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Defecation disorders: An important subgroup of functional constipation, its pathophysiology, evaluation and treatment with biofeedback

Defekasyon bozuklukları: Fonksiyonel kabızlığın önemli bir alt grubu, patofizyolojisi, değerlendirmesi ve biofeedback ile tedavisi

Ramazan ÖZTÜRK[1], Satish S. C. RAO[2]

Department of [1]Gastroenterology, Güzelyalı Military Hospital, İzmir

Department of [2]Internal Medicine, Section of Neurogastroenterology, Division of Gastroenterology-Hepatology, University of Iowa, Carver College of Medicine, Iowa City, USA

Functional defecation disorders are common and affect approximately 50% of patients with chronic constipation. The etiology of functional defecation disorders is not well known, but several pathophysiologic mechanisms have been described, including failure of rectoanal coordination, paradoxical anal contraction or insufficient relaxation of anal sphincter during defecation and impairment of rectal sensation as well as secondary slowing of colonic transit. Symptoms alone are inadequate to distinguish patients with defecation disorders from those with other types of constipation. Detailed clinical evaluation and anorectal physiologic tests are required for definitive diagnosis. There is also a pathophysiological association between functional defecation disorders and other anorectal conditions such as solitary rectal ulcer syndrome. Among the various treatment modalities, biofeedback therapy has emerged as an effective and specific treatment method for functional defecation disorders. The main goals of biofeedback therapy are to relax the pelvic floor and anal sphincter muscles during defecation and to improve rectoanal coordination and sensory perception. Today, it is possible to diagnose most functional disorders of defecation and either effectively treat or ameliorate symptoms in a majority of these patients.

Key words: Constipation, defecation disorders, biofeedback therapy

Fonksiyonel defekasyon bozuklukları yaygın görülür ve kabız hastaların yaklaşık %50'sini oluşturur. Fonksiyonel defekasyon bozukluklarının etyolojisi iyi bilinmemekle birlikte etyolojisinde defekasyon esnasında rektoanal koordinasyon yetersizliği, anal sfinkterin yetersiz gevşemesi veya paradoksal kasılması, rektum duyarlılığında bozulma gibi birkaç patofizyolojik mekanizma yanısıra bu faktörlere sekonder oluşan kolonik transit yavaşlaması ileri sürülmüştür. Semptomlar tek başına defekasyon bozukluklarını diğer tip kabızlıklardan ayırt etmemize yardımcı olmaz. Kesin tanı için detaylı klinik değerlendirmeye ve anorektal fizyoloji testlerine ihtiyaç vardır. Soliter rektal ülser gibi bazı anorektal bölge hastalıkları ile defekasyon bozuklukları arasında patofizyolojik bir ilişki vardır. Defekasyon bozuklukları açısından, tedavi yaklaşımları içinde, biofeedback tedavisi etkili ve spesifik tedavi yöntemidir. Biofeedbak tedavisinin temel amaçları, defekasyon esnasında pelvik taban kaslarını ve anal sfinkteri gevşetebilmek, rektoanal koordinasyonu sağlamak ve rektal duyarlılığı geliştirmektir. Günümüzde defekasyon ile ilgili fonksiyonel bozuklukların çoğunluğunun tanısını koymak ve bu hastaların büyük bir kısmını etkin bir şekilde tedavi etmek veya semptomlarını düzeltmek mümkündür.

Anahtar kelimeler: Kabızlık, defekasyon bozuklukları, biofeedback tedavisi

INTRODUCTION AND CLASSIFICATION

Constipation, with an average prevalence of 15% in western societies, remains one of the most frequent reasons for seeking health care and has significant economical implications (1). There are many descriptions for constipation. In order to obviate some of the inherent deficiencies in defining this heterogeneous clinical condition, a consensus definition has been proposed by a group of experts [Rome III] (Table 1) (2).

Even though a number of classifications for constipation can be found in classical text-books, the classification shown in Table 2 has gained in popularity because of its practical value regarding the underlying pathophysiology (3).

Address for correspondence: Ramazan ÖZTÜRK
Department of Gastroenterology, Güzelyalı Military Hospital, Güzelyalı, İzmir, Turkey
Phone: +90 232 285 96 50/4140 - 4143
E-mail: drrozturk@yahoo.com

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Table 1. Diagnostic criteria for functional constipation (Rome III)

1. Must include two or more of the following:
a. Straining during at least 25% of defecations,
b. Lumpy or hard stools in at least 25% of defecations,
c. Sensation of incomplete evacuation in at least 25% of de fecations,
d. Sensation of anorectal obstruction / blockage in at least 2% of defecations,
e. Manual maneuvers to facilitate in at least 25% of defecations (e.g. digital evacuation, support of the pelvic floor),
f. Fewer than three defecations per week.
2. Loose stools are rarely present without the use of laxatives.
3. There are insufficient criteria for irritable bowel syndrome.

