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Neural crosstalk and symptom overlap: The correlation between urinary and intestinal symptoms in patients undergoing colonoscopy

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Purpose: Neural crosstalk in the pelvis involves intrinsic communication networks among pelvic structures that direct afferent inputs to converge on neurons, leading to viscerovisceral and somatovisceral reflexes. We aimed to explore the overlap between intestinal and urinary symptoms and their correlations in patients undergoing colonoscopy.

Materials and Methods: Cross-sectional study with 167 participants who underwent colonoscopy and were assessed using three self-administered questionnaires: the International Prostate Symptom Score (IPSS) for lower urinary tract symptoms, the International Consultation on Incontinence Questionnaire Overactive Bladder (ICIQ-OAB) for overactive bladder symptoms, and the Gastrointestinal Symptom Rating Scale (GSRS) for gastrointestinal (GI) symptoms.

Results: Among the participants, 55.1% were male, and the median age was 57 years. Most colonoscopies (80.8%) were performed for screening, and the most common finding was diverticular disease (DD) (35.9%). The IPSS and ICIQ-OAB were strongly correlated (rho=0.544, p<0.001), while the IPSS and GSRS scores showed a moderate correlation (rho=0.304, p<0.001). In the DD subgroup, both ICIQ-OAB and IPSS (rho=0.568, p<0.001), and IPSS and GSRS (rho=0.493, p<0.001) showed strong correlations. In contrast, the subgroup without DD showed a strong correlation between the ICIQ-OAB and IPSS (rho=0.510, p<0.001), but only a weak correlation between the IPSS and GSRS (rho=0.188, p=0.057), suggesting that the urinary-GI connection is influenced by the presence of DD.

Conclusions: The findings revealed intrinsic relationships between urinary and GI symptoms, with DD as a significant factor influencing these relationships, suggesting that a more integrated approach to evaluate and manage these patients can potentially improve diagnostic accuracy and treatment outcomes.

Keywords: Diverticular diseases; Lower gastrointestinal tract; Lower urinary tract symptoms; Pelvic pain; Urinary incontinence

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INTRODUCTION

The large bowel, anus, and urinary bladder are similar in terms of storage and elimination of feces and urine, respectively. Neural crosstalk in the pelvis refers to the intricate and interconnected communication network among various pelvic structures that direct their afferent inputs to converging neurons, resulting in underlying viscerovisceral and somatovisceral reflexes [1]. This phenomenon occurs when the activation of sensory nerves (afferents) in one pelvic structure influences the output of motor nerves (efferents) in another nearby structure [2].

Coordinating and regulating activities in the pelvis with special attention to storage and expulsion functions may result in an array of complex symptoms that might later be translated into morphological alterations of the bladder or colon due to its convergence to intramedullary interneurons as well as in the pontine center [1,3]. Therefore, some symptom manifestations may overlap and modify structurally different but interconnected organs. In this regard, it has become clearer that lower urinary tract symptoms (LUTS) and gastrointestinal (GI) manifestations are at pace with one another [4]. Although it is poorly understood, this phenomenon has been demonstrated in several animal models [5-8].

In addition to neurological crosstalk, recent studies show that abdominal and pelvic organs, including the microbiome, are closely interconnected. Research by Choi et al. [9] highlights the role of microbial interactions between organs such as the GI tract and bladder, affecting urinary health. These findings further emphasize the complexity of pelvic dysfunction and the need for a holistic approach.

Clinically, this interaction has significant implications, as it explains how dysfunction in one organ, such as the bladder, can lead to symptoms in another, like the colon, due to shared neural pathways. The recognition of these interconnections is crucial for clinicians, as it encourages a more holistic approach to patient diagnosis and treatment. Patients with overlapping urinary and GI symptoms may be misdiagnosed or undergo unnecessary tests if the relationship between these systems is not considered. Understanding neural crosstalk can help clinicians identify the root cause of the symptoms and avoid redundant or missed diagnoses, ultimately improving patient care [3,10].

