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Abdominal Symptoms Are Common and Benefit from Biofeedback Therapy in Patients with Dyssynergic Defecation

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OBJECTIVES: Dyssynergic defecation (DD) is a subtype of chronic constipation that responds to biofeedback therapy (BFT). Abdominal, anorectal, and stool symptoms are commonly reported by DD patients, but limited data exist to demonstrate the improvement of these associated symptoms to BFT. Aims to prospectively study the response of constipation and associated abdominal, rectal, and stool symptoms to biofeedback in a population with dyssynergia.

METHODS: Patients with DD as determined by anorectal manometry and balloon expulsion testing were included into the study. All patients completed a validated survey, the Personal Assessment of Constipation Symptom (PAC-SYM) questionnaire, before and following BFT. The PAC-SYM is a clinical tool to assess constipation-related symptom frequency and severity.

RESULTS: Seventy-seven dyssynergic patients fulfilled the study requirements. Abdominal symptoms were present in up to 74% of patients with dyssynergia. PAC-SYM summation scores improved following completion of biofeedback by 48%, from 22.08 to 11.48 ($P<0.001$). The proportion of patients with at least moderate symptoms decreased in all 12 questionnaire items, including all abdominal symptoms, after completing BFT (46.8% to 14.3%, $P<0.001$).

CONCLUSIONS: Abdominal symptoms are common in patients with dyssynergia. BFT improves both anorectal-related constipation symptoms and associated abdominal symptoms in patients with DD. Limitations of this study are observational design, lack of control group, and lack of long-term follow-up.

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INTRODUCTION

Constipation is a prevalent, symptom-based disorder of diverse pathogenesis.[1] Broadly speaking, constipation arises as a consequence of some combination of altered motility, altered secretion/absorption, and/or defecatory dysfunction. Twenty to eighty percent of constipated patients evaluated with physiological testing at tertiary care centers have evidence of defecatory dysfunction, which can be structural (rectocele, enterocele, intussusception, rectal prolapse) or functional (dyssynergic defecation, DD) in origin.[2] DD results from the inability to coordinate the series of activities involving the abdominal wall musculature, puborectalis sling, and anal sphincter, which allows normal expulsion of stool from the rectum.

The symptoms most commonly associated with constipation include "bowel-related" complaints such as infrequent bowel movements, hard or lumpy bowel movements, straining and a sensation of incomplete evacuation following a bowel movement. In recent years, it has grown increasingly clear that constipated patients also commonly experience "abdominal symptoms" including pain, discomfort, and bloating. In fact, the frequency with which constipated patients report abdominal symptoms has called into question the validity of the Rome III diagnostic criteria model of separately categorizing patients as suffering with chronic functional constipation and irritable bowel syndrome with constipation.[3,4]

In general, symptoms do not reliably identify patients with DD. The need for digital maneuvers to facilitate defecation has been reported by more than a third of patients with dyssynergia but many patients without dyssynergia will also report this complaint.[5] Few reports have detailed the prevalence of abdominal symptoms, such as pain, discomfort, cramping, or bloating, in patients with DD. In particular, pain, discomfort, and cramping have typically been considered hallmarks of the diagnosis of irritable bowel syndrome rather than as part of the symptom complex of DD.

Biofeedback therapy (BFT) is the most effective treatment for DD.[6] BFT training utilizes real-time visual or auditory feedback cues to correct maladaptive behaviors involving the abdominal wall, puborectalis, and anal sphincter. In addition, rectal sensory balloon training is employed to improve rectal sensory abnormalities that may coexist in some patients with

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dyssynergia.[7] BFT not only improves subjective constipation symptoms but also objective parameters of anorectal function as demonstrated by anorectal manometry (ARM), balloon expulsion testing (BET), or imaging.[8]

The aims of our study were twofold: (i) to better characterize the prevalence and severity of bowel-related and abdominal symptoms in patients with manometrically confirmed DD; (ii) to determine whether both bowel and abdominal symptoms would improve following biofeedback training.