*Criteria fulfilled for the last 3 months with symptom onset at least 6 months prior to diagnosis

Table 2. Classification of constipation

1. IBS with constipation
2. Slow transit constipation
3. Defecation disorders

1. IRRITABLE BOWEL SYNDROME (IBS) WITH CONSTIPATION

Most of these patients complain of hard stools, straining and discomfort or pain associated with bowel function. They may also complain of psychological problems. Although most of them have normal colonic transit time and normal defecation frequency, a subgroup of these patients may have a defecation disorder. Hence, patients who are refractory to treatment must undergo further evaluation (3).

2. SLOW TRANSIT CONSTIPATION

This type of constipation is usually present in younger women. The onset of symptoms is generally around puberty. The frequency of defecation is usually once a week or less. Patients with significantly prolonged transit time usually do not respond well to medical treatment. High amplitude propagating contractions (HAPC) of the colonic wall have been shown to be decreased or absent in many of these patients (4).

Histopathological studies have shown that anomalies concerning substance P, VIP and nitric oxide are present in the myenteric plexus of these patients. In addition, the interstitial Cajal cells, which are the intrinsic pacemakers in the gut that regulate gastrointestinal motility, are diminished or absent (3).

3. DEFECATION DISORDERS

Defecation is a complicated process that involves the voluntary muscles (abdominal muscles and the external anal sphincter) and the smooth muscles. To achieve defecation, both a normal anorectal sensation and healthy anorectal reflexes and voluntary coordination of the anorectal and abdominal muscles are necessary. Disorders that result from an impairment of this process are termed as defecation disorders (5). Many terms have been used in the medical literature to describe the functional defecation disorders associated with constipation. These include: anismus, outlet obstruction, pelvic floor dyssynergia, pelvic outlet obstruction, spastic pelvic floor syndrome, obstructive defecation and dyssynergic defecation (6). Many local structural abnormalities, for example anal fissure, anorectal neoplasia, and proctitis, may also lead to obstacles with defecation. Although these terms have a general meaning, they are best reserved to describe dysfunction of the pelvic floor or anal sphincter.

According to a recent consensus of experts, the term "functional defecation disorders" (FDD) has been used to describe the constipation that is associated with anorectal dysfunction. There are two subgroups, F3a: dyssynergic defecation and F3b: inadequate defecatory propulsion. Although useful in providing a better understanding of these disorders, these terms may also cause confusion. Previously the term "dyssynergic defecation" also included some "inadequate defecatory propulsion". Today, according to Rome III, these two conditions should be evaluated as separate disorders (5).

Here, we will discuss FDD. Because the cause and outcome relationship of some disorders such as solitary rectal ulcers is similar to FDD (7, 8), these diseases will also be briefly discussed.

Defecation dynamics: Feces are normally stored in the distal segments of the descending colon, sigmoid colon and the proximal portion of the rectum until it is convenient to expel. Normally, no feces are present below the middle rectal fold (9). Following the distention of the descending colon, when a certain threshold pressure is exceeded, the peristaltic waves shift feces towards the rectum. This process, which usually takes place daily, is

affected by several factors such as habit, environment, reflex conditions and the contents of the feces. When feces reach the rectum, the internal anal sphincter reflex relaxes. During this reflex response, the upper portion of the anal canal opens up and the feces are perceived by the specified receptors located in this region of the anal canal. The reflex that facilitates an appropriate response according to the type of fecal material (gas, liquid or solid) is called the anorectal sampling reflex. The incoming feces increase the intrarectal pressure and bring on a need to go to the toilet, which is called an urge to defecate. Under inappropriate conditions (e.g. in absence of a nearby restroom), the local reflexes mediating defecation are inhibited through cortical control. The intrarectal pressure, which increases because of feces that have entered the rectum, gradually decreases to its initial level over a few minutes as the smooth muscle of the rectal wall relaxes (accommodation response). This process either repeats itself again when new feces arrive in the rectum or the voluntary action of defecation is initiated by the person under appropriate circumstances.

When the act of defecation is initiated, the anorectal angle widens, the external anal sphincter and the puborectalis muscles relax and the intraabdominal and intrarectal pressures increase. These effects, together with peristaltic waves initiated from the sigmoid colon and the rectum, mobilize the feces towards the anal canal. Any alteration in this normal sequence of events in the pelvic floor muscle function, or during any stage of the complex mechanism of defecation, may lead to FDD (10).