Symptomatic or asymptomatic diverticular disease (DD) may be the morphological result of increased dyssynergic colonic microenvironment activity or peristalsis. Recognized as an age-related condition, it can increase collagen cross-linking due to an amplified neuroimmune response, resulting in an overactive colon and diverticula formation in the long run [11]. Bold evidence for the diverticulum formation is related to abnormal functional responses to different neurotransmitters in the enteric nervous system [12].

Validated questionnaires are commonly used in research and clinical practice to assess various aspects of pelvic function and related symptoms. These questionnaires effectivly collect subjective data from individuals experiencing pelvic conditions, and provide valuable insights into their experiences and quality of life [13].

No clinical studies with validated questionnaires or objective colonoscopy findings exist in literature. This study primarily aimed to evaluate the correlations between urinary and GI symptoms using validated questionnaires in patients who underwent colonoscopy. Additionally, associations between colonoscopic findings and demographic and clinical characteristics of the study population were evaluated.

MATERIALS AND METHODS

The design, analysis, interpretation of data, drafting, and revisions followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement, which is available through the EQUATOR (Enhancing the Quality and Transparency of Health Research) network (https://www.equator-network.org). The study design was approved by the local independent Research Ethics Committee (approval number: CAAE: 35606720.9.0000.0071). All patients in this study signed an informed consent form to participate. The primary objective was to evaluate the correlation between scores obtained from validated urinary and GI symptom questionnaires. Secondary objectives included analyzing the relationship between colonoscopic morphological findings and urinary symptoms, as well as assessing the association between questionnaire scores and the anthropometric, demographic, and clinical characteristics of the studied population.

1. Patients

In this cross-sectional, single-center, single-arm, observational study, patients undergoing colonoscopy examination at Hospital Israelita Albert Einstein (São Paulo, Brazil) from November 2020 to April 2022 were prospectively enrolled after signing the informed consent form. Patients aged >18 years who underwent colonoscopy for any reason were included in the study. Patients with underlying neurological diseases or spinal trauma were excluded from the study, as these conditions can significantly alter pelvic function through independent disruptions to the neural pathways

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and reflexes involved in urinary and GI systems. These disorders could have confounded the results of our study, which aimed to assess the correlations between urinary and GI symptoms in patients without these additional complexities. By excluding patients with neurological or spinal conditions, we ensure that the relationships between symptoms were reflective of the natural overlap between the two systems, without the interference of more complex, non-physiological disturbances. None of the participants had acute distress, and the examination was requested for investigational purposes.

2. Questionnaires

All patients completed the three self-administered and validated questionnaires before the colonoscopy (International Prostate Symptom Score [IPSS], International Consultation on Incontinence Questionnaire Overactive Bladder [ICIQ-OAB], and Gastrointestinal Symptom Rating Scale [GSRS]) regarding their urinary and colorectal symptoms, as well as with the Likert scale of pain and Charlson comorbidity index (CCI). While we recognize anticipatory anxiety or stress related to the upcoming procedure could potentially influence patient responses, we took measures to minimize this effect. Patients were provided with sufficient time and a calm environment to complete the questionnaires, ensuring they could focus on their general experiences of urinary and GI symptoms. We aimed to assess established symptom patterns rather than acute responses to the colonoscopy, relying on validated questionnaires designed to reflect the long-term severity of symptoms.

The IPSS quantifies LUTS such as incomplete emptying, frequency, urgency, weak stream, and nocturia. Patients rated the severity of these symptoms, and the scores were added to classify symptom severity as mild (0–7), moderate (8–19), or severe (20–35). Despite having been developed for the assessment of prostate symptoms in males, several studies have demonstrated the feasibility of using the IPSS to assess LUTS in the female population [14]. The ICIQ-OAB assesses overactive bladder symptoms, particularly urgency, frequency, and urge incontinence, while considering their impact on daily life. Higher ICIQ-OAB scores reflect increased symptom severity and influence. The GSRS measures a wide range of GI symptoms, such as reflux, abdominal pain, and diarrhea, without a specific classification, focusing on symptom burden and its effects on daily functioning. However, it does not typically lead to specific classifications. These questionnaires facilitate the standardized evaluation and classification of symptoms, aiding healthcare professionals in patient diagnosis and management.