METHODS

In this observational, open-label cohort study, patients with chronic constipation referred to the Gastrointestinal Physiology Laboratory at the University of Michigan for ARM and BET from May 2008 to June 2013 were considered for inclusion. All patients experienced at least two chronic constipation complaints including infrequent stools (<3 bowel movements/week), hard or lumpy stools (Bristol Stool Form Scale Score of 1–2), straining, a sense of incomplete evacuation following a bowel movement, or a sense of anorectal blockage for more than 6 months. All constipated patients had been referred for physiological testing after failing to improve with fiber supplements and one or more laxative treatments as suggested by the Rome III algorithm for functional constipation.[9,10] On ARM, patients demonstrating a paradoxical anal sphincter contraction of >10 mm Hg above baseline during simulated defecation and a prolonged BET (inability to expel a 50 cc water filled balloon in <1 min) were considered to have DD. Each ARM was performed using a water-perfused system (Sandhill Scientific, Milwaukee, WI), which only measured anal sphincter pressures; therefore, a defecation index (maximum rectal pressure during attempted defecation/minimum anal residual pressure during attempted defecation) was unable to be calculated.[11] All ARM and BET procedures were performed by a single expert technician. Stable doses of fiber and laxative therapies were allowed during evaluation with ARM and during BFT. This study was approved by the University of Michigan Institutional Review Board.

Biofeedback training was completed by expert pelvic floor physical therapists at the Michigan Bowel Control Program. Patients who were unable to complete a full course of BFT with a trained physical therapist in the Michigan Bowel Control Program were excluded from the analysis. Completion of the BFT plan required meeting treatment goals formulated by the physical therapist. Progression toward these goals was evaluated and updated every 30 days.

Patients were treated for 6–8 weeks of BFT at the University of Michigan's Physical Therapy Department between 2008 and 2013 with physical therapists specializing in the pelvic floor. Duration of treatment was determined by the patients' objective findings, availability to attend therapy sessions, insurance limitations, and achievement of goals. BFT included manual/verbal feedback, surface electromyography, exercises using a rectal catheter, rectal balloon sensory therapy, ultrasound, pelvic floor and abdominal massage, electrical stimulation, core strengthening, and stretching in order to correct maladaptive dyssynergic behaviors during simulated defecation.[12,13] For the purposes of this study, patients were invited to complete a follow-up Personal Assessment of Constipation Symptom (PAC-SYM) questionnaire immediately after their biofeedback training. A sub-group analysis was performed to understand the effect of BFT on individual abdominal symptom scores for discomfort, pain, bloating, and cramping.

Assessment of parameters. The PAC-SYM questionnaire was developed as a brief, easily administered tool for assessing symptom frequency and severity in patients with chronic constipation (Appendix 1). Using the Rome II definition for constipation, this instrument is accepted as a reliable and valid tool for assessing constipation symptoms.[14] The PAC-SYM questionnaire includes 12 items subdivided into three separate domains (abdominal, rectal, and stool). The "false-alarm" parameter refers to the sensation of needing to defecate without expelling stool. Items are scored on a four-point Likert scale. A score of 0 corresponds to absent symptoms, 1 for mild symptoms, 2 for moderate symptoms, 3 for severe symptoms, and 4 for very severe symptoms. A total score for the PAC-SYM can range from 0 to 48. A summation score of 22 represents an average for moderate symptoms. Stool frequency is not measured with this assessment tool. We administered the PAC-SYM questionnaire to evaluate symptoms before BFT and following completion of BFT.

Paired sample *t*-tests were utilized for analyzing mean differences related to PAC-SYM summations and individual PAC-SYM elements. χ^2 analysis tests with a McNemar test and Pearson test were used to compare proportions regarding symptom severity for pre- and post-PAC-SYM items associated with abdominal symptoms and among different subgroups. Independent *t*-tests were performed to evaluate the mean differences regarding abdominal symptoms for patients who reported improved abdominal symptom severity following BFT vs. patients in whom symptoms were unchanged. A multiple linear regression model was performed to evaluate the relationship between age, race, and gender among participants who underwent BFT and PAC-SYM summation and individual PAC-SYM items. A *P*-value of <0.05 was considered statistically significant.

RESULTS

One hundred eighty-nine patients were evaluated for inclusion into the study (Figure 1). Seventy-seven patients met inclusion criteria and successfully completed BFT. One hundred twelve patients were not included in the analysis either because they did not meet inclusion criteria for dyssynergia or because they did not initiate BFT. Patients cited multiple reasons regarding failure to complete BFT: lack of insurance coverage for this service, travel distance, and interference of other medical problems. The average age was 51 years old (median = 52 years, range = 18–88 years). In all, 64% of patients were female and 88% were Caucasian. The multiple linear regression model including age, gender, and race depicted no significant association for BFT improvement.