A- EPIDEMIOLOGY

Because it is impossible to perform population-based studies of colonic transit time, balloon expulsion test and anorectal manometry to identify the prevalence of FDD, determination of an exact number is difficult. In a population study recently carried out in the United States, it was observed that among all patients suffering from constipation, 9% reported less than three defecations per week, 30% complained of having a feeling of insufficient evacuation, 24% complained of a feeling of blockage of bowel movement, 29% described hard feces and 12% reported that they had to use digital maneuvers to defecate (11). Thus, difficulty with defecation and FDD are important causes of constipation, and despite the limited studies, it is generally accepted that they account for 50% of chronic constipation (12, 13).

B- ETIOLOGY

The etiology of FDD is still unclear. In a recent study, half of the patients reported that their constipation began in adulthood and 37% had experienced this problem since childhood, but there was no gender difference. Fifteen percent of patients reported that their constipation was precipitated by an illness, such as influenza, depression or anorexia, and 9% reported that surgery precipitated their constipation. Five percent of women reported that pregnancy or childbirth was a precipitating factor. A family history of constipation was reported by 58% of patients, and this was more common in women than in men (14).

C- PATHOPHYSIOLOGY

FDD may result from either paradoxical contraction of the external anal sphincter or from inability to relax sufficiently during defecation. This paradoxical anal sphincter contraction or insufficient relaxation may also occur in healthy people, with a probability of 20%, during defecation (15). Myotomy of the external anal sphincter or injection of botulinum toxin has been applied for the treatment of patients with FDD, but the results were generally poor. These experiences suggest that the problem is not confined solely to the paradoxical anal sphincter contraction (6). In a prospective study, it was shown that 60% of cases had impaired rectoanal coordination, 78% had paradoxical anal sphincter contraction or insufficient relaxation and 66% suffered from different degrees of impaired rectal sensation (16). One-third of patients with FDD had reported constipation since birth or childhood, while the others developed constipation during adulthood (14). The onset of symptoms during childhood suggests that at least one-third of patients with FDD may have never learned the art of proper defecation or acquired a faulty habit during toilet training. In the remaining two-thirds of patients, a severe illness, surgery, repeated excessive straining in the presence of hard stools (17, 18) or local anorectal problems, such as anal fissure or anorectal pain, may have played a role in development of FDD. Physiologic stress and anxiety may also contribute to the development of constipation by altering stool transit and increasing tension in skeletal muscles (19). Furthermore, 58% of patients, twice as many women as men, reported a family history of constipation. This suggests that environmental factors and genetics may play a role in the pathogenesis of FDD (14). Although the outcome of studies is speculative, sexual abuse may also play a role (14, 20, 21).

D- CLINICAL FEATURES

Common symptoms of FDD are: need to strain excessively (84%), feeling of incomplete evacuation (76%), abdominal bloating (74%), hard stool (60% in women, 41% in men), and need to use fingers to facilitate bowel movement (54% in women, 25% in men), and less commonly, infrequent defecation (14).

Structural lesions that cause difficulty with defecation such as hemorrhoids, anal fissures, proctitis, rectal tumors and perirectal abscesses should be ruled out with appropriate diagnostic tools before the patients are evaluated for FDD. Other anorectal problems that can accompany FDD, such as excessive perineal descent syndrome (22), rectal prolapse, rectal mucosal intussusception, solitary rectal ulcers (23), and paradoxical anal contraction that can be seen following ileoanal pouch reconstruction operations (24) should be taken into consideration.

E- DIAGNOSTIC PROCEDURES

History: A careful case history is the initial step for the diagnosis of constipated patients and those with FDD. Although symptoms alone cannot distinguish patients with FDD from those with other types of constipation, symptoms allow a better characterization of the patient (6). A more reliable evaluation of the constipated patients is use of validated questionnaires that investigate their symptoms.

Rectal examination: Besides the classical rectal examination, the ability of the anal sphincter to relax should be assessed by asking the patient to strain as if they are defecating (in the defecation position, if possible). If a lack of relaxation of the anal canal is recognized, the possibility of FDD must be considered (6). Under normal circumstances, the perineum should bulge for 1 to 3.5 cm extracorporeally during attempted defecation. Demonstration of any impairment in this action indicates the lack of anal sphincter relaxation, which favors the diagnosis of FDD. Asking the patient to strain as if to defecate during rectal examination is also of value for detecting other problems such as rectal prolapse and excessive perineal descent syndrome (3). The sacral reflex must also be tested as a part of the anal examination. The anocutaneous reflex is a contraction of the external sphincter in response to touch or pin stimulus of the perianal skin (all four quadrants to be assessed), and is mediated by the pudendal nerves (S2-S5). The bulbocavernous reflex is elicited by pinching or pricking the dorsal glans penis or by pressing the clitoris, and palpating for external anal sphincter contraction within the anal canal. Presence of both reflexes suggests the integrity of a conus-mediated (S2-S3) reflex activity. If absent, a neuropathy should be considered (25).