3. Data collection

During colonoscopy, the presence of polyps (classified by number as <2, 2–10, or >10), diagnosis of colitis, DD and other findings were recorded. Anthropometric and demographic information, age, comorbidities, previous medical treatment, previous surgeries, number of pregnancies/mode of delivery (if applicable), and clinical data were collected from the participants after obtaining signed informed consent.

4. Statistical analysis

The sample was characterized using descriptive statistics, including the mean and standard deviation, minimum and maximum values, median and quartiles for quantitative variables, and absolute and relative frequencies for qualitative variables. Data normality was assessed using the Shapiro–Wilk test.

Comparisons of scores and examination findings based on the variables of interest were conducted using the chi-square test or Fisher's exact test for qualitative variables; the t-test or Mann–Whitney test, depending on the data distribution, for quantitative variables; and the Cochran–Armitage test. Correlations between the scales were examined using Spearman's correlation coefficients. Cohen's guidelines were applied, where values between 0.10 and 0.29 were considered weak, scores between 0.30 and 0.49 were considered moderate, and values between 0.50 and 1 were interpreted as strong.

All analyses were performed using the R packages and IBM SPSS software version 26.0 (IBM Corp.). The significance level was set at 5%.

RESULTS

1. Patient characteristics

One hundred sixty-seven participants (92 males [55.1%] and 75 females [44.9%]; median age, 57 years [range, 21–83 years]) were enrolled in the study. The median body mass index was 25.4 kg/m², ranging from 16.8 to 49 kg/m². Of 142 patients who responded, 96 (67.6%) had comorbidities, the most common being hypertension (44/96, 45.8%), dyslipidemia (26/96, 27.1%), and hypothyroidism (20/96, 20.8%). Of 132 patients, 71 (53.8%) had a history of abdominal or pelvic surgery.

2. Colonoscopic findings

Table 1 presents the data related to colonoscopic findings. The majority of participants underwent colonoscopy for routine screening purposes (80.8%, n=135). Colitis was observed in 3.6% (n=6) of the participants, with polyps in 44.9% (n=75),

Table 1. Colonoscopy data (n=167)

Variable	Value
Colonoscopy indication	
Screening	135 (80.8)
Inflammatory bowel disease	1 (0.6)
Bleeding	2 (1.2)
Post-polypectomy follow-up	11 (6.6)
Others	30 (18.0)
Presence of colitis	6 (3.6)
Presence of polyps	75 (44.9)
Quantity of polyps (n=75)	
<2	42 (56.0)
2–9	32 (42.7)
≥10	0 (0.0)
Countless	1 (1.3)
Presence of diverticular disease	60 (35.9)
Other findings	20 (12.0)

Values are presented as number (%).

DD in 35.9% (n=60), and miscellaneous diagnoses in 12.0% (n=20). Forty-two (56.0%) of the patients with polyps had <2 polyps, and 32 (42.7%) had 2–9 polyps (Table 1).

Comorbidities ranked using the CCI were higher in males than in females (median, 1×2) (p<0.001). Notably, 20.9% of participants presented with various comorbidities, including diabetes mellitus (DM) (9.6%) or previous myocardial infarction (5.2%). In the population with diabetes, 92.3% of patients showed DD.

3. Questionnaires

Patients with higher IPSS scores reported higher urinary urgency and involuntary urinary leakage measured by the ICIQ, on pace with higher abdominal problems scores according to the GSRS questionnaire. Interestingly, the ICIQ showed a weak correlation with the GSRS (p=0.200) in this study.

We observed a strong correlation coefficient between the IPSS and ICIQ (coefficient=0.544, p<0.001), revealing significant overlap between urinary symptoms and urgency measures. The IPSS×GSRS (coefficient=0.304, p<0.001) correlation was moderate, revealing crossing symptoms between urinary and GI/defecatory complaints among participants. Surprisingly, the ICIQ×GSRS correlation was weak and not statistically significant (coefficient=0.101, p=0.200).