At baseline, the mean summation score was 22.08, with 46.8% of patients having at least moderate symptoms in the PAC-SYM summation (defined as a summation score of 22–48 before BFT). Before BFT, a substantial proportion of

patients reported moderate to severe abdominal symptoms (48.1–74%) and stool-related symptoms (49.4–83.1%), whereas fewer reported moderate to severe anorectal symptoms (24.7–53.2%; Table 1). The most common abdominal complaints were bloating and discomfort, whereas the most common stool-related complaints were a sensation of incomplete evacuation and straining.

Following BFT completion, the overall PAC-SYM summation score improved from a baseline mean of 22.08 to 11.48 after BFT ($P<0.001$; Table 2). In addition, significant decreases in mean PAC-SYM scores in all three domains were observed following completion of BFT: abdominal domain 7.12 vs. 3.93, $P=<0.001$, rectal domain 3.72 vs. 1.81, $P=<0.001$, and stool domain 10.94 vs. 5.71, $P=<0.001$. Improvements in abdominal domain symptoms were similar in magnitude to improvements in stool domain symptoms. Statistically significant improvements were demonstrated in all mean individual symptom scores following BFT (Table 2). Similarly, the proportion of patients with moderate or severe symptoms measured by the overall summation score and all individual PAC-SYM items within the abdominal, stool, and rectal domains significantly decreased following completion of BFT (Table 1).

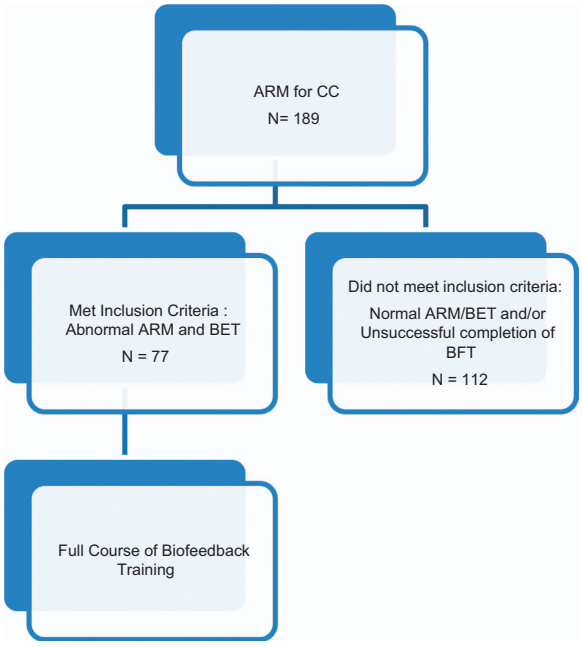

Figure 1 Flowchart for participant inclusion. Anorectal manometry (ARM), chronic constipation (CC), balloon expulsion test (BET).

Predictors of response to BFT. Age ($P=0.810$), race ($P=0.666$), and gender ($P=0.784$) were not predictors for response to BFT as measured by overall PAC-SYM summation scores. There were no significant differences in baseline PAC-SYM summation or domain scores between those that did or did not improve following BFT.

DISCUSSION

DD is an increasingly recognized cause of laxative refractory chronic constipation. As symptoms do not reliably identify patients with DD, physiologic testing with ARM, balloon expulsion testing, or, in selected cases, imaging with defecography or defecating magnetic resonance imaging, is necessary to confirm the diagnosis. BFT has been shown to improve bowel-related complaints in constipated patients, such as infrequent stools, hard stool consistency, straining, and a sensation of incomplete evacuation.[6,8] BFT can also improve objective abnormalities in anorectal function on ARM and BET.[8] However, there is limited literature which has addressed abdominal symptoms, such as discomfort, pain, bloating, and cramping in dyssynergic patients. Further, the impact of BFT on abdominal symptoms remains largely undefined.

