/2015/O/Sper) and was performed in accordance with the Helsinki declaration. All women gave informed written consent to participate in the study and all data were anonymized.

3 | RESULTS

3.1 | Study population

Overall, 87 women were enrolled in the study. These were divided into two groups according to the KESS questionnaire score: 29 (33%) women with CC and 58 (67%) without CC. Diagnosis of endometriosis was subsequently confirmed by histologic examination in all cases.

Baseline characteristics, disease localization, and pain symptoms did not differ significantly between the two groups (Table 1), except for dyspareunia symptoms, which were of higher severity in the CC group.

3.2 | Main analyses

Transperineal ultrasound was successfully performed in all patients, with none excluded because of discomfort or pain. The ultrasound findings are displayed in Table 2. Women with endometriosis and CC showed a significantly smaller LHA during Valsalva maneuver,

TABLE 1 Patient characteristics, pain symptoms, and endometriotic localizations compared between endometriosis patients with and without chronic constipation[a]

	CC group ($n = 29$)	Non-CC group ($n = 58$)	*P* value[b]
Age, years	35 ± 7	35 ± 6	0.761
BMI	22 ± 5	22 ± 4	0.733
Pain symptoms (NRS score)			
Dysmenorrhea	8 (6–8)	7 (6–8)	0.904
Dyspareunia	7 (5–8)	4 (0–7)	0.002
Chronic pelvic pain	7 (6–7)	6 (6–7)	0.711
Dysuria	0 (0–0)	0 (0–0)	0.638
Dyschezia	5 (0–7)	4 (0–7)	0.327
Endometriosis location			
Rectum/rectovaginal septum	12 (41%)	23 (40%)	0.877
Ovary	20 (69%)	42 (72%)	0.645
Vagina	0 (0%)	2 (3%)	0.550
Sigmoid	2 (7%)	4 (7%)	1
Utero-sacral ligaments	4 (14%)	7 (12%)	1

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); CC, chronic constipation; NRS, numeric rating scale.

[a]Data are given as mean ± standard deviation, median (interquartile range) or number (percentage).

[b]Student's *t*-test or Mann–Whitney *U*-test for continuous data and χ^2 or Fisher's exact test for categorical data.

TABLE 2 Transperineal ultrasound findings compared between endometriosis patients with and without chronic constipation[a]

	CC group ($n = 29$)	Non-CC group ($n = 58$)	*P* value[b]
At rest			
LHA (cm^2)	11.5 ± 2.4	11.9 ± 3.5	0.613
APD (cm)	5.9 ± 5.2	4.8 ± 0.8	0.084
At maximum Valsalva maneuver			
LHA (cm^2)	12.6 ± 3.2	14.6 ± 4.4	0.041
APD (cm)	5.0 ± 0.7	5.3 ± 0.9	0.047
Change from rest to Valsalva			
LHA (cm^2)	1.1 ± 3.2	2.7 ± 2.8	0.025
LHA (%)	12.0 ± 30.4	24.0 ± 25.5	0.56
APD (cm)	−1.0 ± 5.2	0.5 ± 0.8	0.035
APD (%)	−2.4 ± 24.5	11.5 ± 17.2	0.003
LAM coactivation	19 (65.5%)	11 (18.9%)	<0.001

Abbreviations: APD, antero-posterior diameter of the levator hiatus; CC, chronic constipation; LAM, levator ani muscle; LHA, levator hiatal area.

[a]Data are given as mean ± standard deviation or number (percentage).

[b]Student's *t*-test or Mann–Whitney *U*-test for continuous data and χ^2 or Fisher's exact test for categorical data.

TABLE 3 Patient characteristics, pain symptoms, and endometriotic localizations compared between endometriosis patients with and without chronic constipation in two subgroups, namely women with isolated ovarian endometriosis and those with deep infiltrating endometriosis[a]