Patients presenting with or without findings of DD on colonoscopy (Table 2), ICIQ×IPSS (coefficient=0.568, p<0.001) and IPSS×GSRS (rho=0.493, p<0.001) correlated strongly in the DD (+) group, suggesting strong overlap of urinary and GI symptoms (Fig. 1). Although an ICIQ×GSRS correlation was observed (coefficient=0.290, p=0.027), it was weaker than that of the other questionnaires.

Table 2. Correlation between questionnaires divided by presence or absence of diverticular disease

Subgroup	rho[a]	p-value
Diverticular disease (-)		
CCI×ICIQ	0.202	0.036*
CCI×IPSS	0.133	0.177
CCI×GSRS	-0.349	<0.001*
ICIQ×IPSS	0.510	<0.001*
ICIQ×GSRS	-0.008	0.938
IPSS×GSRS	0.188	0.057
Diverticular disease (+)		
CCI×ICIQ	0.129	0.331
CCI×IPSS	-0.090	0.494
CCI×GSRS	-0.117	0.377
ICIQ×IPSS	0.568	<0.001*
ICIQ×GSRS	0.290	0.027*
IPSS×GSRS	0.493	<0.001*

CCI, Charlson comorbidity index; ICIQ, International Consultation on Incontinence Questionnaire; IPSS, International Prostate Symptom Score; GSRS, Gastrointestinal Symptom Rating Scale.
[a]:Spearman correlations.
*p<0.05.

The population without DD also showed a strong correlation between ICIQ and IPSS (coefficient=0.510, p<0.001) but a weak correlation between IPSS and GSRS (coefficient=0.188, p=0.057) (Fig. 1) and a statistically insignificant and unexpected negative correlation between ICIQ and GSRS (coefficient=-0.008, p=0.938).

Analysis of the eight urinary urgency questions in the ICIQ-OAB showed that there were no statistically significant differences between participants who presented with or not colonic diverticula (p<0.05). Neither the seven IPSS questions nor the GSRS questions provided evidence for diverticula diagnosis (p>0.05). Likewise, none of the single questions in each of the three validated questionnaires had discriminatory power to anticipate the presence of diverticula on colonoscopy in this study (p>0.5).

The demographic characteristics of the study population revealed a balanced distribution of sex (male, 55.1%; female, 44.9%) and reason for the examination (screened male vs. screened female, 83.7% vs. 83.7%). Colonic diverticula were more prevalent in females than in males (male vs. female, 54.3% vs. 76.0%; p=0.04). The diagnosis of polypoid diseases did not differ between sexes (p<0.05).

When questionnaire scores were compared by sex (Table 3), we found a difference between sexes in the IPSS score, which was higher among males (male vs. female, 5 vs. 4;

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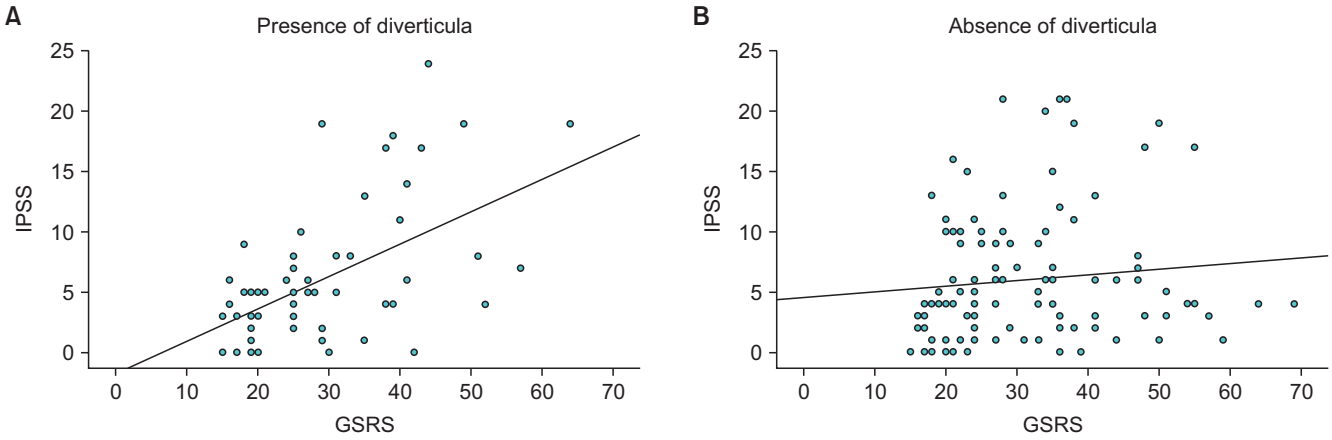

Fig. 1. Correlation coefficient between International Prostate Symptom Score (IPSS) and Gastrointestinal Symptom Rating Scale (GSRS) questionnaires in patients with (A) and without (B) diverticular disease.