Tests for differential diagnosis: Following the history and physical examination, erythrocyte sedimentation rate (ESR), full blood counts, routine blood tests, fecal occult blood tests and, if necessary, additional tests such as thyroid function tests should be planned. Although their routine use has not been substantiated and there is lack of evidence, flexible sigmoidoscopy and colonoscopy should be performed in order to rule out the organic lesions of the colon, and colonic X-rays should be taken as well to exclude megacolon, megarectum and Hirschsprung's disease (15).

Colonic transit time test: The most accepted method is the administration of 24 radio-opaque markers orally and to take one single abdominal radiograph 120 hours post-administration. While the detection of five or less markers on this radiograph favors normal colonic transit time, the presence of more than five markers reveals slow colonic transit (26, 27). Slow colonic transit may not necessarily imply colonic inertia (slow transit constipation). Radio-opaque markers can either be bought commercially (Sitzmarks capsule - Konsyl Pharmaceuticals, Fort Worth, Texas), or tiny rings can be obtained by circularly cutting radio-opaque tubes. If the patient is using laxatives, it is advisable they be stopped before the test (27).

Anorectal manometry: This test detects pressure changes in the anal canal and rectum and is measured by placing a probe with multiple sensors in the anorectum. A rectal balloon is also placed in the rectum and inflated serially in order to detect the volume at which it is initially felt by the patient (first sensation), the volume that brings on a sense of the need to defecate (desire to defecate), the volume that brings the sense of urgency (urgency to defecate), and the maximum tolerable volume. The parameters that should be determined by a standard anorectal manometry are: anal sphincter rest pressure, anal sphincter voluntary squeeze pressure and squeeze duration, anal and rectal pressures during straining (attempting defecation), anal and rectal pressures during coughing, recto-inhibitory reflex, and thresholds of rectal sensory perception (threshold volumes for first

sensation, desire to defecate, urgency to defecate and maximum tolerable volume) (28).

The calculation of pressures of the anal canal and rectum during attempted defecation is important for the diagnosis of FDD. Therefore, the patient is asked to sit on a portable toilet-like apparatus (commode) and asked to strain as if to defecate, during which the pressure changes in the anal canal and rectum are recorded. During attempted defecation in a healthy person, under normal conditions, the intrarectal pressure increases simultaneously as the anal canal pressure decreases. The pressure in the anal canal calculated during attempted defecation is called the residual anal canal pressure. A parameter (the defecation index) has been developed to display the anorectal coordination. The defecation index is calculated by dividing the value of the intrarectal pressure by the value of the anal residual pressure during attempted defecation (28).

According to the pressure curves observed on the manometry, three different types of FDD have been described. **Type I:** The patient can generate an adequate pushing force (rise in intraabdominal and intrarectal pressure) along with paradoxical increase in the anal sphincter. **Type II:** The patient is unable to generate an adequate pushing force (no increase in intrarectal pressure), but can exhibit a paradoxical anal contraction. **Type III:** The patient can generate an adequate pushing force (increase in intrarectal pressure), but has absent or incomplete (<20%) sphincter relaxation (i.e., no decrease in anal sphincter pressure) (Figure 1) (6).

Balloon expulsion test: In this test, a non-latex balloon, 4-5 cm in length, attached to a thin catheter is placed inside the rectum and filled with 50 ml of warm water. Next, the patient is seated on a portable toilet (normal defecation position) and asked to expel the balloon. It is expected that it will take a normal healthy person one minute or less to expel the balloon. A delay of more than one minute is abnormal (28) and favors probability of FDD (6). Patients are often embarrassed during this test and hence it should be carried out with due respect and under circumstances that are similar to normal toilet conditions (28). Pelsang et al. (29) developed a simple silicone device ("fecom" – artificial feces) for this test, which is more similar to the shape and structure of feces than the balloon, and its use has been recommended for standardization of this test. The fecom has not yet gained widespread usage. A small, stool-like in shape, party balloon can also be used for this purpose.