	CC group	Non-CC group	*P* value[b]
Isolated ovarian endometriosis	*n* = 12	*n* = 30	
Age, years	35 ± 7	35 ± 6	0.876
BMI	20 ± 3	22 ± 3	0.061
Pain symptoms (NRS score)			
Dysmenorrhea	8 [5–8]	8 [7–8]	0.624
Dyspareunia	4 [2–5]	2 [0–5]	0.267
Chronic pelvic pain	6 [6–7]	6 [6–7]	0.522
Dysuria	0 [0–0]	0 [0–0]	0.624
Dyschezia	0 [0–1]	0 [0–3]	0.646
Deep infiltrating endometriosis	*n* = 17	*n* = 28	
Age, years	35 ± 7	35 ± 7	0.785
BMI	24 ± 5	23 ± 5	0.205
Pain symptoms (NRS score)			
Dysmenorrhea	8 (7–8)	7 (6–9)	0.841
Dyspareunia	8 (7–8)	6 (3–8)	0.006
Chronic pelvic pain	7 (6–8)	7 (6–8)	0.522
Dysuria	0 (0–0)	0 (0–0)	0.897
Dyschezia	7 (7–8)	7 (7–7)	0.596
Endometriosis location			
Rectum/rectovaginal septum	12 (71%)	23 (82%)	0.366
Ovary	8 (47%)	12 (43%)	0.783
Vagina	0 (0%)	2 (7%)	0.519
Sigmoid	2 (12%)	4 (14%)	1
Utero-sacral ligaments	4 (24%)	7 (25%)	1

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); CC, chronic constipation; NRS, numeric rating scale.

[a]Data are given as mean ± standard deviation, median (interquartile range), or number (percentage).

[b]Student's *t*-test or Mann–Whitney *U*-test for continuous data and χ^2 or Fisher's exact test for categorical data.

less LHA (absolute change) and APD (absolute and proportional change) enlargement from rest to maximum Valsalva, and a higher prevalence of LAM coactivation (65.5% versus 18.9%; $P < 0.001$) in comparison with women without CC.

3.3 | Additional analyses

Of the 87 patients enrolled in the study, 42 (48%) presented exclusively ovarian endometriosis, while the remaining 45 (52%) were affected also by DIE.

Patient characteristics, disease localization, and pain symptoms in the two subgroups are reported in Table 3, and the ultrasound findings compared between women with and without CC in the two subgroups are shown in Table 4. As shown in Table 3, the clinical characteristics were comparable between women with and without CC in both subgroups, with the exception of dyspareunia, which was more pronounced in women with CC in the DIE subgroup.

In the ovarian endometriosis subgroup, 12 out of 42 (29%) patients complained of CC. In this subgroup of patients, women with CC had smaller LHA at Valsalva maneuver, less enlargement of LHA and APD from rest to maximum Valsalva (both absolute and proportional) and a higher prevalence of LAM coactivation in comparison with non-CC patients (Table 4).

Among the DIE subgroup, 17 out of 45 (38%) patients presented CC (Table 4). As shown in Table 4, in the DIE subgroup, no significant difference was demonstrated between the ultrasound findings in women with and without CC.

4 | DISCUSSION

This study showed that women with CC and endometriosis had sonographic signs of pelvic floor muscle hypertonia in comparison with women with no CC. In particular, sonographic signs of hypertonia included less ability to increase the LHA at Valsalva maneuver and LAM coactivation at maximum Valsalva maneuver. This was also true when analyzing data in the subgroup of ovarian endometriosis, whereas no statistically significant differences were found at transperineal ultrasound between women with and without CC in the subgroup of women with DIE. This study suggests a significant role of the pelvic floor in the pathophysiology of CC in women with ovarian endometriosis.

To date, the implications of LAM coactivation are not completely understood and little is known about its clinical significance and management. Initial reports suggested that this phenomenon was quite common in nulliparous women with no particular clinical significance, although its persistence seemed to have some association with obstructed defecation.[25] Subsequently, some studies have shown that women with endometriosis had identifiable signs of pelvic floor hypertonia at transperineal ultrasound including LAM coactivation, thus questioning the innocence of the phenomenon, at least in some women.[17,18] Sonographic signs of hypertonia were found also to correlate with superficial dyspareunia and voiding dysfunction in endometriosis patients.[26] Recently, it has been demonstrated that nulliparous women with LAM coactivation at term of pregnancy were more likely to have a longer second stage of labor and to have a less engaged fetal head.[23,24]

Our data not only increase our understanding of the relationship between endometriosis and bowel symptoms, but more importantly they may have significant clinical implications. The management of constipation in endometriosis patients remains challenging. Our data may help in the selection of women who have the potential to benefit from specific interventions targeting the pelvic floor hypertonia, such as physiotherapy. Furthermore, in these patients, ultrasound can help in the improvement of symptoms. In a recent study, the authors found that ultrasound visual feedback improves superficial

TABLE 4 Transperineal ultrasound findings compared between endometriosis patients with and without chronic constipation in two subgroups, namely women with isolated ovarian endometriosis and those with deep infiltrating endometriosis