Table 3. Evaluation of total questionnaires scores by sex

Variable	Male	Female	p-value
ICIQ score	2 (1–4)	2.5 (1–5)	0.372[a]
IPSS score	5 (2–10)	4 (1–6)	0.021[a]
IPSS classification			0.009[b]
Mild	57 (62.6)	61 (82.4)	
Moderate	31 (34.1)	11 (14.9)	
Severe	3 (3.3)	2 (2.7)	
GSRS score	27.5 (20–35)	29 (21–42)	0.097[a]

Values are presented as median (interquartile range) or number (%).
ICIQ, International Consultation on Incontinence Questionnaire; IPSS, International Prostate Symptom Score; GSRS, Gastrointestinal Symptom Rating Scale.
[a]:Mann–Whitney test. [b]:Fisher's exact test.

p=0.021). When we considered the score tiers, we found that females presented with mild urinary symptoms more frequently than males (male vs. female, 62.6% vs. 82.4%; p=0.009). The ICIQ, GSRS, and Likert scores did not differ significantly (p>0.05).

In this study, age was not a confounder in the statistical analysis because of the homogeneity of the population.

DISCUSSION

Adults, especially females, regularly experience combined bowel and urinary problems [4,13], which affect their quality of life and work productivity. Surprisingly, few clinical studies have attempted to understand these complex presentations, with special attention paid to the lack of validated questionnaires that would allow doctors and health practitioners to better understand and apply effective treatment in the clinical setting with expediting tools [15]. Departments may use their own refined symptomatology questionnaires, preventing comparative studies [16]. Our study used validated questionnaires that integrated different systems, allowing further comparative studies on evolving pelvic conditions.

Neural crosstalk in the pelvis plays a critical role in coordinating various physiological processes in the pelvic organs and structures. This interconnected communication network allows for the regulation of bodily functions and the maintenance of homeostasis in the pelvis. Disturbances or habituation of this network may lead to wide pelvic dysfunction and a spectrum of pelvic-related disorders, where intervention in one organ system affects the other [17-19].

Recognition of neural crosstalk in the pelvis has gained increasing attention, as it has been clearly demonstrated in several animal models that the colon and bladder are functionally related, indicating the potential clinical significance of associated and elusive pelvic disorders [20,21].

It has already been recognized in healthy volunteers that rectal sensation decreases when the bladder is full [22], with the reverse also observed being more pronounced and clearly established in children [18,19]. Similarly, irritable bowel syndrome (IBS) often exhibits a constellation of signs of bladder hypersensitivity, manifested as frequency, nocturia, and urgency, as observed in our study.

These data suggest that convergent bladder/colon neurons receive signals from both organs that reciprocally modulate each other, blurring diagnostic and therapeutic approaches because of their elusive symptoms [1].

Questionnaires represent an accepted and useful tool in the clinical setting [23-25] allowing expedited and multidimensional understanding of the diseases and their impact on daily activities, as well as secondarily saving complex diagnostic resources for effective treatment; however, the quantification of symptoms and applicability of clinical studies in humans are currently unclear and deserve deeper understanding.

Validated questionnaires, such as the IPSS, ICIQ-OAB, GSRS, and Likert scale of pain used in the present study are crucial for understanding the overlap of intestinal and urinary symptoms and their correlations in patients with established morphological pelvic organ alterations. In this study, we opted to analyze the total IPSS score as a measure of overall LUTS severity, given its well-documented association with voiding dysfunction and bladder outlet obstruction. While the IPSS can be divided into storage and voiding domains, we chose to utilize the total score to provide a comprehensive evaluation of LUTS severity. For the specific assessment of storage symptoms, including urgency and overactive bladder, we employed the ICIQ-OAB, a more targeted and validated instrument for these symptom patterns. This approach allowed us to avoid redundancy and ensured a clearer delineation between the contributions of each questionnaire to our analysis.