In our study, symptoms related to constipation as measured by the PAC-SYM questionnaire improved by 48% after BFT, confirming and extending previous observations.[6,12,15,16] We found that before BFT, abdominal bloating was the most common and most bothersome abdominal symptom in this cohort of patients with DD. All of the abdominal symptoms

Table 1 Proportion of patients with moderate and severe symptoms at baseline and after biofeedback therapy by summation and individual PAC-SYM item

PAC-SYM item	Before BFT, %	After BFT, %	*P*-value	% Improvement
Summation score ≥ 22	46.8 (36/77)	14.3 (11/77)	<0.001	32.5
Abdominal domain				
Abdominal discomfort	64.9 (50/77)	31.2 (14/77)	<0.001	33.7
Abdominal pain	48.1 (37/77)	18.2 (14/77)	<0.001	29.9
Abdominal bloating	74.0 (57/77)	31.2 (24/77)	<0.001	42.8
Abdominal cramps	48.1 (37/76)	15.6 (12/77)	<0.001	32.5
Rectal domain				
Painful bowel movements	53.2 (41/77)	19.5 (15/77)	0.001	33.7
Rectal burning	40.3 (31/77)	14.3 (11/77)	<0.001	26
Rectal bleeding	24.7 (19/77)	10.4 (8/77)	0.008	14.3
Stool domain				
Incomplete bowel movements	83.1 (64/77)	35.1 (27/76)	<0.001	48
Hard bowel movements	49.4 (38/77)	20.8 (16/77)	<0.001	28.6
Small bowel movements	66.2 (51/77)	31.2 (24/76)	<0.001	35
Strain during a bowel movement	80.5 (62/77)	35.1 (27/77)	<0.001	45.4
"False-alarm"	75.3 (58/77)	23.4 (18/77)	<0.001	51.9

BFT, biofeedback therapy; PAC-SYM, Personal Assessment of Constipation Symptom.

Table 2 Mean PAC-SYM scores before and after biofeedback therapy

Paired PAC-SYM Score	Mean score before BFT (0–4; s.d.)	Mean score after BFT (0–4; s.d.)	Mean difference (% improvement)	*P*-value
Total score	22.08 (9.43)	11.48 (8.55)	10.06 (48)	<0.001
Abdominal domain	7.12	3.93	3.19 (45)	<0.001
Abdominal discomfort	1.95 (1.09)	1.25 (0.989)	0.70 (36)	< 0.001
Abdominal pain	1.47 (1.21)	0.78 (1.05)	0.69 (47)	<0.001
Abdominal bloating	2.14 (1.09)	1.29 (1.09)	0.85 (40)	<0.001
Abdominal cramps	1.51 (1.23)	0.64 (0.919)	0.87 (58)	<0.001
Rectal domain	3.72	1.81	1.91 (52)	<0.001
Painful bowel movements	1.53 (1.14)	0.70 (0.961)	0.83 (54)	<0.001
Rectal burning	1.21 (1.12)	0.64 (0.916)	0.57 (47)	<0.001
Rectal bleeding	0.98 (1.14)	0.47 (0.771)	0.51 (52)	<0.001
Stool domain	10.94	5.71	5.23 (48)	<0.001
Incomplete bowel movements	2.56 (1.08)	1.40 (1.07)	1.16 (45)	<0.001
Hard stools	1.62 (1.20)	0.88 (0.959)	0.74 (46)	<0.001
Small bowel movements	2.03 (1.19)	1.16 (1.13)	0.87 (43)	<0.001
Straining	2.60 (1.21)	1.27 (1.10)	1.33 (51)	<0.001
False alarm	2.13 (1.19)	1.00 (1.08)	1.13 (53)	<0.001

BFT, biofeedback therapy; PAC-SYM, Personal Assessment of Constipation Symptom.

measured improved significantly following BFT, with cramping improving by 58%, abdominal discomfort by 36%, abdominal pain by 47%, and bloating by 40%. Interestingly, the magnitude of improvement in overall constipation symptoms as measured by the summation PAC-SYM score was similar to the degree of improvement in abdominal symptoms reported after BFT.

The reasons that abdominal symptoms in patients with dyssynergia improve following BFT remain to be established. Unfortunately, our study design does not shed light on the mechanism by which abdominal symptoms improve. It is known that improving defecatory mechanics can accelerate colonic transit in some constipated patients.[12] It is conceivable then that improvement in defecatory function might reduce rectal and/or colonic distention with an attendant decrease in activation of stretch receptors.[17,18] Another possibility is that abdominal and pelvic pain reported by patients with DD in the consequence of a repetitive use injury, not unlike a "strain" sustained by overuse of muscles of the limbs or trunk. It is reasonable to speculate that BFT, by correcting maladaptive use of the puborectalis, anal sphincter, and pelvic floor, allows healing of this repetitive use injury leading to consequent improvement in abdominal symptoms. Further studies to understand the mechanism by which symptoms improve are of considerable interest.