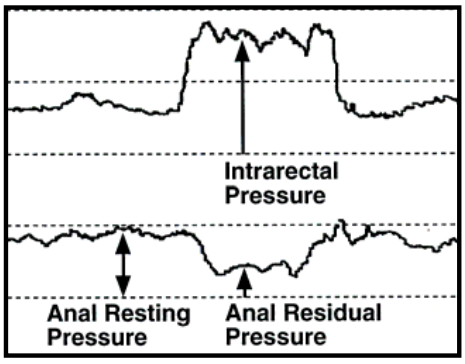
Defecography: Following the placement of approximately 120 ml of barium into the rectum transanally, the patient is asked to sit on a portable wooden toilet, given the physiologic defecation position and asked to defecate. Simultaneously, video fluoroscopic images are recorded from one side of the patient. This is a valuable test for the evaluation of the structural and functional disorders of the anorectal region. However, its practice is limited because of inconvenience to the patient and patient embarrassment, exposure to radiation, lack of standardization of the test and interobserver differences (30). A recent study found that defecography did not confer any additional diagnostic benefit over and above that obtained from anorectal manometry, colonic transit study, and balloon expulsion test (31). Because of these inherent deficiencies, defecography should be regarded as an adjunct to clinical and manometric assessment of anorectal function and should not be relied upon as a sole test for assessing defecatory dysfunction (32).

Diagnostic criteria for FDD: Recently, an expert group has updated the diagnostic criteria for FDD (Rome III) (Table 3) (5). Similar to the previous Working Team Report (Rome II) (33), the new criteria for FDD require symptoms of constipation and abnormal diagnostic tests because symptoms alone do not consistently distinguish the patient from those without FDD (5).

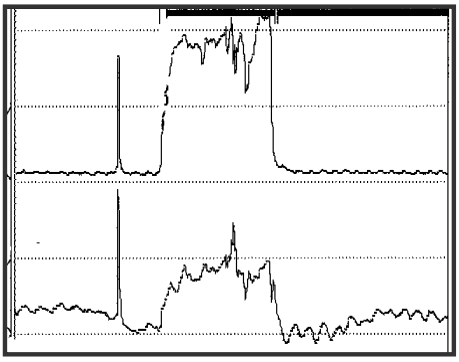
The diagnostic utility of Rome III criteria for FDD has not been validated. Similar to Rome II, the new criteria mostly contain general explanation. This may lead to different interpretation among physicians.

Table 3. Diagnostic criteria for functional defecation disorders (Rome III)

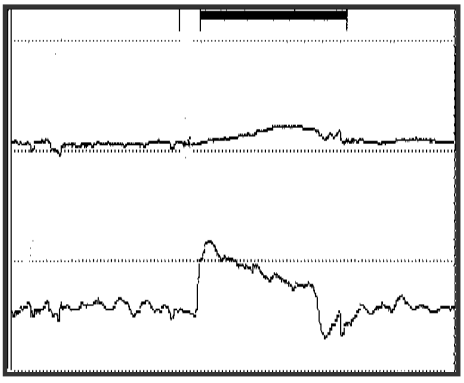
1. The patients must satisfy diagnostic criteria for functional constipation (2).
2. During repeated attempts to defecate, must have at least two of the following:
   a. Evidence of impaired evacuation, based on balloon expulsi on test or imaging
   b. Inappropriate contraction of the pelvic floor muscles (i.e. anal sphincter or puborectalis) or less than 20% relaxation of basal resting sphincter pressure by manometry, imaging or electromyography
   c. Inadequate propulsive forces assessed by manometry or imaging



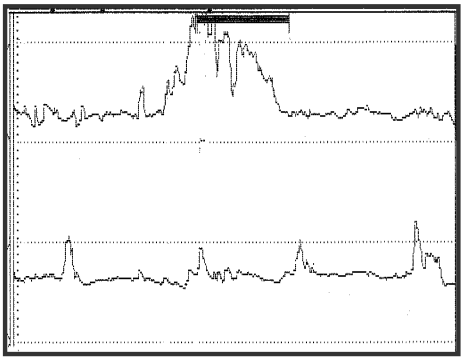
Normal: Normal anorectal manometry pattern is characterized by increased intrarectal pressure associated with relaxation of the anal sphincter during attempted defecation.



Type I: This pattern is characterized by both adequate propulsive forces (intrarectal pressure ≥ 45 mmHg) and paradoxically increased anal sphincter pressure during attempted defecation.



Type II: This pattern is characterized by inadequate propulsion (intrarectal pressure < 45 mmHg) and insufficient relaxation (< 20%) or paradoxical contraction of the anal sphincter during attempted defecation.



Type III: This pattern is characterized by increased intrarectal pressure (intrarectal pressure ≥ 45 mmHg) with absent or insufficient (< 20%) relaxation of basal anal sphincter pressure during attempted defecation.