We hypothesized that finding DD on colonoscopy could predict voiding dysfunction when measured using questionnaires, as colon-bladder cross-sensitization is bidirectional, even though colon dysfunction interferes substantially more in the bladder than vice-versa. The reasons for this are not clear, but the larger colonic surface of integrated sensory receptors and a larger number of intrinsic neurons conveying information enhance the colonic capacity to amplify inputs or outputs compared to the bladder [1,2].

In our study, we found a strong correlation between urinary symptoms and urinary urgency perceptions and, as expected, a strong correlation between urinary urgency symptoms detected by the ICIQ questionnaire and the diagnosis of DD, revealing the entangled relationship between both systems.

The findings from our study highlight the complexity of interactions between urinary and GI symptoms in patients with pelvic conditions, particularly those with DD. A key observation was the discrepancy in correlations between the ICIQ-OAB and GSRS versus the IPSS and GSRS. While the overall cohort demonstrated a weak, statistically insignificant correlation between the ICIQ-OAB and GSRS ($p=0.027$), a strong correlation between the IPSS and GSRS was observed, specifically in the subgroup with DD. This suggests that the presence of DD may amplify the connection between LUTS and GI symptoms. DD is associated with localized inflammation, visceral hypersensitivity, and neural activation, which may enhance cross-sensitization pathways between the bladder and colon. These mechanisms could lead to a heightened overlap of symptoms and stronger correlations between urinary and GI symptoms. The IPSS, which captures a broader range of LUTS, might be more sensitive to these interactions than the ICIQ-OAB, which focuses specifically on overactive bladder symptoms. This finding emphasizes the need for further research into how specific pathologies of the colon, such as DD, modulate pelvic organ crosstalk. Longitudinal studies and advanced imaging or neurophysiological assessments would be valuable for gaining deeper insights into the bidirectional interactions between the bladder and colon in the context of pelvic dysfunction.

In contrast, the correlation between the GSRS and other symptom scales, such as the IPSS and ICIQ-OAB, was weaker in patients without DD. This could be attributed to the less specific or severe nature of GI symptoms in this group, particularly when compared to patients with identifiable GI conditions like diverticulosis. The GSRS evaluates a broad range of symptoms, encompassing different pathophysiological mechanisms that may have varying degrees of interaction with the lower urinary tract. For instance, some GI conditions may be more prone to eliciting neural crosstalk or inflammatory responses that influence urinary symptoms, while others may have minimal impact. IBS has been linked to urinary dysfunction, likely due to shared neural pathways and visceral hypersensitivity, contributing to a higher risk of increased urinary frequency, urgency, and dysuria compared to healthy controls regardless of IBS subtype or severity [26]. This may explain the stronger correlation between urinary and GI symptoms in patients with DD, where inflammation and hypersensitivity further amplify pelvic organ interactions.

While the strong correlation between the IPSS and ICIQ-OAB scores underscores the interconnectedness of lower urinary tract and overactive bladder symptoms, this relationship was consistent across the entire cohort and not notably influenced by the presence of DD. In contrast, the observed strong correlation between the IPSS and GSRS in the DD subgroup suggests that colonic pathologies may amplify the interplay between urinary and GI symptoms. This finding elucidates the role of DD in pelvic health, highlighting the importance of an integrated approach to diagnosing and managing patients with overlapping pelvic dysfunctions.

The strong correlations observed between urinary and GI symptoms in patients with DD suggest that colonic pathologies may influence the interactions between pelvic organ systems through neural-crosstalk. Notably, the finding of DD does not necessarily indicate an urinary dysfunction. Future studies incorporating neurophysiological and mechanistic approaches are needed to further explore whether and how DD impacts neural communication within the pelvis.