	CC group	Non-CC group	*P* value[b]
Isolated ovarian endometriosis	*n* = 12	*n* = 30	
At rest			
LHA, cm^2	12.1 ± 2.2	12.0 ± 3.3	0.881
APD, cm	7.3 ± 8.1	4.8 ± 0.8	0.095
At maximum Valsalva maneuver			
LHA, cm^2	12.7 ± 2.3	15.4 ± 4.0	0.037
APD, cm	4.9 ± 0.5	5.4 ± 0.9	0.047
Change from rest to Valsalva			
LHA, cm^2	0.6 ± 1.9	3.4 ± 2.3	0.001
LHA, %	5.9 ± 16.2	30.1 ± 23.4	0.002
APD, cm	−2.4 ± 8.0	0.6 ± 0.6	0.039
APD, %	−9.0 ± 24.6	14.6 ± 14.6	<0.001
LAM coactivation	9 (75%)	2 (6.7%)	<0.001
Deep infiltrating endometriosis	(*n* = 17)	(*n* = 28)	
At rest			
LHA, cm^2	11.1 ± 2.4	11.8 ± 3.8	0.499
APD, cm	5.0 ± 0.8	4.9 ± 0.7	0.659
At maximum Valsalva maneuver			
LHA, cm^2	12.6 ± 3.7	13.7 ± 4.7	0.427
APD, cm	5.0 ± 0.9	5.2 ± 0.9	0.412
Change from rest to Valsalva			
LHA, cm^2	1.5 ± 3.9	1.9 ± 3.2	0.731
LHA, %	16.4 ± 37.2	17.5 ± 26.4	0.908
APD, cm	0.01 ± 1.1	0.3 ± 0.9	0.289
APD, %	2.3 ± 24.1	8.2 ± 19.3	0.373
LAM coactivation	10 (58.8%)	9 (32.1%)	0.082

Abbreviations: APD, antero-posterior diameter of the levator hiatus; CC, chronic constipation; LAM, levator ani muscle; LHA, levator hiatal area.

[a]Data are given as mean ± standard deviation or number (percentage).

[b]Student's *t*-test or Mann–Whitney *U*-test for continuous data and χ^2 or Fisher's exact test for categorical data.

and deep dyspareunia symptoms, and improved ultrasound signs of hypertonia in women with endometriosis.[27] We highly encourage the evaluation of this approach in women with endometriosis and bowel symptoms, especially in those with sonographic evidence of pelvic floor muscle hypertonia.

Interestingly, despite the reported association between DIE and pelvic floor, urinary, and sexual dysfunction,[18,28] when analyzing the subgroups of women according to endometriosis location, our findings were confirmed in women with ovarian endometriosis and not those with DIE. The interpretation of these findings is not straightforward. One explanation may be our small study population. Further studies with larger populations are needed in order to examine this speculation. Another possibility is that more pathophysiologic mechanisms other than pelvic floor hypertonia are involved in CC in DIE patients in comparison with ovarian endometriosis, thus masking the effect of pelvic floor dysfunction in the former. These mechanisms may including anterior fixation of the rectum to the uterine cervix or vaginal fornix, bowel wall inflammation,[8,29] injuries of autonomic nerves or intramural plexuses by endometriosis per se, or retroperitoneal dissection.[6,7]

Strengths of our study include the prospective design, the use of a reliable and non-invasive technique, the exclusive selection of nulliparous women, the use of a validated questionnaire to evaluate CC, the histologic confirmation of endometriosis, and the blinding of the examiner analyzing the sonographic data. Our results, however, cannot be generalized because of the small sample size and rigorous selected criteria. Other limits may be the lack of stratification of women by constipation causes and the absence of comparison with other objective methods (i.e. anorectal manometry).

In conclusion, women with endometriosis and CC have transperineal ultrasound signs of pelvic floor muscle hypertonia, in comparison with endometriosis patients with no CC. This improves our understanding of the pathophysiology of bowel symptoms in endometriosis and may have implications for the management of these patients.

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CONFLICTS OF INTEREST

The authors report no conflict of interest.

AUTHOR CONTRIBUTIONS

DR was responsible for study conception and design, data acquisition, statistical analysis, and manuscript drafting. LC, AR, SDF, and RI contributed to study design, statistical analysis and interpretation, and manuscript drafting. MM, ACA, PS, and MA were responsible for data acquisition and contributed to manuscript drafting. AM was responsible for data analysis and interpretation, and manuscript revision; AY, PC, and RS were reponsible for study conception and design, and manuscript drafting and revision. All authors read and approved the final manuscript and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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