Figure 1. Normal anorectal manometry and the manometric types of defecation disorders: According to recent experts' meeting, types I and III are defined as dyssynergic defecation and type II as inadequate defecatory propulsion (5). (Previously, all three types were defined under the term of pelvic floor dyssynergia (32) or dyssynergic defecation (6).

In the future, magnetic resonance defecography may provide good evidence for morphologic and functional assessment of the anorectal region (34). Currently, this technique is expensive and is not commonly used for the assessment of anorectal functions. Although colon transit study does not differentiate the subtypes of constipation, it provides an objective and confirmatory evidence for normal or slow transit constipation (31). In light of some of these factors and due to insufficient criteria for identifying type II dyssynergia, alternative criteria have been proposed by Rao et al. (6) for the diagnosis of dyssynergic defecation (Table 4).

Table 4. Diagnostic criteria for FDD (proposed by Rao)

In addition to fulfilling the Rome III symptomatic criteria for functional constipation (2), at least two or more of the following physiologic criteria should be present for diagnosis (6).

1. Dyssynergic or obstructive pattern of defecation (types 1 through 3; see Figure 1) which is defined as paradoxical increase in anal sphincter pressure or less than 20% relaxation of the resting anal sphincter pressure during attempted defecation.
2. A defecation index (*) of less than 1.2.
3. Inability to expel a balloon or stool-like device such as a fecom within 3 minutes.
4. A prolonged colon transit time (i.e., > 5 markers on a plain abdominal radiograph taken 120 hours after ingestion of 1 Sitz mark capsule containing 24 radiopaque markers).

*Defecation index = intrarectal pressure during attempted defecation ÷ residual anal canal pressure
- Residual anal canal pressure = the anal canal pressure during attempted defecation
- % anal relaxation = residual anal canal pressure ÷ anal canal resting pressure x 100

F- TREATMENT

Addressing the underlying pathophysiologic cause that leads to constipation constitutes the basic principle of treatment. Therefore, relieving dyssynergia or inadequate defecatory propulsion must be the first approach considered. Hence, the use of enterokinetic drugs and laxatives alone in the treatment of FDD is unsatisfactory. At centers that have the opportunity to perform biofeedback therapy, it is recommended to start treatment with this step (35). Where there is lack of such a facility, it is reasonable to begin with general measures such as enterokinetic drugs and laxatives (36). Initially, factors that can provoke the patients' problems, such as poor liquid consumption, low-fiber diet, immobilization or consumption of drugs that cause constipation, should be eliminated. The patient is recommended to visit the restroom twice a day (in the morning and in the evening) 30 minutes following their regular meals, and is asked to attempt defecation without straining excessively (without applying too much effort for this action and for less than five minutes) during these visits. If the patient is observed to be on a low-fiber diet, the fiber supplement should be increased gradually (6). Laxatives can be choices for treatment. This particular patient group usually does not respond to laxatives administered in standard doses. However, adverse effects such as severe diarrhea can take place with high-dose laxative consumption (3). Fecal impaction may be seen in patients with FDD. In order to remove fecal impaction, low volume enemas or orally administered polyethylene glycol solutions can be used.

Biofeedback treatment: Biofeedback treatment is the specific treatment method for FDD. The main goals are to relax the pelvic floor and anal sphincter muscles during defecation, improve rectoanal coordination, and improve sensory perception using visual, verbal, and audio feedback.

1) Training in rectoanal coordination: Training for rectoanal coordination can be divided into three parts as a) diaphragmatic breathing exercises that improve rectoanal coordination, b) training for rectoanal coordination carried out with the manometry system and c) training for rectoanal coordination carried out with the artificial feces (balloon or fecom).

a) Diaphragmatic breathing exercises that improve anorectal coordination: The goal of these exercises is to strengthen the abdominal muscles that are one of the propulsive factors for defecation and orient the patients to practice abdominal respiration. Table 5 demonstrates the respiratory exercise form prepared for the patients, which is used in the University of Iowa Carver College Of Medicine, Division of Gastroenterology-Hepatology. Additionally, a set of instructions of various exercises to tone and strengthen the abdominal muscle may be included in the training.

b) Education in coordination carried out with the manometry system: An anorectal manometry probe is placed into the anal canal and rectum to provide rectoanal coordination. The part

Table 5. Abdominal or diaphragmatic breathing exercises for constipation

The purpose of this breathing exercise is to improve coordination between the abdominal muscles, anal muscles and your breathing pattern. By using this technique, you can have a normal, easy and spontaneous bowel movement.
We use a step-by-step approach for learning this exercise:

A. Your breathing pattern: Usually, we breathe using one or two techniques – the chest type or the abdominal type. In order to understand your breathing pattern, place one hand on your upper chest and the other hand on your abdomen and take a deep breath. Inhale slowly. Observe the movements of your hands. If you see a greater movement of the hand placed on your chest, your breathing pattern is commonly referred to as the "chest type" On the other hand, if you observe a greater movement of the hand placed on your abdomen, your pattern is referred to as the "abdominal type" **The goal of this exercise is to achieve an abdominal type of breathing.**

B. Technique:

1. Choose a quiet place where you can concentrate undisturbed for 20 minutes.
2. Sit comfortably on a chair or a toilet seat with your legs 20 cm apart.
3. Rest your feet on a small stool at least 15 cm high.
4. Place one hand on your chest and the other on your abdomen.
5. **Inhale slowly and steadily** by taking a deep breath for 6-8 seconds.
6. When breathing in, you must observe and expect the hands placed on the abdomen to move outwards, as if you are trying to fill the abdomen.
7. When breathing in, the upper chest and rib cage should not expand. Therefore, there must be very little or no movement of the hand placed on your chest.
8. Next, you must **hold your breath** and count for 30 seconds.
9. Then, **breathe out (exhale) gradually** over 6-8 seconds.
10. You must pause briefly for 10-15 seconds before repeating the maneuver.

C. How long and how often?

There is no limit to the amount of the time you may wish to spend practicing this exercise, but we recommend **a minimum of 15-20 minutes, at least three times a day.** At first, this pattern of breathing may feel awkward. However, our experience has shown that with patience and practice, the new method will become easy and natural. Remember, "Practice makes perfect."

D. Who would benefit?

This exercise will help those who have constipation associated with obstructive defecation. Additionally, it may help patients who experience a feeling of incomplete bowel movement and those who have to strain excessively to pass a bowel movement.

F. Comment:

Few people normally breathe this way. It is a healthy way to breathe and may also help reduce stress. However, if you feel uncomfortable or frustrated with this technique, please stop for a while and practice again later. Practicing these exercises **must not feel like a chore.** It should be a pleasant and relaxing experience. If you have continued difficulty, please stop the exercises until you talk with your physician/therapist.

of the probe that remains extracorporeal is fixed to the perineum by adhesive tapes to prevent its sliding out. The patient is seated on a portable toilet having taken the physiologic defecation position and asked to strain as if defecating. Meanwhile, the pressure diagrams of the anal canal and rectum are presented to the patient's view on a monitor. If we assume that a Type I FDD pattern is present, the anal canal pressure, which should decrease during the attempted defecation under normal circumstances, increases, and there is upward increase in the pressure (Figure 1). First, the appearance of a normal pressure tracing is explained to the patient. Then, the patient's recording is shown and the patient is taught how the anal canal pressure increases paradoxically, which means that the anal sphincter is contracting abnormally instead of relaxing. In order to reinforce that the anal sphincter can be controlled by will, the patient is asked to contract his/her anal sphincter and then he/she is shown that the pressure diagram increases during contraction and decreases during relaxation. The patient is then asked to strain as if to defecate and asked to relax the sphincter to decrease the pressure of the anal canal at the same time. Through verbal and visual feedback, the patient is trained to relax his/her anal sphincter. Since it can be difficult for some patients to relax their anal sphincters when the rectum is empty, a balloon is placed into the rectum to simulate presence of feces and inflated with 50-60 ml of air and the procedure is repeated. Most of the commercial anorectal manometry devices have a balloon of this kind on the rectal tip of their probes. For the second level, the patient is asked to repeat these procedures and relax the anal sphincter without visualizing the monitor. If the patient has acquired the capability of relaxing the sphincter without looking at the monitor on every single attempt, the third level is reached. At this level, the patient is encouraged to regularly practice these exercises at home (6).

c) Education in coordination is carried out with an artificial stool-like device (balloon or fecom) (simulated defecation): A balloon with a dimension of 4 cm is placed into the rectum (6).

Six-inch baby balloons available in the market or balloons made out of the cut finger parts of non-sterilized latex medical examination gloves may also be used for this purpose. The use of a fecom, created for anorectal coordination education, which has physical properties similar to feces, would be most appropriate (29). The balloon, placed in the rectum, is inflated with either 50 ml of air or filled with the same amount of warm water. The patient is seated on the portable toilet. Initially, the respiratory pattern is observed, and it is determined whether or not the patient follows the orders as directed in the respiratory exercises form (Table 5). Any inappropriate behaviors noted in this observation are corrected. Thereafter, the patient is asked to distend his/her abdomen (by creating a barrel-like abdomen using abdominal respiration) and then to strain without expiring, in a slightly bent-forward position, and to expel the balloon placed in the rectum (24). If the patient is unable to expel the balloon, a gentle traction is applied to the catheter in order to assist defecation. This educational procedure is repeated until the patient gains the ability to easily expel the balloon without external help (6). Patients may be encouraged to practice this procedure at home following initial training, but the efficacy of home training has not been established.