Interestingly, despite the observed correlations between

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urinary and GI symptoms, our study found no statistically significant findings in predicting DD using validated questionnaires such as the IPSS, ICIQ-OAB, and GSRS. This lack of predictive value may be explained by the complex nature of DD, which is often asymptomatic or presents with nonspecific symptoms that do not directly correlate with disease severity. While these questionnaires effectively capture overlapping symptom patterns, they are not designed to detect DD itself, which requires direct visualization. The colon-bladder interaction, as suggested by neural crosstalk mechanisms, contributes to symptom overlap, but it does not provide a reliable diagnostic tool for DD diagnosis based solely on subjective symptom reports. Therefore, while symptom-based questionnaires can highlight the presence of related urinary and GI issues, they should not be used as standalone diagnostic tools for DD, underscoring the necessity of clinical and imaging evaluations for precise diagnosis.

The demographic characteristics of our population revealed a balanced sex distribution, with 55.1% males and 44.9% females. The observed sex-based differences in LUTS and GI symptoms provide valuable insights but also introduce complexity to the interpretation of our findings. In our study, males demonstrated higher IPSS scores and comorbidity burdens, as indicated by the CCI, while females reported a higher prevalence of mild urinary symptoms and DD. These differences likely reflect a combination of biological, hormonal, and anatomical factors. Hormonal influences, such as those related to menopause or androgen levels, may modulate both urinary and GI symptom expression, while anatomical variations, including pelvic floor structure, could affect symptom patterns.

Studies have demonstrated that estrogen and progesterone receptors are present in the bladder, urethra, and pelvic floor muscles, indicating that these hormones directly affect lower urinary tract function. Fluctuations in hormone levels, such as those occurring during the menstrual cycle, pregnancy, or menopause, can lead to changes in bladder sensitivity and control, potentially resulting in symptoms like increased urinary frequency or urgency [27,28].

Furthermore, sociocultural and emotional factors may influence symptom reporting, with females potentially being more attuned to or forthcoming about their symptoms, while in males, the correlation between anxiety and LUTS suggests that psychological distress may also play a role in symptom perception and reporting [29].

The higher prevalence of DD in males with diabetes in our study further underscores the importance of comorbid conditions as potential confounders in the analysis of pelvic organ crosstalk. These findings highlight the need for a nuanced approach in interpreting correlations between LUTS and GI symptoms. Future studies should prioritize stratified analyses or focus on sex-specific mechanisms to unravel the distinct contributions of biological, anatomical, and sociocultural factors in shaping the complex interplay between pelvic organs.

In our study population, 20.9% of the participants presented with metabolic morbidities that might be implicated in the microenvironment of pelvic dysfunction, such as DM. In this regard, out of the 9.6% of patients who presented with DM, 92.3% were diagnosed with DD.

The high prevalence of comorbidities among the study participants was noteworthy, with 67.6% reporting additional medical conditions. Hypertension, dyslipidemia, and hypothyroidism were the most common comorbidities. These findings highlight the importance of considering the impact of these medical conditions on pelvic symptoms and colonoscopic findings.

In our study, 53.8% of participants reported a history of prior abdominal or pelvic surgery. We consider any history of abdominal or pelvic surgery to be relevant in the context of pelvic dysfunction, as surgical interventions in these areas can lead to manipulation of neural pathways, potentially influencing both urinary and GI symptoms.

Our primary objective was to correlate urinary and GI symptoms rated by validated questionnaires and colonoscopic findings never before reported in medical literature despite any abdominal manipulation. Although neural convergence was already demonstrated in animal models, clinical implications are currently only intuitive and wait exploratory demonstration, as done in the present study. We acknowledge that any pelvic disruption or prolonged sensitization of afferent routes can redirect or modulate neural pathways that will impact organs. Future studies could benefit from a more detailed analysis of the types of pelvic surgeries performed, to better understand their potential influence on the neural mechanisms involved in pelvic organ function.

Among the female participants, 76.0% reported a history of previous pregnancies, with 82.3% opting for cesarean section as the mode of delivery. This factor may influence pelvic symptoms and colonoscopic findings, warranting further analysis. Regarding colonoscopy findings, the presence of diverticula in 35.9% of the patients indicated a considerable prevalence, which may have a strong relationship with pelvic symptoms, such as constipation and bowel disorders, mainly in the GI tract.