Our study has a number of important limitations. The lack of a control group in our study is an important weakness, which limits our ability to draw definitive conclusions from our data. However, it was our intent to perform a pilot study to generate hypotheses, which can then be tested in a properly powered, randomized, and controlled trial. Another limitation is the lack of standardization of the biofeedback training protocol offered by our physical therapists. However, given the fact that DD can result from several different types of abnormalities (inability to recruit the abdominal wall musculature, dysfunction of the puborectalis, and/or anal sphincter), behavioral therapy is generally tailored to address abnormalities identified in each individual patient. Future studies would benefit from a more precise definition of DD and standardization of the BFT intervention. This would allow a better understanding of the components of BFT, which most effectively improve constipation vs. abdominal symptoms. In addition, the PAC-SYM questionnaires were administered shortly after completing BFT. Thus, durability of response was not assessed. Longitudinal data in patients with DD treated with BFT would be of considerable interest. Preliminary data from Rao *et al.* suggest that the benefits of BFT may be long-lasting.[12]

Although our entire study population had complaints of constipation as defined by the Rome III criteria, the majority also had abdominal symptoms, which technically would disqualify them from the Rome III definition of functional constipation. However, patients with functional constipation and IBS-C often reside on a spectrum, with IBS-C representing the severe end and functional constipation representing the milder end.[19] Thus, these dyssynergic patients, rather than representing a heterogeneous group, may actually exist in a continuum, and it would follow that their bowel as well as their abdominal symptoms may improve with biofeedback training.

In summary, in patients with manometrically proven DD, abdominal symptoms are common. BFT training led to significant improvements in bowel and abdominal symptoms. These findings have potential implications for patients with chronic constipation and varying degrees of abdominal pain/discomfort and bloating including patients with IBS-C. Our findings would benefit from confirmation by an adequately powered, randomized, controlled clinical trial to further explore mechanisms by which these effects are seen.

CONFLICT OF INTEREST

Guarantor of the article: Shanti Eswaran, MD.
Specific author contributions: Shanti Eswaran: study concept and design; acquisition of data; analyses and interpretation of data; drafting of the manuscript; statistical analysis; study supervision. Jason Baker: study concept and design; acquisition of data; analysis and interpretation of data; drafting of the manuscript; statistical analysis. Stacy Menees, Richard Saad, Jennifer Shifferd, Anne Barthelemy, and

Kim Erickson: acquisition of data; analysis and interpretation of data; critical revision of the manuscript for important intellectual content. William D. Chey: study concept and design; acquisition of data; analysis and interpretation of data; drafting of the manuscript; statistical analysis; study supervision.

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Study Highlights

WHAT IS CURRENT KNOWLEDGE

- ✓ In addition to constipation, patients with dyssynergic defecation complain of abdominal symptoms to an unknown extent.
- ✓ Biofeedback improves constipation-related symptoms in patients with dyssynergic defecation.

WHAT IS NEW HERE

- ✓ Abdominal symptoms are common in patients with dyssynergic defecation.
- ✓ Abdominal symptoms of bloating, pain, discomfort, and cramping improved after biofeedback therapy.

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APPENDIX 1

Constipation-Symptom Questionnaire (modified PAC-SYM)

This questionnaire asks you about your constipation symptoms in the past two weeks. Answer each question according to your symptoms, as accurately as possible. Please indicate how severe your symptoms have been during the past two weeks. If you have not had the symptom during the past two weeks, check 0. If the symptom seemed mild check 1. If the symptom seemed moderate check 2. If the symptom seemed severe, check 3. If the symptom seemed very severe, check 4. Please be sure to answer every question.

Referring Physician **Patient Age:**

How severe have each of these symptoms been in the last two weeks?	Absent 0	Mild 1	Moderate 2	Severe 3	Very severe 4
1. Discomfort in your abdomen					
2. Pain in your abdomen					
3. Bloating in your abdomen					
4. Stomach cramps					
5. Painful bowel movements					
6. Rectal burning during or after a bowel movement					
7. Rectal bleeding or tearing during or after a bowel movement					
8. Incomplete bowel movements, like you didn't "finish"					
9. Bowel movements that were too hard					
10. Bowel movements that were too small					
11. Straining or squeezing to try to pass bowel movements					
12. Feeling to pass a bowel movement but you couldn't					