2) Education to improve sensory perception: This educational procedure is carried out for patients with impaired rectal sensation. Healthy individuals have the ability to perceive a balloon inflated with 15-20 ml of air placed in the rectum. If the patient does not perceive a balloon with volumes of even greater than 20 ml, impaired rectal sensation is identified (37). The majority of patients with FDD (64%) demonstrate this condition. Some believe that this condition constitutes the most important pathophysiologic mechanism of constipation related with FDD (38). Rectal sensation can also be improved with biofeedback therapy.

Any of the manometry probes that have a pressure sensor at the tip and a balloon around this sensor can be used for this purpose. The pressure level perceived by the sensor that remains at the center of the balloon will increase as the balloon is inflated, and the elevation in pressure can meanwhile be observed on the monitor. The patient is asked to watch the pressure tracing on the monitor while the balloon is inflating. Initially, the balloon volume at which the patient experiences first sensation is detected. Then the patient is encouraged to sense the feel of the balloon at gradually lower volumes (6). This procedure is best illustrated by the following example, assuming that the patient's threshold volume for first sensation is 70 ml. In this instance, the patient is told that he/she has sensed the balloon at a 70 ml volume, but most probably felt something at a level of 60 ml but did not make any comment because of uncertainty. The next balloon distention is carried out with a 65 ml volume and, if sensed, the attempt will be repeated by not allowing the patient to see the monitor. If the patient senses the new threshold volume without monitor assistance, a new threshold volume is established. Gradually stepwise smaller and smaller volumes are perceived until the patient's first sensation volume reaches normal levels. This procedure can also be carried out with a syringe and a simple balloon, if manometry equipment is not available. In this case, the patient watches the hand movements of the educator as the syringe is inflated.

Biofeedback therapy is a non-invasive but time-consuming treatment that has an efficacy rate of 67-80% in constipated patients with FDD. It requires a motivated patient and a trained educator. Since it corrects the underlying pathophysiologic mechanism(s) in FDD, it should be considered as the first approach for these patients (6).

OTHER CONDITIONS ASSOCIATED WITH FUNCTIONAL DEFECATION DISORDERS

Solitary rectal ulcer syndrome (SRUS): SRUS is characterized by either single or multiple ulcerations of rectal mucosa, associated with passage of blood and mucus and specific histological changes. Most patients with SRUS exhibit FDD and impaired evacuation (7, 8, 23). Type I dyssynergic pattern is detected in most patients with SRUS by anorectal manometry. Biofeedback therapy improves FDD, restores normal defecation dynamics, and improves subjective parameters (straining, using digital maneuvers, blood and mucus in stool) and mucosal changes. These findings suggest a pathophysiological association between SRUS and FDD (7).

Rectocele: Rectoceles are protrusions of the anterior rectal wall usually toward the vagina. Obstetric injury and excessive straining are major causes of rectocele. Post- menopausal status and hysterectomy are other etiological factors associated with rectocele. There is also an association between FDD and rectocele. A rectocele can be a cause

or a consequence of chronic constipation (8). The cause of defecation difficulties appears to be a misdirection of the feces towards a large pouch instead of passage through the anal canal (36).

Rectal prolapse: A complete rectal prolapse involves the protrusion of all layers of the rectal wall through the anal canal. Constipation is common and is found in 67% of patients with rectal prolapse and may be due to preexisting FDD (23).

Rectal intussusception: Rectal intussusceptions, occult rectal prolapse, or internal procidentia consist of intussusception of the rectal prolapse may that dose not protrude through the anus. Approximately 60% of patients with rectal prolapse may present with FDD (23).

Descending perineum syndrome: Descending perineum syndrome is a complex disorder of the pelvic floor. It is characterized by excessive descent or ballooning of the perineum several centimeters below the bony outlet of the pelvis during straining (22). Clinical features include excessive and frequent straining to pass a bowel movement and difficulty with defecation resulting in a sense of incomplete evacuation, mucus discharge, and rectal bleeding, which may result from SRUS. Descending perineum syndrome can be a result of neuropathy due to a stretch injury to the terminal portion of the pudendal nerve and sacral roots (39). Approximately 75% of patients with descending perineum syndrome present with FDD (22).

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