Age is a factor related to urinary and defecatory dysfunctions, but our population was homogenous, and no age correlation was observed regarding the prevalence of uri-

nary or evacuatory symptoms [30].

The overlap between urinary and GI symptoms, as demonstrated by our findings, underscores the importance of considering neural crosstalk in the pelvis when evaluating patients with comorbid symptoms. Diseases manifesting primarily in one system may present with symptoms that mimic or influence another system, misleading both clinical interpretation and diagnostic workups. For instance, patients with abdominal or pelvic pain may be evaluated with a range of GI or urological tests without considering the potential relationship between these systems. The failure to recognize this overlap can lead to delays in diagnosis, unnecessary testing, and increased healthcare costs. Our study highlights the need for clinicians to consider both urinary and GI symptoms in tandem, which could enhance diagnostic accuracy, streamline the investigation process, and ultimately improve patient outcomes.

The main limitations of this study include the use of self-administered questionnaires, the cross-sectional design, small sample size, and the study being conducted at a single center. The reliance on self-reported data captured by questionnaires introduces potential biases where patients may over or underestimate the severity of their symptoms or provide answers they perceive as more acceptable reflecting. Additionally, the interpretation of symptoms vary subjectively between individuals, leading to inconsistencies in reporting urinary and GI symptoms. Additionally, this study did not include an objective assessment of pre-procedure stress, which may have influenced symptom reporting. Despite efforts to minimize this potential bias, we cannot exclude the possibility that stress-related factors affected patient responses, warranting consideration in future research. The cross-sectional nature of this study prevents the establishment of causality or understanding the temporal relationship between symptoms but it clearly establishes a statistical relationship between the explored systems with important implications for medical practice at large. Variations in health behavior, healthcare access, and patient demographics may have influenced symptom prevalence and reporting. Cultural factors and differences in healthcare infrastructure could also affect how symptoms are perceived and managed in different regions as well. As the sample may not be fully representative of the whole population generalizability is limited. Multicenter designs and more diverse cohorts are needed to confirm these findings and to better understand how regional and demographic factors may shape the relationship between urinary and GI symptoms.

Another limitation of this study is that while neural crosstalk provides a plausible mechanism underlying the observed correlations, its application in clinical practice remains theoretical. Currently, no standardized diagnostic or therapeutic guidelines exist to address cross-system interactions between urinary and GI symptoms, highlighting the need for further research to bridge this gap. Combining subjective measures with objective diagnostic tools, such as urodynamics or imaging studies, are also desirable and would help strength the relationship of the systems.

CONCLUSIONS

Our study underscores the complex relationship between urinary and GI symptoms in patients undergoing colonoscopy. The strong correlation observed between the IPSS and ICIQ-OAB suggests a significant connection between lower urinary tract and overactive bladder symptoms. Notably, in the subgroup of patients with DD, a stronger correlation was found between the IPSS and GSRS, indicating that the presence of DD may amplify the relationship between urinary and GI symptoms. These findings emphasize the need for further investigation into how colonic pathologies influence pelvic health through mechanisms such as neural crosstalk. Future research should aim to explore these interactions further, which could lead to improved diagnostic and management strategies for patients with overlapping pelvic dysfunctions, ultimately enhancing patient care and outcomes.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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AUTHORS' CONTRIBUTIONS

Research conception and design: Pedro Henrique P. Costa and Paulo Rodrigues. Data acquisition: Pedro Henrique P. Costa, Marina A. Germano, Mariane Ellen S. Sales, and Gustavo A. de Paulo. Statistical analysis: Pedro Henrique P. Costa, Bianca Bianco, and Maria Beatriz Lemos. Data analysis and interpretation: Pedro Henrique P. Costa, Paulo Rodrigues, and Lucas S. Takemura. Drafting of the manuscript: Pedro Henrique P. Costa, Paulo Rodrigues, and Lucas S. Takemura. Critical revision of the manuscript: Bianca Bianco, Maria Beatriz Lemos, Gustavo C. Lemos, and Arie Carneiro. Supervision: Gustavo C. Lemos and Arie Carneiro.

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